Semi-Annual Sampling of Fourmile Branch and its Seepelines in the F and H Areas of SRS: July 1992 (U)

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Semi-Annual Sampling of Fourmile Branch and its Seep Lines in the F and H Areas of SRS: July 1992 (U)

by

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DOE Contract No. DE-AC09-89SR18035

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K. L. Dixon and V. A. Rogers

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Semi-Annual Sampling of Fourmile Branch and Its Seepines in the F and H Areas of SRS: July 1992

K. L. Dixon and V. A. Rogers

Executive Summary

In July 1992, water samples were collected from Fourmile Branch (FMB) and its seepines in the vicinity of the F- and H-Area seepage basins. The samples were collected from five seepine locations in F Area, five seepine locations in H Area, and three stream locations on FMB. The sampling event was the first in a series of three semi-annual sampling events aimed at characterizing the shallow groundwater outcropping into FMB and its wetlands. In the past, this groundwater has been shown to contain contaminants migrating from the F- and H-Area seepage basins. The samples were analyzed for Appendix IX metals, various radionuclides, selected volatile compounds, and selected inorganic constituents and parameters.

Results from the July 1992 sampling event suggest that the seepines in both F and H Areas and FMB continue to be influenced by contaminants migrating from the F- and H-Area seepage basins. However, when compared to 1989 measurements (Haselow et al. 1990), the concentrations of most of the constituents have declined.

Contaminant concentrations measured in July 1992 were compared to primary drinking water standards (PDWS), secondary drinking water standards (SDWS), and maximum contaminant levels (MCL) enforceable in 1993. Results were also compared to 1989 measurements at corresponding sampling locations and to background samples collected as part of the July 1992 sampling event.

Using two different statistical tests, concentrations of selected F- and H-Area seepine analytes were compared to background samples. These tests were designed to detect if concentrations of contaminants along the F- and H-Area seepines were greater than background concentrations.

Analytes detected with concentrations significantly greater than background (at a Type 1 error rate of 0.05) using the two statistical tests were:

Area	Analytes
F	alkalinity, barium, calcium, manganese, ^3H
H	alkalinity, aluminum, calcium, sodium, ^3H , ^{226}Ra

None of the metals or volatile organic compounds analyzed were found to be elevated above the PDWS or MCL. Those contaminants elevated above the PDWS or MCL were

Area	Analytes
F	nitrate, nonvolatile beta, ^3H , ^{129}I , ^{228}Ra , ^{90}Sr , ^{99}Tc
H	nitrate, gross alpha, nonvolatile beta, ^3H , ^{129}I , ^{228}Ra , ^{90}Sr , ^{99}Tc
FMB	nonvolatile beta, ^3H , ^{129}I , ^{228}Ra , ^{90}Sr , ^{99}Tc

Those analytes found to be elevated above 1989 measurements at one or more location were:

Area	Analytes
F	aluminum, chloride, mercury, ^{129}I
H	aluminum, chloride, mercury, lead, sodium, zinc, ^{129}I
FMB	alkalinity, chloride, mercury, sodium, zinc, ^{137}Cs , ^{226}Ra , ^{90}Sr

It should be noted that most of the nonradiological parameters, particularly sodium and aluminum, have declined in concentration at both F- and H-Area seep lines and in FMB.

Several seepage locations in both F and H Area continue to be influenced by ^{129}I and ^{90}Sr . Contributions of ^{90}Sr , ^{129}I , ^3H , and ^{137}Cs from the F- and H-Area seepage basin operations continue to be measurable in FMB.

While the July 1992 results suggest that contaminant levels have declined somewhat since 1989, the concentrations of some radionuclides have remained unchanged. Further analysis based on future data from the semi-annual sampling program will allow for a more complete assessment of the temporal changes in the contaminant levels at FMB and its seep lines.

Introduction

Seepage basins in the F and H Areas of the Savannah River Site (SRS) received low-level radioactive waste effluent from the chemical separation processes in the General Separation Areas (GSA). The basins retained the effluent to delay its release to the environment. The waste effluent consisted principally of sodium hydroxide, nitric acid, low levels of various radionuclides, and some metals (Killian et al. 1985a and b). Discharges of tritiated water to the seepage basins account for most of the radioactivity (Fenimore and Horton 1972). Other relatively mobile radionuclides introduced into the basins via the waste effluent were ^{90}Sr , ^{99}Tc , and ^{129}I (Looney et al. 1988).

In 1988 and 1989, the Savannah River Laboratory (now the Savannah River Technology Center) conducted an extensive study aimed at characterizing the shallow groundwater outcropping into Fourmile Branch and its associated seepine (Looney et al. 1988, Haselow et al. 1990). These studies were prompted by observed vegetation stress in relatively small isolated areas of the wetlands on the northern side of Fourmile Branch.

Looney et al. (1988) collected water samples from upstream and downstream locations on Fourmile Branch and from its associated seepines in suspect areas. The samples were analyzed for a wide range of non-radioactive parameters including selected metals, inorganic constituents and parameters, pH, conductivity, nitrate, and nitrite. Results from the analysis of the seepwater suggested that

- sodium, nitrate, and hydrogen ions had reached the seepine from the basins and were affecting the bulk chemistry of the seepwater
- several constituents (aluminum, calcium, copper, etc.) were being leached from the soil profile by the low pH shallow groundwater
- cadmium in F Area and nitrate in both F and H Area were elevated above primary drinking water standards
- Fourmile Branch was being impacted by constituents (primarily nitrate and sodium) input by either the seepwater or local outfalls

Looney et al. (1988) concluded that these factors, combined with the flooding of previously dry areas resulting from basin operations, were primarily responsible for the observed vegetation stress in the seep areas and suggested that a more extensive study be performed to further characterize the occurrence of contaminants in the stream and seepwater.

Haselow et al. (1990) collected soil cores, stream, and seepine water samples from Fourmile Branch and its seepines in 1988 and 1989 as a follow-up to the Looney et al. (1988) study. These samples were analyzed for both radioactive and non-radioactive parameters. Between the 1988 and 1989 sampling events, an extensive survey for tritium, pH, and conductivity was conducted along the seepines. Results from these studies suggested that

- cadmium and nitrate concentrations along the F-Area seepine and nitrate concentrations along the H-Area seepine were above primary drinking water standards
- manganese and iron concentrations were above the secondary drinking water standards along both the F- and H-Area seepines
- aluminum and sodium concentrations were apparently elevated along both the F- and H-Area seepines although no standard existed for comparison
- gross alpha, nonvolatile beta, ^{241}Am , ^{129}I , ^3H , ^{226}Ra , ^{89}Sr , ^{90}Sr , and $^{233/234}\text{U}$ were elevated above the proposed or established drinking water standard at one or more points along the F-Area seepine
- gross alpha, ^3H , ^{226}Ra , ^{89}Sr , and ^{90}Sr were elevated above the proposed or established drinking water standard at one or more points along the H-Area seepine
- ^{244}Am , ^{60}Co , ^{134}Cs , and ^{136}Cs had also impacted the seepine but were not above drinking water standards
- nonvolatile beta and tritium were above the Primary Drinking Water Standards (PDWS) in FMB at one or more points
- tritium and conductivity were elevated at several points along the F- and H-Area seepines
- seepwater along the F- and H-Area seepines generally exhibited low pH
- cadmium, nonvolatile beta, ^{90}Sr , $^{233/234}\text{U}$, and ^{238}U in the soil samples were elevated above SRS background values for soils in at least one sample
- ^{241}Am , ^{244}Cm , ^{60}Co , ^{129}I , ^{238}Pu , and ^{226}Ra were also suspected to be above background levels in at least one sample, although no established background data existed for comparison

These studies confirmed that contaminants migrating from the seepage basins were impacting the water chemistry along the F- and H-Area seepines.

Discharges to the seepage basins were discontinued in 1988 and the basins were capped and sealed in 1990 to minimize the release of contaminants to the environment. Scientists hypothesized that after eliminating the contaminant source, annual rainfall amounts and natural ground-

water flow would, over time, dilute and flush the remaining contaminant plume out of the shallow groundwater and FMB wetland system. After the contaminant plume in the shallow groundwater is diluted and flushed out, the FMB wetland systems below the basins will begin to recover.

To investigate this hypothesis and to monitor the post-basin closure temporal changes in the contaminant levels outcropping along the FMB seep line, two sampling programs were established. These were the quarterly F- and H-Area tritium survey and a semi-annual sampling program for monitoring Appendix IX metals, various inorganics, and selected radionuclides. Results from the quarterly tritium surveys, in which tritium, pH, and conductivity are measured at several locations along the seep line, have been

presented by Dixon and Rogers (1991a and b). The results have shown a significant decrease in tritium activities and conductivity values with pH values increasing to more natural (pH 5-6) ranges.

The objectives of this report are to

- present the results from the July 1992 sampling event of FMB and its seep lines
- compare, where possible, these results to established standards enforceable in 1993 (Table 1) and 1989 (Haselow et al., 1990) results where possible
- make inferences about the temporal changes in contaminant concentrations resulting from basin closure

Table 1. PDWS, MCL, and SDWS Standards Used in Data Comparisons

Analyte	Standard	Units	Source	Status
1,1,1-Trichloroethane	200	µg/L	EPA, 1993	93-MCL
Aluminum	NS*			
Americium-241	6.34	pCi/L	EPA 1991c	Proposed
Antimony	5	µg/L	EPA 1990	Proposed
Antimony-125	300	pCi/L	EPA, 1977	Final
Arsenic	50	µg/L	EPA, 1993	93-MCL
Barium	2000	µg/L	EPA, 1993	93-MCL
Beryllium	1	µg/L	EPA, 1990	Proposed
Cadmium	5	µg/L	EPA, 1993	93-MCL
Calcium	NS			
Carbon tetrachloride	5	µg/L	EPA, 1993	93-MCL
Cerium-144	261	pCi/L	EPA, 1991c	Proposed
Cesium-134	81.3	pCi/L	EPA, 1991c	Proposed
Cesium-137	200	pCi/L	EPA, 1991c	Proposed
Chloride	NS			
Chloroform	100	µg/L	EPA, 1991a	Final
Chromium	100	µg/L	EPA, 1993	93-MCL
Cobalt-57	1000	pCi/L	EPA, 1977	Final
Cobalt-60	100	pCi/L	EPA, 1977	Final
Copper	1300	µg/L	EPA, 1993	93-MCL
Curium-242	0.133	pCi/L	EPA, 1991c	Proposed
Curium-243,244	8.3	pCi/L	EPA, 1991c	Proposed
Europium-152	NS			
Europium-154	200	pCi/L	EPA, 1977	Final
Europium-155	600	pCi/L	EPA, 1977	Final
Fluoride	4	mg/L	EPA, 1991a	Final
Gross alpha	15	pCi/L	EPA, 1993	93-MCL
Iodine-129	1	pCi/L	EPA, 1977	Final
Iron	300	µg/L	EPA, 1991b	
Lead	15	µg/L	EPA, 1993	93-MCL
Magnesium	NS			
Manganese	50	µg/L	EPA, 1991b	
Manganese-54	300	pCi/L	EPA, 1977	Final
Mercury	2	µg/L	EPA, 1993	93-MCL
Neptunium-237	7.06	pCi/L	EPA, 1991c	Proposed

(Table 1. Continued)

Analyte	Standard	Units	Source	Status
Nickel	100	µg/L	EPA, 1990	Proposed
Nitrate as nitrogen	10	mg/L	EPA, 1993	93-MCL
Nonvolatile beta	50	pCi/l	EPA, 1986b	Proposed
Plutonium-238	7.02	pCi/L	EPA, 1991c	Proposed
Plutonium-239,240	62.1	pCi/L	EPA, 1991c	Proposed
Potassium	NS			
Potassium-40	300	pCi/L	EPA, 1986b	Proposed
Promethium-144	NS			
Promethium-146	NS			
Radium-226	15.7	pCi/L	EPA, 1991c	Proposed
Radium-228	7.85	pCi/L	EPA, 1991c	Proposed
Ruthenium-106	30	pCi/L	EPA, 1977	Final
Selenium	50	µg/L	EPA, 1991a	Final
Silver	50	µg/L	EPA, 1991a	Final
Sodium	NS			
Sodium-22	466	pCi/L	EPA, 1991c	Proposed
Strontium-90	8	pCi/L	EPA, 1993	93-MCL
Technetium-99	900	pCi/L	EPA, 1977	Final
Thallium	1	µg/L	EPA, 1990	Proposed
Thorium-228	125	pCi/L	EPA, 1991c	Proposed
Thorium-230	79.2	pCi/L	EPA, 1991c	Proposed
Thorium-232	88	pCi/L	EPA, 1991c	Proposed
Tin	NS			
Total organic carbon	NS			
Total organic halogens	NS			
Total phenols	NS			
Trichloroethylene	5	µg/L	EPA, 1991a	Final
Tetrachloroethylene	5	µg/L	EPA, 1991a	Final
Tritium	20	pCi/ml	EPA, 1993	93-MCL
Uranium-234	13.9	pCi/L	EPA, 1991c	Proposed
Uranium-235	14.5	pCi/L	EPA, 1991c	Proposed
Uranium-238	14.6	pCi/L	EPA, 1991c	Proposed
Vanadium	NS			
Yttrium-88	NS			
Zinc	5000	µg/L	EPA, 1991b	
Zinc-65	300	pCi/L	EPA, 1977	Proposed

*NS = No Standard

Methods

Seepline water sampling services were obtained via task order under contract AA46327P (Task 26) with Metcalf and Eddy, Inc. Metcalf and Eddy subcontracted the field sampling portion of the task to Normandeau Associates, Inc. Sampling activities occurred between July 20, 1992 and July 29, 1992 and have been described in detail by Metcalf and Eddy (1992) and are reproduced in part for this discussion and completely in Appendix A.

Analytical services were arranged for by the WSRC-Environmental Monitoring Section (EMS) and were provided by a combination of several laboratories. General Engineering (nonradiological analyses) and Environmental Physics (radiological analyses) were used as the primary laboratories. Weston Analytics (nonradiological analyses) and Clemson Technical Center (radiological analyses)

were used for split sample analyses. The laboratories provided all sample containers with preservatives, blue ice, and coolers necessary to collect and ship the samples. Chain of custody forms and packing materials were provided by EMS. At each location, a sample was collected to measure for total activity for shipping clearance. These analyses were performed onsite by EMS. A list of the constituents analyzed by each lab, plus the methods used and method detection limits, is given in Tables 2 and 3.

Confirmation analysis was performed for ^{99}Tc on several samples by the Environmental Technology Section (ETS) of SRTC using an isotope dilution inductively coupled plasma - mass spectrometry procedure (ICP/MS) (Beals 1992). The method detection limit for this procedure was 5 pCi/L.

Table 2. Methods and Detection Limits for General Engineering (GE) and Environmental Physics (GP) Analyses

Analyte	Method	Source	Detection Limit	Units	Lab
1,1,1-trichloroethylene	EPA801	EPA, 1986a	1	μg/L	GE
Alkalinity	EPA310.1	EPA, 1983	1	mg/L	GE
Aluminum	EPA6010	EPA, 1986a	20	μg/L	GE
Americium-241	HAS300	DOE, 1992	1	pCi/L	GP
Ammonia nitrogen	EPA350.1	EPA, 1983	0.1	mg/L	GE
Antimony	EPA7041	EPA, 1986a	2	μg/L	GE
Antimony-125	HASL300	DOE, 1992	20	pCi/L	GP
Arsenic	EPA7060	EPA, 1986a	2	μg/L	GE
Barium	EPA6010	EPA, 1986a	3	μg/L	GE
Beryllium	EPA6010	EPA, 1986a	3	μg/L	GE
Cadmium	EPA6010	EPA, 1986a	2	μg/L	GE
Calcium	EPA6010	EPA, 1986a	10	μg/L	GE
Carbon tetrachloride	EPA8010	EPA, 1986a	1	μg/L	GE
Cerium-144	HASL300	DOE, 1992	60	pCi/L	GP
Cesium-134	HASL300	DOE, 1992	10	pCi/L	GP
Cesium-137	HASL300	DOE, 1992	10	pCi/L	GP
Chloride	EPA300.0	EPA, 1983	0.25	mg/L	GE
Chloroform	EPA8010	EPA, 1986	1	μg/L	GE
Chromium	EPA6010	EPA, 1986a	4	μg/L	GE
Cobalt-57	HASL300	DOE, 1992	10	pCi/L	GP
Cobalt-60	HASL300	DOE, 1992	10	pCi/L	GP
Copper	EPA6010	EPA, 1986a	4	μg/L	GE
Curium-242	HASL300	DOE, 1992	1	pCi/L	GP
Curium-243,244	HASL300	DOE, 1992	1	pCi/L	GP
Europium-152	HASL300	DOE, 1992	40	pCi/L	GP
Europium-154	HASL300	DOE, 1992	20	pCi/L	GP
Europium-155	HASL300	DOE, 1992	30	pCi/L	GP
Fluoride	EPA340.2	EPA, 1983	0.1	mg/L	GE
Gross alpha	EPA900.0	EPA, 1980	2	pCi/L	GE
Hardness	EPA130.2	EPA, 1983	1	mg/L	GE
Iodine-129	HASL300	DOE, 1992	2	pCi/L	TE

(Table 2. Continued)

Analyte	Method	Source	Detection Limit	Units	Lab
Iron	EPA6010	EPA, 1986a	4	µg/L	GE
Lead	EPA7421	EPA, 1986a	3	µg/L	GE
Magnesium	EPA6010	EPA, 1986a	2	µg/L	GE
Manganese	EPA6010	EPA, 1986a	2	µg/L	GE
Manganese-54	HASL300	DOE, 1992	10	pCi/L	GP
Mercury	EPA7470	EPA, 1986a	0.2	µg/L	GE
Neptunium-237	HASL300	DOE, 1992	10	pCi/L	TE
Nickel	EPA6010	EPA, 1986a	4	µg/L	GE
Nitrate as nitrogen	EPA353.3	EPA, 1983	0.05	mg/L	GE
Nonvolatile beta	EPA900.0	EPA, 1980	2	pCi/L	GE
Plutonium-238	HASL300	DOE, 1992	1	pCi/L	GP
Plutonium-239,240	HASL300	DOE, 1992	1	pCi/L	GP
Potassium	EPA6010	EPA, 1986a	500	µg/L	GE
Potassium-40	HASL300	DOE, 1992	110	pCi/L	GP
Promethium-144	HASL300	DOE, 1992	10	pCi/L	GP
Promethium-146	HASL300	DOE, 1992	10	pCi/L	GP
Radium-226	HASL300	DOE, 1992	1	pCi/L	GP
Radium-228	HASL300	DOE, 1992	1	pCi/L	GP
Ruthenium-106	HASL300	DOE, 1992	90	pCi/L	GP
Selenium	EPA7740	EPA, 1986a	2	µg/L	GE
Silver	EPA6010	EPA, 1986a	2	µg/L	GE
Sodium	EPA6010	EPA, 1986a	10	µg/L	GE
Sodium-22	HASL300	DOE, 1992	10	pCi/L	GP
Strontium-90	HASL300	DOE, 1992	2	pCi/L	GP
Technetium-99	HASL300	DOE, 1992	300	pCi/L	GP
Tetrachloroethylene	EPA8010	EPA, 1986a	1	µg/L	GE
Thallium	EPA7841	EPA, 1986a	2	µg/L	GE
Thorium-228	HASL300	DOE, 1992	1	pCi/L	GP
Thorium-230	HASL300	DOE, 1992	1	pCi/L	GP
Thorium-232	HASL300	DOE, 1992	1	pCi/L	GP
Tin	EPA6010	EPA, 1986a	2	µg/L	GE
Total organic carbon	EPA9060	EPA, 1986a	1	mg/L	GE
Total organic halogens	EPA9020	EPA, 1986a	5	µg/L	GE
Total phenols	EPA420.2	EPA, 1983	5	µg/L	GE
Trichloroethylene	EPA8010	EPA, 1986a	1	µg/L	GE
Tritium	EPA906.0	EPA, 1980	0.7	pCi/ml	GE
Uranium-234	HASL300	DOE, 1992	1	pCi/L	GP
Uranium-235	HASL300	DOE, 1992	1	pCi/L	GP
Uranium-238	HASL300	DOE, 1992	1	pCi/L	GP
Vanadium	EPA6010	EPA, 1986a	8	µg/L	GE
Yttrium-88	HASL30	DOE, 1992	60	pCi/L	GP
Zinc	EPA6010	EPA, 1986a	2	µg/L	GE
Zinc-65	HASL300	DOE, 1992	20	pCi/L	GP

Table 3. Methods and Detection Limits for Weston Analytics (WA) and Clemson Technical Center (CN) Analyses

Analyte	Method	Source	Detection Limit	Units	Lab
1,1,1-trichloroethylene	EPA8010	EPA, 1986a	1	µg/L	WA
Aluminum	EPA200.7	EPA, 1983	14.6	µg/L	WA
Americium-241	CTC0009	CTC, 1992	1	pCi/L	CN
Antimony	EPA200.7	EPA, 1983	2.6	µg/L	WA
Antimony-125	EPA901.1	EPA, 1980	20	pCi/L	CN
Arsenic	EPA206.2	EPA, 1983	2	µg/L	WA
Barium	EPA200.7	EPA, 1983	6.6	µg/L	WA
Beryllium	EPA200.7	EPA, 1983	0.18	µg/L	WA
Cadmium	EPA200.7	EPA, 1983'	0.35	µg/L	WA
Calcium	EPA200.7	EPA, 1983	14.4	µg/L	WA
Carbon tetrachloride	EPA8010	EPA, 1986a	1	µg/L	WA
Cerium-144	EPA901.1	EPA, 1980	50	pCi/L	CN
Cesium-134	EPA901.1	EPA, 1980	10	pCi/L	CN
Cesium-137	EPA901.1	EPA, 1980	10	pCi/L	CN
Chloride	EPA325.2	EPA, 1983	0.25	mg/L	WA
Chloroform	EPA8010	EPA, 1986a	1	µg/L	WA
Chromium	EPA200.7	EPA, 1983	1.1	µg/L	WA
Cobalt-57	EPA901.1	EPA, 1980	10	pCi/L	CN
Cobalt-60	EPA901.1	EPA, 1980	10	pCi/L	CN
Copper	EPA200.7	EPA, 1983	1.1	µg/L	WA
Curium-242	CTC0009	CTC, 1992	1	pCi/L	CN
Curium-243, 244	CTC0009	CTC, 1992	1	pCi/L	CN
Europium-152	EPA901.1	EPA, 1980	40	pCi/L	CN
Europium-154	EPA901.1	EPA, 1980	25	pCi/L	CN
Europium-155	EPA901.1	EPA, 1980	25	pCi/L	CN
Fluoride	EPA340.2	EPA, 1983	0.1	mg/L	WA
Gross alpha	EPA900.0	EPA, 1980	1.9	pCi/L	TM
Iodine-129	EPA901.1	EPA, 1980	2	pCi/L	CN
Iron	EPA200.7	EPA, 1983	1.9	µg/L	WA
Lead	EPA239.2	EPA, 1983	2	µg/L	WA
Magnesium	EPA200.7	EPA, 1983	8.9	µg/L	WA
Manganese	EPA200.7	EPA, 1983	0.35	µg/L	WA
Manganese-54	EPA901.1	EPA, 1980	10	pCi/L	CN
Mercury	EPA245.1	EPA, 1983	0.2	µg/L	WA
Neptunium-237	EPA901.1	EPA, 1980	45	pCi/L	CN
Nickel	EPA200.7	EPA, 1983	3.1	µg/L	WA
Nitrate as nitrogen	EPA353.2	EPA, 1983	0.01	mg/L	WA
Nonvolatile beta	EPA900.0	EPA, 1980	2.1	pCi/L	TM
Plutonium-238	CTC0009	CTC, 1992	1	pCi/L	CN
Plutonium-239, 240	CTC0009	CTC, 1992	1	pCi/L	CN
Potassium	EPA200.7	EPA, 1983	83.5	µg/L	WA
Potassium-40	EPA901.1	EPA, 190	175	pCi/L	CN
Promethium-144	EPA901.1	EPA, 1980	10	pCi/L	CN
Promethium-146	EPA901.1	EPA, 1980	20	pCi/L	CN
Radium-226	EPA901.1	EPA, 1980	175	pCi/L	CN
Radium-228	EPA904.0	EPA, 1980	1	pCi/L	CN
Ruthenium-103	EPA901.1	EPA, 1980	10	pCi/L	CN
Ruthenium-106	EPA901.1	EPA, 1980	70	pCi/L	CN
Selenium	EPA270.2	EPA, 1983	2	µg/L	WA
Silver	EPA200.7	EPA, 1983	0.7	µg/L	WA
Sodium	EPA200.7	EPA, 1983	111	µg/L	WA

(Table 3. Continued)

Analyte	Method	Source	Detection Limit	Units	Lab
Sodium-22	EPA901.1	EPA, 1980	10	pCi/L	CN
Strontium-90	EPA905.0	EPA, 1980	2	pCi/L	CN
Technetium-99	MMEC038	MMEC, 1992	300	pCi/L	CN
Tetrachloroethylene	EPA8010	EPA, 1986a	1	µg/L	WA
Thallium	EPA279.2	EPA, 1983	2	µg/L	WA
Thorium-228	CTC0009	CTC, 1992	1	pCi/L	CN
Thorium-230	CTC0009	CTC, 1992	1	pCi/L	CN
Thorium-232	CTC0009	CTC, 1992	1	pCi/L	CN
Tin	EPA200.7	EPA, 1983	1.9	µg/L	WA
Total organic carbon	EPA415.1	EPA, 1983	0.5	mg/L	WA
Total organic halogens	EPA9020A	EPA, 1986a	5	µg/L	WA
Total phenols	EPA420.1	EPA, 1983	5	µg/L	WA
Trichloroethylene	EPA8010	EPA, 1986a	1	µg/L	WA
Tritium	EPA906.0	EPA, 1980	491.02	pCi/L	TM
Uranium-234	CTC0009	CTC, 1992	1	pCi/L	CN
Uranium-235	CTC0009	CTC, 1992	1	pCi/L	CN
Uranium-238	CTC0009	CTC, 1992	1	pCi/L	CN
Vanadium	EPA200.7	EPA, 1983	0.88	µg/L	WA
Yttrium-88	EPA901.1	EPA, 1980	10	pCi/L	CN
Zinc	EPA200.7	EPA, 1983	0.35	µg/L	WA
Zinc-65	EPA901.1	EPA, 1980	20	pCi/L	CN

Sampling Locations

FMB stream water samples were collected from three locations and seepline water samples were collected from ten locations as identified in Table 4. Figures 1 and 2 show the stream and seepline sampling locations. Background samples were collected at one stream and two seepline locations from areas upstream of the General Separations Areas (GSA). For quality assurance/quality control (QA/QC) purposes, duplicate samples were collected at locations HSP043 and FSP047 and sent to General Engineering and Environmental Physics. At locations HSP008 and FSP290, triplicate samples were collected. One sample (reference

sample) was sent to General Engineering and Environmental Physics; a second was also sent as a blind sample. The third sample (split sample) was sent to Weston Analytics and Clemson Technical Center.

One trip blank sample was carried throughout sampling for each seepline area, yielding a total of two trip blank samples for the event. The trip blank samples consisted of one of each type sample container filled with deionized water. These samples were carried to each designated sampling location, handled like the collected samples, and shipped to General Engineering and Environmental Physics for analyses.

Table 4. FMC Stream and Seepline Sampling Locations

Seepline	SRS Coordinates	
	North	East
F Area		
FSP012	73602	49644
FSP032	73367	50258
FSP047	73609	50607
FSP204	73281	48801
FSP290	73160	46865
H Area		
HSP008	71005	56990
HSP029	71278	56257
HSP043	71644	55722
HSP060	71629	55190
HSP092	72672	54129
Stream		
FMC001F	70350	57050
FMC001H	72600	53000
FMC002H	72200	43900
Background*		
BG001	Seepline	
BG002	Seepline	
BG003	Stream	

*Background locations were within the grid identified by the Site Use Grid Maps 13 and 14 as 71750N - 60000N and 40000E - 70000E.

Figure 1. Location of F-Area Seepage Basins, Seepine Sampling Points (FSP), and Fourmile Branch Sampling Points

Figure 2. Location of H-Area Seepage Basins, Seepine Sampling Points (HSP), and Fourmile Branch Sampling Points

Decontamination Procedures

All sampling equipment was decontaminated prior to the collection of each sample. The equipment was first cleaned with Milli-Q water and phosphate-free laboratory detergent (Liquinox), using a brush if necessary to remove particulate matter and surface films. The equipment was then rinsed thoroughly with Milli-Q water. Finally, the equipment was rinsed two times with pesticide-grade methanol solvent and allowed to air dry. When necessary, the dry equipment was wrapped with aluminum foil to prevent contamination during storage or transport.

Decontamination rinse waters were discharged to the ground and methanol was collected in a pan and allowed to evaporate. Two samples were collected from the equipment rinsate water (QA 3 and QA 4) to evaluate the efficiency of the decontamination procedure. Two samples of the deionized water (QA 1 and QA 2) used for decontamination purposes, one from the source and one from the field carboy, were collected and sent to General Engineering and Environmental Physics for analyses.

Sample Collection Procedures

Each stream and seepage sampling location had been marked previously with PVC stakes. Identification numbers had been written on these stakes which served as the sample location ID.

Seepage Water

After locating the sampling station, a hole was excavated using a decontaminated stainless steel shovel within a three-foot radius of the PVC stake. A five-gallon plastic bucket screened on the sides and bottom was placed into the hole and covered with a lid. One bucket was set at each location, except locations HSP008, HSP043, FSP047 and FSP290 where two buckets were set side by side. The additional bucket at these locations was needed to collect sufficient water for duplicate and split samples.

The buckets were installed 24 hours prior to sample collection to allow suspended matter resulting from site preparation to settle. The time between installing the buckets and sample collection was recorded in the field notebook.

Samples for volatile organic analysis (VOA) were collected first by dipping the VOA vials directly into the buckets. These vials were completely filled so that no head space remained. All metals samples were filtered through a 0.45 μ m membrane disposable filter to remove fine particulate matter from the sample. This filtering was performed in the field, away from the sampling locations using porta-

ble filtering equipment, within four hours of sample collection. To facilitate this, an aliquot of sufficient volume was collected from the sampling location in an unpreserved sample container and transported to the filtering location immediately following VOA collection. All apparatus used in filtering the metals samples was rinsed and flushed thoroughly with deionized water after processing each sample.

Using a peristaltic pump powered by a 12-volt battery and silastic (silicone) tubing, water was pumped from the bucket to the remaining sample containers. New tubing was used for each sampling location and was flushed for 20 seconds with water from the bucket prior to sample collection.

Stream Water Sampling

Collection of stream water samples was performed by dipping the sample container directly into the stream. This collection method minimized alteration of the sample as well as the potential for sample cross-contamination through the use of poorly decontaminated sampling equipment.

Surface grab samples were collected in the middle of the stream from the top of the water column. The container was placed into the water with the mouth of the container facing upstream so that water flowed directly into the container. Care was taken when opening and filling the bottles to prevent the loss of any preservatives.

All containers, except the VOA vials, were filled to the shoulder with water. VOA vials were filled completely, with no head space remaining. Filtering procedures for metals samples were the same as for the seepage water samples.

Sample Processing

Once all sample containers had been filled for a sampling location, they were stored in a cooler containing blue ice for transport to the staging area. Prior to transporting the samples, they were delivered to the Health Protection Department where container exteriors were scanned for radioactivity. The purpose of this scan was to identify any radiological health hazards associated with handling the samples. At the staging area, the samples were placed in a refrigerator and stored at 4°C until they were packaged for shipping. Samples were packed and shipped to analytical subcontractors according to the procedures "Packaging Non-radioactive Water Samples for Off-Site Shipment" and "Packaging Radioactive Water Samples for Off-Site Shipment" (WSRC-3Q5, Ch. 12). The particular proce-

procedure used was determined by the total activity results provided by EMS. Chain of custody procedures were followed at all times for all samples. Copies of the completed chain of custody forms for each sampling location have been presented by Metcalf and Eddy (1992).

The pH and conductivity of the water at each sampling location was measured *in situ* at the time of sampling and recorded in the field notebook. The probes were rinsed with deionized water between each sampling location.

Discussion

Concentrations of constituents measured at seepine sampling locations are expected to fluctuate throughout the year. Climate, especially rainfall, influences measured concentrations. Low rainfall amounts for a few months prior to sampling could concentrate constituents, and high rainfall amounts could dilute the constituents in the shallow groundwater at the seepine intercept. Rainfall amounts measured at the F-Area weather station from January through July 1992 totaled 75.23 cm. The average rainfall from 1960 to 1991 for the weather station in F Area through the month of July was 78.91 cm. This indicates for the July 1992 sampling event, rainfall amounts in F and H Areas were near normal. This should be considered when interpreting the results.

Analytical services were provided by several laboratories. General Engineering (nonradiological analyses) and Environmental Physics (radiological analyses) were used as the primary laboratories. Weston Analytics (nonradiological analyses) and Clemson Technical Center (radiological analyses) were used for split sample analyses. For this report, samples analyzed by General Engineering, Environmental Physics, and their subcontractors were considered to be the reference samples on which all analyses and interpretation was based. Samples analyzed by Weston Analytics, Clemson Technical Center, and their subcontractors were considered to be quality assurance samples and were not used in any analyses or interpretations. This should prevent inter-lab variability of constituent concentrations from biasing any analyses and interpretations. Environmental Physics subcontracted ^{129}I and ^{237}Np analyses to Teledyne Isotopes, Inc. for the reference samples and Weston Analytics subcontracted gross alpha, nonvolatile beta, and tritium analyses to TMA/Eberline, Inc. for the split samples.

Analytical results for the July 1992 sampling event of the semi-annual sampling program along FMB and its seepines are presented in Analytical Results (page 32). The results are presented in a format similar to that used in the quarterly groundwater monitoring reports issued by EMS (EMS 1992). For each sampling location (seepine and stream), sampling date, field measurements including depth to water, pH, and specific conductance, and all laboratory analyses are presented (excluding lab blanks and standards). Included in the laboratory analyses table for each analyte is the lab that performed the analyses, any analytical modifiers, the analytical result, the accuracy of the result (detected radiological parameters only), any established standard (PDWS, MCL, SDWS), any 1989 analytical results for that analyte and location, and the units the results are reported in. At the beginning of Ana-

lytical Results (page 32), a legend provides explanations for the abbreviations and modifiers used to present the data. For locations where split samples were collected, results from each lab are presented for each analyte. Laboratory duplicates were averaged with their corresponding reference sample for both presentation in Analytical Results and analysis purposes and blind duplicate samples analyzed by General Engineering and Environmental Physics were also averaged with their corresponding reference samples for analysis.

Analytical results from the trip blank (QA 2S, QA 4S) and the other quality assurance samples (QA 1, QA 2, QA 3, and QA 4) are also presented in Analytical Results. Both trip blank samples exhibit elevated sodium concentrations attributed to the deionizing system from which the water used in the samples was obtained. Independent analyses have confirmed that sodium concentrations in the water from the system are elevated. Water from this system was used only in the trip blank samples; therefore, the elevated sodium concentrations characteristic of the water from this system will have no impact on any other analytical results for this project.

Stream and Seepine Water Conductivity and pH

Conductivity and pH are often used as indicator parameters of overall water quality and can aide the researcher in the overall assessment of the contamination of a site. Conductivity has been particularly useful in delineating areas exhibiting high ion concentrations. The extensive study of pH, conductivity, and tritium in 1989 (Haselow et al. 1990) showed that the seepine water in both F and H Areas exhibited low pH and high conductivity. Since 1989, quarterly surveys of pH, conductivity, and tritium (Dixon and Rogers 1991a and b) have shown that these parameters have been trending towards more normal ranges. The pH of the F-Area and H-Area seepine water in July 1992 ranged from 4.10 - 5.38 and 4.80 - 6.32, respectively. The conductivity of the F-Area and H-Area seepine water ranged from 88 - 277 $\mu\text{S}/\text{cm}$ and 33 - 237 $\mu\text{S}/\text{cm}$, respectively. The pH and conductivity of the FMB stream water in July 1992 ranged from 6.67 - 7.19 and 70 - 94 $\mu\text{S}/\text{cm}$. The seepine pH values appear to be near normal ranges, while the conductivity values suggest that some locations are being influenced by elevated concentrations of ions. This is substantiated by the fact that locations exhibiting high conductivity values also exhibit high concentrations of ions, particularly aluminum, calcium, iron, magnesium, and sodium. FMB pH values appear to be near normal. Conductivity values in FMB are elevated somewhat over background as a result of ion contribution from the F- and H-Area seeps (particularly calcium and sodium).

Comparison of Seepline Locations to Background Locations

Data used in this comparison consisted of the contaminant concentration results from all seepline and background sampling locations. The data was analyzed to determine if contaminant concentrations along the seepline were significantly greater than concentrations of the same contaminant in background samples.

Frequently, the data were reported by the laboratory as below the limit of detection (LOD). Analytical results calculated to be less than the LOD are not considered reliable and therefore are reported as the LOD value. Such data are said to be left censored. Common practice is to include these data in subsequent statistical analyses as LOD/2, which was the method chosen for this comparison.

Contaminants were selected for statistical analysis only when 50% or more of the data in the background or other seepline areas were greater than the LOD. Also, when both background samples were reported as LOD for a particular analyte, no statistical analysis was performed.

The data for background samples and the two seepline areas (FSP and HSP) were plotted and examined. When these data collectively spanned one or more orders of magnitude, a natural log transformation was performed. Subsequently, a one-way ANOVA was performed on the log-transformed data. The method of single degree of freedom contrasts (Steel and Torrie 1980) was used to compare the background mean to each of the two seepline area means. Ranks of the concentration data were also computed and the same parametric statistical methods were performed again using these ranks, instead of the concentration data (Conover 1980). The latter analysis was corroborative of the former.

Significance probabilities, or p-values, obtained from each of the single degree of freedom contrasts were examined

and compared to the standard Type I error rate criterion of 5% (i.e., 0.05). However, since these tests were performed on approximately 20 different chemical constituents measured from the same water samples, a potential for Type I error inflation exists. To protect against such inflation, the Bonferroni multiple comparison method (Miller 1981) was also used. Instead of declaring contrasts among the two pairs of seepline means (BG-FSP or BG-HSP) to be significant at the 0.05 level, they were declared significant if their p-values were less than or equal to $0.05/20$ or 0.0025.

Plots of the natural logs of the constituent concentrations were examined; in most instances, the log transformation apparently preserved the assumption of equal variances among treatment groups. However, when the within-group variation appeared disparate between groups, a Levene's test for variance homogeneity (Levene 1960) was performed. When this statistical test was significant, a Welch's test of the equality of means (Welch 1951) was also performed to corroborate the results of the one-way ANOVA with single degree of freedom contrasts among log-transformed means.

Table 5 shows the probabilities resulting from both statistical tests and Table 6 gives the mean and range of concentration for each analyte used in the statistical tests. Plots of the analyte concentrations as a function of seepline area (i.e., BG, FSP, HSP) are given in Appendix B. These plots should provide the reader with a view of the variability associated with each analyte on which statistical analysis was performed.

FMB stream samples were not compared to background using the above-mentioned statistical techniques, since there was only one background stream sample.

Table 5. Comparison of FSP and HSP Sampling Locations to Background Locations

Analyte		Natural Log Transform Contrasts		Ranked Sum Averaged Contrasts	
		BG-FSP	BG-HSP	BG-FSP	BG-HSP
Alkalinity	Prob > t _d	0.1768	0.1249	0.0537	0.0332
Aluminum	Prob > t _d	0.2671	0.0135	0.1349	0.0143
Barium	Prob > t _d	0.0071	0.1628	0.0030	0.1249
Calcium	Prob > t _d	0.1000	0.1436	0.0488	0.0549
Chloride	Prob > t _d	*-	-	0.1198	0.1336
Gross alpha	Prob > t _d	0.9927	0.9900	0.9062	0.8139
Hardness	Prob > t _d	-	-	0.6410	0.3162
Lead	Prob > t _d	0.8538	0.3586	0.7124	0.4242
Magnesium	Prob > t _d	0.0607	0.3040	0.0838	0.3082
Manganese	Prob > t _d	0.0590	0.2012	0.0422	0.1293
Mercury	Prob > t _d	0.4698	0.8353	0.4844	0.8873
Nitrate as nitrogen	Prob > t _d	0.3454	0.2917	0.1336	0.1198
Nonvolatile beta	Prob > t _d	0.1099	0.1283	0.1061	0.1475
Potassium	Prob > t _d	0.3587	0.5626	0.3366	0.4869
Radium-226	Prob > t _d	0.9564	0.0515	0.8048	0.0958
Radium-228	Prob > t _d	0.6047	0.5570	0.5730	0.8811
Sodium	Prob > t _d	0.0851	0.0078	0.0655	0.0045
Strontium-90	Prob > t _d	0.2412	0.3803	0.2203	0.3999
Total Organic Carbon	Prob > t _d	0.7147	0.6730	0.6673	0.3812
Total Organic Halogens	Prob > t _d	0.9609	0.4233	0.9019	0.7077
Tritium	Prob > t _d	0.0174	0.0000	0.0604	0.0025
Zinc	Prob > t _d	0.4661	0.5202	0.3809	0.6317

*Natural log transform was not performed since data range was less than one order of magnitude.

Table 6. List of Mean Concentrations and Ranges for Analytes Used in Statistical Analysis

Analyte	Seepine	Units	Mean	Range
Alkalinity	BG	mg/L	1.43	1.43-1.43
	FSP		11.23	1.55-26.0
	HSP		16.31	1.5-42.5
Aluminum	BG	µg/L	215.5	175-256
	FSP		619.70	224-936
	HSP		4449.80	606-11515
Barium	BG	µg/L	16.50	12.2-20.8
	FSP		83.67	33.45-101.5
	HSP		34.76	17.8-68.7
Calcium	BG	µg/L	374.50	262-487
	FSP		1909.40	491-5720
	HSP		1242.33	747-1820

(Table 6. Continued)

Analyte	Seepline	Units	Mean	Range
Chloride	BG	mg/L	2.41	1.85-2.98
	FSP		3.99	2.43-6.52
	HSP		3.93	2.38-6.05
Gross alpha	BG	pCi/L	3.70	2.5-4.9
	FSP		4.66	1.0-10.2
	HSP		7.54	1.0-19.0
Hardness	BG	mg/L	15.25	8.5-22.0
	FSP		12.57	7.79-25.0
	HSP		9.26	2.8-19.5
Lead	BG	µg/L	2.33	1.50-3.16
	FSP		2.28	1.5-5.45
	HSP		5.07	1.5-8.68
Magnesium	BG	µg/L	425.50	349-502
	FSP		1934.00	485-4770
	HSP		928.60	379-1830
Manganese	BG	µg/L	30.17	18.4-41.95
	FSP		1157.22	49.6-2560
	HSP		211.91	28.5-527
Mercury	BG	µg/L	0.42	0.37-0.47
	FSP		0.27	0.1-0.47
	HSP		0.77	0.1-1.9
Nitrate as nitrogen	BG	mg/L	0.24	0.23-0.26
	FSP		8.55	0.27-32.2
	HSP		7.49	0.02-20.05
Nonvolatile beta	BG	pCi/L	3.35	2.1-4.6
	FSP		129.89	2.15-354.5
	HSP		240.58	3.0-1070.0
Potassium	BG	µg/L	460.50	250-671
	FSP		1504.00	250-3960
	HSP		744.50	250-1110
Radium-226	BG	pCi/L	0.88	0.5-1.26
	FSP		0.99	0.5-1.75
	HSP		3.37	1.17-5.46

(Table 6. Continued)

Analyte	Seep Line	Units	Mean	Range
Radium-228	BG	pCi/L	4.98	4.73-5.23
	FSP		25.93	1.88-90.6
	HSP		136.51	1.17-523
Sodium	BG	µg/L	1027	794-1260
	FSP		8658.00	2440-27000
	HSP		31310.00	2850-59100
Strontium-90	BG	pCi/L	2.43	1.0-3.86
	FSP		43.08	1.0-124.0
	HSP		118.31	1.0-549
Total Organic Carbon	BG	mg/L	14.00	7.0-21.0
	FSP		23.10	3.0-50.0
	HSP		5.28	2.6-7.9
Total Organic Halogens	BG	µg/L	17.15	9.2-21.5
	FSP		22.33	2.5-51.4
	HSP		16.37	2.5-32.5
Tritium	BG	pCi/ml	6.50	4.86-8.15
	FSP		440.31	28.9-1290.0
	HSP		2646.70	305.5-5320
Zinc	BG	µg/L	119.10	95.2-143.0
	FSP		97.16	57.8-140.0
	HSP		149.86	77.3-199.0

Using the natural log transform, the following analytes exhibited concentrations significantly greater than background at the Type 1 error rate of 0.05:

Area	Analytes
F	barium, ^3H
H	aluminum, sodium, ^3H

Using the ranks of the concentration data, the following analytes exhibited concentrations significantly greater than background at a Type 1 error rate of 0.05:

Area	Analytes
F	alkalinity, barium, calcium, manganese
H	alkalinity, aluminum, calcium, sodium, ^3H , ^{226}Ra

Using the Bonferroni multiple comparison Type 1 error rate of 0.0025, the only analyte exhibiting concentrations significantly greater than background for either the transformed or ranked data was tritium at the H-Area seepage line.

Aluminum, barium, calcium, magnesium, manganese, and potassium are likely being leached from the soil profile by low pH water as suggested by Looney et al. (1989) and Haselow et al. (1990). Observation of the data suggests that the concentrations of these constituents has decreased at most locations for which 1989 measurements are available for comparison. This can probably be attributed to the increase in pH of the seepage water in general since 1989 (Dixon and Rogers 1992a and b). An increase in pH (to about neutral) will reduce the solubility of these metals and their concentrations in the seepage water. Data from 1989 for barium were not available for comparison; however, most F-Area seepage line locations exhibited slightly elevated barium concentrations. The maximum concentration of barium measured at the F-Area seepage line was 101.5 mg/L, well below the MCL of 2000 mg/L. Barium concentrations in H Area did not appear to be elevated above background levels. Although tritium appears to be impacting both seepage lines and sodium appears to be impacting the H-Area seepage line, the general trend, when compared to 1989 concentrations, is towards decline. The decline in tritium concentrations at both seepage lines has been documented by Dixon and Rogers (1992a and b).

Comparison of Stream and Seepine Locations to Established Standards

In conjunction with the statistical tests, analysis and interpretation of the data was also performed based on observed trends. A list of those analytes occurring above LOD without any other analytical modifier (except V) is given in Table 7. Analytes with occurrences greater than their LOD totaled 42 of 74 and represented 56.8 percent of the total analyte list.

A list of the analytes, along with the corresponding sampling locations where concentrations were at levels greater than those established by the PDWS or MCL lists, is given in Table 8. Seven analytes were found to be above these standards at one or more sampling locations (stream or seepine). They included gross alpha, nonvolatile beta, ^{129}I , ^{228}Ra , ^{90}Sr , and ^3H . Of these six analytes, five were detected at levels greater than the PDWS or MCL in 1989 (Haselow et al. 1990). In 1989, ^{228}Ra analysis was not performed.

Analytes elevated above the PDWS or MCL at one or more sampling locations included:

Date	Area	Analytes
7/92	F	nitrate, nonvolatile beta, ^3H , ^{129}I , ^{228}Ra , ^{90}Sr
1989		cadmium, nitrate, gross alpha, nonvolatile beta, ^{249}Am , ^{129}I , ^3H , ^{226}Ra , ^{89}Sr , ^{90}Sr , $^{233/234}\text{U}$, ^{238}U
7/92	H	nitrate, gross alpha, nonvolatile beta, ^3H , ^{129}I , ^{228}Ra , ^{90}Sr
1989		nitrate, gross alpha, nonvolatile beta, ^3H , ^{226}Ra , ^{89}Sr , ^{90}Sr
7/92	FMB	nonvolatile beta, ^3H , ^{129}I , ^{228}Ra , ^{90}Sr
1989		nonvolatile beta, ^3H

A list of the analytes, along with the corresponding sampling locations where concentrations were at levels greater than those established by the SDWS, is given in Table 9. Two analytes were found to be above the SDWS at one or more seepine and stream sampling locations: iron and manganese. Iron and manganese were also elevated above the SDWS at the background stream location. They were also elevated above the SDWS at one or more seepine location in 1989. As pointed out by Haselow et al. (1990), SDWS for iron and manganese were established to minimize staining from rust spots. Aluminum, calcium, magnesium, potassium and sodium appear to be elevated at both the F-and H-Area seepines; however, no standards such as the PDWS, SDWS, or MCL exist for comparison.

Table 7. Analytes Reported at Concentrations Greater Than Their Method Detection Limit

Analyte	Analyte
Alkalinity	Nickel
Aluminum	Nitrate as nitrogen
Ammonia nitrogen	nonvolatile beta
Arsenic	Plutonium-238
Barium	Potassium
Calcium	Radium-226
Cesium-137	Radium-228
Chloride	Sodium
Chloroform	Strontium-90
Chromium	Thorium-230
Cobalt-60	Thorium-232
Copper	Tin
Fluoride	Total organic carbon
Gross alpha	Total organic halogens
Hardness	Total phenols
Iodine-129	Tritium
Iron	Uranium-234
Lead	Uranium-238
Magnesium	Vanadium
Manganese	Zinc
Mercury	

Table 8. Analytes and Corresponding Sampling Locations Where July 1992 Concentrations Exceeded Either the PDWS or MCL

Analyte	Lab	Mod*	7/92 Result	Acc**	Standard	Units	Location
Gross alpha	GE		19	13	15	pCi/L	HSP008
Iodine-129	TE		2.8	1.3	1	pCi/L	FMC001F
Iodine-129	TE		4.2	1.3	1	pCi/L	FSP012
Iodine-129	TE		2.8	1.5	1	pCi/L	FSP032
Iodine-129	TE		41.4	5.7	1	pCi/L	FSP204
Iodine-129	TE		14.6	2.1	1	pCi/L	HSP008
Iodine-129	TE		7.8	1.2	1	pCi/L	HSP029
Iodine-129	TE		52.2	3.1	1	pCi/L	HSP043
Nitrate as nitrogen	GE		32.2		10	mg/L	FSP204
Nitrate as nitrogen	GE		20.05		10	mg/L	HSP008
Nitrate as nitrogen	GE		12.2		10	mg/L	HSP029
Nonvolatile beta	GE	V	65.5	4.5	50	pCi/L	FMC001H
Nonvolatile beta	GE		75.6	4.8	50	pCi/L	FSP012
Nonvolatile beta	GE		168	7	50	pCi/L	FSP032
Nonvolatile beta	GE		354.5	9.3	50	pCi/L	FSP204
Nonvolatile beta	GE		56.4	9	50	pCi/L	HSP008
Nonvolatile beta	GE	V	1070	18	50	pCi/L	HSP029
Radium-228	GP		16.5	1.4	7.85	pCi/L	FMC001F
Radium-228	GP		11.4	1.2	7.85	pCi/L	FMC002H
Radium-228	GP		14	2.7	7.85	pCi/L	FSP012
Radium-228	GP		10.6	1.1	7.85	pCi/L	FSP032
Radium-228	GP		12.6	1.6	7.85	pCi/L	FSP047

(Table 8. Continued)

Analyte	Lab	Mod*	7/92 Result	Acc**	Standard	Units	Location
Radium-228	GP		90.6	3.6	7.85	pCi/L	FSP204
Radium-228	GP		523	7.4	7.85	pCi/L	HSP029
Radium-228	GP		153	3.6	7.85	pCi/L	HSP060
Strontium-90	GP		27.9	3.7	8	pCi/L	FMC001F
Strontium-90	GP		12.4	2.7	8	pCi/L	FMC001H
Strontium-90	GP		16.7	1.9	8	pCi/L	FMC002H
Strontium-90	GP		22.7	2	8	pCi/L	FSP012
Strontium-90	GP		124	4	8	pCi/L	FSP032
Strontium-90	GP		18.5	2.45	8	pCi/L	FSP047
Strontium-90	GP		49.2	3	8	pCi/L	FSP204
Strontium-90	GP		549	8.4	8	pCi/L	HSP029
Strontium-90	GP		33.8	3.6	8	pCi/L	HSP060
Tritium	GE		640	3.8	20	pCi/ml	FMC001F
Tritium	GE		72.8	1.3	20	pCi/ml	FMC001H
Tritium	GE		170	2	20	pCi/ml	FMC002H
Tritium	GE		28.9	1	20	pCi/ml	FSP012
Tritium	GE		730	4	20	pCi/ml	FSP032
Tritium	GE		94.2	1.6	20	pCi/ml	FSP047
Tritium	GE		1290	5.6	20	pCi/ml	FSP204
Tritium	GE		58.45	1.33	20	pCi/ml	FSP290
Tritium	GE		5320	10.5	20	pCi/ml	HSP008
Tritium	GE		858	4.4	20	pCi/ml	HSP029
Tritium	GE		3260	8.4	20	pCi/ml	HSP043
Tritium	GE		3490	11	20	pCi/ml	HSP060
Tritium	GE		305.5	2.8	20	pCi/ml	HSP092

*Analytical Modifier (See Table 14)

**Accuracy

Table 9. Analytes and Corresponding Sampling Locations Where July 1992 Concentrations Exceeded the SDWS

Analyte	Lab	Mod*	7/92 Result	Standard	Units	Location
Iron	GE		843	300	µg/L	BG003
Iron	GE		392	300	µg/L	FMC001F
Iron	GE		349	300	µg/L	FMC001H
Iron	GE		919.5	300	µg/L	FMC002H
Iron	GE		7140	300	µg/L	FSP012
Iron	GE		12000	300	µg/L	FSP047
Iron	GE		698	300	µg/L	FSP204
Iron	GE		3105	300	µg/L	HSP008
Iron	GE		1920	300	µg/L	HSP043
Iron	GE		2810	300	µg/L	HSP060

(Table 9. Continued)

Analyte	Lab	Mod*	7/92 Result	Standard	Units	Location
Iron	GE		2880	300	µg/L	HSP092
Manganese	GE		223	50	µg/L	BG003
Manganese	GE		65.3	50	µg/L	FMC001H
Manganese	GE		704	50	µg/L	FMC002H
Manganese	GE		862	50	µg/L	FSP047
Manganese	GE		2560	50	µg/L	FSP204
Manganese	GE		91.05	50	µg/L	HSP008
Manganese	GE		527	50	µg/L	HSP029
Manganese	GE		206	50	µg/L	HSP060
Manganese	GE		207	50	µg/L	HSP092

*Analytical Modifier (See Table 14)

Comparison of 1989 and July 1992 Stream and Seepine Locations

Some of the locations sampled in July 1992 were also sampled in 1989. These locations are given in Table 10. To facilitate comparison, data from 1989 are presented with the July 1992 data for coinciding sampling locations (Analytical Results, page 32). A list of analytes along with the corresponding sampling locations where the July 1992 concentrations were greater than those measured at the same locations in 1989 is given in Table 11. A total of 11 different analytes were measured at concentrations greater than those measured in 1989 at the same locations.

Analytes where July 1992 concentrations exceeded those measured in 1989 at one or more sampling location included:

Area	Analytes
F	aluminum, chloride, mercury, ^{129}I
H	aluminum, chloride, mercury, lead, sodium, zinc, ^{129}I
FMB	alkalinity, chloride, mercury, sodium, zinc, ^{137}Cs , ^{226}Ra , ^{90}Sr

It appears from this information that mercury may be influencing the seepine water in both F and H Areas as well as in FMB; however, closer examination of the data leads one to conclude otherwise. Mercury concentrations at all F-Area seepine locations and at the FMB stream locations are within range of the background concentrations measured upstream of F and H Area. In H Area, three of five seepine locations exhibit elevated mercury concentrations. The highest concentration of mercury measured

(but slightly less than the MCL) was at location HSP008, which lies in a previously delineated mercury plume migrating from the H-Area basins (Nixon et al. 1991).

As mentioned earlier, at most locations along the F- and H-Area seepines where 1989 data are available for comparison, concentrations of most constituents have declined, particularly aluminum and sodium. Chloride concentrations for all seepine and stream locations are less than 8.0 mg/L, within the range of concentrations observed in the groundwater monitoring wells in the area.

A list of the analytes and their corresponding sampling locations where July 1992 concentrations were measured above the 1989 concentrations and above either the PDWS or MCL is given in Table 12. Two analytes met these criteria: ^{129}I and ^{90}Sr .

Analytes where July 1992 concentrations exceeded those measured in 1989 and either the PDWS or MCL at one or more sampling location included:

Area	Analytes
F	^{129}I
H	^{129}I
FMB	^{90}Sr

Several seepine locations in both F and H Area continue to be influenced by ^{129}I and ^{90}Sr . Contributions of ^{90}Sr , ^{129}I , ^3H and ^{137}Cs from the F- and H-Area seepage basin operations continue to be measurable in FMB.

Table 10. Correlation Between 1989 and July 1992 Sampling Locations

July 1992	1989
FMC001F	New Location
FMC001H	89HW7
FMC002H	89HW2
FSP012	89FW5
FSP032	89FW6
FSP047	89FW7
FSP204	89FW3
FSP290	New Location
HSP008	New Location
HSP029	New Location
HSP043	89HW4
HSP060	New Location
HSP090	New Location

Table 11. Analytes and Corresponding Sampling Locations Where 1992 Concentrations Exceeded 1989 Concentrations

Analyte	Lab	Mod*	7/92 Result	Acc*	Standard	Mod*	89-Result	Units	ID
Alkalinity	GE	V	13.2				8	mg/L	FMC001H
Aluminum	GE		224				130	µg/L	FSP047
Aluminum	GE		4440				80	µg/L	HSP043
Cesium-137	GP		102	7.6	200		62	pCi/L	FMC001H
Cesium-137	GP		10.3	4.2	200		4.4	pCi/L	FMC002H
Chloride	GE		7.5				5.5	mg/L	FMC001H
Chloride	GE		3.2				1.9	mg/L	FSP012
Chloride	GE		2.43				2	mg/L	FSP032
Chloride	GE		6.52				3.8	mg/L	FSP047
Chloride	GE		3.86				2.4	mg/L	FSP204
Chloride	GE		3.94				1.2	mg/L	HSP043
Iodine-129	TE		41.4	5.7	1	U	24	pCi/L	FSP204
Iodine-129	TE		52.2	3.1	1	U	39	pCi/L	HSP043
Lead	GE		8.68		15	U	3	µg/L	HSP043
Mercury	GE		0.22		2	U	0.2	µg/L	FMC001H
Mercury	GE		0.24		2	U	0.2	µg/L	FSP012
Mercury	GE		0.47		2	U	0.2	µg/L	FSP047
Mercury	GE		0.38		2	U	0.2	µg/L	FSP204
Mercury	GE		0.94		2	U	0.2	µg/L	HSP043
Radium-226	GP		1.66	0.31	15.7		1.2	pCi/L	FMC001H
Sodium	GE		11900				10200	µg/L	FMC001H
Sodium	GE		15400				11700	µg/L	FMC002H
Sodium	GE		41900				63.3	µg/L	HSP043

(Table 11. Continued)

Analyte	Lab	Mod*	7/92 Result	Acc*	Standard	Mod*	89-Result	Units	ID
Strontium-90	GP		12.4	2.7	8		5.5	pCi/L	FMC001H
Strontium-90	GP		16.7	1.9	8		6.8	pCi/L	FMC002H
Zinc	GE		13.65		5000	U	9	µg/L	FMC002H
Zinc	GE		199			U	9	µg/L	HSP043

*Analytical Modifier (See Table 14)

**Accuracy

Table 12. Analytes and Corresponding Sampling Locations Where 1992 Concentrations Exceeded 1989 Concentrations and Either the PDWS or MCL

Analyte	Lab	Mod*	7/92 Result	Acc**	Standard	Mod*	89-Result	Units	ID
Strontium-90	GP		12.4	2.7	8		5.5	pCi/L	FMC001H
Strontium-90	GP		16.7	1.9	8		6.8	pCi/L	FMC002H
Iodine-129	TE		41.4	5.7	1	U	24	pCi/L	FSP204
Iodine-129	TE		52.2	3.1	1	U	39	pCi/L	HSP043

*Analytical Modifier (See Table 14)

**Accuracy

Technetium-99 Results

^{99}Tc was reported by Environmental Physics at concentrations greater than the PDWS at several locations. The reported concentrations were also elevated considerably above 1989 concentrations at the same locations. Reported concentrations ranged from 300 (detection limit) to 12,450 pCi/L. These results were suspect for several reasons.

- Reported concentrations were higher than any measured at the seep line in the past.
- Concentrations were higher than would be expected based on the total ^{99}Tc inventory for both F and H basins during their operating history.
- The lab performing split sample analyses rejected their ^{99}Tc results due to a matrix interference.
- Gross radiological indicators (gross alpha and gross beta) were not at concentrations sufficient to suggest that large quantities of ^{99}Tc were present in the samples.

A comparison of the analytical methods used by the two labs revealed that both used an acid extraction liquid scintillation procedure, which should have produced similar results. Both labs were contacted and asked to explain their ^{99}Tc methods and results. Environmental Physics reported that no interferences of any kind were noted in their analytical logs (including any mention of solids). Based on spike recoveries from the samples, they felt confident of their results. Clemson Technical Center reported a matrix interference (resulting from a large amount of solids) which they reported would greatly interfere with ^{99}Tc analyses and was expected to yield falsely elevated results. As expected, elevated results were obtained. Clemson Technical Center rejected the results because the noted matrix interference was expected to yield elevated results and the gross radiological indicators did not support that ^{99}Tc of the quantity suggested by the scintillation counts was present in the samples. Gross alpha and gross beta results

reported by Environmental Physics did not indicate that ^{99}Tc of the quantity reported could be present in the samples.

Confirmation samples were collected in March 1993 and analyzed onsite by ETS using an ICP/MS method (Beals 1992) that eliminated the effect of matrix interferences resulting from suspended solids. The ICP/MS methodology also eliminated the possibility of erroneously counting other radionuclides with energies of similar magnitudes as ^{99}Tc (i.e. ^3H). This may account for the overestimation. The count window used by Environmental Physics for ^{99}Tc analyses ranged from 0 to 760 Kev. This count range includes both ^{99}Tc and ^3H , which are both low-energy beta emitters. Examination of the results reveals that locations at which Environmental Physics reported elevated ^{99}Tc also reported elevated ^3H . This suggests that, even though an acid extraction procedure was used in which the aqueous phase was to be separated and removed from the sample, a portion of the aqueous phase may have remained in the extract used for analysis. The aqueous portion of the extract would contain ^3H , which would be counted as ^{99}Tc , resulting in overestimation of ^{99}Tc concentration.

Results of the confirmation analyses showed that actual ^{99}Tc concentrations ranged from 19 to 108 pCi/L. These results confirm that the acid extraction liquid scintillation methodologies used for ^{99}Tc analysis have overestimated the actual ^{99}Tc concentrations present in the samples. For water samples containing large amounts of suspended solids and/or ^3H , this should be taken into consideration. Table 13 shows the results as reported by all three laboratories. For the purpose of this report, all ^{99}Tc results reported by Environmental Physics and Clemson Technical Center were considered inaccurate and excluded from all analyses.

Table 13. Comparison of ^{99}Tc Results Between Laboratories

Location	Environmental Physics			Clemson Technical Center			Environmental Technology Section			
	^{99}Tc	Mod*	Method	^{99}Tc	Mod	Method	^{99}Tc	Mod	Method	Units
FSP032	1650		HASL300				19		Beals, 1992	pCi/L
FSP204	2755		HASL300				37		Beals, 1992	pCi/L
HSP008	12450		HASL300	7300	R4**	MMEC038	108		Beals, 1992	pCi/L
HSP029	1910		HASL300				52		Beals, 1992	pCi/L
HSP043	6080		HASL300	7240	R4	MMEC038	60		Beals, 1992	pCi/L
HSP060	8640		HASL300				31		Beals, 1992	pCi/L

*Analytical Modifier

**Analytical results were rejected due to a matrix interference.

Summary

Results from the July 1992 sampling event of the semi-annual sampling program along FMB and its seepines suggest that the seepines in both F and H Areas and FMB continue to be influenced by contaminants migrating from the F- and H-Area seepage basins.

Comparisons of F-Area seepine locations to background locations suggested that alkalinity, barium, calcium, and manganese were significantly impacting the seepine. Comparisons of H-Area seepine locations to background suggested that aluminum, calcium, sodium, ^{226}Ra , and ^3H were impacting the seepine. However, the July 1992 concentrations of most of these analytes (aluminum, sodium, etc.) had decreased substantially, compared to 1989 concentrations for the same sampling locations.

Comparisons of July 1992 concentrations to established standards revealed that several analytes were elevated above either the PDWS or MCL at one or more sampling location (seepine and stream). No metals concentrations were detected above the PDWS or MCL at any sampling location. Those analytes elevated above the PDWS or MCL at one or more locations for both the F- and H-Area seepines and FMB included nonvolatile beta, ^3H , ^{129}I , ^{228}Ra , and ^{90}Sr . Gross alpha in H Area and nitrate in both F and H Area were also above either the PDWS or MCL at one or more sampling locations.

Based on results from the July 1992 sampling event, the following analytes appear to be impacting the seepines and stream:

Area	Analytes
F	alkalinity, aluminum, barium, calcium, iron, manganese, nitrate, nonvolatile beta, ^3H , ^{129}I , ^{228}Ra , and ^{90}Sr
H	aluminum, calcium, sodium, iron, manganese, mercury, lead, nitrate, zinc, nonvolatile beta, ^3H , ^{129}I , ^{228}Ra , and ^{90}Sr
FMB	alkalinity, mercury, sodium, zinc, nonvolatile beta, ^{137}Cs , ^3H , ^{129}I , ^{226}Ra , and ^{90}Sr

While July 1992 results suggest that contaminant levels have declined somewhat since 1989, the concentrations of some radionuclides have remained unchanged. Further analysis based on future data from the semi-annual sampling program will allow for a more complete assessment of the temporal changes in the contaminant levels at FMB and its seepines.

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Analytical Results

The analytical results from the July 1992 sampling event of the semi-annual sampling program for Fourmile Branch and its seep lines is presented in this section. The analytical data for each sampling location is presented in tabular form with the background samples presented first followed by the stream samples, F-Area seepage samples (FSP), H-Area seepage samples (HSP), trip blank samples (QA 2S and QA 4S), and the remaining QA samples (QA 1-4).

For each sampling location, the results of all field measurements are presented including sampling date, depth to water, pH, and specific conductance. This information is followed by all laboratory analyses for that sampling location. For each analyte in the laboratory analyses table, the following information is presented: the lab that performed the analyses, any analytical modifiers, the analytical results, the accuracy of the result (for detected radiological parameters only), any appropriate standard for comparison, and the units in which the results are presented. Table 14 lists the analytical modifiers used to qualify any analytical results.

The following is a list of abbreviations used in the tables:

Lab	Laboratory performing analysis
Mod	Analytical modifier
Acc	Accuracy of the result (detected radiological parameters only)
GE	General Engineering
GP	Environmental Physics
WA	Weston Analytics
CN	Clemson Technical Center
TE	Teledyne Isotopes
TM	TMA/Eberline

Table 14. Analytical Modifiers

Result Qualifier	Definition
(Blank)	Data not qualified. Number should be interpreted exactly as reported
J	Estimated because quantitation in the sample or in associated quality control samples did not meet specifications
L	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
Q	Sample held beyond normal holding time. If the holding time is exceeded by less than 30 days, the sample is coded QJ; if the holding time is exceeded by 30 days or more, the sample is coded QR
R	Rejected because performance requirements in the sample analysis or associated quality control analyses were not met
U	Undetected; if present, below the criteria of detection
V	Indicates the analyte was detected in the associated method blank
1	The associated result may be an underestimation of the true value due to analytical bias
2	The associated 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	Matrix interference
5	The sample result is four or more times greater than the standard concentration
6	Re-analyzed out of holding time because of problems with the original analysis

Table 15. BG001 Laboratory Analyses

Field Measurements:

Sample Date: 07/29/92

pH: 4.82

Specific Conductance: 21 $\mu\text{S}/\text{cm}$

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Alkalinity	GE		1.43			mg/L
Aluminum	GE		175			$\mu\text{g}/\text{L}$
Americium-241	GP	U	1		6.34	pCi/L
Ammonia nitrogen	GE	U	0.1			mg/L
Antimony	GE	U	2		5	$\mu\text{g}/\text{L}$
Antimony-125	GP	U	20		300	pCi/L
Arsenic	GE	U	2		50	$\mu\text{g}/\text{L}$
Barium	GE		12.2		2000	$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1	$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5	$\mu\text{g}/\text{L}$
Calcium	GE		262			$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5	$\mu\text{g}/\text{L}$
Cerium-144	GP	U	60		261	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-137	GP	U	10		200	pCi/L
Chloride	GE		1.85			mg/L
Chloroform	GE	U	1		100	$\mu\text{g}/\text{L}$
Chromium	GE	U	4		100	$\mu\text{g}/\text{L}$
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Copper	GE	U	4		1300	$\mu\text{g}/\text{L}$
Curium-242	GP	U	1		0.133	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Europium-152	GP	U	40			pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-155	GP	U	30		600	pCi/L
Fluoride	GE	U	0.1		4	mg/L
Gross alpha	GE		2.5	1.45	15	pCi/L
Hardness	GE		8.5			mg/L
Iodine-129	TE	U	2		1	pCi/L
Iron	GE	J2	186		300	$\mu\text{g}/\text{L}$
Lead	GE		3.16		15	$\mu\text{g}/\text{L}$
Magnesium	GE		349			$\mu\text{g}/\text{L}$
Manganese	GE		18.4		50	$\mu\text{g}/\text{L}$
Manganese-54	GP	U	10		300	pCi/L
Mercury	GE		0.37		2	$\mu\text{g}/\text{L}$
Neptunium-237	TE	U	10		7.06	pCi/L
Nickel	GE	U	4		100	$\mu\text{g}/\text{L}$
Nitrate as nitrogen	GE		0.26		10	mg/L
Nonvolatile beta	GE		2.1	1.6	50	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Potassium	GE	U	500			$\mu\text{g}/\text{L}$
Potassium-40	GP	U	110		300	pCi/L
Promethium-144	GP	U	10			pCi/L

(Table 15. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Promethium-146	GP	U	10			pCi/L
Radium-226	GP		1.26	0.2	15.7	pCi/L
Radium-228	GP		5.23	0.78	7.85	pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Selenium	GE	UJ1	2		50	µg/L
Silver	GE	U	2		50	µg/L
Sodium	GE		794			µg/L
Sodium-22	GP	U	10		466	pCi/L
Strontium-90	GP	U	2		8	pCi/L
Technetium-99	GP	U	300		900	pCi/L
Tetrachloroethylene	GE	U	1		5	µg/L
Thallium	GE	U	2		1	µg/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-232	GP	U	1.14		88	pCi/L
Tin	GE	U	2			µg/L
Total organic carbon	GE		7			mg/L
Total organic halogens	GE		9.2			µg/L
Total phenols	GE	U	5			µg/L
Trichloroethylene	GE	U	1		5	µg/L
Tritium	GE		8.15	0.5	20	pCi/ml
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-235	GP	U	1		14.5	pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Vanadium	GE	U	8			µg/L
Yttrium-88	GP	U	60			pCi/L
Zinc	GE		95.2		5000	µg/L
Zinc-65	GP	U	20		300	pCi/L

Table 16. BG002 Laboratory Analyses

Field Measurements:

Sample Date: 07/29/92

pH: 5.00

Specific Conductance: 38 $\mu\text{S}/\text{cm}$

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
1,1,1-Trichloroethane	GE	U	1		200	$\mu\text{g}/\text{L}$
Alkalinity	GE		1.43			mg/L
Aluminum	GE		256			$\mu\text{g}/\text{L}$
Americium-241	GP	U	1		6.34	pCi/L
Ammonia nitrogen	GE	U	0.1			mg/L
Antimony	GE	U	2		5	$\mu\text{g}/\text{L}$
Antimony-125	GP	U	20		300	pCi/L
Arsenic	GE	U	2		50	$\mu\text{g}/\text{L}$
Barium	GE		20.8		2000	$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1	$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5	$\mu\text{g}/\text{L}$
Calcium	GE		487			$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5	$\mu\text{g}/\text{L}$
Cerium-144	GP	U	60		261	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-137	GP	U	10		200	pCi/L
Chloride	GE		2.98			mg/L
Chloroform	GE	U	1		100	$\mu\text{g}/\text{L}$
Chromium	GE	U	4		100	$\mu\text{g}/\text{L}$
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Copper	GE	U	4		1300	$\mu\text{g}/\text{L}$
Curium-242	GP	U	1		0.133	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Europium-152	GP	U	40			pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-155	GP	U	30		600	pCi/L
Fluoride	GE	U	0.1		4	mg/L
Gross alpha	GE		4.9	1.9	15	pCi/L
Hardness	GE		22			mg/L
Iodine-129	TE	U	2		1	pCi/L
Iron	GE	J2	1980		300	$\mu\text{g}/\text{L}$
Lead	GE	U	3		15	$\mu\text{g}/\text{L}$
Magnesium	GE		502			$\mu\text{g}/\text{L}$
Manganese	GE		41.95		50	$\mu\text{g}/\text{L}$
Manganese-54	GP	U	10		300	pCi/L
Mercury	GE		0.47		2	$\mu\text{g}/\text{L}$
Neptunium-237	TE	U	10		7.06	pCi/L
Nickel	GE	U	4		100	$\mu\text{g}/\text{L}$
Nitrate as nitrogen	GE		0.23		10	mg/L
Nonvolatile beta	GE		4.6	1.6	50	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Potassium	GE		671			$\mu\text{g}/\text{L}$
Potassium-40	GP	U	110		300	pCi/L
Promethium-144	GP	U	10			pCi/L

(Table 16. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Promethium-146	GP	U	10			pCi/L
Radium-226	GP	U	1		15.7	pCi/L
Radium-228	GP		4.73	1.2	7.85	pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Selenium	GE	UJ1	2		50	µg/L
Silver	GE	U	2		50	µg/L
Sodium	GE		1260			µg/L
Sodium-22	GP	U	10		466	pCi/L
Strontium-90	GP		3.86	1.8	8	pCi/L
Technetium-99	GP	U	300		900	pCi/L
Tetrachloroethylene	GE	U	1		5	µg/L
Thallium	GE	U	2		1	µg/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-232	GP	U	1		88	pCi/L
Tin	GE		2.81			µg/L
Total organic carbon	GE		21			mg/L
Total organic halogens	GE		25.1			µg/L
Total phenols	GE	U	5			µg/L
Trichloroethylene	GE	U	1		5	µg/L
Tritium	GE		4.86	0.4	20	pCi/ml
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-235	GP	U	1		14.5	pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Vanadium	GE	U	8			µg/L
Yttrium-88	GP	U	60			pCi/L
Zinc	GE		143		5000	µg/L
Zinc-65	GP	U	20		300	pCi/L

Table 17. BG003 Laboratory Analyses

Field Measurements:

Sample Date: 07/22/92

pH: 5.80

Specific Conductance: 20 $\mu\text{S}/\text{cm}$

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
1,1,1-Trichloroethane	GE	U	1		200	$\mu\text{g}/\text{L}$
Alkalinity	GE	V	5			mg/L
Aluminum	GE		73.9			$\mu\text{g}/\text{L}$
Americium-241	GP	U	1		6.34	pCi/L
Ammonia nitrogen	GE	U	0.1			mg/L
Antimony	GE	U	2		5	$\mu\text{g}/\text{L}$
Antimony-125	GP	U	20		300	pCi/L
Arsenic	GE	U	2		50	$\mu\text{g}/\text{L}$
Barium	GE		24.5		2000	$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1	$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5	$\mu\text{g}/\text{L}$
Calcium	GE		1260			$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5	$\mu\text{g}/\text{L}$
Cerium-144	GP	U	60		261	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-137	GP	U	10		200	pCi/L
Chloride	GE		2.68			mg/L
Chloroform	GE	U	1		100	$\mu\text{g}/\text{L}$
Chromium	GE	U	4		100	$\mu\text{g}/\text{L}$
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Copper	GE	U	4		1300	$\mu\text{g}/\text{L}$
Curium-242	GP	U	1		0.133	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Europium-152	GP	U	40			pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-155	GP	U	30		600	pCi/L
Fluoride	GE	U	0.1		4	mg/L
Gross alpha	GE	U	2		15	pCi/L
Hardness	GE		5.4			mg/L
Iodine-129	TE	U	2		1	pCi/L
Iron	GE		843		300	$\mu\text{g}/\text{L}$
Lead	GE		4.48		15	$\mu\text{g}/\text{L}$
Magnesium	GE		468			$\mu\text{g}/\text{L}$
Manganese	GE		223		50	$\mu\text{g}/\text{L}$
Manganese-54	GP	U	10		300	pCi/L
Mercury	GE	U	0.2		2	$\mu\text{g}/\text{L}$
Neptunium-237	TE	U	10		7.06	pCi/L
Nickel	GE	U	4		100	$\mu\text{g}/\text{L}$
Nitrate as nitrogen	GE	U	0.05		10	mg/L
Nonvolatile beta	GE	UV	2		50	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Potassium	GE	U	500			$\mu\text{g}/\text{L}$
Potassium-40	GP	U	110		300	pCi/L
Promethium-144	GP	U	10			pCi/L

(Table 17. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Promethium-146	GP	U	10			pCi/L
Radium-226	GP	U	1		15.7	pCi/L
Radium-228	GP		2.2	0.88	7.85	pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Selenium	GE	UJ1	2		50	µg/L
Silver	GE	U	2		50	µg/L
Sodium	GE		2120			µg/L
Sodium-22	GP	U	10		466	pCi/L
Strontium-90	GP	U	2		8	pCi/L
Technetium-99	GP	U	300		900	pCi/L
Tetrachloroethylene	GE	U	1		5	µg/L
Thallium	GE	U	2		1	µg/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-232	GP	U	1		88	pCi/L
Tin	GE	U	2			µg/L
Total organic carbon	GE		9			mg/L
Total organic halogens	GE		18			µg/L
Total phenols	GE	U	5.05			µg/L
Trichloroethylene	GE	U	1		5	µg/L
Tritium	GE		1.97	0.4	20	pCi/ml
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-235	GP	U	1		14.5	pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Vanadium	GE	U	8			µg/L
Yttrium-88	GP	U	60			pCi/L
Zinc	GE		14		5000	µg/L
Zinc-65	GP	U	20		300	pCi/L

Table 18. FMC001F Laboratory Analyses

Field Measurements:

Sample Date: 07/22/92

pH: 6.75

Specific Conductance: 70 uS/cm

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
1,1,1-Trichloroethane	GE	U	1		200	µg/L
Alkalinity	GE	V	14.6			mg/L
Aluminum	GE		107			µg/L
Americium-241	GP	U	1		6.34	pCi/L
Ammonia nitrogen	GE	U	0.1			mg/L
Antimony	GE	U	2		5	µg/L
Antimony-125	GP	U	20		300	pCi/L
Arsenic	GE	U	2		50	µg/L
Barium	GE		21.9		2000	µg/L
Beryllium	GE	U	3		1	µg/L
Cadmium	GE	U	2		5	µg/L
Calcium	GE		3300			µg/L
Carbon tetrachloride	GE	U	1		5	µg/L
Cerium-144	GP	U	60		261	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-137	GP		16.1	3.8	200	pCi/L
Chloride	GE		3.36			mg/L
Chloroform	GE	U	1		100	µg/L
Chromium	GE	U	4		100	µg/L
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Copper	GE	U	4		1300	µg/L
Curium-242	GP	U	1		0.133	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Europium-152	GP	U	40			pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-155	GP	U	30		600	pCi/L
Fluoride	GE	U	0.1		4	mg/L
Gross alpha	GE	U	2		15	pCi/L
Hardness	GE		20			mg/L
Iodine-129	TE		2.8	1.3	1	pCi/L
Iron	GE		392		300	µg/L
Lead	GE	U	3		15	µg/L
Magnesium	GE		646			µg/L
Manganese	GE		47.2		50	µg/L
Manganese-54	GP	U	10		300	pCi/L
Mercury	GE	U	0.2		2	µg/L
Neptunium-237	TE	U	10		7.06	pCi/L
Nickel	GE	U	4		100	µg/L
Nitrate as nitrogen	GE		2.38		10	mg/L
Nonvolatile beta	GE	V	47.5	3.9	50	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Potassium	GE		505			µg/L
Potassium-40	GP	U	110		300	pCi/L
Promethium-144	GP	U	10			pCi/L

(Table 18. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Promethium-146	GP	U	10			pCi/L
Radium-226	GP		1.16	0.25	15.7	pCi/L
Radium-228	GP		16.5	1.4	7.85	pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Selenium	GE	UJ1	2		50	µg/L
Silver	GE	U	2		50	µg/L
Sodium	GE		9720			µg/L
Sodium-22	GP	U	10		466	pCi/L
Strontium-90	GP		27.9	3.7	8	pCi/L
Technetium-99	GP	1270	56		900	pCi/L
Tetrachloroethylene	GE	U	1		5	µg/L
Thallium	GE	U	2		1	µg/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-232	GP	U	1		88	pCi/L
Tin	GE	U	2			µg/L
Total organic carbon	GE		5.22			mg/L
Total organic halogens	GE		91.7			µg/L
Total phenols	GE	U	5			µg/L
Trichloroethylene	GE	U	1		5	µg/L
Tritium	GE		640	3.8	20	pCi/ml
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-235	GP	U	1		14.5	pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Vanadium	GE	U	8			µg/L
Yttrium-88	GP	U	60			pCi/L
Zinc	GE		31.8		5000	µg/L
Zinc-65	GP	U	20		300	pCi/L

Table 19. FMC001H Laboratory Analyses

Field Measurements:

Sample Date: 07/22/92

pH: 7.19

Specific Conductance: 86 μ S/cm

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
1,1,1-Trichloroethane	GE	U	1		200			μ g/L
Alkalinity	GE	V	13.2				8	mg/L
Aluminum	GE		102				470	μ g/L
Americium-241	GP	U	1		6.34			pCi/L
Ammonia nitrogen	GE		0.3					mg/L
Antimony	GE	U	2		5			μ g/L
Antimony-125	GP	U	20		300			pCi/L
Arsenic	GE	U	2		50	U	3	μ g/L
Barium	GE		13.3		2000			μ g/L
Beryllium	GE	U	3		1			μ g/L
Cadmium	GE	U	2		5	U	6	μ g/L
Calcium	GE		3210					μ g/L
Carbon tetrachloride	GE	U	1		5			μ g/L
Cerium-144	GP	U	60		261			pCi/L
Cesium-134	GP	U	10		81.3	U	5.3	pCi/L
Cesium-137	GP		102	7.6	200		62	pCi/L
Chloride	GE		7.5				5.5	mg/L
Chloroform	GE		1.2		100			μ g/L
Chromium	GE	U	4		100		2.1	μ g/L
Cobalt-57	GP	U	10		1000			pCi/L
Cobalt-60	GP	U	10		100	U	1.1	pCi/L
Copper	GE		5.72		1300			μ g/L
Curium-242	GP	U	1		0.133			pCi/L
Curium-243,244	GP	U	1		8.3			pCi/L
Europium-152	GP	U	40					pCi/L
Europium-154	GP	U	20		200			pCi/L
Europium-155	GP	U	30		600			pCi/L
Fluoride	GE	U	0.1		4			mg/L
Gross alpha	GE	U	2		15	U	3	pCi/L
Hardness	GE		11.3				196	mg/L
Iodine-129	TE	U	2		1	U	47	pCi/L
Iron	GE		349		300			μ g/L
Lead	GE		3.87		15		4.9	μ g/L
Magnesium	GE		477					μ g/L
Manganese	GE		65.3		50			μ g/L
Manganese-54	GP	U	10		300			pCi/L
Mercury	GE		0.22		2	U	0.2	μ g/L
Neptunium-237	TE	U	10		7.06	U	1	pCi/L
Nickel	GE	U	4		100	U	34	μ g/L
Nitrate as nitrogen	GE		0.99		10		5.7	mg/L
Nonvolatile beta	GE	V	65.5	4.5	50		190	pCi/L
Plutonium-238	GP	U	1		7.02	U	1	pCi/L
Plutonium-239,240	GP	U	1		62.1	U	1	pCi/L
Potassium	GE		1900					μ g/L
Potassium-40	GP	U	110		300			pCi/L
Promethium-144	GP	U	10					pCi/L

(Table 19. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
Promethium-146	GP	U	10					pCi/L
Radium-226	GP		1.66	0.31	15.7		1.2	pCi/L
Radium-228	GP		6.11	2.8	7.85			pCi/L
Ruthenium-106	GP	U	90		30			pCi/L
Selenium	GE	UJ1	2		50	U	2	µg/L
Silver	GE	U	2		50	U	4	µg/L
Sodium	GE		11900				10200	µg/L
Sodium-22	GP	U	10		466			pCi/L
Strontium-90	GP		12.4	2.7	8		5.5	pCi/L
Technetium-99	GP	U	300		900	U	7	pCi/L
Tetrachloroethylene	GE	U	1		5			µg/L
Thallium	GE	U	2		1			µg/L
Thorium-228	GP	U	1		125			pCi/L
Thorium-230	GP	U	1		79.2			pCi/L
Thorium-232	GP	U	1		88			pCi/L
Tin	GE	U	2					µg/L
Total organic carbon	GE		2.8					mg/L
Total organic halogens	GE		41.5					µg/L
Total phenols	GE	U	5					µg/L
Trichloroethylene	GE	U	1		5			µg/L
Tritium	GE		72.8	1.3	20		86	pCi/ml
Uranium-234	GP	U	1		13.9			pCi/L
Uranium-235	GP	U	1		14.5			pCi/L
Uranium-238	GP	U	1		14.6	U	1	pCi/L
Vanadium	GE	U	8					µg/L
Yttrium-88	GP	U	60					pCi/L
Zinc	GE		24.9		5000		28	µg/L
Zinc-65	GP	U	20		300			pCi/L

Table 20. FMC002H Laboratory Analyses

Field Measurements:

Sample Date: 07/22/92

pH: 6.67

Specific Conductance: 94 μ S/cm

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
1,1,1-Trichloroethane	GE	U	1		200			μ g/L
Alkalinity	GE	V	33.2					mg/L
Aluminum	GE		42.2				50	μ g/L
Americium-241	GP	U	1		6.34			pCi/L
Ammonia nitrogen	GE	U	0.1					mg/L
Antimony	GE	U	2		5			μ g/L
Antimony-125	GP	U	20		300			pCi/L
Arsenic	GE	U	2		50	U	3	μ g/L
Barium	GE		26.15		2000			μ g/L
Beryllium	GE	U	3		1			μ g/L
Cadmium	GE	U	2		5	U	6	μ g/L
Calcium	GE		4150					μ g/L
Carbon tetrachloride	GE	U	1		5			μ g/L
Cerium-144	GP	U	60		261			pCi/L
Cesium-134	GP	U	10		81.3	U	9.1	pCi/L
Cesium-137	GP		10.3	4.2	200		4.4	pCi/L
Chloride	GE		2.93				4.6	mg/L
Chloroform	GE	U	1		100			μ g/L
Chromium	GE	U	4		100	U	7	μ g/L
Cobalt-57	GP	U	10		1000			pCi/L
Cobalt-60	GP	U	10		100	U	4.7	pCi/L
Copper	GE	U	4		1300			μ g/L
Curium-242	GP	U	1		0.133			pCi/L
Curium-243,244	GP	U	1		8.3			pCi/L
Europium-152	GP	U	40					pCi/L
Europium-154	GP	U	20		200			pCi/L
Europium-155	GP	U	30		600			pCi/L
Fluoride	GE	U	0.1		4			mg/L
Gross alpha	GE	U	2		15		4	pCi/L
Hardness	GE		13.2				139	mg/L
Iodine-129	TE	U	2		1	U	61	pCi/L
Iron	GE		919.5		300			μ g/L
Lead	GE	U	3		15	U	3	μ g/L
Magnesium	GE		630					μ g/L
Manganese	GE		704		50			μ g/L
Manganese-54	GP	U	10		300			pCi/L
Mercury	GE	U	0.2		2	U	0.2	μ g/L
Neptunium-237	TE	U	10		7.06	U	1	pCi/L
Nickel	GE	U	4		100	U	34	μ g/L
Nitrate as nitrogen	GE	U	0.05		10		1.4	mg/L
Nonvolatile beta	GE	V	32.7	3.3	50		39	pCi/L
Plutonium-238	GP	U	1		7.02	U	1	pCi/L
Plutonium-239,240	GP	U	1		62.1	U	1	pCi/L
Potassium	GE	U	500					μ g/L
Potassium-40	GP	U	110		300			pCi/L
Promethium-144	GP	U	10					pCi/L

(Table 20. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
Promethium-146	GP	U	10					pCi/L
Radium-226	GP	U	1		15.7		1.8	pCi/L
Radium-228	GP		11.4	1.2	7.85			pCi/L
Ruthenium-106	GP	U	90		30			pCi/L
Selenium	GE	UJ1	2		50	U	2	µg/L
Silver	GE	U	2		50	U	4	µg/L
Sodium	GE		15400				11700	µg/L
Sodium-22	GP	U	10		466			pCi/L
Strontium-90	GP		16.7	1.9	8		6.8	pCi/L
Technetium-99	GP		403	42	900		50	pCi/L
Tetrachloroethylene	GE	U	1		5			µg/L
Thallium	GE	U	2		1			µg/L
Thorium-228	GP	U	1		125			pCi/L
Thorium-230	GP	U	1		79.2			pCi/L
Thorium-232	GP	U	1		88			pCi/L
Tin	GE	U	2.41					µg/L
Total organic carbon	GE		6.42					mg/L
Total organic halogens	GE		82.5					µg/L
Total phenols	GE	U	5					µg/L
Trichloroethylene	GE	U	1		5			µg/L
Tritium	GE		170	2	20		1100	pCi/ml
Uranium-234	GP	U	1		13.9			pCi/L
Uranium-235	GP	U	1		14.5			pCi/L
Uranium-238	GP	U	1		14.6	U	1	pCi/L
Vanadium	GE	U	8					µg/L
Yttrium-88	GP	U	60					pCi/L
Zinc	GE		13.65		5000	U	9	µg/L
Zinc-65	GP	U	20		300			pCi/L

Table 21. FSP012 Laboratory Analyses

Field Measurements:

Sample Date: 07/28/92

pH: 5.14

Specific Conductance: 106 $\mu\text{S}/\text{cm}$

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
1,1,1-Trichloroethane	GE	U	1		200			$\mu\text{g}/\text{L}$
Alkalinity	GE	V	26					mg/L
Aluminum	GE		856				76800	$\mu\text{g}/\text{L}$
Americium-241	GP	U	1		6.34			pCi/L
Ammonia nitrogen	GE		1.08					mg/L
Antimony	GE	U	2		5			$\mu\text{g}/\text{L}$
Antimony-125	GP	U	20		300			pCi/L
Arsenic	GE	U	2		50	U	3	$\mu\text{g}/\text{L}$
Barium	GE		94.6		2000			$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1			$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5	U	6	$\mu\text{g}/\text{L}$
Calcium	GE		1510					$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5			$\mu\text{g}/\text{L}$
Cerium-144	GP	U	60		261			pCi/L
Cesium-134	GP	U	10		81.3		0.6	pCi/L
Cesium-137	GP	U	10		200		1.7	pCi/L
Chloride	GE		3.2				1.9	mg/L
Chloroform	GE	U	1		100			$\mu\text{g}/\text{L}$
Chromium	GE	U	4		100	U	3	$\mu\text{g}/\text{L}$
Cobalt-57	GP	U	10		1000			pCi/L
Cobalt-60	GP	U	10		100		5.1	pCi/L
Copper	GE	U	4		1300		60	$\mu\text{g}/\text{L}$
Curium-242	GP	U	1		0.133			pCi/L
Curium-243,244	GP	U	1		8.3			pCi/L
Europium-152	GP	U	40					pCi/L
Europium-154	GP	U	20		200			pCi/L
Europium-155	GP	U	30		600			pCi/L
Fluoride	GE	U	0.1		4			mg/L
Gross alpha	GE		4.8	2.4	15		4.9	pCi/L
Hardness	GE		11				3400	mg/L
Iodine-129	TE		4.2	1.3	1		130	pCi/L
Iron	GE		7140		300			$\mu\text{g}/\text{L}$
Lead	GE	U	3		15		3.3	$\mu\text{g}/\text{L}$
Magnesium	GE		1750					$\mu\text{g}/\text{L}$
Manganese	GE	J2	3100		50			$\mu\text{g}/\text{L}$
Manganese-54	GP	U	10		300			pCi/L
Mercury	GE		0.24		2	U	0.2	$\mu\text{g}/\text{L}$
Neptunium-237	TE	U	10		7.06	U	1	pCi/L
Nickel	GE	U	4		100	U	34	$\mu\text{g}/\text{L}$
Nitrate as nitrogen	GE		0.29		10		1090	mg/L
Nonvolatile beta	GE		75.6	4.8	50		94	pCi/L
Plutonium-238	GP	U	1		7.02	U	1	pCi/L
Plutonium-239,240	GP	U	1		62.1	U	1	pCi/L
Potassium	GE		3960					$\mu\text{g}/\text{L}$
Potassium-40	GP	U	110		300			pCi/L
Promethium-144	GP	U	10					pCi/L

(Table 21. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
Promethium-146	GP	U	10					pCi/L
Radium-226	GP		1.69	0.3	15.7		48	pCi/L
Radium-228	GP		14	2.7	7.85			pCi/L
Ruthenium-106	GP	U	90		30			pCi/L
Selenium	GE	U	2		50	U	2	µg/L
Silver	GE	U	2		50	U	4	µg/L
Sodium	GE		2440				105000	µg/L
Sodium-22	GP	U	10		466			pCi/L
Strontium-90	GP		22.7	2	8		370	pCi/L
Technetium-99	GP	U	300		900		330	pCi/L
Tetrachloroethylene	GE	U	1		5			µg/L
Thallium	GE	U	2		1			µg/L
Thorium-228	GP	U	1		125			pCi/L
Thorium-230	GP		1.6	0.26	79.2			pCi/L
Thorium-232	GP	U	1		88			pCi/L
Tin	GE		3.42					µg/L
Total organic carbon	GE		50					mg/L
Total organic halogens	GE		30.9					µg/L
Total phenols	GE		6.9					µg/L
Trichloroethylene	GE	U	1		5			µg/L
Tritium	GE		28.9	1	20		12000	pCi/ml
Uranium-234	GP	U	1		13.9			pCi/L
Uranium-235	GP	U	1		14.5			pCi/L
Uranium-238	GP	U	1		14.6		95	pCi/L
Vanadium	GE	U	8					µg/L
Yttrium-88	GP	U	60					pCi/L
Zinc	GE		94.1		5000		120	µg/L
Zinc-65	GP	U	20		300			pCi/L

Table 22. FSP032 Laboratory Analyses

Field Measurements:

Sample Date: 07/28/92

pH: 4.10

Specific Conductance: 95 $\mu\text{S}/\text{cm}$

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
1,1,1-Trichloroethane	GE	U	1		200			$\mu\text{g}/\text{L}$
Alkalinity	GE	V	1.55					mg/L
Aluminum	GE		936				86900	$\mu\text{g}/\text{L}$
Americium-241	GP	U	1		6.34			pCi/L
Ammonia nitrogen	GE	U	0.1					mg/L
Antimony	GE	U	2		5			$\mu\text{g}/\text{L}$
Antimony-125	GP	U	20		300			pCi/L
Arsenic	GE	U	2		50	U	3	$\mu\text{g}/\text{L}$
Barium	GE		101.5		2000			$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1			$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5	U	6	$\mu\text{g}/\text{L}$
Calcium	GE		1215					$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5			$\mu\text{g}/\text{L}$
Cerium-144	GP	U	60		261			pCi/L
Cesium-134	GP	U	10		81.3	U	6.5	pCi/L
Cesium-137	GP	U	10		200		5.6	pCi/L
Chloride	GE		2.43				2	mg/L
Chloroform	GE	U	1		100			$\mu\text{g}/\text{L}$
Chromium	GE	U	4		100	U	3	$\mu\text{g}/\text{L}$
Cobalt-57	GP	U	10		1000			pCi/L
Cobalt-60	GP	U	10		100		6.1	pCi/L
Copper	GE	U	4		1300		60	$\mu\text{g}/\text{L}$
Curium-242	GP	U	1		0.133			pCi/L
Curium-243,244	GP	U	1		8.3			pCi/L
Europium-152	GP	U	40					pCi/L
Europium-154	GP	U	20		200			pCi/L
Europium-155	GP	U	30		600			pCi/L
Fluoride	GE		0.181		4			mg/L
Gross alpha	GE		5.1	2.7	15		1800	pCi/L
Hardness	GE		11				1500	mg/L
Iodine-129	TE		2.8	1.5	1		370	pCi/L
Iron	GE		226.5		300			$\mu\text{g}/\text{L}$
Lead	GE	U	3		15		4.3	$\mu\text{g}/\text{L}$
Magnesium	GE		1075					$\mu\text{g}/\text{L}$
Manganese	GE	J2	1415		50			$\mu\text{g}/\text{L}$
Manganese-54	GP	U	10		300			pCi/L
Mercury	GE	U	0.2		2	U	0.2	$\mu\text{g}/\text{L}$
Neptunium-237	TE	U	10		7.06	U	1	pCi/L
Nickel	GE	U	4		100		60	$\mu\text{g}/\text{L}$
Nitrate as nitrogen	GE		9.5		10		1130	mg/L
Nonvolatile beta	GE		168	7	50		2800	pCi/L
Plutonium-238	GP	U	1		7.02	U	1	pCi/L
Plutonium-239,240	GP	U	1		62.1	U	1	pCi/L
Potassium	GE	U	500					$\mu\text{g}/\text{L}$
Potassium-40	GP	U	110		300			pCi/L
Promethium-144	GP	U	10					pCi/L

(Table 22. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
Promethium-146	GP	U	10					pCi/L
Radium-226	GP	U	1		15.7		72	pCi/L
Radium-228	GP		10.6	1.1	7.85			pCi/L
Ruthenium-106	GP	U	90		30			pCi/L
Selenium	GE	U	2		50	U	2	µg/L
Silver	GE	U	2		50		12	µg/L
Sodium	GE		4490				118000	µg/L
Sodium-22	GP	U	10		466			pCi/L
Strontium-90	GP		124	4	8		350	pCi/L
Technetium-99	GP		1650	66	900		1200	pCi/L
Tetrachloroethylene	GE	U	1		5			µg/L
Thallium	GE	U	2		1			µg/L
Thorium-228	GP	U	1		125			pCi/L
Thorium-230	GP	U	1		79.2			pCi/L
Thorium-232	GP	U	1		88			pCi/L
Tin	GE	U	2					µg/L
Total organic carbon	GE		3					mg/L
Total organic halogens	GE	U	5					µg/L
Total phenols	GE	U	5					µg/L
Trichloroethylene	GE	U	1		5			µg/L
Tritium	GE		730	4	20		15000	pCi/ml
Uranium-234	GP		2.32	0.61	13.9			pCi/L
Uranium-235	GP	U	1		14.5			pCi/L
Uranium-238	GP		1.695	0.5	14.6		96	pCi/L
Vanadium	GE	U	8					µg/L
Yttrium-88	GP	U	60					pCi/L
Zinc	GE		140		5000		160	µg/L
Zinc-65	GP	U	20		300			pCi/L

Table 23. FSP047 Laboratory Analyses

Field Measurements:

Sample Date: 07/28/92

pH: 5.38

Specific Conductance: 88 $\mu\text{S}/\text{cm}$

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
1,1,1-Trichloroethane	GE	U	1		200			$\mu\text{g}/\text{L}$
1,1,1-Trichloroethane	WA	U	1		200			$\mu\text{g}/\text{L}$
Alkalinity	GE	V	14.1					mg/L
Aluminum	GE		224				130	$\mu\text{g}/\text{L}$
Aluminum	WA		316					$\mu\text{g}/\text{L}$
Americium-241	GP	U	1		6.34			pCi/L
Americium-241	CN	U	1		6.34			pCi/L
Antimony	GE	U	2		5			$\mu\text{g}/\text{L}$
Antimony	WA	U	2.6		5			$\mu\text{g}/\text{L}$
Antimony-125	GP	U	20		300			pCi/L
Antimony-125	CN	U	20		300			pCi/L
Arsenic	GE		2.19		50	U	3	$\mu\text{g}/\text{L}$
Arsenic	WA	J3	4.1		50			$\mu\text{g}/\text{L}$
Barium	GE		48.8		2000			$\mu\text{g}/\text{L}$
Barium	WA		52.6		2000			$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1			$\mu\text{g}/\text{L}$
Beryllium	WA	U	0.18		1			$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5		1.7	$\mu\text{g}/\text{L}$
Cadmium	WA	U	0.35		5			$\mu\text{g}/\text{L}$
Calcium	GE		491					$\mu\text{g}/\text{L}$
Calcium	WA		595					$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5			$\mu\text{g}/\text{L}$
Carbon tetrachloride	WA	U	1		5			$\mu\text{g}/\text{L}$
Carbon tetrachloride	WA	U	1		5			$\mu\text{g}/\text{L}$
Cerium-144	GP	U	60		261			pCi/L
Cerium-144	CN	U	50		261			pCi/L
Cesium-134	GP	U	10		81.3	U	71	pCi/L
Cesium-134	CN	U	10		81.3			pCi/L
Cesium-137	GP	U	10		200	U	13	pCi/L
Cesium-137	CN	U	10		200			pCi/L
Chloride	GE		6.52				3.8	mg/L
Chloride	WA		6.06					mg/L
Chloroform	GE	U	1		100			$\mu\text{g}/\text{L}$
Chloroform	WA	U	1		100			$\mu\text{g}/\text{L}$
Chloroform	WA	U	1		100	U	3	$\mu\text{g}/\text{L}$
Chromium	GE	U	4		100			$\mu\text{g}/\text{L}$
Chromium	WA	J3	2.8		100			$\mu\text{g}/\text{L}$
Cobalt-57	GP	U	10		1000			pCi/L
Cobalt-57	CN	U	10		1000			pCi/L
Cobalt-60	GP	U	10		100		130	pCi/L
Cobalt-60	CN	U	10		100			pCi/L
Copper	GE	U	4		1300	U	7	$\mu\text{g}/\text{L}$
Copper	WA	UV	1.1		1300			$\mu\text{g}/\text{L}$
Curium-242	GP	U	1		0.133			pCi/L
Curium-242	CN	U	1		0.133			pCi/L
Curium-243,244	GP	U	1		8.3			pCi/L

(Table 23. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
Curium-243,244	CN	U	1		8.3			pCi/L
Europium-152	GP	U	40					pCi/L
Europium-152	CN	U	40					pCi/L
Europium-154	GP	U	20		200			pCi/L
Europium-154	CN	U	25		200			pCi/L
Europium-155	GP	U	30		600			pCi/L
Europium-155	CN	U	25		600			pCi/L
Fluoride	GE	U	0.1		4			mg/L
Fluoride	WA	U	0.1		4			mg/L
Gross alpha	GE		2.2	1.8	15		350	pCi/L
Gross alpha	TM		7.2	5.3	15			pCi/L
Hardness	GE		7.79				117	mg/L
Iodine-129	TE	U	2		1			pCi/L
Iodine-129	CN	U	2		1		410	pCi/L
Iron	GE		12000		300			μg/L
Iron	WA	V	13000		300			μg/L
Lead	GE	U	3		15	U	3	μg/L
Lead	WA	J3V	4.1		15			μg/L
Magnesium	GE		1590					μg/L
Magnesium	WA	V	1650					μg/L
Manganese	GE		862		50			μg/L
Manganese	WA		886		50			μg/L
Manganese-54	GP	U	10		300			pCi/L
Manganese-54	CN	U	10		300			pCi/L
Mercury	GE		0.47		2	U	0.2	μg/L
Mercury	WA		0.5985		2			μg/L
Neptunium-237	TE	U	10		7.06	U	1	pCi/L
Neptunium-237	CN	U	45		7.06			pCi/L
Neptunium-237	CN	U	1		7.06	U	34	pCi/L
Nickel	GE	U	4		100			μg/L
Nickel	WA	U	3.1		100			μg/L
Nitrate as nitrogen	GE		0.52		10		177	mg/L
Nitrate as nitrogen	WA		0.193		10			mg/L
Nonvolatile beta	GE		49.2	3.9	50		4600	pCi/L
Nonvolatile beta	TM	V	67.65	9.9	50			pCi/L
Plutonium-238	GP	U	1		7.02	U	1	pCi/L
Plutonium-238	CN	U	1		7.02			pCi/L
Plutonium-239,240	GP	U	1		62.1	U	1	pCi/L
Plutonium-239,240	CN	U	1		62.1			pCi/L
Potassium	GE	U	500					μg/L
Potassium	WA		625					μg/L
Potassium-40	GP	U	110		300			pCi/L
Potassium-40	CN	U	175		300			pCi/L
Promethium-144	GP	U	10					pCi/L
Promethium-144	CN	U	10					pCi/L
Promethium-146	GP	U	10					pCi/L
Promethium-146	CN	U	20					pCi/L
Radium-226	GP	U	1		15.7		430	pCi/L
Radium-226	CN	U	175		15.7			pCi/L

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(Table 23. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
Radium-226	CN	U	1		15.7			pCi/L
Radium-228	GP		12.6	1.6	7.85			pCi/L
Radium-228	CN		2.32	0.86	7.85			pCi/L
Ruthenium-103	CN	U	10					pCi/L
Ruthenium-106	GP	U	90		30			pCi/L
Ruthenium-106	CN	U	70		30			pCi/L
Selenium	GE	U	2		50	U	2	µg/L
Selenium	WA	U	2		50			µg/L
Silver	GE	U	2		50	U	4	µg/L
Silver	WA	UV	0.7		50			µg/L
Sodium	GE		6690				29700	µg/L
Sodium	WA		7450					µg/L
Sodium-22	GP	U	10		466			pCi/L
Sodium-22	CN	U	10		466			pCi/L
Strontium-90	GP		18.5	2.45	8		3200	pCi/L
Strontium-90	CN		14.6	1.66	8			pCi/L
Technetium-99	GP	U	300		900		22	pCi/L
Technetium-99	CN	U	300		900			pCi/L
Tetrachloroethylene	GE	U	1		5			µg/L
Tetrachloroethylene	WA	U	1		5			µg/L
Tetrachloroethylene	WA	U	1		5		2900	µg/L
Thallium	GE	U	2		1			µg/L
Thallium	WA	U	2		1			µg/L
Thorium-228	GP	U	1		125			pCi/L
Thorium-228	CN	U	1		125			pCi/L
Thorium-228	CN	U	400		125			pCi/L
Thorium-230	GP		1.15	0.21	79.2			pCi/L
Thorium-230	CN	U	1		79.2			pCi/L
Thorium-232	GP	U	1		88			pCi/L
Thorium-232	CN	U	1		88			pCi/L
Tin	GE	U	2					µg/L
Tin	WA		15					µg/L
Total organic carbon	GE		20					mg/L
Total organic carbon	WA		25.7					mg/L
Total organic halogens	GE		8.6					µg/L
Total organic halogens	WA	JQ	5.7					µg/L
Total phenols	GE	U	5					µg/L
Total phenols	WA	U	5					µg/L
Trichloroethylene	GE	U	1		5			µg/L
Trichloroethylene	WA	U	1		5			µg/L
Trichloroethylene	WA	U	1		5			µg/L
Tritium	GE		94.2	1.6	20			pCi/ml
Tritium	TM		95.2	16.9	20			pCi/L
Uranium-234	GP	U	1		13.9			pCi/L
Uranium-234	CN	U	1		13.9			pCi/L
Uranium-235	GP	U	1		14.5			pCi/L
Uranium-235	CN	U	15		14.5			pCi/L
Uranium-235	CN	U	1		14.5	U	1	pCi/L
Uranium-238	GP	U	1		14.6			pCi/L

(Table 23. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
Uranium-238	CN	U	1		14.6			pCi/L
Vanadium	GE	U	8					µg/L
Vanadium	WA	J3	2.2					µg/L
Yttrium-88	GP	U	60					pCi/L
Yttrium-88	CN	U	10					pCi/L
Zinc	GE		57.8		5000		160	µg/L
Zinc	WA		83.2		5000			µg/L
Zinc-65	GP	U	20		300			pCi/L
Zinc-65	CN	U	20		300			pCi/L

Table 24. FSP204 Laboratory Analyses

Field Measurements:

Sample Date: 07/28/92

pH: 5.35

Specific Conductance: 277 $\mu\text{S}/\text{cm}$

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
1,1,1-Trichloroethane	GE	U	1		200			$\mu\text{g}/\text{L}$
Alkalinity	GE	V	11.7					mg/L
Aluminum	GE		443				35900	$\mu\text{g}/\text{L}$
Americium-241	GP	U	1		6.34			pCi/L
Ammonia nitrogen	GE		0.77					mg/L
Antimony	GE	U	2		5			$\mu\text{g}/\text{L}$
Antimony-125	GP	U	20		300			pCi/L
Arsenic	GE	U	2		50		3.2	$\mu\text{g}/\text{L}$
Barium	GE		140		2000			$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1			$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5		7.3	$\mu\text{g}/\text{L}$
Calcium	GE		5720					$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5			$\mu\text{g}/\text{L}$
Cerium-144	GP	U	60		261			pCi/L
Cesium-134	GP	U	10		81.3		0.4	pCi/L
Cesium-137	GP	U	10		200	U	0.7	pCi/L
Chloride	GE		3.86				2.4	mg/L
Chloroform	GE	U	1		100			$\mu\text{g}/\text{L}$
Chromium	GE	U	4		100		4.8	$\mu\text{g}/\text{L}$
Cobalt-57	GP	U	10		1000			pCi/L
Cobalt-60	GP	U	10		100		2.2	pCi/L
Copper	GE	U	4		1300	U	7	$\mu\text{g}/\text{L}$
Curium-242	GP	U	1		0.133			pCi/L
Curium-243,244	GP	U	1		8.3			pCi/L
Europium-152	GP	U	40					pCi/L
Europium-154	GP	U	20		200			pCi/L
Europium-155	GP	U	30		600			pCi/L
Fluoride	GE		0.228		4			mg/L
Gross alpha	GE		10.2	3.8	15		89	pCi/L
Hardness	GE		25				187	mg/L
Iodine-129	TE		41.4	5.7	1	U	24	pCi/L
Iron	GE		698		300			$\mu\text{g}/\text{L}$
Lead	GE	U	3		15	U	3	$\mu\text{g}/\text{L}$
Magnesium	GE		4770					$\mu\text{g}/\text{L}$
Manganese	GE		2560		50			$\mu\text{g}/\text{L}$
Manganese-54	GP	U	10		300			pCi/L
Mercury	GE		0.38		2	U	0.2	$\mu\text{g}/\text{L}$
Neptunium-237	TE	U	10		7.06	U	1	pCi/L
Nickel	GE	U	4		100		50	$\mu\text{g}/\text{L}$
Nitrate as nitrogen	GE		32.2		10		687	mg/L
Nonvolatile beta	GE		354.5	9.3	50		2100	pCi/L
Plutonium-238	GP	U	1		7.02	U	1	pCi/L
Plutonium-239,240	GP	U	1		62.1	U	1	pCi/L
Potassium	GE		1970					$\mu\text{g}/\text{L}$
Potassium-40	GP	U	110		300			pCi/L
Promethium-144	GP	U	10					pCi/L

(Table 24. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	1989 Result	Units
Promethium-146	GP	U	10					pCi/L
Radium-226	GP		1.75	0.3	15.7		140	pCi/L
Radium-228	GP		90.6	3.6	7.85			pCi/L
Ruthenium-106	GP	U	90		30			pCi/L
Selenium	GE	U	2		50	U	2	µg/L
Silver	GE	U	2		50	U	4	µg/L
Sodium	GE		27000				94900	µg/L
Sodium-22	GP	U	10		466			pCi/L
Strontium-90	GP		49.2	3	8		790	pCi/L
Technetium-99	GP		2755	83	900		130	pCi/L
Tetrachloroethylene	GE	U	1		5			µg/L
Thallium	GE	U	2		1			µg/L
Thorium-228	GP	U	1		125			pCi/L
Thorium-230	GP	U	1		79.2			pCi/L
Thorium-232	GP	U	1		88			pCi/L
Tin	GE	U	2					µg/L
Total organic carbon	GE		20					mg/L
Total organic halogens	GE		18.3					µg/L
Total phenols	GE	U	5					µg/L
Trichloroethylene	GE	U	1		5			µg/L
Tritium	GE		1290	5.6	20		5900	pCi/ml
Uranium-234	GP	U	1		13.9			pCi/L
Uranium-235	GP	U	1		14.5			pCi/L
Uranium-238	GP	U	1		14.6		2.5	pCi/L
Vanadium	GE	U	8					µg/L
Yttrium-88	GP	U	60					pCi/L
Zinc	GE		103		5000		107	µg/L
Zinc-65	GP	U	20		300			pCi/L

Table 25. FSP290 Laboratory Analyses

Field Measurements:

Sample Date: 07/29/92

pH: 4.83

Specific Conductance: 46 μ S/cm

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
1,1,1-Trichloroethane	GE	U	1		200	μ g/L
1,1,1-Trichloroethane	GE	U	1		200	μ g/L
1,1,1-trichloroethane	WA	U	1		200	μ g/L
Alkalinity	GE		3.22			mg/L
Alkalinity	GE		2.39			mg/L
Aluminum	GE		635			μ g/L
Aluminum	GE		644			μ g/L
Aluminum	WA	V	638			μ g/L
Americium-241	GP	U	1		6.34	pCi/L
Americium-241	GP	U	1		6.34	pCi/L
Americium-241	CN	U	1		6.34	pCi/L
Ammonia nitrogen	GE	U	0.1			mg/L
Ammonia nitrogen	GE	U	0.1			mg/L
Antimony	GE	U	2		5	μ g/L
Antimony	GE	U	2		5	μ g/L
Antimony	WA	U	2.6		5	μ g/L
Antimony-125	GP	U	20		300	pCi/L
Antimony-125	GP	U	20		300	pCi/L
Antimony-125	CN	U	20		300	pCi/L
Arsenic	GE	U	2		50	μ g/L
Arsenic	GE	U	2		50	μ g/L
Arsenic	WA	U	2		50	μ g/L
Barium	GE		33.3		2000	μ g/L
Barium	GE		33.6		2000	μ g/L
Barium	WA		33.4		2000	μ g/L
Beryllium	GE	U	3		1	μ g/L
Beryllium	GE	U	3		1	μ g/L
Beryllium	WA	U	0.18		1	μ g/L
Cadmium	GE	U	2		5	μ g/L
Cadmium	GE	U	2		5	μ g/L
Cadmium	WA	U	0.35		5	μ g/L
Calcium	GE		645			μ g/L
Calcium	GE		577			μ g/L
Calcium	WA		654			μ g/L
Carbon tetrachloride	GE	U	1		5	μ g/L
Carbon tetrachloride	GE	U	1		5	μ g/L
Carbon tetrachloride	WA	U	1		5	μ g/L
Cerium-144	GP	U	60		261	pCi/L
Cerium-144	GP	U	60		261	pCi/L
Cerium-144	CN	U	50		261	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-134	CN	U	10		81.3	pCi/L
Cesium-137	GP	U	10		200	pCi/L
Cesium-137	GP	U	10		200	pCi/L
Cesium-137	CN	U	10		200	pCi/L

(Table 25. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Chloride	GE		3.85			mg/L
Chloride	GE		4.06			mg/L
Chloride	WA		5.12			mg/L
Chloroform	GE	U	1		100	µg/L
Chloroform	GE	U	1		100	µg/L
Chloroform	WA	U	1		100	µg/L
Chromium	GE	U	4		100	µg/L
Chromium	GE	U	4		100	µg/L
Chromium	WA	UV	1.1		100	µg/L
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-57	CN	U	10		1000	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Cobalt-60	CN	U	10		100	pCi/L
Copper	GE	U	4		1300	µg/L
Copper	GE	U	4		1300	µg/L
Copper	WA	U	1.1		1300	µg/L
Curium-242	GP	U	1		0.133	pCi/L
Curium-242	GP	U	1		0.133	pCi/L
Curium-242	CN	U	1		0.133	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Curium-243,244	CN	U	1		8.3	pCi/L
Europium-152	GP	U	40			pCi/L
Europium-152	GP	U	40			pCi/L
Europium-152	CN	U	40			pCi/L
Europium-154	CN	U	25		200	pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-155	GP	U	30		600	pCi/L
Europium-155	GP	U	30		600	pCi/L
Europium-155	CN	U	25		600	pCi/L
Fluoride	GE	U	0.1		4	mg/L
Fluoride	GE	U	0.1		4	mg/L
Fluoride	WA	U	0.1		4	mg/L
Gross alpha	GE	U	2		15	pCi/L
Gross alpha	GE	U	2		15	pCi/L
Gross-alpha	TM		0.9	0.9		pCi/L
Hardness	GE		3.62			mg/L
Hardness	GE		12.5			mg/L
Iodine-129	TE	U	2		1	pCi/L
Iodine-129	TE	U	2		1	pCi/L
Iodine-129	CN	U	2		1	pCi/L
Iron	GE	J2	3440		300	µg/L
Iron	GE	J2	3240		300	µg/L
Iron	WA	V	3810		300	µg/L
Lead	GE		4.74		15	µg/L
Lead	GE		6.15		15	µg/L

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(Table 25. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Lead	WA	J3V	5.8		15	µg/L
Magnesium	GE		487			µg/L
Magnesium	GE		483			µg/L
Magnesium	WA		486			µg/L
Manganese	GE		50.6		50	µg/L
Manganese	GE		48.7		50	µg/L
Manganese	WA		54.4		50	µg/L
Manganese-54	GP	U	10		300	pCi/L
Manganese-54	GP	U	10		300	pCi/L
Manganese-54	CN	U	10		300	pCi/L
Mercury	GE	U	0.2		2	µg/L
Mercury	GE		0.51		2	µg/L
Mercury	WA	U	0.2		2	µg/L
Neptunium-237	TE	U	10		7.06	pCi/L
Neptunium-237	TE	U	10		7.06	pCi/L
Neptunium-237	CN	U	45		7.06	pCi/L
Neptunium-237	CN	U	1		7.06	pCi/L
Nickel	GE	U	4		100	µg/L
Nickel	GE	U	4		100	µg/L
Nickel	WA	J3	5.3		100	µg/L
Nitrate as nitrogen	WA		0.56		10	mg/L
Nitrate as nitrogen	GE		0.37		10	mg/L
Nitrate as nitrogen	GE		0.17		10	mg/L
Nonvolatile beta	GE		2.3	1.4	50	pCi/L
Nonvolatile beta	GE	U	2		50	pCi/L
Nonvolatile beta	TM	U	0.7		50	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-238	CN	U	1		7.02	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Plutonium-239,240	CN	U	1		62.1	pCi/L
Potassium	GE		1110			µg/L
Potassium	GE		1070			µg/L
Potassium	WA	V	1130			µg/L
Potassium-40	GP	U	110		300	pCi/L
Potassium-40	GP	U	110		300	pCi/L
Potassium-40	CN	U	175		300	pCi/L
Promethium-144	GP	U	10			pCi/L
Promethium-144	GP	U	10			pCi/L
Promethium-144	CN	U	10			pCi/L
Promethium-146	GP	U	10			pCi/L
Promethium-146	GP	U	10			pCi/L
Promethium-146	CN	U	20			pCi/L
Radium-226	GP	U	1		15.7	pCi/L
Radium-226	GP	U	1		15.7	pCi/L
Radium-226	CN	U	175		15.7	pCi/L
Radium-228	GP		1.93	1.4	7.85	pCi/L
Radium-228	GP		1.83	0.84	7.85	pCi/L

(Table 25. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Radium226	CN	U	1			pCi/L
Radium228	CN		12.1	0.9		pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Ruthenium-106	CN	U	70			pCi/L
Selenium	GE	UJ1	2		50	µg/L
Selenium	GE	UJ1	2		50	µg/L
Selenium	WA	U	2		50	µg/L
Silver	GE	U	2		50	µg/L
Silver	GE	U	2		50	µg/L
Silver	WA	U	0.7		50	µg/L
Sodium	GE		2660			µg/L
Sodium	GE		2680			µg/L
Sodium	WA		2780			µg/L
Sodium-22	GP	U	10		466	pCi/L
Sodium-22	GP	U	10		466	pCi/L
Sodium-22	CN	U	10		466	pCi/L
Strontium-90	GP	U	2		8	pCi/L
Strontium-90	GP	U	2		8	pCi/L
Strontium-90	CN	U	2		8	pCi/L
Technetium-99	GP	U	300		900	pCi/L
Technetium-99	GP	U	300		900	pCi/L
Technetium-99	CN	U	300		900	pCi/L
Tetrachloroethylene	GE	U	1		5	µg/L
Tetrachloroethylene	GE	U	1		5	µg/L
Tetrachloroethylene	WA	U	1		5	µg/L
Thallium	GE	U	2		1	µg/L
Thallium	GE	U	2		1	µg/L
Thallium	WA	U	2		1	µg/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-228	CN	U	400		125	pCi/L
Thorium-228	CN	U	1		125	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-230	GP		1.32	0.28	79.2	pCi/L
Thorium-230	CN	U	1		79.2	pCi/L
Thorium-232	GP	U	1		88	pCi/L
Thorium-232	GP	U	1		88	pCi/L
Thorium-232	CN	U	1		88	pCi/L
Tin	GE		2.48			µg/L
Tin	GE	U	2			µg/L
Tin	WA	V	13.2			µg/L
Total organic carbon	GE		21			mg/L
Total organic carbon	GE		24			mg/L
Total organic carbon	WA		40.1			mg/L
Total organic halogens	GE		59.65			µg/L
Total organic halogens	GE		43.1			µg/L
Total organic halogens	WA		65.8			µg/L
Total phenols	GE	U	5			µg/L

(Table 25. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Total phenols	GE	U	5			µg/L
Total phenols	WA	U	5			µg/L
Trichloroethylene	GE	U	1		5	µg/L
Trichloroethylene	GE	U	1		5	µg/L
Trichloroethylene	WA	U	1		5	µg/L
Tritium	GE		60.1	1.35	20	pCi/ml
Tritium	GE		56.8	1.3	20	pCi/ml
Tritium	TM		66	7.3	20	pCi/L
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-234	CN	U	1		13.9	pCi/L
Uranium-235	GP	U	1		14.5	pCi/L
Uranium-235	GP	U	1		14.5	pCi/L
Uranium-235	CN	U	15		14.5	pCi/L
Uranium-235	CN	U	1		14.5	pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Uranium-238	CN	U	1		14.6	pCi/L
Vanadium	GE	U	8			µg/L
Vanadium	GE	U	8			µg/L
Vanadium	WA	U	0.88			µg/L
Yttrium-88	GP	U	60			pCi/L
Yttrium-88	GP	U	60			pCi/L
Yttrium-88	CN	U	10			pCi/L
Zinc	GE		91		5000	µg/L
Zinc	GE		90.8		5000	µg/L
Zinc	WA		92.9		5000	µg/L
Zinc-65	GP	U	20		300	pCi/L
Zinc-65	GP	U	20		300	pCi/L
Zinc-65	CN	U	20		300	pCi/L

Table 26. HSP008 Laboratory Analyses

Field Measurements:

Sample Date: 07/23/92

pH: 6.32

Specific Conductance: 237 $\mu\text{S}/\text{cm}$

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
1,1,1-Trichloroethane	GE	U	1		200	$\mu\text{g}/\text{L}$
1,1,1-Trichloroethane	GE	U	1		200	$\mu\text{g}/\text{L}$
1,1,1-Trichloroethane	WA	U	1		200	$\mu\text{g}/\text{L}$
Alkalinity	GE	U	1			mg/L
Alkalinity	GE		66.9			mg/L
Aluminum	GE		8930			$\mu\text{g}/\text{L}$
Aluminum	GE		14100			$\mu\text{g}/\text{L}$
Aluminum	WA	V	23000			$\mu\text{g}/\text{L}$
Americium-241	GP	U	1		6.34	pCi/L
Americium-241	GP	U	1		6.34	pCi/L
Americium-241	CN	U	1		6.34	pCi/L
Ammonia nitrogen	GE	U	0.1			mg/L
Ammonia nitrogen	GE	U	0.1			mg/L
Antimony	GE	U	2		5	$\mu\text{g}/\text{L}$
Antimony	GE	U	2		5	$\mu\text{g}/\text{L}$
Antimony	WA	U	2.6		5	$\mu\text{g}/\text{L}$
Antimony-125	GP	U	20		300	pCi/L
Antimony-125	GP	U	20		300	pCi/L
Antimony-125	CN	U	20		300	pCi/L
Arsenic	GE	U	2		50	$\mu\text{g}/\text{L}$
Arsenic	GE	U	2		50	$\mu\text{g}/\text{L}$
Arsenic	WA	U	2		50	$\mu\text{g}/\text{L}$
Barium	GE		28.5		2000	$\mu\text{g}/\text{L}$
Barium	GE		32.1		2000	$\mu\text{g}/\text{L}$
Barium	WA		82.5		2000	$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1	$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1	$\mu\text{g}/\text{L}$
Beryllium	WA	J3	0.6		1	$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5	$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5	$\mu\text{g}/\text{L}$
Cadmium	WA	U	0.35		5	$\mu\text{g}/\text{L}$
Calcium	GE	J2	1430			$\mu\text{g}/\text{L}$
Calcium	GE	J2	2230			$\mu\text{g}/\text{L}$
Calcium	WA		1560			$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5	$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5	$\mu\text{g}/\text{L}$
Carbon tetrachloride	WA	U	1		5	$\mu\text{g}/\text{L}$
Cerium-144	GP	U	60		261	pCi/L
Cerium-144	GP	U	60		261	pCi/L
Cerium-144	CN	U	50		261	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-134	CN	U	10		81.3	pCi/L
Cesium-137	GP	U	10		200	pCi/L
Cesium-137	GP	U	10		200	pCi/L
Cesium-137	CN	U	10		200	pCi/L

(Table 26. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Chloride	GE		3.47			mg/L
Chloride	GE		3.24			mg/L
Chloride	WA		4.14			mg/L
Chloroform	GE	U	1		100	µg/L
Chloroform	GE	U	1		100	µg/L
Chloroform	WA	U	1		100	µg/L
Chromium	GE		5.78		100	µg/L
Chromium	GE		8.68		100	µg/L
Chromium	WA		25.1		100	µg/L
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-57	CN	U	10		1000	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Cobalt-60	CN	U	10		100	pCi/L
Copper	GE		4.33		1300	µg/L
Copper	GE		5.19		1300	µg/L
Copper	WA	J3	3.5		1300	µg/L
Curium-242	GP	U	1		0.133	pCi/L
Curium-242	GP	U	1		0.133	pCi/L
Curium-242	CN	U	1		0.133	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Curium-243,244	CN	U	1		8.3	pCi/L
Europium-152	GP	U	40			pCi/L
Europium-152	GP	U	40			pCi/L
Europium-152	CN	U	40			pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-154	CN	U	25		200	pCi/L
Europium-155	GP	U	30		600	pCi/L
Europium-155	GP	U	30		600	pCi/L
Europium-155	CN	U	25		600	pCi/L
Fluoride	GE	U	0.1		4	mg/L
Fluoride	GE	U	0.1		4	mg/L
Fluoride	WA	U	0.1		4	mg/L
Gross alpha	GE		28	13	15	pCi/L
Gross alpha	GE		10	4.2	15	pCi/L
Gross alpha	CN		48.8	1.48	15	pCi/L
Gross alpha	TM		11.8	4.3	15	pCi/L
Hardness	GE		19			mg/L
Hardness	GE		20			mg/L
Iodine-129	TE		16	2.1	1	pCi/L
Iodine-129	TE		13.2	2	1	pCi/L
Iodine-129	CN	U	2		1	pCi/L
Iron	GE		2570		300	µg/L
Iron	GE		3640		300	µg/L
Iron	WA	V	9840		300	µg/L
Lead	GE		6.71		15	µg/L

(Table 26. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Lead	GE		7.53		15	µg/L
Lead	WA	V	20.5		15	µg/L
Magnesium	GE		1210			µg/L
Magnesium	GE		1350			µg/L
Magnesium	WA	V	1380			µg/L
Manganese	GE		83.8		50	µg/L
Manganese	GE		98.3		50	µg/L
Manganese	WA		164		50	µg/L
Manganese-54	GP	U	10		300	pCi/L
Manganese-54	GP	U	10		300	pCi/L
Manganese-54	CN	U	10		300	pCi/L
Mercury	GE		1.43		2	µg/L
Mercury	GE		2.38		2	µg/L
Mercury	WA		1.27		2	µg/L
Neptunium-237	TE	U	10		7.06	pCi/L
Neptunium-237	TE	U	10		7.06	pCi/L
Neptunium-237	CN	U	45		7.06	pCi/L
Neptunium-237	CN	U	1		7.06	pCi/L
Nickel	GE		4.59		100	µg/L
Nickel	GE		8.32		100	µg/L
Nickel	WA	J3	8		100	µg/L
Nitrate as nitrogen	GE		19.9		10	mg/L
Nitrate as nitrogen	GE		20.2		10	mg/L
Nitrate as nitrogen	WA		15.3		10	mg/L
Nonvolatile beta	GE		80.2	13	50	pCi/L
Nonvolatile beta	GE		32.6	5	50	pCi/L
Nonvolatile beta	CN		46.8	1.79	50	pCi/L
Nonvolatile beta	TM		64.9	7.3	50	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-238	CN		1.17	0.5	7.02	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Plutonium-239,240	CN	U	1		62.1	pCi/L
Potassium	GE		810			µg/L
Potassium	GE		941			µg/L
Potassium	WA	V	873			µg/L
Potassium-40	GP	U	110		300	pCi/L
Potassium-40	GP	U	110		300	pCi/L
Potassium-40	CN	U	175		300	pCi/L
Promethium-144	GP	U	10			pCi/L
Promethium-144	GP	U	10			pCi/L
Promethium-144	CN	U	10			pCi/L
Promethium-146	GP	U	10			pCi/L
Promethium-146	GP	U	10			pCi/L
Promethium-146	CN	U	20			pCi/L
Radium-226	GP		4.95	0.45	15.7	pCi/L
Radium-226	GP		4.51	0.37	15.7	pCi/L
Radium-226	CN	U	175		15.7	pCi/L

(Table 26. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Radium-226	CN	U	1		15.7	pCi/L
Radium-228	GP		5.185	1.2	7.85	pCi/L
Radium-228	GP		2.17	1.5	7.85	pCi/L
Radium-228	CN	U	1		7.85	pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Ruthenium-106	CN	U	70		30	pCi/L
Selenium	GE	U	2		50	µg/L
Selenium	GE	U	2		50	µg/L
Selenium	WA	U	2		50	µg/L
Silver	GE	U	2		50	µg/L
Silver	GE	U	2		50	µg/L
Silver	WA	U	0.7		50	µg/L
Sodium	GE		59500			µg/L
Sodium	GE		58700			µg/L
Sodium	WA		37900			µg/L
Sodium-22	GP	U	10		466	pCi/L
Sodium-22	GP	U	10		466	pCi/L
Sodium-22	CN	U	10		466	pCi/L
Strontium-90	GP	U	2		8	pCi/L
Strontium-90	GP	U	2		8	pCi/L
Strontium-90	CN	U	2		8	pCi/L
Technetium-99	GP		13100	155	900	pCi/L
Technetium-99	GP		11800	130	900	pCi/L
Technetium-99	CN	R4			900	pCi/L
Tetrachloroethylene	GE	U	1		5	µg/L
Tetrachloroethylene	GE	U	1		5	µg/L
Tetrachloroethylene	WA	U	1		5	µg/L
Thallium	GE	U	2		1	µg/L
Thallium	GE	U	2		1	µg/L
Thallium	WA	U	2		1	µg/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-228	CN	U	400		125	pCi/L
Thorium-228	CN	U	1		125	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-230	CN	U	1		79.2	pCi/L
Thorium-232	GP	U	1		88	pCi/L
Thorium-232	GP	U	1		88	pCi/L
Thorium-232	CN	U	1		88	pCi/L
Tin	GE	U	2			µg/L
Tin	GE		6.81			µg/L
Tin	WA	J3	6			µg/L
Total organic carbon	GE	JQ	19.9			mg/L
Total organic carbon	GE	JQ	29.5			mg/L
Total organic carbon	WA		38.1			mg/L
Total organic halogens	GE	JQ	25.4			µg/L
Total organic halogens	GE	JQ	30.6			µg/L

(Table 26. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Total organic halogens	WA	JQ	22.25			µg/L
Total phenols	GE	U	5			µg/L
Total phenols	GE	U	5			µg/L
Total phenols	WA	U	5			µg/L
Trichloroethylene	GE	U	1		5	µg/L
Trichloroethylene	GE	U	1		5	µg/L
Trichloroethylene	WA	U	1		5	µg/L
Tritium	GE		4910	10	20	pCi/ml
Tritium	GE		5730	11	20	pCi/ml
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-234	CN	U	1		13.9	pCi/L
Uranium-235	GP	U	1		14.5	pCi/L
Uranium-235	GP	U	1		14.5	pCi/L
Uranium-235	CN	U	15		14.5	pCi/L
Uranium-235	CN	U	1		14.5	pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Uranium-238	CN	U	1		14.6	pCi/L
Vanadium	GE		15.2			µg/L
Vanadium	GE		20.8			µg/L
Vanadium	WA	V	70.2			µg/L
Yttrium-88	GP	U	60			pCi/L
Yttrium-88	GP	U	60			pCi/L
Yttrium-88	CN	U	10			pCi/L
Zinc	GE		119			µg/L
Zinc	GE		131			µg/L
Zinc	WA		93.1			µg/L
Zinc-65	GP	U	20		300	pCi/L
Zinc-65	GP	U	20		300	pCi/L
Zinc-65	CN	U	20		300	pCi/L

Table 27. HSP029 Laboratory Analyses

Field Measurements:

Sample Date: 07/21/92

pH: 4.80

Specific Conductance: 97 $\mu\text{S}/\text{cm}$

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
1,1,1-Trichloroethane	GE	U	1		200	$\mu\text{g}/\text{L}$
Alkalinity	GE	V	1.5			mg/L
Aluminum	GE		606			$\mu\text{g}/\text{L}$
Americium-241	GP	U	1		6.34	pCi/L
Ammonia nitrogen	GE	U	0.1			mg/L
Antimony	GE	U	2		5	$\mu\text{g}/\text{L}$
Antimony-125	GP	U	20		300	pCi/L
Arsenic	GE	U	2		50	$\mu\text{g}/\text{L}$
Barium	GE		68.7		2000	$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1	$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5	$\mu\text{g}/\text{L}$
Calcium	GE		1820			$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5	$\mu\text{g}/\text{L}$
Cerium-144	GP	U	60		261	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-137	GP	U	10		200	pCi/L
Chloride	GE		2.38			mg/L
Chloroform	GE	U	1		100	$\mu\text{g}/\text{L}$
Chromium	GE	U	4		100	$\mu\text{g}/\text{L}$
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-60	GP		64.4	8	100	pCi/L
Copper	GE	U	4		1300	$\mu\text{g}/\text{L}$
Curium-242	GP	U	1		0.133	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Europium-152	GP	U	40			pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-155	GP	U	30		600	pCi/L
Fluoride	GE	U	0.1		4	mg/L
Gross alpha	GE	U	2		15	pCi/L
Hardness	GE		13.4			mg/L
Iodine-129	TE		7.8	1.2	1	pCi/L
Iron	GE		19.7		300	$\mu\text{g}/\text{L}$
Lead	GE	U	3		15	$\mu\text{g}/\text{L}$
Magnesium	GE		1730			$\mu\text{g}/\text{L}$
Manganese	GE		527		50	$\mu\text{g}/\text{L}$
Manganese-54	GP	U	10		300	pCi/L
Mercury	GE	U	0.2		2	$\mu\text{g}/\text{L}$
Neptunium-237	TE	U	10		7.06	pCi/L
Nickel	GE		7.47		100	$\mu\text{g}/\text{L}$
Nitrate as nitrogen	GE		12.2		10	mg/L
Nonvolatile beta	GE	V	1070	18	50	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Potassium	GE		943			$\mu\text{g}/\text{L}$
Potassium-40	GP	U	110		300	pCi/L
Promethium-144	GP	U	10			pCi/L

(Table 27. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Promethium-146	GP	U	10			pCi/L
Radium-226	GP		1.17	0.23	15.7	pCi/L
Radium-228	GP		523	7.4	7.85	pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Selenium	GE	UJ1	2		50	µg/L
Silver	GE	U	2		50	µg/L
Sodium	GE		12700			µg/L
Sodium-22	GP	U	10		466	pCi/L
Strontium-90	GP		549	8.4	8	pCi/L
Technetium-99	GP		1910	68	900	pCi/L
Tetrachloroethylene	GE	U	1		5	µg/L
Thallium	GE	U	2		1	µg/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-232	GP	U	1		88	pCi/L
Tin	GE	U	2			µg/L
Total organic carbon	GE		2.63			mg/L
Total organic halogens	GE	U	5			µg/L
Total phenols	GE	U	5			µg/L
Trichloroethylene	GE	U	1		5	µg/L
Tritium	GE		858	4.4	20	pCi/ml
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-235	GP	U	1		14.5	pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Vanadium	GE	U	8			µg/L
Yttrium-88	GP	U	60			pCi/L
Zinc	GE		77.3			µg/L
Zinc-65	GP	U	20		300	pCi/L

Table 28. HSP043 Laboratory Analyses

Field Measurements:

Sample Date: 07/23/92

pH: 5.73

Specific Conductance: 155 μ S/cm

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	Result	Units
1,1,1-Trichloroethane	GE	U	1		200			μ g/L
1,1,1-Trichloroethane	WA	U	1		200			μ g/L
Alkalinity	GE		42.5				148	mg/L
Aluminum	GE		4440				80	μ g/L
Aluminum	WA	V	4820					μ g/L
Americium-241	GP	U	1		6.34			pCi/L
Americium-241	CN	U	1		6.34			pCi/L
Ammonia nitrogen	GE		0.21					mg/L
Antimony	GE	U	2		5			μ g/L
Antimony	WA	U	2.6		5			μ g/L
Antimony-125	GP	U	20		300			pCi/L
Antimony-125	CN	U	20		300			pCi/L
Arsenic	GE	U	2		50	U	3	μ g/L
Arsenic	WA	U	2		50			μ g/L
Barium	GE		17.8		2000			μ g/L
Barium	WA	J3	13.4		2000			μ g/L
Beryllium	GE	U	3		1			μ g/L
Beryllium	WA	U	0.18		1			μ g/L
Cadmium	GE	U	2		5	U	6	μ g/L
Cadmium	WA	J3	1.3		5			μ g/L
Calcium	GE	J2	833					μ g/L
Calcium	WA		524					μ g/L
Carbon tetrachloride	GE	U	1		5			μ g/L
Carbon tetrachloride	WA	U	1		5			μ g/L
Cerium-144	GP	U	60		261			pCi/L
Cerium-144	CN	U	50		261			pCi/L
Cesium-134	GP	U	10		81.3	U	6.5	pCi/L
Cesium-134	CN	U	10		81.3			pCi/L
Cesium-137	GP	U	10		200		4.4	pCi/L
Cesium-137	CN	U	10		200			pCi/L
Chloride	GE		3.94				1.2	mg/L
Chloride	WA		5.94					mg/L
Chloroform	GE	U	1		100			μ g/L
Chloroform	WA	U	1		100			μ g/L
Chromium	GE		5.07		100	U	7	μ g/L
Chromium	WA	J3	3.7		100			μ g/L
Cobalt-57	GP	U	10		1000			pCi/L
Cobalt-57	CN	U	10		1000			pCi/L
Cobalt-60	GP	U	10		100		64	pCi/L
Cobalt-60	CN	U	10		100			pCi/L
Copper	GE		4.02		1300			μ g/L
Copper	WA	J3	1.7		1300			μ g/L
Curium-242	GP	U	1		0.133			pCi/L
Curium-242	CN	U	1		0.133			pCi/L
Curium-243,244	GP	U	1		8.3			pCi/L
Curium-243,244	CN	U	1		8.3			pCi/L

(Table 28. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	Result	Units
Europium-152	GP	U	40					pCi/L
Europium-152	CN	U	40					pCi/L
Europium-154	GP	U	20		200			pCi/L
Europium-154	CN	U	25		200			pCi/L
Europium-155	GP	U	30		600			pCi/L
Europium-155	CN	U	25		600			pCi/L
Fluoride	GE	U	0.1		4			mg/L
Fluoride	WA	U	0.1		4			mg/L
Gross alpha	GE		14.7	4.8	15		33	pCi/L
Gross alpha	CN		72	1.92	15			pCi/L
Gross alpha	TM		7.25	3.35	15			pCi/L
Hardness	GE		7.8				73.3	mg/L
Iodine-129	TE		52.2	3.1	1	U	39	pCi/L
Iodine-129	CN	U	2		1			pCi/L
Iron	GE		1920		300			μg/L
Iron	WA	V	3240		300			μg/L
Lead	GE		8.68		15	U	3	μg/L
Lead	WA	V	18		15			μg/L
Magnesium	GE		379					μg/L
Magnesium	WA	V	252					μg/L
Manganese	GE		28.5		50			μg/L
Manganese	WA		17.9		50			μg/L
Manganese-54	GP	U	10		300			pCi/L
Manganese-54	CN	U	10		300			pCi/L
Mercury	GE		0.94		2	U	0.2	μg/L
Mercury	WA		1.68		2			μg/L
Neptunium-237	TE	U	10		7.06	U	1	pCi/L
Neptunium-237	CN	U	45		7.06			pCi/L
Neptunium-237	CN	U	1		7.06			pCi/L
Nickel	GE	U	4		100	U	34	μg/L
Nickel	WA	U	3.1		100			μg/L
Nitrate as nitrogen	GE		2.4		10		8.9	mg/L
Nitrate as nitrogen	WA		5.18		10			mg/L
Nonvolatile beta	GE		23.8	4.4	50		4800	pCi/L
Nonvolatile beta	CN		66.5	1.91	50			pCi/L
Nonvolatile beta	TM		59.55	7.1	50			pCi/L
Plutonium-238	GP	U	1		7.02	U	1	pCi/L
Plutonium-238	CN	U	1		7.02			pCi/L
Plutonium-239,240	GP	U	1		62.1	U	1	pCi/L
Plutonium-239,240	CN	U	1		62.1			pCi/L
Potassium	GE		544					μg/L
Potassium	WA	J3V	378					μg/L
Potassium-40	GP	U	110		300			pCi/L
Potassium-40	CN	U	175		300			pCi/L
Promethium-144	GP	U	10					pCi/L
Promethium-144	CN	U	10					pCi/L
Promethium-146	GP	U	10					pCi/L
Promethium-146	CN	U	20					pCi/L
Radium-226	GP		3.88	0.37	15.7		30	pCi/L

(Table 28. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	Result	Units
Radium-226	CN	U	175		15.7			pCi/L
Radium-226	CN	U	1		15.7			pCi/L
Radium-228	GP		1.17	0.82	7.85			pCi/L
Radium-228	CN	U	1		7.85			pCi/L
Ruthenium-103	CN	U	10					pCi/L
Ruthenium-106	GP	U	90		30			pCi/L
Ruthenium-106	CN	U	70		30			pCi/L
Selenium	GE	U	2		50	U	2	µg/L
Selenium	WA	U	2		50			µg/L
Silver	GE	U	2		50	U	4	µg/L
Silver	WA	U	0.7		50			µg/L
Sodium	GE		41900				63.3	µg/L
Sodium	WA		31100					µg/L
Sodium-22	GP	U	10		466			pCi/L
Sodium-22	CN	U	10		466			pCi/L
Strontium-90	GP	U	2		8		1800	pCi/L
Strontium-90	CN	U	2		8			pCi/L
Technetium-99	GP		6080	100	900		280	pCi/L
Technetium-99	CN	R4			900			pCi/L
Tetrachloroethylene	GE	U	1		5			µg/L
Tetrachloroethylene	WA	U	1		5			µg/L
Thallium	GE	U	2		1			µg/L
Thallium	WA	U	2		1			µg/L
Thorium-228	GP	U	1		125			pCi/L
Thorium-228	CN	U	400		125			pCi/L
Thorium-228	CN	U	1		125			pCi/L
Thorium-230	GP	U	1		79.2			pCi/L
Thorium-230	CN	U	1		79.2			pCi/L
Thorium-232	GP	U	1		88			pCi/L
Thorium-232	CN	U	1		88			pCi/L
Tin	GE	U	2					µg/L
Tin	WA	U	1.9					µg/L
Total organic carbon	GE	JQ	40					mg/L
Total organic carbon	WA		53.3					mg/L
Total organic halogens	GE	JQ	52.6					µg/L
Total organic halogens	WA	JQ	124					µg/L
Total phenols	GE	U	5					µg/L
Total phenols	WA	U	5					µg/L
Trichloroethylene	GE	U	1		5			µg/L
Trichloroethylene	WA	U	1		5			µg/L
Tritium	GE		3260	8.4	20		16000	pCi/ml
Uranium-234	GP	U	1		13.9			pCi/L
Uranium-234	CN	U	1		13.9			pCi/L
Uranium-235	GP	U	1		14.5			pCi/L
Uranium-235	CN	U	15		14.5			pCi/L
Uranium-235	CN	U	1		14.5			pCi/L
Uranium-238	GP	U	1		14.6	U	1	pCi/L
Uranium-238	CN	U	1		14.6			pCi/L
Vanadium	GE	U	8					µg/L

(Table 28. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Mod	Result	Units
Vanadium	WA	V	7.9					µg/L
Yttrium-88	GP	U	60					pCi/L
Yttrium-88	CN	U	10					pCi/L
Zinc	GE		199			U	9	µg/L
Zinc	WA		37.8					µg/L
Zinc-65	GP	U	20		300			pCi/L
Zinc-65	CN	U	20		300			pCi/L

Table 29. HSP060 Laboratory Analyses

Field Measurements:

Sample Date: 07/21/92

pH: 6.07

Specific Conductance: 173 $\mu\text{S}/\text{cm}$

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
1,1,1-Trichloroethane	GE	U	1		200	$\mu\text{g}/\text{L}$
Alkalinity	GE	JQ	60.9			mg/L
Aluminum	GE		5040			$\mu\text{g}/\text{L}$
Americium-241	GP	U	1		6.34	pCi/L
Ammonia nitrogen	GE		0.1			mg/L
Antimony	GE	U	2		5	$\mu\text{g}/\text{L}$
Antimony-125	GP	U	20		300	pCi/L
Arsenic	GE	U	2		50	$\mu\text{g}/\text{L}$
Barium	GE		24.5		2000	$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1	$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5	$\mu\text{g}/\text{L}$
Calcium	GE		1160			$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5	$\mu\text{g}/\text{L}$
Cerium-144	GP	U	60		261	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-137	GP		31.2	6.3	200	pCi/L
Chloride	GE		6.05			mg/L
Chloroform	GE	U	1		100	$\mu\text{g}/\text{L}$
Chromium	GE	U	4		100	$\mu\text{g}/\text{L}$
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Copper	GE		7.37		1300	$\mu\text{g}/\text{L}$
Curium-242	GP	U	1		0.133	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Europium-152	GP	U	40			pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-155	GP	U	30		600	pCi/L
Fluoride	GE	U	0.1		4	mg/L
Gross alpha	GE		2	2.6	15	pCi/L
Hardness	GE		2.8			mg/L
Iodine-129	TE	U	2		1	pCi/L
Iron	GE		2810		300	$\mu\text{g}/\text{L}$
Lead	GE		6.565		15	$\mu\text{g}/\text{L}$
Magnesium	GE		492			$\mu\text{g}/\text{L}$
Manganese	GE		206		50	$\mu\text{g}/\text{L}$
Manganese-54	GP	U	10		300	pCi/L
Mercury	GE		0.71		2	$\mu\text{g}/\text{L}$
Neptunium-237	TE	U	10		7.06	pCi/L
Nickel	GE	U	4		100	$\mu\text{g}/\text{L}$
Nitrate as nitrogen	GE		2.8		10	mg/L
Nonvolatile beta	GE		49.7	4.7	50	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Potassium	GE		1110			$\mu\text{g}/\text{L}$
Potassium-40	GP	U	110		300	pCi/L
Promethium-144	GP	U	10			pCi/L

(Table 29. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Promethium-146	GP	U	10			pCi/L
Radium-226	GP		5.46	0.43	15.7	pCi/L
Radium-228	GP		153	3.6	7.85	pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Selenium	GE	U	2		50	µg/L
Silver	GE	U	2		50	µg/L
Sodium	GE		40000			µg/L
Sodium-22	GP	U	10		466	pCi/L
Strontium-90	GP		33.8	3.6	8	pCi/L
Technetium-99	GP		8640	140	900	pCi/L
Tetrachloroethylene	GE	U	1		5	µg/L
Thallium	GE	U	2		1	µg/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-232	GP	U	1		88	pCi/L
Tin	GE		2.16			µg/L
Total organic carbon	GE	JQ6	33.6			mg/L
Total organic halogens	GE		32.5			µg/L
Total phenols	GE	U	5			µg/L
Trichloroethylene	GE	U	1		5	µg/L
Tritium	GE		3490	11	20	pCi/ml
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-235	GP	U	1		14.5	pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Vanadium	GE		11.7			µg/L
Yttrium-88	GP	U	60			pCi/L
Zinc	GE		153			µg/L
Zinc-65	GP	U	20		300	pCi/L

Table 30. HSP092 Laboratory Analyses

Field Measurements:

Sample Date: 07/21/92

pH: 5.68

Specific Conductance: 33 $\mu\text{S}/\text{cm}$

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
1,1,1-Trichloroethane	GE	U	1		200	$\mu\text{g}/\text{L}$
Alkalinity	GE	V	4.3			mg/L
Aluminum	GE		648			$\mu\text{g}/\text{L}$
Americium-241	GP	U	1		6.34	pCi/L
Ammonia nitrogen	GE	U	0.1			mg/L
Antimony	GE	U	2		5	$\mu\text{g}/\text{L}$
Antimony-125	GP	U	20		300	pCi/L
Arsenic	GE	U	2		50	$\mu\text{g}/\text{L}$
Barium	GE		32.5		2000	$\mu\text{g}/\text{L}$
Beryllium	GE	U	3		1	$\mu\text{g}/\text{L}$
Cadmium	GE	U	2		5	$\mu\text{g}/\text{L}$
Calcium	GE		747			$\mu\text{g}/\text{L}$
Carbon tetrachloride	GE	U	1		5	$\mu\text{g}/\text{L}$
Cerium-144	GP	U	60		261	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-137	GP	U	10		200	pCi/L
Chloride	GE		3.93			mg/L
Chloroform	GE	U	1		100	$\mu\text{g}/\text{L}$
Chromium	GE	U	4		100	$\mu\text{g}/\text{L}$
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Copper	GE	U	4		1300	$\mu\text{g}/\text{L}$
Curium-242	GP	U	1		0.133	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Europium-152	GP	U	40			pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-155	GP	U	30		600	pCi/L
Fluoride	GE		0.127		4	mg/L
Gross alpha	GE	U	2		15	pCi/L
Hardness	GE		2.8			mg/L
Iodine-129	TE	U	2		1	pCi/L
Iron	GE		2880		300	$\mu\text{g}/\text{L}$
Lead	GE	U	3		15	$\mu\text{g}/\text{L}$
Magnesium	GE		762			$\mu\text{g}/\text{L}$
Manganese	GE		207		50	$\mu\text{g}/\text{L}$
Manganese-54	GP	U	10		300	pCi/L
Mercury	GE		0.22		2	$\mu\text{g}/\text{L}$
Neptunium-237	TE	U	10			pCi/L
Nickel	GE	U	4		100	$\mu\text{g}/\text{L}$
Nitrate as nitrogen	GE	U	0.05		10	mg/L
Nonvolatile beta	GE	V	3	1.5	50	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Potassium	GE	U	500			$\mu\text{g}/\text{L}$
Potassium-40	GP	U	110		300	pCi/L
Promethium-144	GP	U	10			pCi/L

(Table 30. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
Promethium-146	GP	U	10			pCi/L
Radium-226	GP		1.595	0.27	15.7	pCi/L
Radium-228	GP		1.75	0.72	7.85	pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Selenium	GE	UJ1	2		50	µg/L
Silver	GE	U	2		50	µg/L
Sodium	GE		2850			µg/L
Sodium-22	GP	U	10		466	pCi/L
Strontium-90	GP		6.79	1.5	8	pCi/L
Technetium-99	GP		696	44	900	pCi/L
Tetrachloroethylene	GE	U	1		5	µg/L
Thallium	GE	U	2		1	µg/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-232	GP	U	1		88	pCi/L
Tin	GE	U	2			µg/L
Total organic carbon	GE		7.93			mg/L
Total organic halogens	GE	U	5			µg/L
Total phenols	GE	U	5			µg/L
Trichloroethylene	GE	U	1		5	µg/L
Tritium	GE		305.5	2.8	20	pCi/ml
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-235	GP	U	1			pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Vanadium	GE	U	8			µg/L
Yttrium-88	GP	U	60			pCi/L
Zinc	GE		195			µg/L
Zinc-65	GP	U	20		300	pCi/L

Table 31. QA 2S Laboratory Analyses

Field Measurements: Trip blank

Sample Date: NA

pH: NA

Specific Conductance: NA

Analyte	Lab	Mod	Result	Acc	Standard	Units
1,1,1-Trichloroethane	GE	JQ	25.4		200	µg/L
Alkalinity	GE	JQ	8.36			mg/L
Aluminum	GE	U	20			µg/L
Americium-241	GP	U	1		6.34	pCi/L
Ammonia nitrogen	GE	U	0.1			mg/L
Antimony	GE	U	2		5	µg/L
Antimony-125	GP	U	20		5	pCi/L
Arsenic	GE	U	2		50	µg/L
Barium	GE	U	3		2000	µg/L
Beryllium	GE	U	3		1	µg/L
Cadmium	GE	U	2		5	µg/L
Calcium	GE	U	10			µg/L
Carbon tetrachloride	GE	JQU	1		5	µg/L
Cerium-144	GP	U	60		261	pCi/L
Chloride	GE		6.4			mg/L
Chloroform	GE	JQU	1		100	µg/L
Chromium	GE	U	4		100	µg/L
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Copper	GE	U	4		1300	µg/L
Curium-242	GP	U	1		0.133	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Europium-152	GP	U	40			pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-155	GP	U	30		600	pCi/L
Fluoride	GE	U	0.1		4	mg/L
Gross Alpha	GE	U	2		15	pCi/L
Hardness	GE		7.5			mg/L
Iodine-129	TE	U	2		1	pCi/L
Iron	GE	UJ1	4		300	µg/L
Lead	GE	U	3		15	µg/L
Magnesium	GE	U	2			µg/L
Manganese	GE	U	2		50	µg/L
Manganese-54	GP	U	10		50	pCi/L
Mercury	GE	U	0.2		2	µg/L
Neptunium-237	TE	U	10			pCi/L
Nickel	GE		8.65		100	µg/L
Nitrate as nitrogen	GE	U	0.05		10	mg/L
Nonvolatile beta	GE	U	2		50	pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Potassium	GE		777			µg/L
Potassium-40	GP	U	110		300	pCi/L
Promethium-144	GP	U	10			pCi/L
Promethium-146	GP	U	10			pCi/L
Radium-226	GP		1.1	0.15		pCi/L
Radium-228	GP	U	1		7.85	pCi/L

(Table 31. Continued)

Analyte	Lab	Mod	Result	Acc	Standard	Units
Ruthenium-106	GP	U	90		30	pCi/L
Selenium	GE	UJ1	2		50	µg/L
Silver	GE	U	2		50	µg/L
Sodium	GE		11400			µg/L
Sodium	GP	U	10			pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-137	GP	U	10		200	pCi/L
Strontium-90	GP	U	2		8	pCi/L
Technetium-99	GP	U	300		900	pCi/L
Thallium	GE	U	2		1	µg/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-232	GP	U	1			pCi/L
Tin	GE		4.81			µg/L
Total organic carbon	GE	JQU	1			mg/L
Total organic halogens	GE	JQU	5			µg/L
Total phenols	GE	U	5			µg/L
Trichloroethylene	GE	JQU	1		5	µg/L
Tetrachloroethylene	GE	JQU	1		5	µg/L
Tritium	GE	U	0.7		20	pCi/ml
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-235	GP	U	1			pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Vanadium	GE	U	8			µg/L
Yttrium-88	GP	U	60			pCi/L
Zinc	GE	U	2			µg/L
Zinc-65	GP	U	20		300	pCi/L

Table 32. QA 4S Laboratory Analyses

Field Measurements: Trip blank

Sample Date: NA

pH: NA

Specific Conductance: NA

Analyte	Lab	Mod	7/92 Result	Acc	Standard	Units
1,1,1-Trichloroethane	GE	U	1		200	µg/L
Alkalinity	GE	V	11.9			mg/L
Aluminum	GE	U	20			µg/L
Americium-241	GP	U	1		6.34	pCi/L
Ammonia nitrogen	GE	U	0.1			mg/L
Antimony	GE	U	2		5	µg/L
Antimony-125	GP	U	20			pCi/L
Arsenic	GE	U	2		50	µg/L
Barium	GE	U	3		2000	µg/L
Beryllium	GE	U	3		1	µg/L
Cadmium	GE	U	2		5	µg/L
Calcium	GE	U	10			µg/L
Carbon tetrachloride	GE	U	1		5	µg/L
Cerium-144	GP	U	60		261	pCi/L
Cesium-134	GP	U	10		81.3	pCi/L
Cesium-137	GP	U	10		200	pCi/L
Chloride	GE		10.3			mg/L
Chloroform	GE	U	1		100	µg/L
Chromium	GE	U	4		100	µg/L
Cobalt-57	GP	U	10		1000	pCi/L
Cobalt-60	GP	U	10		100	pCi/L
Copper	GE	U	4		1300	µg/L
Curium-242	GP	U	1		0.133	pCi/L
Curium-243,244	GP	U	1		8.3	pCi/L
Europium-152	GP	U	40			pCi/L
Europium-154	GP	U	20		200	pCi/L
Europium-155	GP	U	30		600	pCi/L
Fluoride	GE	U	0.1		4	mg/L
Gross alpha	GE	U	2		15	pCi/L
Hardness	GE		3			mg/L
Iodine-129	TE	U	2		1	pCi/L
Iron	GE	U	4		300	µg/L
Lead	GE	U	3		15	µg/L
Magnesium	GE	U	2			µg/L
Manganese	GE	U	2		50	µg/L
Manganese-54	GP	U	10			pCi/L
Mercury	GE	U	0.2		2	µg/L
Neptunium-237	TE	U	10			pCi/L
Nickel	GE	U	4		100	µg/L
Nitrate as nitrogen	GE	U	0.05		10	mg/L
Nonvolatile beta	GE	U	2			pCi/L
Plutonium-238	GP	U	1		7.02	pCi/L
Plutonium-239,240	GP	U	1		62.1	pCi/L
Potassium	GE		715			µg/L
Potassium-40	GP	U	110		300	pCi/L
Promethium-144	GP	U	10			pCi/L

(Table 32. Continued)

Analyte	Lab	Mod	7/92	Acc	Standard	Units
			Result			
Promethium-146	GP	U	10			pCi/L
Radium-226	GP	U	1			pCi/L
Radium-228	GP		1.145	0.8	7.85	pCi/L
Ruthenium-106	GP	U	90		30	pCi/L
Selenium	GE	U	2		50	µg/L
Silver	GE	U	2		50	µg/L
Sodium	GE		11200			µg/L
Sodium-22	GP	U	10			pCi/L
Strontium-90	GP	U	2		8	pCi/L
Technetium-99	GP	U	300		900	pCi/L
Thallium	GE	U	2		1	µg/L
Thorium-228	GP	U	1		125	pCi/L
Thorium-230	GP	U	1		79.2	pCi/L
Thorium-232	GP	U	1			pCi/L
Tin	GE	U	2			µg/L
Total organic carbon	GE	U	1			mg/L
Total organic halogens	GE	U	5			µg/L
Total phenols	GE	U	5			µg/L
Trichloroethylene	GE	U	1		5	µg/L
Tetrachloroethylene	GE	U	1		5	µg/L
Tritium	GE	U	0.7		20	pCi/ml
Uranium-234	GP	U	1		13.9	pCi/L
Uranium-235	GP	U	1			pCi/L
Uranium-238	GP	U	1		14.6	pCi/L
Vanadium	GE	U	8			µg/L
Yttrium-88	GP	U	60			pCi/L
Zinc	GE	U	2			µg/L
Zinc-65	GP	U	20		300	pCi/L

Table 33. QA1 Laboratory Analyses

Collected from deionized water source used in all field activities (except trip blanks).

Field Measurements:

Sample Date: 07/27/92

pH: NA

Specific Conductance: NA

Analyte	Lab	Mod	7/92 Result	Acc	Units
Aluminum	GE		22.4		µg/L
Americium-241	GE	U	1		pCi/L
Ammonia Nitrogen	GE	U	0.1		mg/L
Antimony	GE	U	2		µg/L
Antimony-125	GE	U	20		pCi/L
Arsenic	GE	U	2		µg/L
Barium	GE	U	3		µg/L
Beryllium	GE	U	3		µg/L
Cadmium	GE	U	2		µg/L
Calcium	GE		15.7		µg/L
Cerium-144	GE	U	60		pCi/L
Cesium-134	GE	U	10		pCi/L
Cesium-137	GE	U	10		pCi/L
Chloride	GE	U	0.25		mg/L
Chromium	GE	U	4		µg/L
Cobalt-57	GE	U	10		pCi/L
Cobalt-60	GE	U	10		pCi/L
Copper	GE	U	4		µg/L
Curium-242	GE	U	1		pCi/L
Curium-243,244	GE	U	1		pCi/L
Europium-152	GE	U	40		pCi/L
Europium-154	GE	U	20		pCi/L
Europium-155	GE	U	30		pCi/L
Fluoride	GE	U	0.1		mg/L
Hardness	GE	U	1		mg/L
Iodine-129	TE	U	2		pCi/L
Iron	GE		21.7		µg/L
Lead	GE	U	3		µg/L
Magnesium	GE		3.55		µg/L
Manganese	GE	U	2		µg/L
Manganese-54	GE	U	10		pCi/L
Mercury	GE	U	0.2		µg/L
Neptunium-237	TE	U	10		pCi/L
Nickel	GE	U	0.05		mg/L
Nickel	GE	U	4		µg/L
Plutonium-238	GE	U	1		pCi/L
Plutonium-239,240	GE	U	1		pCi/L
Potassium	GE	U	500		µg/L
Potassium-40	GE	U	110		pCi/L
Promethium-144	GE	U	10		pCi/L
Promethium-146	GE	U	10		pCi/L
Radium-226	GE	U	1		pCi/L

(Table 33. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Units
Radium-228	TE	U	1		pCi/L
Ruthenium-106	GE	U	90		pCi/L
Selenium	GE	U	2		µg/L
Silver	GE	U	2		µg/L
Sodium	GE		27.2		µg/L
Sodium-22	GE	U	10		pCi/L
Strontium-90	GE	U	2		pCi/L
Technetium-99	GE	U	300		pCi/L
Tetrachloroethylene	GE	U	1		µg/L
Thallium	GE	U	2		µg/L
Thallium-228	GE	U	1		pCi/L
Thallium-230	GE	U	1		pCi/L
Thallium-232	GE	U	1		pCi/L
Tin	GE	U	2		µg/L
Total organic carbon	GE	U	1		mg/L
Total organic halogens	GE	U	5		µg/L
Total phenols	GE		5.1		µg/L
Tritium	GE	U	0.7		pCi/ml
Uranium-234	GE	U	1		pCi/L
Uranium-235	GE	U	1		pCi/L
Uranium-238	GE	U	1		pCi/L
Vanadium	GE	U	8		µg/L
Yttrium-88	GE	U	60		pCi/L
Zinc	GE	U	2		µg/L
Zinc-65	GE	U	20		pCi/L

Table 34. QA2 Laboratory Analyses

Collected from carboy used to transport all deionized water used in field activities.

Field Measurements:

Sample Date: 07/27/92

pH: NA

Specific Conductance: NA

Analyte	Lab	Mod	7/92 Result	Acc	Units
Alkalinity	GE	V	1.6		mg/L
Aluminum	GE	U	20		µg/L
Americium-241	GE	U	1		pCi/L
Ammonia nitrogen	GE	U	0.1		mg/L
Antimony	GE	U	2		µg/L
Antimony-125	GE	U	20		pCi/L
Arsenic	GE	U	2		µg/L
Barium	GE	U	3		µg/L
Beryllium	GE	U	3		µg/L
Cadmium	GE	U	2		µg/L
Calcium	GE	U	10		µg/L
Cerium-144	GE	U	60		pCi/L
Cesium-134	GE	U	10		pCi/L
Cesium-137	GE	U	10		pCi/L
Chloride	GE	U	0.25		mg/L
Chromium	GE	U	4		µg/L
Cobalt-57	GE	U	10		pCi/L
Cobalt-60	GE	U	10		pCi/L
Copper	GE	U	4		µg/L
Curium-242	GE	U	1		pCi/L
Curium-243,244	GE	U	1		pCi/L
Europium-152	GE	U	40		pCi/L
Europium-154	GE	U	20		pCi/L
Europium-155	GE	U	30		pCi/L
Fluoride	GE	U	0.1		mg/L
Gross Alpha	GE	U	2		pCi/L
Hardness	GE	U	1		mg/L
Iodine-129	TE	U	2		pCi/L
Iron	GE	U	4		µg/L
Lead	GE	U	3		µg/L
Magnesium	GE	U	2		µg/L
Manganese	GE	U	2		µg/L
Manganese-54	GE	U	10		pCi/L
Mercury	GE	U	0.2		µg/L
Neptunium-237	TE	U	10		pCi/L
Nickel	GE	U	4		µg/L
Nitrate as nitrogen	GE	U	0.05		mg/L
Nonvolatile beta	GE	U	2		pCi/L
Plutonium-238	GE	U	1		pCi/L
Plutonium-239,240	GE	U	1		pCi/L
Potassium	GE	U	500		µg/L
Potassium-40	GE	U	110		pCi/L
Promethium-144	GE	U	10		pCi/L
Promethium-146	GE	U	10		pCi/L

(Table 34. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Units
Radium-226	GE	U	1		pCi/L
Radium-228	TE	U	1		pCi/L
Ruthenium-106	GE	U	90		pCi/L
Selenium	GE	U	2		µg/L
Silver	GE	U	2		µg/L
Sodium	GE		17.1		µg/L
Sodium-22	GE	U	10		pCi/L
Strontium-90	GE	U	2		pCi/L
Technetium-99	GE	U	300		pCi/L
Tetrachloroethylene	GE	U	1		µg/L
Thallium	GE	U	2		µg/L
Thorium-228	GE	U	1		pCi/L
Thorium-230	GE		1.58	0.7	pCi/L
Thorium-232	GE	U	1		pCi/L
Tin	GE	U	2		µg/L
Total organic carbon	GE	U	1		mg/L
Total organic halogens	GE	U	5		µg/L
Total phenols	GE		5.9		µg/L
Tritium	GE	U	0.7		pCi/ml
Uranium-234	GE	U	1		pCi/L
Uranium-235	GE	U	1		pCi/L
Uranium-238	GE	U	1		pCi/L
Vanadium	GE	U	8		µg/L
Yttrium-88	GE	U	60		pCi/L
Zinc	GE	U	2		µg/L
Zinc-65	GE	U	20		pCi/L

Table 35. QA3 Laboratory Analyses

Collected from post-decontamination equipment rinse water.

Field Measurements: Trip blank

Sample Date: 07/27/92

pH: NA

Specific Conductance: NA

Analyte	Lab	Mod	7/92 Result	Acc	Units
Alkalinity	GE	V	2.63		mg/L
Aluminum	GE		40.7		µg/L
Americium-241	GE	U	1		pCi/L
Ammonia nitrogen	GE	U	0.1		mg/L
Antimony	GE	U	2		µg/L
Antimony-125	GE	U	20		pCi/L
Arsenic	GE	U	2		µg/L
Barium	GE	U	3		µg/L
Beryllium	GE	U	3		µg/L
Cadmium	GE	U	2		µg/L
Calcium	GE		71.3		µg/L
Cerium-144	GE	U	60		pCi/L
Cesium-134	GE	U	10		pCi/L
Cesium-137	GE	U	10		pCi/L
Chloride	GE	U	0.25		mg/L
Chromium	GE	U	4		µg/L
Cobalt-57	GE	U	10		pCi/L
Cobalt-60	GE	U	10		pCi/L
Copper	GE	U	4		µg/L
Curium-242	GE	U	1		pCi/L
Curium-243,244	GE	U	1		pCi/L
Europium-152	GE	U	40		pCi/L
Europium-154	GE	U	20		pCi/L
Europium-155	GE	U	30		pCi/L
Fluoride	GE	U	0.1		mg/L
Gross alpha	GE	U	2		pCi/L
Hardness	GE		1		mg/L
Iodine-129	TE	U	2		pCi/L
Iron	GE		17.6		µg/L
Lead	GE		35.2		µg/L
Magnesium	GE		7.65		µg/L
Manganese	GE	U	2		µg/L
Manganese-54	GE	U	10		pCi/L
Mercury	GE	U	0.2		µg/L
Neptunium-237	TE	U	10		pCi/L
Nickel	GE	U	4		µg/L
Nitrate as nitrogen	GE		0.06		mg/L
Nonvolatile beta	GE	U	2		pCi/L
Plutonium-238	GE	U	1		pCi/L
Plutonium-239,240	GE	U	1		pCi/L
Potassium	GE	U	500		µg/L
Potassium-40	GE	U	110		pCi/L
Promethium-144	GE	U	10		pCi/L
Promethium-146	GE	U	10		pCi/L

(Table 35. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Units
Radium-226	GE	U	1		pCi/L
Radium-228	TE	U	1		pCi/L
Ruthenium-106	GE	U	90		pCi/L
Selenium	GE	U	2		µg/L
Silver	GE	U	2		µg/L
Sodium	GE		126		µg/L
Sodium-22	GE	U	10		pCi/L
Strontium-90	GE	U	2		pCi/L
Technetium-99	GE	U	300		pCi/L
Tetrachloroethylene	GE	U	1		µg/L
Thallium	GE	U	2		µg/L
Thorium-228	GE	U	1		pCi/L
Thorium-230	GE	U	1		pCi/L
Thorium-232	GE	U	1		pCi/L
Tin	GE		2.37		µg/L
Total organic carbon	GE	U	1		mg/L
Total organic halogens	GE	JQU	5		µg/L
Total phenols	GE	U	5		µg/L
Tritium	GE	U	0.7		pCi/ml
Uranium-234	GE	U	1		pCi/L
Uranium-235	GE	U	1		pCi/L
Uranium-238	GE	U	1		pCi/L
Vanadium	GE	U	8		µg/L
Yttrium-88	GE	U	60		pCi/L
Zinc	GE	U	2		µg/L
Zinc-65	GE	U	34		pCi/L

Table 36. QA4 Laboratory Analyses

Collected from post-decontamination equipment rinse water.

Field Measurements: Trip blank

Sample Date: NA

pH: NA

Specific Conductance: NA

Analyte	Lab	Mod	7/92 Result	Acc	Units
Alkalinity	GE	UV	1		mg/L
Aluminum	GE		41.8		µg/L
Americium-241	GE	U	1		pCi/L
Ammonia nitrogen	GE	U	0.1		mg/L
Antimony	GE	U	2		µg/L
Antimony-125	GE	U	20		pCi/L
Arsenic	GE	U	2		µg/L
Barium	GE	U	3		µg/L
Beryllium	GE	U	3		µg/L
Cadmium	GE	U	2		µg/L
Calcium	GE		36.6		µg/L
Cerium-144	GE	U	60		pCi/L
Cesium-134	GE	U	10		pCi/L
Cesium-137	GE	U	10		pCi/L
Chloride	GE	U	0.25		mg/L
Chromium	GE	U	4		µg/L
Cobalt-57	GE	U	10		pCi/L
Cobalt-60	GE	U	10		pCi/L
Copper	GE	U	4		µg/L
Curium-242	GE	U	1		pCi/L
Curium-243,244	GE	U	1		pCi/L
Europium-152	GE	U	40		pCi/L
Europium-154	GE	U	20		pCi/L
Europium-155	GE	U	30		pCi/L
Fluoride	GE	U	0.1		mg/L
Gross alpha	GE	U	2		pCi/L
Hardness	GE		1		mg/L
Iodine-129	TE	U	2		pCi/L
Iron	GE		22.2		µg/L
Lead	GE		42.8		µg/L
Magnesium	GE		2.93		µg/L
Manganese	GE	U	2		µg/L
Manganese-54	GE	U	10		pCi/L
Mercury	GE	U	0.2		µg/L
Neptunium-237	TE	U	10		pCi/L
Nickel	GE	U	4		µg/L
Nitrate as nitrogen	GE		0.05		mg/L
Nonvolatile beta	GE	U	2		pCi/L
Plutonium-238	GE	U	1		pCi/L
Plutonium-239,240	GE	U	1		pCi/L
Potassium	GE	U	500		µg/L
Potassium-40	GE	U	110		pCi/L
Promethium-144	GE	U	10		pCi/L
Promethium-146	GE	U	10		pCi/L

(Table 36. Continued)

Analyte	Lab	Mod	7/92 Result	Acc	Units
Radium-226	GE	U	1		pCi/L
Radium-228	TE	U	1		pCi/L
Ruthenium-106	GE	U	90		pCi/L
Selenium	GE	U	2		µg/L
Silver	GE	U	2		µg/L
Sodium	GE		75.9		µg/L
Sodium-22	GE	U	10		pCi/L
Strontium-90	GE	U	2		pCi/L
Technetium-99	GE	U	300		pCi/L
Tetrachloroethylene	GE	U	1		µg/L
Thallium	GE	U	2		µg/L
Thorium-228	GE	U	1		pCi/L
Thorium-230	GE	U	1		pCi/L
Thorium-232	GE	U	1		pCi/L
Tin	GE	U	2		µg/L
Total organic carbon	GE	U	0.85		mg/L
Total organic halogens	GE	JQU	5		µg/L
Total phenols	GE	U	5		µg/L
Tritium	GE	U	0.7		pCi/ml
Uranium-234	GE	U	1		pCi/L
Uranium-235	GE	U	1		pCi/L
Uranium-238	GE	U	1		pCi/L
Vanadium	GE	U	8		µg/L
Yttrium-88	GE	U	60		pCi/L
Zinc	GE	U	2		µg/L
Zinc-65	GE	U	20		pCi/L

Appendix A
July 1992 Sampling Event

Introduction

From 1955 to 1988, low-level radioactive wastewater generated by chemical separation processes within the General Separations Area (GSA) were discharged to seepage basins in the F and H Areas of the Savannah River Site (SRS). These basins were designed to permit the infiltration of the process wastewaters. As wastewater percolated downward through the basins, chemical and radioactive constituents were retained or delayed in the subsoils.

An extensive study aimed at characterizing the groundwater seeping into Fourmile Branch and its associated seepine was conducted in 1988 and 1989 (Haselow et al. 1990). Results of this study suggested that contaminants leaching from the F and H Area seepage basins were impacting the Fourmile Branch wetland system. The seepage basins were closed in 1988 and capped and sealed in 1990. This effectively eliminated the hydraulic head driving the migration of contaminants from the basins. It has been hypothesized that, after the elimination of the head, annual rainfall amounts would be sufficient to dilute and flush out contaminants remaining in the subsoils and groundwaters beneath the basins. Westinghouse Savannah River Company has designed a semi-annual sampling and analytical program for the Fourmile Branch (FMB) seepine and stream water to test the hypothesis.

Twelve seepine water and four stream water sampling locations are included in the semi-annual monitoring. These sampling locations include three background locations. Sampling locations were selected by WSRC based on previous sampling results. Sampling location numbers and SRS coordinates are presented in Table A-1.

The first of the three scheduled semi-annual sampling events took place from July 20, 1992, through July 29, 1992. This report summarizes the results of the field monitoring obtained during this event and presents a brief comparison to previous data.

Table A-1. Sample Location Numbers and SRS Coordinates

Seepine	SRS Coordinates	
	North	East
H Area		
HSP008	71005	56990
HSP029	71278	56257
HSP043	71644	55722
HSP060	71629	55190
HSP092	72672	54129
F Area		
FSP012	73602	49644
FSP032	73367	50258
FSP047	73609	50607
FSP204	73281	48801
FSP290	73160	46865
Background¹		
BG001	Seepine	
BG002	Seepine	
BG003	Stream water	
Stream Sites		
FMC0001H	70350	57050
FMC0002H	72600	53000
FMC0001F	72200	43900

¹The locations of background samples were within the grid identified by Site Use Grid Maps 13 and 14 as 71750N-60000N and 40000E-70000E. The exact location was identified by ESS technical personnel.

Experimental Methods

Mobilization

Labeled sample bottles, with preservatives added as necessary, "blue ice", and coolers were provided by the following pairs of subcontracted analytical laboratories: General Engineering Laboratories (non-radiological analyses)/Environmental Physics (radiological analyses) and Roy F. Weston (non-radiological analyses)/Clemson Technical Center (radiological analyses). Additional bottles for on-site analysis of total activity were supplied by the WSRC-EMS Radiological Laboratory. WSRC provided chain-of-custody forms and packaging materials. The sample bottles needed for one day of sampling were separated by station and carried to the sampling station.

Equipment List

The following equipment was used during seepage groundwater sampling.

- Rubber gloves
- Safety glasses
- Clipboard, waterproof pens, waterproof markers
- Field data logbook
- Chain-of-custody forms
- Shipping orders
- Samples bottles
- Backpacks
- Shovel, post-hole digger, hatchet or axe
- Peristaltic pump
- Paper and cloth towels
- Ziplock bags
- Coolers with cool packs
- Bubble pack
- Sampling buckets (5-gallon) with lids
- Water quality meters (pH, conductivity, redox)
- Silicone (Silastic) tubing
- 1 one-liter Nalgene bottle for each station sampled
- 0.45 micron filters and filtering equipment
- Tyvek aprons

The following equipment was used during stream water sampling:

- Rubber gloves
- Safety glasses
- Clipboard, waterproof pens, waterproof markers
- Field data logbook
- Chain-of-custody forms
- Shipping orders
- Sample bottles
- Backpacks

- Paper and cloth towels
- Ziplock bags
- Coolers with cool packs
- Bubble pack
- Water quality meters (pH, conductivity, redox)
- 1 one-liter Nalgene bottle for each station sampled
- 0.45 micron filters and filtering equipment
- Life jackets
- Hip boots
- Tyvek aprons

Decontamination Procedures

Cleaning and decontamination procedures for all sampling equipment are outlined below. All sampler parts were decontaminated prior to the collection of each sample.

Sampling equipment was first cleaned with Milli-Q water and phosphate-free laboratory detergent (Liquinox), using a brush, if necessary, to remove particulate matter and surface films. The equipment was then rinsed thoroughly with Milli-Q water. Finally, the equipment was rinsed two times with pesticide-grade methanol solvent and allow to air dry. When necessary, the dry equipment was wrapped with aluminum foil to prevent contamination during storage or transport.

All decontamination rinse waters were discharged to the ground. The methanol was collected in a pan and allowed to evaporate.

Sample Collection Procedures

Groundwater

All sample locations had been permanently marked by WSRC with a 1-inch Schedule 40 PVC stake driven two feet below grade. An identification number was written on each PVC stake.

After locating the sampling station, the sampling crew excavated a hole using a decontaminated stainless steel shovel. The hole was excavated within a three-foot radius of the PVC stake. Water was encountered in each hole at the depths indicated in Table A-2. The sampling bucket was placed into the hole and covered with a lid. One bucket was set at each location, except locations HSP008, HSP043, FSP047 and FSP290, where two buckets were set. The additional bucket was needed in order to collect sufficient water for duplicate and QA samples. The buckets were set out one day prior to sample collection to allow the sediment in the water to settle. The time between setting the bucket and sample collection was recorded in the field notebook.

Table A-2. Depth Water Encountered

Location	Water Depth
H Area	
HSP008	8 inches
HSP029	2 inches
HSP043	2 feet
HSP060	2 inches
HSP092	1.5 feet
F Area	
FSP012	2 feet
FSP032	8 inches
FSP047	Data not available
FSP204	Surface
FSP290	1 foot
Background	
BG001	7 inches
BG002	8 inches

The 40-ml GCMS/VOA vials and the 1-liter sample bottle used for water to be filtered for metals analysis were filled first by dipping them into the bucket. This was done in a manner that avoids disturbance of the sediment. The VOA vial was filled completely so that no air bubbles were present in the sample.

The remaining samples were collected by pumping the water from the bucket to the remaining sample jars through Silastic (silicone) tubing, using a peristaltic pump powered by a 12-volt battery. New tubing was used for each sample location. The new tubing was flushed for 20 seconds with water from the bucket before the sampling crew collected the sample.

Samples collected for metals analysis were filtered in the field through a 0.45-micron membrane filter to remove fine particulate matter from the water being analyzed. This filtering occurred within four hours of sample collection. The filtering apparatus was flushed with deionized or distilled water between filtering each sample.

Samples collected on July 22, 1992, were very turbid, possibly due to a rainfall event that occurred the previous evening. The turbidity caused filtering problems and increased field processing time. As a result, the field crew collected approximately one-half the volume of water required for metals analysis for the duplicate sample at station HSP043 and were unable to collect the metals sample for QA-1S.

The pH, conductivity, and redox potential of the water at each location were measured at the time of sampling. These readings were taken directly from the water collected in the five-gallon bucket and recorded in the field data logbook. The probes were rinsed with DI water prior to taking these measurements.

Blue ice was used to keep the samples cool from the time of sampling until they were received at the analytical laboratory.

At each sampling location, a 250-ml plastic sample container was filled with the water and sent to the WSRC EMS Radiological Laboratory to determine the total activity in the samples. These data were used to determine the packaging and shipping requirements of the specific samples.

Duplicate samples were collected at both HSP043 and FSP047 and sent to General Engineering/Environmental Physics and Roy F. Weston/Clemson for QA/QC purposes. A triplicate sample was collected from HSP008. This triplicate sample consisted of HSP008 sent to General Engineering/Environmental Physics, QA-1S sent to General Engineering/Environmental Physics, and QA-1S sent to Roy F. Weston/Clemson. A triplicate sample was collected from FSP290. This triplicate sample consisted of FSP290 sent to General Engineering/Environmental Physics, QA-3S sent to General Engineering/Environmental Physics, and QA-3S sent to Roy F. Weston/Clemson.

Two trip blanks were included for the semi-annual sampling event (QA-2S and QA-4S).

Two equipment rinsate samples (QA-3 and QA-4) were collected on July 27, 1992.

Two samples of Milli-Q water, one from the source (QA-1) and one from the field carboy (QA-2), were collected on July 27, 1992, and sent to General Engineering.

At the end of each day, the samples were transported to the Health Protection office in the Central Shops area where the outside of the containers were scanned for radioactivity. The purpose of this scan was to identify any radiological health hazards associated with handling the samples. The samples were then transported to the laboratory at 704B, where they remained until cleared for shipment.

Surface Water Sampling

Collection of the surface water samples was performed by dipping the sample container directly into the stream water. This collection method minimizes alteration of the

sample. Also, the potential for sample cross-contamination through the use of poorly decontaminated sampling equipment is eliminated. Sampling personnel wore hip boots and gloves to minimize exposure to potential contaminants.

The sample bottles to be used at each location were removed from the coolers and the bottle labels were completed with waterproof markers or ballpoint pens.

Surface grab samples were collected in the middle of the stream from the top of the water column. The container was placed into the water with the mouth of the container facing upstream so that water flowed directly into the container. Care was taken when opening and filling the bottles, since some of the bottles contained carefully measured amounts of chemical preservatives.

All containers, except the VOA vials, were filled to the shoulder with water. VOA vials were filled completely and

capped so that no air bubbles were present in the sample. Water collected for metals analysis was filtered in the field prior to preservation. The filled sample containers were capped tightly and placed in a plastic ziplock bag. The samples were placed in coolers and kept cool.

The *in situ* pH, conductivity, and redox potential of the stream was measured and recorded in the field notebook.

Evidence of sample collection, shipment, laboratory receipt, and laboratory custody until sample disposal must be documented to ensure the sample traceability scheme. Documentation was accomplished through a chain-of-custody record that contains the necessary information for individual sample identification and lists the individuals responsible for sample collection, shipment, and receipt, along with necessary signatures and dates. Completed chain-of-custody forms for this sampling event are presented in Appendix A of WSRC-TR-92-559.

Results

The pH, conductivity, and redox potential measurements collected in the field are summarized in Table A-3. The pH readings for H Area seepage samples ranged from 4.80 to 6.32, with an average value of 5.72. The pH readings for F Area seepage samples ranged from 4.10 to 5.38, with an average value of 4.96. The average pH of the background seepage samples was 4.91. The conductivity readings for the seepage samples in H Area ranged from 33 $\mu\text{mhos/cm}$ to 237 $\mu\text{mhos/cm}$, with an average value of 139 $\mu\text{mhos/cm}$.

The conductivity readings for the seepage samples in F Area ranged from 46 $\mu\text{mhos/cm}$ to 277 $\mu\text{mhos/cm}$, with an average value of 122 $\mu\text{mhos/cm}$. The average conductivity of the background seepage samples was 30 $\mu\text{mhos/cm}$. The redox potential readings for the seepage samples in H Area ranged from 107 mV to 205 mV, with an average value of 158 mV. The redox potential readings for the seepage samples in F Area ranged from 53 mV to 227 mV, with an average value of 148 mV. The average redox potential of the background seepage samples was 200 mV.

Table A-3. Water Quality Parameters Measured in the Field

Station	Date Sampled	Time Sampled	SRS Coordinates		pH (pH units)	Conductivity (μmhos/cm)	Redox (mV)
			North	East			
H Area							
HSP008	7/23/92	9:30	71005	56990	6.32	237	195
HSP029	7/12/92	12:30	71278	56257	4.80	97	205
HSP043	7/23/92	11:45	71644	55722	5.73	155	175
HSP060	7/21/92	Not Recorded	71629	55190	6.07	173	107
HSP092	7/21/92	10:47	72672	54129	5.68	33	110
Average					5.72	139	158
F Area							
FSP012	7/28/92	11:45	73602	49644	5.14	106	53
FSP032	7/28/92	10:30	73367	50258	4.10	95	227
FSP047	7/28/92	9:00	73609	50607	5.38	88	120
FSP204	7/28/92	11:30	7328	48801	5.35	277	180
FSP290	7/29/92	9:30	73160	46865	5.83	46	160
Average					4.96	122	148
Background							
BG001	7/29/92	11:30			4.82	21	265
BG002	7/29/92	12:00			5.00	38	135
*BG003	7/22/92	11:26			5.80	20	-13
Average (BG001 and BG002)					4.96	122	148
Stream Sites							
FMC001H	7/22/92	12:20	70350	57050	7.19	86	178
FMC002H	7/22/92	10:30	72600	53000	6.67	94	136
FMC001F	7/22/92	9:48	72200	43900	6.75	70	136
Average					6.87		

*Stream Site

The pH readings for the stream samples ranged from 6.67 to 7.19, with an average value of 6.87. The pH of the background stream sample was 5.80. The conductivity readings for the stream samples ranged from 70 $\mu\text{mhos/cm}$ to 94 $\mu\text{mhos/cm}$, with an average value of 83 $\mu\text{mhos/cm}$. The conductivity of the background stream sample was 20 $\mu\text{mhos/cm}$. The redox potential readings for the stream samples ranged from 136 mV to 178 mV, with an average

value of 150 mV. The redox potential of the background stream sample was -13 mV.

The conductivity and pH of the seepage water was measured previously in March 1989 (Haselow et al. 1990) and in May 1992 (Dixon et al. 1992). This previous data is summarized and current data presented in Tables A-4 and A-5 and displayed in Figures A-1 through A-4.

Table A-4. Summary of Conductivity Measurements

H Area	Conductivity ($\mu\text{mhos/cm}$)				
	HSP008	HSP029	HSP043	HSP060	HSP092
Mar 89	556	257	413	473	ND
May 92	334	234	294	274	ND
Jul 92	237	97	155	173	33

F Area	Conductivity ($\mu\text{mhos/cm}$)				
	FSP012	FSP032	FSP047	FSP204	FSP290
Mar 89	30	174	52	895	49
May 92	58	138	125	311	28
Jul 92	106	95	88	277	46

Table A-5. Summary of pH Measurements

H Area	pH				
	HSP008	HSP029	HSP043	HSP060	HSP092
Mar 89	5.7	5.2	5.3	5.9	ND
May 92	5.6	6.1	6.2	5.6	ND
Jul 92	6.32	4.8	5.73	6.07	5.68

F Area	pH				
	FSP012	FSP032	FSP047	FSP204	FSP290
Mar 89	5.3	5	4.7	4.4	3.6
May 92	5.4	4.3	4.6	.4	4.8
Jul 92	5.14	4.1	5.38	5.35	4.83

Figures A-1 and A-2 illustrate the conductivity measurements collected from H Area and F Area, respectively. A general trend of decreasing conductivity is evident in H Area. This decreasing trend is not seen in F Area. The conductivity measurements at sample locations FSP032 and FSP204 in F Area show a decreasing trend in conductivity. The measurements at sample location FSP012 show an increasing trend. The measurements at sample locations FSP047 and FSP290 show no decreasing or increasing trend. The average background conductivity of the seepage water collected during this sampling event was

29.5 $\mu\text{mhos/cm}$. Ninety-six percent of the data presented in Table A-4 exceeds this background conductivity value.

Figures A-3 and A-4 illustrate the pH measurements collected from H Area and F Area, respectively. No specific trend is evident in either of these figures. The average background pH of the seepage water collected during this sampling event was 4.91. Sixty-five percent of the data presented in Table A-5 has a pH measurement which is greater than 4.91.

Figure A-1. Conductivity Measurements in H Area

Figure A-2. Conductivity Measurements in F Area

Figure A-3. pH Measurements in H Area

Figure A-4. pH Measurements in F Area

The background stream measurement for pH (5.80) and conductivity (20 μ mhos/cm) was exceeded in all of the downgradient stream samples.

There is no historical data available on redox potential; thus, we cannot assess any possible trends at this time. However, the average background redox potential of the seep line water collected during this sampling event was 200 mV. Twenty percent of the data presented in Table A-3 has a redox potential measurement that is greater than 200 mV. The redox potential of the background stream water

was -13 mV. The redox potential of the down stream sites were significantly higher than -13 mV.

Metcalf and Eddy conducted a surveillance of the sampling procedures to verify that sampling was being conducted in accordance with the approved task-specific Quality Assurance Project Plan. The results of this surveillance is provided in Appendix B of WSRC-TR-92-559.

Conclusions

The average pH and conductivity values measured during this field event for F Area seepage samples, H Area seepage samples, and the stream samples are higher than the average pH and conductivity of the background seepage and stream water samples. The average redox potential of both F Area and H Area seepage samples is less than the average redox potential of the background seepage sample. However, the redox potential of the background stream water was lower than the average redox potential of the downgradient stream samples.

Historical trends indicate decreasing conductivity measurements in H Area seepage samples. No trends are evident in the conductivity measurements for the F Area seepage.

Historical pH measurements in both F Area and H Area seepage samples show no general trends. There is no historical information available regarding the redox potential of the seepage or stream water samples.

References

- Haselow, J. S., M. Harris, B. B. Looney, N. V. Halverson, and J. B. Gladden. 1990. Analysis of soil and water at the Fourmile Branch seepage near the F and H Area of the SRS (U). WSRC-RP-90-0591, Savannah River Laboratory, Aiken, South Carolina.
- Dixon, K. L. and V. A. Rogers. Results of the first quarter tritium survey of the F- and H-Area seepines: May 1992 (U). WSRC-TR-92-304, Savannah River Technology Center, Aiken, South Carolina.

Appendix B

*Plots of Analyte Concentrations
as a Function of Seep Line Areas*

Introduction

The following plots are of analyte concentrations as a function of seepage area for those analytes on which statistical analysis was performed. The plots were prepared using the untransformed concentration data and should provide the reader a view of the variability associated with each analyte. The dashed line observed in each plot represents the mean of all data points (BG, FSP, HSP combined) for that analyte.

Figure B-1. Aluminum (µg/L)

Figure B-2. Alkalinity (mg/L)

Figure B-3. Barium (µg/L)

Figure B-4. Nonvolatile beta (pCi/L)

Figure B-5. Calcium ($\mu\text{g/L}$)

Figure B-6. Chloride (mg/L)

Figure B-7. Gross alpha (pCi/L)

Figure B-8. Hardness (mg/L)

Figure B-9. Mercury (µg/L)

Figure B-10. Potassium (µg/L)

Figure B-11. Lead (µg/L)

Figure B-12. Magnesium (µg/L)

Figure B-13. Manganese ($\mu\text{g/L}$)

Figure B-14. Nitrate (mg/L)

Figure B-15. Radium-226 (pCi/L)

Figure B-16. Radium-228 (pCi/L)

Figure B-17. Sodium (µg/L)

Figure B-18. Strontium-90 (pCi/L)

Figure B-19. Total organic carbon (mg/L)

Figure B-20. Total organic halogens (µg/L)

Figure B-21. Tritium (pCi/ml)

Figure B-22. Zinc ($\mu\text{g/L}$)