Results of the Quarterly Tritium Survey of Fourmile Branch and its Seepelines in the F- and H-Areas of SRS: June 1994

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V. A. Rogers, K. L. Dixon, and B. B. Looney

Abstract

The Environmental Sciences Section (ESS) of the Savannah River Technology Center (SRTC) established a quarterly monitoring program of the Fourmile Branch (FMB) stream and its associated seepine down gradient from the F- and H-Area seepage basins. The program surveys and tracks changes in tritium, specific conductivity, and pH primarily for seepine water, but a few stream locations have been added. Measurements from the ninth quarterly survey (June 1994) showed similar tritium, conductivity, measurements, and pH values comparing measurements from previous studies. Increased tritium concentrations, compared to the previous survey, are attributed to lower rainfall and seasonal drop in the water table since the March 1994 sampling event. However, overall results of the tritium survey and stream monitoring data (Looney, et al. 1993) suggest that the tritium plume that resulted from operation of the seepage basins is flushing from the FMB system.

Executive Summary

In June 1994, the Environmental Sciences Section (ESS) surveyed the Fourmile Branch (FMB) seepine down gradient from the F- and H-Area seepage basins for tritium, specific conductivity, and pH. The survey was the ninth of ten quarterly surveys scheduled to monitor the movement of contaminants from the basins since closure in 1990. Surface-water samples were collected from 60 locations along the seepine and from three stream locations along FMB. The seepine locations included 22 from F Area, 22 from H Area, and 16 from the seepine south of 643-E, which is a decommissioned area in the Solid Waste Disposal Facility. The Savannah River Laboratory (now Savannah River Technology Center) sampled 44 locations in 1989 as part of an extensive characterization study (Haselow et al. 1990). ESS found that tritium activities in F- and H-Area seepines in June 1994 were significantly lower than the activities measured by Haselow et al. (1990). One location showed an increase in tritium activity above the March 1989 results.

Theoretically, lower discharge shifts the plume upward and the arrival point away from FMB and toward the seepage basins. Therefore, the more concentrated portion of the plume moved within the sampling zone at the seepine intercept. This should increase tritium concentrations at the seepine intercepts at both F- and H-Area seepines.

Previous sampling events have consistently shown a declining trend in tritium activity at the F- and H-Area seepine. Total tritium fluxes to the wetlands and FMB have steadily declined since basin closure (Looney et al. 1993) and overall results from the tritium survey support this finding. Differences in tritium activities measured at individual seepine sampling locations from one sampling event to the next represent seasonal variability in depth to water table, variable amounts of rainfall, as well as changes due to the flushing of the plume from the wetland system. Conclusions about tritium fluxes to the wetlands and FMB should consider the long-term surface water, seepine, and groundwater monitoring data and not rely on quarterly changes in concentrations at seepine monitoring stations alone.

June 1994 conductivity measurements exhibited the same general trends as tritium activities in F and H Areas. Concentrations of hydrogen ions increased in both areas, indicating that conditions are changing from extremely acid (pH <4.5) and strongly to slightly acid (pH 5.1–6.5), which is closer to normal for this type of wetland. Aluminum concentrations measured along the seepine in 1989 (Haselow et al. 1990) were high enough to be potentially toxic to plants. Each increase in pH reduces the solubility of aluminum, thereby, decreasing the potential

detect gamma radiation; therefore, ESS selected rubber boots and disposable rubber gloves as protective clothing to prevent dermal contact with seepage water during sampling operations.

Seepage sampling locations had been previously marked and labeled with PVC stakes. Samples were collected within a three-foot radius of the PVC stake by boring a hole into the soil with a small bucket soil auger, generally six inches and not more than eighteen inches deep to obtain a sample. To collect water for tritium analysis, polyethylene sample containers (25 mL) were dipped into the water until full and then capped. The outside of each container was rinsed with deionized water and sealed in a small polyethylene bag to minimize the possibility of contamination. The small bags were sealed in a large polyethylene bag. The Environmental Monitoring Section (EMS) performed tritium analysis (total activity). EMS counted 5 mL aliquots for 20 minutes, which yielded a lower detection limit of 1.3 pCi/mL (WSRC-3Q1-4 1992).

ESS measured specific conductivity and pH *in situ* with conductivity and pH electrodes (WSRC-L14.1 1992a and 1992b). The electrodes were rinsed with deionized water after each sampling. All sampling equipment was thoroughly rinsed with deionized water at the end of each day.

Results and Observations

Concentrations of variables measured at seepage sampling locations fluctuate throughout the year. Climatic and seasonal conditions, especially rainfall amounts, influence measured concentrations. Seepage measurements are made on water collected from fixed locations at the distal end, or toe slope outcrop, of the contaminant plume. Because the plume is dynamic (i.e., influenced by weather and other activities in the area) seepage monitoring is sensitive to long-term changes and seasonal/transient influences. Groundwater flow paths in F and H Area are complex, as illustrated in Figures 3 and 4. Recharge to the groundwater is primarily due to infiltration of rainwater (rainfall minus runoff and evapotranspiration). Groundwater then moves laterally to FMB and its tributaries.

As the water travels toward the stream, additional infiltration forces upgradient water deeper. Near the stream, the flow lines rise to the surface, emerging between the seepage and the stream (which acts as the groundwater "drain"). This classic vertical trajectory, a path curving downward near the groundwater divide and then upward into draining surface water, is shown as flow lines on Figures 3 and 4.

Figure 3 shows the flow lines without contaminated water from the seepage basins and Figure 4 shows the addition of contaminated flow lines resulting from operations of the basins. The theoretical plume geometry is clearly confirmed by the real vertical profile of the F-Area Seepage Basin plume based on the detailed grid wells available in the 1970s (Looney et al. 1993). Changes in the water balance in the area influence the flow velocity and tend to move the plume either deeper or shallower and cause the location of the contaminated water to move. This is especially important to data interpretation if the "toe" of the plume is shifting relative to the fixed sample locations. Figure 5 summarizes the projected changes in the plume based on a range of transient activities. Increased rainfall (or other activities that increase infiltration such as harvesting trees) result in increased plume velocity and movement downward and away from the seepage. This decreases contaminant concentrations at the seepage sampling locations. Less infiltration decreases plume velocity and the plume moves upward and closer to the seepage. This results in increased contaminant concentrations as measured at the seepage sampling locations.

Low rainfall for a few months prior to sampling increases constituent concentrations, and high rainfall decreases constituent concentrations in the shallow groundwater at the seepage intercept. Rainfall measured at SRS at the weather station in F Area in April and May 1994 was 5.6 cm. From 1960 to 1991, the average rainfall measured in F Area for the months of April and May was 19.3 cm. This indicates that average rainfall in the area was much below normal for this sample period. Figure 6 shows a comparison of 1993–1994 rainfall to the long-term average (1960–1991) from January through May 1994, indicating that rainfall was substantially lower than the long-term average. It is hypothesized that below average rainfall observed in the area for this period would cause contaminant concentrations to decrease at sample locations closer to the basins and to increase at the more distant locations. This increase in infiltration causes the toe of the plume to migrate downward through the soil profile and the arrival point to move away from the basins and towards FMB. In general, this pattern was observed in the June 1994 sampling event. One sample location was above the March 1989 reading, with this sample location showing a tritium activity increase of 1130 pCi/mL; it was the most distant sample location from the closed basins.

Figures 7 through 12 show comparisons of March 1989 with March and June 1994 tritium, conductivity, and pH measurements for locations in F- and H-Area seepage. Data for the first eight surveys can be found in Dixon and Rogers (1992, 1993a, 1993b, 1993c, 1993d and 1993e,

for aluminum toxicity to plants. Concentrations of aluminum, as well as other metals, measured along the seepage line in July 1992 were substantially lower than 1989 concentrations reflecting the increase in pH (Dixon and Rogers 1993e). Field observations revealed that vegetation in all areas except the wetland below location FSP014 shows noticeable recovery.

The seepage line south of 643-E, along a tributary of FMB is influenced by tritium migrating from the burial grounds. The tributary (old F-Area effluent ditch) is a natural drainage that received effluent discharge from F-Area Separations prior to construction of the engineered effluent canal. June 1994 tritium activities ranged from 27 to 769 pCi/mL on the east side of the drainage and from 632 to 30,300 pCi/mL on the west side. The tritium activity measured in the stream of the natural drainage was 21,700 pCi/mL. Results suggest that the tritium outcrop area has been delineated by the sampling locations established on the west side of the drainage channel. While the tritium activity shifts slightly among sample locations there is no indication that there has been a reduction in overall tritium activity. Conductivity and pH measurements taken on both sides of the drainage were similar to those recorded in March 1994 and were within the range of normal values for this type wetland. The low conductivity values measured along the drainage-way suggest that the tritium plume outcropping in the area emanates from 643-E because waste introduced into 643-E contained low levels of salt ions compared to the waste in the F- and H-Area basins.

Introduction

Seepage basins in the F and H Areas of SRS received low-level radioactive waste effluent from the chemical separation processes in the general separation areas. The basins retained the effluent to slowly release it into the soil. The waste effluent consisted principally of sodium hydroxide, nitric acid, low levels of various radionuclides, and some metals (Killian et al. 1985a and 1985b). Discharges of tritiated water to the seepage basins accounted for most of the radioactivity (Fenimore and Horton 1972).

SRTC conducted an extensive study designed to characterize the shallow groundwater outcropping into FMB and its associated seepage line in 1988 and 1989 (Haselow et al. 1990). As a part of this study, Haselow et al. (1990) surveyed for tritium, pH, and conductivity. Researchers found low pH and elevated conductivity and tritium values along the seepages and concluded that contaminants leaching from the F- and H-Area seepage basins were impacting the wetlands below the basins. SRS stopped discharges to the seepage basins in 1988 and capped and sealed the basins

in 1990 to eliminate the source of contaminants. Scientists hypothesized that after eliminating the contaminant source, annual rainfall and natural groundwater flow would flush the remaining contaminant plume out of the shallow groundwater over time. After the contaminant plume in the shallow groundwater is flushed out, the impacted wetland systems immediately down gradient from the basins should recover.

To investigate this hypothesis, a quarterly sampling program was established in May 1992. ESS sampled 44 of the seepage line locations sampled by Haselow et al. (1990) for tritium, pH, and specific conductivity. The Haselow et al. (1990) results established the baseline to which the results from the quarterly sampling program are compared. These collection points were chosen as the baseline because they are the only data available that were collected before the basin discharges were discontinued. The Haselow et al. (1990) data should be representative of conditions immediately prior to closing the basins. This sampling program is intended to complement semiannual sampling of the seepage line for selected Resource Conservation Recovery Act, Appendix IX, characterization, which began in July 1992. A report summarizing results from the semiannual sampling program is complete (Dixon and Rogers 1993e).

There was expressed concern about the source of tritium and other contaminants that possibly emanate from an area in the southwest corner of 643-E rather than from the closed basins. To investigate this possibility, numerous sampling locations on the H-Area seepage line south of 643-E were established and are incorporated into the quarterly sampling plan.

Methods

ESS conducted the ninth sampling for the quarterly tritium survey in June 1994. Sampling locations were the same as those selected in the eighth round of sampling. This selection, according to 1989 data, exhibited high and low values for the three variables of concern. Attempts were made to establish even ground coverage along both seepages. ESS collected 60 samples from the seepages in F and H Area: 22 from the F-Area seepage, 22 from the H-Area seepage, and 16 from the FHB seepage south of 643-E Area. ESS also collected three stream samples from locations on FMB. Figures 1 and 2 approximate sampling locations.

Prior to sampling for the first quarter in May 1992, the Health Protection Department (HPD) collected soil samples from several locations along both seepages and monitored them for gamma radioactivity. HPD did not

and 1994), and Rogers et al. (1994a and 1994b). Figures 13 through 15 show the data for the FMB stream locations. Figures 16 through 18 show the data for the sampling locations along the seepline and one stream sample south of 643-E in H Area. These sampling locations were identified with the prefix FHB.

F- and H-Area Seepline Tritium Measurements

F Area

June 1994 tritium values in the F-Area seepline ranged from 11 to 9820 pCi/mL (Figure 6 and Table 2). In F Area, water was attained from six to approximately 18 inches below the soil surface. One of the 22 sampling locations was dry and one site had above background tritium activity that exceeded the 1989 measurements by more than 10%. The tritium activity of 9820 pCi/mL measured at FSP035 is less than the 11,000 pCi/mL recorded at this location in March 1989. In 1989, maximum tritium activity (14,000 pCi/mL) was measured at FSP014 and FSP034 sample locations.

As with data from previous quarters, a Wilcoxon signed-rank test was conducted to compare June 1994 tritium activities to March 1989 activities. The Wilcoxon signed-rank test uses the sign and the magnitude of the rank of the differences between pairs of measurements to compare nonparametric data (Daniel 1978). This test was chosen because it allows comparisons of paired data without assumptions of normality. The results showed that the June 1994 concentrations were significantly less ($P = 0.0006$) than the 1989 concentrations.

H Area

Tritium values in the H-Area seepline ranged from 58 to 11,800 pCi/mL (Figure 8 and Table 3). Three of the 22 sampling locations were dry and four had above-background tritium activities that exceeded the 1989 measurements by more than 10%. No tritium activity exceeded the maximum value of 24,000 pCi/mL measured in March 1989 and all of the locations showing an increase had relatively low activity (values of 544 to 2210 pCi/mL); three of the locations were influenced by the floodplain condition rather than only seepage from the uplands, therefore, inducing greater variability.

As with data from F Area, a Wilcoxon signed-rank test was conducted to compare June 1994 tritium activities to March 1989 activities. The results showed that the

June 1994 concentrations were significantly less ($P = 0.0008$) than the 1989 concentrations for H Area. No sample location showed an increase in tritium activity compared to March 1989 sample events.

Figures 7 and 8 show tritium activity at F and H Area for the June 1994 sampling event, to increase at 22 sample locations; 18 locations either decreased or were relatively unchanged compared to the March sampling event. There were four dry sites. These results were predicted because of a lower seasonal water table and reduced rainfall. Overall sampling events have shown a declining trend in tritium concentrations at the F-and H-Area seeplines.

When rainfall returns to normal amounts, the plume should move deeper in the soil profile and again outcrop closer to FMB. This trend is noted in the June 1994 data. It is important to note that total tritium fluxes to the wetlands and FMB have steadily declined since basin closure (Looney et al. 1993) and that overall results of the tritium survey support this finding. Differences in tritium concentrations measured at seepline sampling locations from one sampling event to the next represent seasonal variability and variable rainfall as well as changes due to the flushing of the plume from the wetland system. Conclusions about tritium fluxes to the wetlands and FMB should consider the complexity of the groundwater system and should be based on long-term surface water, seepline, and groundwater monitoring data and not on quarterly changes in concentrations at seepline monitoring stations.

F- and H-Area Seepline Conductivity Measurements

F Area

Conductivity measurements in the F-Area seepline ranged from 27 to 1366 $\mu\text{S}/\text{cm}$ (Figure 9 and Table 2). Due to the variability of conductivity measurements, only differences of 100 $\mu\text{S}/\text{cm}$ or more are considered significant. Of the 22 locations sampled at the F-Area seepline, one location measured more than 100 $\mu\text{S}/\text{cm}$ above the 1989 measurements. A comparison of Figures 7 and 9 suggests that conductivity follows the same general trends as the tritium activities. Using a Spearman rank correlation test for non-parametric data, it was found that the probability that tritium and conductivity exhibited independent trends was $P < 0.0001$. The rank correlation coefficient was found to be $r_s = 0.94$, suggesting that the two parameters are exhibiting the same trends. This similarity is to be expected because tritium serves to track the movement of the contaminant plume from the basins (Haselow et al. 1990).

H Area

Conductivity measurements in the H-Area seepine ranged from 40 to 488 $\mu\text{S}/\text{cm}$ (Figure 10 and Table 3). None of the 22 sampling locations, had a measurement of more than 100 $\mu\text{S}/\text{cm}$ above the 1989 measurements. Data in Figures 8 and 10 suggest that conductivity and tritium are following the same general trends. The Spearman rank correlation test for nonparametric data was used to investigate the correlation of H Area tritium activities and conductivity values. The probability that the two parameters exhibited independent trends was $P < 0.0001$. The rank correlation coefficient ($r_s = 0.82$) for H Area was lower than that for F Area, but still suggested a good correlation.

F- and H-Area Seepine pH Measurements

F-Area pH values ranged from 3.7 to 6.4 with an average value of 5.0 (Figure 11 and Table 2). H-Area pH values ranged from 4.9 to 6.5 with an average of 5.8 (Figure 12 and Table 3). The pH for the entire seepine (F and H Areas combined) averaged 5.4. The average increased 0.5 units over the 4.9 average in 1989 (Haselow et al. 1990). The hydrogen ion concentration decreased by about threefold compared to 1989 measurements. The increase in pH will affect the solubility of metals in the soil, which should improve the soil water chemistry and enhance the recovery of wetland vegetation stressed indirectly by low pH. Aluminum concentrations measured along the seepine in 1989 (Haselow et al. 1990) were high enough to be toxic to plants. Increases in pH from an average of 4.9 in 1989 to 5.4 reduced the amount of aluminum in solution, thereby reducing it as a possible source of plant toxicity. Concentrations of aluminum and other metals measured along the seepine in July 1992 were substantially lower than 1989 concentrations, reflecting the increase in pH (Dixon and Rogers 1993e). Field observations revealed that vegetation in all the stressed areas, except the wetland south of sample location FSP014, is making noticeable recovery.

Fourmile Branch Measurements

Figures 13 through 15 show the tritium, conductivity, and pH values for the FMB stream sampling locations. Table 4 provides the data used in the figures. Tritium activities at these locations ranged from 42 to 331 pCi/mL. These values were consistent with previous data and show increases in tritium down stream as the seepine water enters the channel of FMB conductivity measurements ranged from 53 to 76 $\mu\text{S}/\text{cm}$ and pH ranged from 5.9 to 6.3. Conductivity and pH values were at near normal levels.

Solid Waste Disposal Facility (643-E) Seepine Measurements

Figures 16 through 18 show tritium, conductivity, and pH values for the seepine and stream sampling locations south of 643-E, which is part of the Solid Waste Disposal Facility. Table 5 provides the data used in the figures. This seepine is along the natural drainage (old F-Area effluent ditch) used to discharge effluent from F-Area separations prior to construction of the engineered effluent canal.

Tritium activities for the locations on the east side of the drainage ranged from 27 to 769 pCi/mL. Activities on the west side of the drainage ranged from 632 to 30,300 pCi/mL. The tritium activity at the stream location in the drainage (FHB012) was 21,700 pCi/mL.

Conductivity measurements on both sides of the drainage were near background at most locations and ranged from 32 to 113 $\mu\text{S}/\text{cm}$. Conductivity values are typical of the conductivity values being reported in the water table wells in the vicinity of the old F-Area effluent ditch (EMS 1993). Using the Spearman rank correlation test, no correlation ($r_s = -0.08$) was found between conductivity and tritium for these locations. Reaction values ranged from pH 4.4 to pH 6.1 with an average of pH 5.2.

These results are consistent with the Haselow et al. (1990) results for the western portion of the H-Area seepine, particularly near location HSP103. Haselow et al. (1990) found that down gradient from 643-E, conductivity values were near background while tritium concentrations were elevated. This was attributed to tritiated wastes deposited in 643-E. Tritium activities measured along the seepine down gradient of 643-E (particularly sample points on the west side) suggest that tritium migrating from 643-E and outcropping in this area is substantial. The appearance of tritium on the west side, as opposed to the east side of the drainage, suggests that soil material placed in the northern reaches of the natural drainage forced the tritium plume to outcrop down gradient. It appears that the groundwater and tritium are moving below the fill material and outcropping on the west side of the drainage channel. The results suggest that the sampling locations on the west side of the drainage have delineated the tritium plume with the center at or near FHB018.

Conclusions

Tritium concentrations measured at most locations during June 1994 remained relatively unchanged, compared to previous sampling events. These results vary slightly from

previous sampling events and are attributed to seasonal water table change along with the dynamic nature of the tritium plume movement. Below-normal rainfall for the past nine months caused the toe of the tritium plume to migrate toward the seepage intercept and away from FMB. Total tritium fluxes to the wetlands and FMB have steadily declined since basin closure (Looney et al. 1993) and overall results from the tritium survey support this finding. These findings support the hypothesis that the tritium plume in F and H Area is being flushed from the shallow groundwater. Differences in tritium concentrations measured at seepage sampling locations from one sampling event to the next represent seasonal and rainfall variability as well as changes due to flushing of the contaminant plume from the wetland system. No correction has been made for tritium decay because of the short time between sample events. Conclusions about tritium fluxes to the wetlands and FMB should consider the complexity of the groundwater system and should be based on long-term surface water, seepage, and groundwater monitoring data, not on quarterly changes in concentrations at seepage monitoring locations.

Evaluation of data from 16 seepage locations south of the 643-E Area indicates that tritium migrating from 643-E is outcropping at the F-Area effluent drain, particularly on the west side of the stream channel. It appears that sampling locations on the west side of the channel have delineated the tritium outcrop area with the present climatic and hydrologic conditions. Data does not indicate that the tritium plume has decreased over the past six sampling events.

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Results of the Quarterly Tritium Survey of Fourmile Branch and Its
Seep Lines in the F and H Areas of SRS: June 1994

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Figure 1. Location of F-Area Seepage Basins Relative to Seepage Line and Stream Sample Sites.

Figure 2. Location of H-Area Seepage Basins Relative to Seepage Line and Stream Sample Sites.

Figure 3. Schematic Diagram of Flow Lines in the Shallow Groundwater at the F- and H-Area without Seepage Basins

Figure 4. Schematic Diagram of Flow Lines in the Shallow Groundwater at the F- and H-Area Seepage Line during Basin Operation

Figure 5. Schematic Diagram of the Tritium Plume Migrating from F- and H-Area Seepage Basins.

Figure 6. Comparison of 1994 Rainfall Totals (January–May) to the Long-Term Average (1960–1991) for the F-Area Weather Station

Results of the Quarterly Tritium Survey of Fourmile Branch and Its
Sewerlines in the F and H Areas of SRS: June 1994

Figure 7. Comparison of Tritium Concentrations for Selected F-Area Seepline Locations

Figure 8. Comparison of Tritium Measurements for Selected H-Area Seepline Locations

Figure 9. Comparison of Conductivity Measurements for Selected F-Area Seepage Locations

Figure 10. Comparison of Conductivity Measurements for Selected H-Area Seepage Locations

Results of the Quarterly Tritium Survey of Fourmile Branch and Its
Sewerlines in the F and H Areas of SRS: June 1994

Figure 11. Comparison of pH Measurements for Selected F-Area Sewerline Locations

Figure 12. Comparison of pH Measurements for Selected H-Area Sewerline Locations

Figure 13. Comparison of Tritium Concentrations for Selected Fourmile Branch Locations

Figure 14. Comparison of Conductivity Measurements for Selected Fourmile Branch Locations

Results of the Quarterly Tritium Survey of Fourmile Branch and Its
Sewerlines in the F and H Areas of SRS: June 1994

Figure 15. Comparison of pH Measurements for Selected Fourmile Branch Locations

Figure 16. Comparison of Tritium Concentrations for Selected Locations on the Seepline South of 643-E (log scale)

Figure 17. Comparison of Conductivity Measurements for Locations on the Seepline South of 643-E

Figure 18. Comparison of pH Measurements for Selected Locations on the Seepline South of 643-E

Results of the Quarterly Tritium Survey of Fourmile Branch and Its
Seeplines in the F and H Areas of SRS: June 1994

Table 1. Comparison of 1993 and 1994 Monthly Rainfall to the Long-Term Average Rainfall (1960–1991) from the F-Area Weather Station

Month	Rainfall (cm)	Long-Term Rainfall (cm)
June 1993	15.3	10.9
July 1993	7.3	12.9
August 1993	8.8	14.3
September 1993	16.7	9.5
October 1993	1.6	5.7
November 1993	5.8	6.6
December 1993	4.5	9.5
January 1994	12.2	11.8
February 1994	8.9	10.8
March 1994	17.0	13.3
April 1994	2.5	8.6
May 1994	3.1	10.7

Table 2. Comparison of F-Area Seepage Measurements of Tritium, Conductivity, and pH for March 1989 and March and June 1994

Location	Tritium (pCi/mL)			Conductivity (μ S/cm)			pH(-log H)		
	March 1989	March 1994	June 1994	March 1989	March 1994	June 1994	March 1989	March 1994	June 1994
2	520	128	408	94	87	208	5.6	5.9	6.2
7	3400	946	844	681	233	330	5.4	6.4	6.3
12	260	28	135	30	70	49	5.3	5.9	5.9
14	14000	16	24	666	27	33	4.2	5.0	4.7
19	4900	4730	3970	1424	1143	1093	4.2	4.1	3.7
26	4400	6150	2990	1095	2264	593	6.5	4.6	6.4
32	3600	23	18	174	63	35	5.0	4.9	5.5
34	14000	1110	3150	810	346	594	3.8	4.0	3.9
35	11000	7730	9820	1100	1085	1491	3.9	4.0	3.7
40	7800	6790	6680	900	1259	1366	5.2	3.9	4.0
47	100	14	20	52	83	64	4.7	5.3	5.6
56	19	11	11	34	51	47	4.5	5.3	5.2
204	3000	2100	2200	895	428	490	4.4	4.2	4.3
213	2800	848	1220	860	164	300	4.6	4.6	4.1
220	560	742	690	147	232	74	4.8	4.6	4.9
226	1300	823	1260	306	255	242	5.1	5.6	5.3
235	580	491	dry	84	92	dry	5.7	5.7	dry
241	560	286	445	36	78	90	4.7	5.3	4.9
249	580	147	169	84	70	97	4.4	5.4	4.9
256	400	363	606	56	77	141	5.1	5.8	5.8
270	40	37	63	50	29	35	4.1	4.6	4.8
290	35	26	22	49	31	27	3.6	5.1	5.0

Results of the Quarterly Tritium Survey of Fourmile Branch and Its
Seeplines in the F and H Areas of SRS: June 1994

Table 3. Comparison of H-Area Seepline Measurements for Tritium, Conductivity, and pH for March 1989 and March and June 1994

Location	Tritium (pCi/mL)			Conductivity (μ S/cm)			pH(-log H)		
	March 1989	March 1994	June 1994	March 1989	March 1994	June 1994	March 1989	March 1994	June 1994
3	14000	1140	2380	468	148	179	5.2	6.0	6.0
4	11000	2650	2890	292	321	296	5.8	6.5	6.1
8	24000	4050	3830	556	205	244	5.7	5.6	6.5
11	960	237	107	80	60	61	5.1	5.6	5.4
13	12000	2260	dry	592	238	dry	6.2	6.1	dry
15	1000	772	1370	82	99	156	5.2	5.3	5.7
20	6500	423	1040	183	78	124	6.2	5.7	6.0
25	3300	963	2410	135	64	125	4.7	5.7	5.7
29	9200	284	262	257	86	86	5.2	5.6	5.52
34	5600	164	773	331	104	145	5.8	5.6	5.8
38	6500	303	298	227	74	106	4.9	5.9	5.7
43	10000	3530	3920	413	209	259	5.3	6.3	6.2
46	11000	4460	1470	318	204	150	5.5	5.9	6.2
49	11000	3680	dry	551	226	dry	4.4	5.5	dry
52	20000	8650	11800	699	344	488	4.1	5.4	5.6
57	15000	1070	1720	581	129	169	5.5	5.3	5.5
60	21000	2660	dry	473	169	dry	5.9	5.5	dry
64	320	42	58	38	35	40	4.7	4.6	4.9
71	450	106	282	40	35	40	5.1	5.0	5.5
76	400	349	544	146	120	96	5.7	5.5	6.5
97	1100	1270	2210	37	74	89	4.3	5.2	5.7
103	510	930	1640	43	47	61	4.4	4.5	5.3

Table 4. Comparison of Fourmile Branch Stream Measurements for Tritium, Conductivity, and pH for December 1993 and March and June 1994

Location	Tritium (pCi/mL)			Conductivity (μ S/cm)			pH(-log H)		
	December 1993	March 1994	June 1994	December 1993	March 1994	June 1994	December 1993	March 1994	June 1994
1F	567	375	331	74	62	76	6.5	6.5	5.9
1H	37	34	42	91	67	53	6.1	6.4	6.2
2H	145	91	82	77	58	61	6.4	6.2	6.3

Table 5. Comparison of Seepage below the 643-E Measurements for Tritium, Conductivity, and pH for the December 1993 and March and June 1994 Sampling Events

Location	Tritium (pCi/mL)			Conductivity (μ S/cm)			pH(-log H)		
	March 1993	March 1994	June 1994	March 1993	March 1994	June 1994	March 1993	March 1994	June 1994
1	387	143	427	60	58	36	5.8	5.4	5.1
2	37	19	27	40	46	79	5.2	5.2	5.6
3	682	293	dry	52	47	dry	5.7	5.4	dry
4	175	386	471	51	38	40	4.8	4.9	5.2
5	263	551	769	29	38	49	5.4	4.7	5.3
6	217	748	124	45	41	71	5.5	4.4	6.6
8	134	172	386	29	34	32	5.2	5.0	5.0
*12	12000	16100	21700	37	40	33	5.4	5.1	4.9
13	2860	10200	12500	47	27	55	5.1	5.0	5.2
14	1150	812	1010	77	35	38	5.3	4.8	4.8
15	29	95	dry	185	128	dry	6.1	5.8	dry
16	306	198	632	88	43	113	6.2	5.3	5.6
17	14100	14440	29100	60	83	49	5.5	5.6	5.3
18	44000	24500	30300	110	49	99	5.6	6.1	5.7
19	546	4190	13800	52	77	53	4.4	4.5	4.6
20	38	27	67	35	51	66	5.0	5.7	5.8

*Stream sample location