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Results of the Quarterly Tritium Survey of Four Mile Creek and its Seeplines in the F- and H-Areas of SRS: June 1993^(U)

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Results of the Quarterly Tritium Survey of Four Mile Creek and its Seep Lines in the F- and H-Areas of SRS: June 1993^(U)

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Abstract

The Environmental Sciences Section (ESS) established a quarterly monitoring program of the Four Mile Creek seepine down gradient from the F- and H-Area seepage basins. The program surveys and tracks changes in tritium, specific conductivity, and pH for the seepine water. Measurements from the fifth quarterly survey (June 1993) showed lower tritium and conductivity measurements and higher pH values (pH 5 - 6) than measurements from previous studies. The results of the quarterly surveys suggest that infiltration of rainfall may be diluting and flushing the contaminants from the ground-water system. More measurements are needed to confirm these trends.

Executive Summary

In June 1993, the Environmental Sciences Section (ESS) surveyed the Four Mile Creek seepine down gradient from the F- and H-Area seepage basins for tritium, specific conductivity, and pH. The survey was the fifth of eight quarterly surveys for monitoring the movement of contaminants from the basins since closure. Surface-water samples were collected from 60 locations along the seepine; Haselow et al. (1990) sampled 44 of the locations, 16 were on the seepine south of 643-E, which is a decommissioned area in the Solid Waste Disposal Facility. Samples were collected from three locations along Four Mile Creek.

Results indicate that rainfall may be diluting the contaminant plume that leached from the seepage basins and flushing the contaminant plume out of the shallow groundwater in the wetland systems below the basins. ESS found tritium activities in the F- and H-Area seepines significantly lower than the activities measured by Haselow et al. (1990). Conductivity measurements exhibited the same trends as tritium activities in both areas, indicating that salt ions are also being removed from the wetland system. Concentrations of hydrogen ions also decreased in both areas, which indicates that conditions are changing from very strongly acidic to slightly acidic (pH 5 - 6), which is normal for these wetlands.

The seepine south of 643-E, along a tributary of Four Mile Creek, is influenced by tritium from the burial grounds. The tributary is a natural drainage that was used

to discharge effluent from F-Area separations prior to the construction of the engineered effluent canal. Tritium activities ranged from 30 to 639 pCi/ml on the east side of the drainage and from 91 to 57,500 pCi/ml on the west side. The tritium concentration measured in the stream of the natural drainage was 15,300 pCi/ml. Results suggest that the tritium outcrop area has been encapsulated by the sampling locations established on the west side of the drainage. Conductivity and pH measurements taken on both sides of the drainage were similar and were within the range of normal values for the area. The low conductivity values measured along the drainage way suggest that the tritium plume outcropping in the area emanates from 643-E since wastes introduced into 643-E contained low levels of salt ions compared to the waste in the F- and H-Area basins.

The results suggest that contaminant concentrations are decreasing at the F- and H-Area seepines and are consistent with results from previous quarters (Dixon and Rogers, 1992; Dixon and Rogers 1993a, b, and c). Areas of stressed vegetation are showing signs of recovery as contaminant concentrations decrease and pH increases. Aluminum concentrations measured along the seepine in 1989 (Haselow et al., 1990) were high enough to be potentially toxic to plants. Increases in pH (to about neutral) will reduce the solubility of aluminum and thereby reduce this as a possible source of plant toxicity. Concentrations of aluminum, as well as other metals, measured along the seepine in July 1992 were substantially lower than 1989 concentrations reflecting the increase in pH (Dixon and

Rogers, 1993d). Field observations of the stressed areas revealed that vegetation in most is recovering.

Introduction

Seepage basins in the F and H Area of SRS received low-level radioactive-waste effluent from the chemical separation processes in the general separation areas. 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 1985b). Discharges of tritiated water to the seepage basins accounted for most of the radioactivity (Fenimore and Horton, 1972).

The Savannah River Laboratory (now the Savannah River Technology Center) conducted an extensive study aimed at characterizing the shallow groundwater outcropping into Four Mile Creek 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 measured low pH values, elevated conductivity, and tritium values along the seep lines and determined that contaminants leaching from the F- and H-Area seepage basins were impacting the areas.

SRS stopped discharges to the seepage basins in 1988 and capped and sealed the basins in 1990 to reduce the release of the contaminants. Scientists hypothesized that after eliminating the contaminant source, annual rainfall amounts and natural groundwater flow would dilute and flush the remaining contaminant plume out of the shallow groundwater over time. After the contaminant plume in the shallow groundwater is diluted and flushed out, the wetland systems below the basins will recover.

To investigate this hypothesis, a quarterly sampling program was established. ESS sampled 44 of the seepage 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 this study were compared. It was chosen as the baseline since it was the only data available that was collected during the time frame that basin discharges were discontinued. The Haselow et al. (1990) data should be representative of conditions during normal operation. 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 draft report summarizing results from the first sampling event of the semiannual sampling program has been completed (Dixon and Rogers, 1993d).

The Environmental Protection Department expressed concern about possible seepage of tritium and other contaminants from 643-E. To investigate this possibility, several locations on the H-Area seepage line south of 643-E were established and have been incorporated into the quarterly sampling plan.

Methods

ESS conducted the fifth round of sampling in the quarterly tritium survey in June 1993. Sampling locations were selected that, 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 seepage lines. ESS collected 60 samples along the seepage lines in F and H Area: 22 along the F-Area seepage line, 22 along the H-Area seepage line, 16 locations on the FHB seepage line south of 643-E, and three locations on Four Mile Creek. Figures 1 and 2 show the sampling locations.

Prior to sampling for the first quarter, the Health Protection Department (HPD) collected and monitored soil samples from several locations along both seepage lines for gamma radioactivity. HPD did not detect measurable levels of gamma radiation and protective clothing was chosen based on the findings. During sampling operations in the seepage areas, protective clothing consisted of rubber boots and disposable rubber gloves. These measures were intended to prevent dermal contact with seepage water.

Seepage sampling locations were marked and labeled previously with PVC stakes. Water samples were collected within a 3-ft radius of the PVC stake by boring a hole into the soil with a 3.5 in. soil auger until water was reached. Polyethylene sample containers (25 ml) were dipped into the water until full and then capped to collect water for tritium analysis. The outside of each container was then rinsed with deionized water and sealed in a small polyethylene bag to minimize the possibility of contamination. The small bags were then placed in a large polyethylene bag, which was sealed for analysis. The Environmental Monitoring Section (EMS) performed tritium analysis. EMS counted aliquots of 5 ml 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 and all sampling equipment was thoroughly rinsed with water at the end of each day.

Results and Observations

Concentrations of variables measured at seepage sampling locations fluctuate throughout the year. Climate, especially rainfall, influences measured concentrations. Low rainfall for a few months prior to sampling could concentrate constituents and high rainfall amounts could dilute the constituents in the shallow groundwater at the seepage intercept. Rainfall measured at SRS at the weather station in F Area from January through June 1993 was 79.83 cm. From 1960 to 1991, the average rainfall in F-Area from the months of January to May was 66.01 cm. This indicates that for the fifth quarterly tritium survey, average rainfall amounts in F and H Areas were above normal. However, the surplus in rainfall occurred primarily in the first three months of the year. This should be considered when interpreting the survey results.

Figures 3 through 8 show comparisons of 1989, March and April 1993, and June 1993 tritium, conductivity, and pH measurements; data for the first four surveys can be found in Dixon and Rogers (1992, 1993a, 1993b, and 1993c). Figures 9 through 11 show the data for the locations on the seepage south of 643-E in H Area. These sampling locations were assigned the identification prefix FHB. Figures 12 through 14 show the data for the FMC locations.

Tritium Measurements

F Area

Tritium values in the F-Area seepage ranged from 13 to 13200 pCi/ml (see Table 1 and Figure 3). Of the 22 sampling locations in F Area, only one had a tritium activity elevated above background that exceeded the 1989 measurements by more than 10%. No values exceeded the maximum value recorded in 1989 of 14,000 pCi/ml. The graphs in Figure 3 show that the tritium activity at most sampling locations either decreased significantly or remained relatively unchanged. These results are generally consistent with the results from previous sampling events.

To investigate the hypothesis that the June 1993 tritium activities are significantly less than in 1989, ESS conducted a Wilcoxon signed-rank test. 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 1993 concentrations were significantly less ($P=0.02$) than the 1989 concentrations.

Generally, the locations with the greatest decrease in tritium activity are closest to the seepage basins. In contrast, those further away show little change or even an increase in tritium activities. These changes indicate that the bulk of the tritium plume in the wetland system has passed the locations closest to the seepage basins and is exiting the wetland system at the points closest to Four Mile Creek. This supports the general hypothesis that annual rainfall amounts would dilute the remainder of the contaminant plume emanating from the seepage basins. Due to the complex hydrologic system present in the basin areas, it is inappropriate to draw final conclusions at this point in the study about why tritium activities are exhibiting these trends. Final conclusions should not be drawn until after further sampling is completed and seepage data is compared to groundwater data.

H Area

Tritium values in the H-Area seepage ranged from 85 to 16400 pCi/ml (see Table 2 and Figure 4). Of the 22 sampling locations, four had tritium activities elevated above background that exceeded the 1989 measurements by more than 10%. No values exceeded the maximum value in 1989 of 24,000 pCi/ml. Figures 5 and 6 show that most locations either decreased or remained relatively unchanged. These results are generally consistent with the results from previous sampling events.

To investigate the hypothesis that June 1993 tritium activities are significantly less than in 1989, ESS conducted a Wilcoxon signed-rank test. This test was chosen because it allows comparisons of paired data without assumptions of normality (Daniel, 1978). The results showed that the June 1993 concentrations were significantly less ($P=0.005$) than the 1989 concentrations.

ESS found the tritium activities in H-Area sampling locations nearest to the seepage basin exhibited the greatest decrease. The activity at locations further away had a less significant decrease or increase. These changes indicate that the bulk of the tritium plume in the wetland system has passed the locations closest to the seepage basins and is exiting the wetland system at the points closest to the creek. Again, due to the complex hydrologic system present in the basin areas, it is inappropriate to draw final conclusions at this point in the study about why tritium activities are exhibiting these trends. Final conclusions should not be drawn until after further sampling is complete and seepage data is compared to groundwater data.

Conductivity Measurements

F Area

Conductivity measurements in the F-Area seepline ranged from 36 to 1433 $\mu\text{S}/\text{cm}$ (see Table 1 and Figure 5). Due to the extreme variability of conductivity measurements, ESS only considered differences of 100 $\mu\text{S}/\text{cm}$ or more to be significant. Of the 22 sampling locations in the F-Area seepline, only two had measurements of more than 100 $\mu\text{S}/\text{cm}$ above the 1989 measurements. A comparison of the graphs in Figures 3 and 5 suggests that conductivity follows the same general trends as the tritium activities. Using a Spearman rank correlation test for nonparametric data, it was found that the probability that tritium and conductivity exhibited independent trends was $P < 0.001$. The rank correlation coefficient was found to be $r_s = 0.85$, suggesting that the two parameters are exhibiting the same trends. This similarity was expected because tritium traces the movement of the contaminant plume from the basins (Haselow et al., 1990). These results suggest that the salt ions are also exiting the wetland system in F Area.

H Area

Conductivity measurements in the H-Area seepline ranged from 39 to 443 $\mu\text{S}/\text{cm}$ (see Table 2 and Figure 6). Of the 22 sampling locations, only two had measurements of more than 100 $\mu\text{S}/\text{cm}$ above the 1989 measurements. Observation of Figures 4 and 6 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. Again, it was found that the probability that the two parameters exhibited independent trends was $P < 0.001$. The rank correlation coefficient ($r_s = 0.70$) for H Area was slightly lower than in F Area, but still suggested a strong correlation.

pH Measurements

F-Area pH values ranged from 3.8 to 6.7 with an average value of 5.1 (Table 1 and Figure 7). H-Area pH values ranged from 5.0 to 6.7 with an average of 6.0 (Table 2 and Figure 8). The pH for the entire seepline (F and H Areas combined) averaged 5.5. The average increased 0.6 units over the 4.9 average in 1989 (Haselow et al., 1990). While the average pH remains in the acidic range, the fourfold decrease in hydrogen ion concentration further indicates that the contaminant plume is exiting the system. The decrease in hydrogen ion concentration has ranged from four to fivefold compared to 1989 measurements in each of the past four surveys. The increase in pH will affect the solubility of metals in the soil, which will enhance the

recovery of wetlands potentially stressed indirectly by low pH. Aluminum concentrations measured along the seepline in 1989 (Haselow et al., 1990) were high enough to be potentially toxic to plants. Increases in pH (to about neutral) will reduce the solubility of aluminum and thereby reduce this as a possible source of plant toxicity. Concentrations of aluminum, as well as other metals, measured along the seepline in July 1992 were substantially lower than 1989 concentrations reflecting the increase in pH (Dixon and Rogers, 1993d). Field observations of the stressed areas revealed that vegetation in most is recovering.

Four Mile Creek

Figures 9 through 11 show the tritium, conductivity, and pH values for the Four Mile Creek sampling locations and Table 3 provides the data used in the figures. Tritium activities at these locations ranged from 61 to 563 pCi/ml suggesting that seepage from the basins is impacting the stream. Conductivity measurements ranged from 101 to 121 $\mu\text{S}/\text{cm}$ and pH ranged from 5.9 to 7.2. Conductivity and pH values are at near normal levels.

Solid Waste Disposal Facility (643-E Old Burial Ground) Seepline Results

The graphs in Figures 12 through 14 show tritium, conductivity, and pH values for the seepline and stream sampling locations south of 643-E, which is part of the Solid Waste Disposal Facility. Table 4 provides the data used in the figures. This seepline is along the natural drainage that was used to discharge effluent from F-Area separations prior to the construction of the engineered effluent canal. Prior to the forth quarterly survey (March/April 1993) several new sampling locations were established on the west side of the drainage. These locations were in addition to those on the east side of the drainage. The new sampling locations were established in an effort to encapsulate the tritium outcrop area along the drainage.

Tritium activities for the locations on the east side of the drainage ranged from 30 to 639 pCi/ml. Activities on the west side of the drainage ranged from 91 to 57,500 pCi/ml. The tritium activity at the stream location in the drainage (FHB012) was 15,300 pCi/ml.

Conductivity measurements for locations on both sides of the drainage were near background and ranged from 30 to 339 $\mu\text{S}/\text{cm}$. No correlation ($r_s = 0.14$) was found to exist between conductivity and tritium for these locations using the Spearman rank correlation test. Values of pH ranged from 4.8 to 6.6 with an average of 5.3.

Tritium conductivity values at locations FHB015 and FHB016 have increased over those measured in the last survey (March, 1993). These increases could represent seasonal variability in water quality at these locations. Observations of these locations over future surveys should show whether the anomalous values represent an increasing trend in tritium activities and conductivity values at these locations.

These results are consistent with the Haselow et al. (1990) results for the western portion of the H-Area seepage line, particularly near location HSP103. Haselow et al. (1990) found that conductivity values down gradient of 643-E were near background while tritium concentrations were elevated. This was attributed to tritiated wastes deposited in 643-E. Tritium activities measured along the seepage line down gradient of 643-E (particularly those 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 impacts the local hydrology. It appears that the groundwater and tritium are moving below the fill material and outcropping on the west side of the drainage. The results suggest that the sampling locations on the west side of the drainage encapsulated the tritium outcrop area with the center located at or near FHB018.

Conclusions

Results from the June 1993 tritium survey indicate that the contaminant plume migrating from the F- and H-Area seepage basins is exiting the wetland system down gradient from the basins. These results are consistent with results from previous sampling events. ESS attributes this to the closure and capping of the basins, which eliminated the hydraulic head driving the contaminants out of the basin, thereby eliminating the source of the contaminants. WSRC scientists hypothesized that after the basins were capped, annual rainfall amounts would dilute and flush out the remaining contaminant plume. Results from each of the past five tritium surveys appear to support this hypothesis; however, due to the complex hydrologic system present in the basin areas, it is inappropriate to draw final conclusions at this point in the study. Additional collections of seepage line data combined with groundwater data will be used to fully assess the trends.

Evaluation of data from several seepage line locations south of the 643-E facility indicates that tritium migrating from 643-E is outcropping at the natural drainage in the area, particularly on the west side. It appears that sampling loca-

tions on the west side of the drainage have delineated the tritium outcrop area.

References

- Daniel, W. W. 1978. *Applied Nonparametric Statistics*. Houghton Mifflin Company, Boston, MA.
- Dixon, K. L. and V. A. Rogers. 1992. *Results of the First Quarter Tritium Survey of the F- and H-Area Seepages: May 1992*. WSRC-TR-92-304, Westinghouse Savannah River Company, Savannah River Technology Center, Aiken, SC.
- Dixon, K. L. and V. A. Rogers. 1993a. *Results of the Second Quarter Tritium Survey of the F- and H-Area Seepages: September 1992*. WSRC-TR-93-129, Westinghouse Savannah River Company, Savannah River Technology Center, Aiken, SC.
- Dixon, K. L. and V. A. Rogers. 1993b. *Results of the Third Quarter Tritium Survey of the F- and H-Area Seepages: December 1992*. WSRC-TR-93-284, Westinghouse Savannah River Company, Savannah River Technology Center, Aiken, SC.
- Dixon, K. L. and V. A. Rogers. 1993c. *Results of the Fourth Quarter Tritium Survey of the F- and H-Area Seepages: March/April 1993*. WSRC-TR-93-284, Westinghouse Savannah River Company, Savannah River Technology Center, Aiken, SC.
- Dixon, K. L. and V. A. Rogers. 1993d. *Semi-Annual Sampling of Fourmile Branch and its Seepages in the F and H Areas of SRS: July 1992*. WSRC-TR-93-289, Westinghouse Savannah River Company, Savannah River Technology Center, Aiken, SC.
- Fenimore, J. W. and J. H. Horton. 1972. *Rating History and Environmental Effects of Seepage Basins in Chemical Separations Areas of the Savannah River Plant*. DPST-72-548, E. I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, SC.
- Haselow, J. S., M. Harris, B. B. Looney, N. V. Halverson, and J. B. Gladden. 1990. *Analysis of Soil and Water at the Four Mile Creek Seepage Line Near the F and H Area of SRS (U)*. WSRC-RP-90-0591, Westinghouse Savannah River Company, Savannah River Technology Center, Aiken, SC.
- Killian, T. H., N. L. Kolb, P. Corbo, and I. W. Marine. 1985a. *F-Area Seepage Basins*. DPST-85-704, E. I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, SC.
- Killian, T. H., N. L. Kolb, P. Corbo, and I. W. Marine. 1985b. *H-Area Seepage Basins*. DPST-85-706, E. I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, SC.
- WSRC-3Q1-4. 1992. *Determination of Tritium in Water*. Procedure 2760, Rev 0. Westinghouse Savannah River Company, Aiken, SC.

WSRC-L14.1. 1992a. *Procedure for Cole-Parmer Portable Conductivity Meter Model 1481-40*. Procedure 2-79, Rev 1. Westinghouse Savannah River Company, Aiken, SC.

WSRC-L14.1. 1992b. *Procedure for Cole-Parmer Model 5985-80 pH Meter*. Procedure 2-81, Rev 1. Westinghouse Savannah River Company, Aiken, SC.

Figure 1. Location of F-Area Seepage Basins and Seepage Sampling Points.

Figure 2. Location of H-Area Seepage Basins and Seepage Sampling Points and FHB Sampling Points.

Figure 3. Comparison of March 1989, March 1993, and June 1993 Tritium Concentrations for selected F-Area Seepage Locations.

Figure 4. Comparison of March 1989, March 1993, and June 1993 Tritium Concentrations for selected H-Area Seepage Locations.

Figure 5. Comparison of March 1989, March 1993, and June 1993 Conductivity Measurements for selected F-Area Seepage Locations.

Figure 6. Comparison of March 1989, March 1993, and June 1993 Conductivity Measurements for selected H-Area Seepage Locations.

Figure 7. Comparison of March 1989, March 1993, and June 1993 pH Measurements for selected F-Area Seepage Locations.

Figure 8. Comparison of March 1989, March 1993, and June 1993 pH Measurements for selected H-Area Seepage Locations.

Figure 9. Comparison of December 1992 and March 1993 Tritium Concentrations for Selected Locations on the Seepine South of 643-E.

Figure 10. Comparison of December 1992 and March 1993 Conductivity Measurements for Selected Locations on the Seepine South of 643-E.

Figure 11. Comparison of December 1992 and March 1993 pH Measurements for Selected Locations on the Seepine South of 643-E.

Figure 12. December 1992 and March 1993 Tritium Measurements for selected Four Mile Creek Locations.

Figure 13. December 1992 and March 1993 pH Measurements for selected Four Mile Creek Locations.

Figure 14. December 1992 and March 1993 Conductivity Measurements for selected Four Mile Creek Locations.

Tables

Table 1. Comparison of F-Area Seepage Measurements of Tritium, Conductivity, and pH in March 1989, March 1993, and June 1993.

Location	Tritium (pCi/mL)			Conductivity (μ S/cm)			pH (- log H)		
	Mar 89	Mar 93	Jun 93	Mar 89	Mar 93	Jun 93	Mar 89	Mar 93	Jun 93
2	520	98	910	94	67	86	5.6	5.4	6.7
7	3400	680	497	681	145	335	5.4	5.3	6.5
12	260	27	29	30	37	212	5.3	5.1	6.3
14	14000	165	76	666	136	81	4.2	4.2	4.3
19	4900	1620	4170	1424	344	609	4.2	3.9	4.1
26	4400	4830	4110	1095	1210	1111	6.5	6.0	6.0
32	3600	65	68	174	74	73	5.0	4.3	4.3
34	14000	965	4380	810	219	637	3.8	3.8	3.8
35	11000	8050	13200	1100	1084	1433	3.9	3.4	3.8
40	7800	8060	7020	900	1548	897	5.2	3.5	4.0
47	100	26	53	52	81	86	4.7	5.5	5.6
56	19	23	13	34	66	49	4.5	5.4	5.2
204	3000	867	1450	895	263	267	4.4	5.9	4.8
213	2800	3060	3700	860	539	542	4.6	4.0	4.2
220	560	423	574	147	79	132	4.8	6.1	5.2
226	1300	825	1100	306	220	237	5.1	5.5	5.4
235	580	329	339	84	63	138	5.7	5.9	5.8
241	560	106	319	36	68	53	4.7	5.9	5.1
249	580	43	141	84	47	52	4.4	5.1	5.2
256	400	402	374	56	102	113	5.1	5.9	5.9
270	40	27	30	50	32	36	4.1	5.2	5.3
290	35	54	43	49	30	74	3.6	5.6	5.7

Table 2. Comparison of H-Area Seep Line Measurements of Tritium, Conductivity, and pH in March 1989, March 1993, June 1993.

Location	Tritium (pCi/mL)			Conductivity (μS/cm)			pH (- log H)		
	Mar 89	Mar 93	Jun 93	Mar 89	Mar 93	Jun 93	Mar 89	Mar 93	Jun 93
3	14000	2450	2510	468	214	177	5.2	6.5	6.4
4	11000	1300	2820	292	153	155	5.8	6.6	6.4
8	24000	6320	5800	556	290	257	5.7	6.2	6.6
11	960	238	306	80	49	52	5.1	5.7	5.5
13	12000	1690	1990	592	138	139	6.2	6.3	6.5
15	1000	466	1250	82	50	142	5.2	5.5	5.9
20	6500	550	894	183	78	170	6.2	5.9	5.8
25	3300	2440	2990	135	72	135	4.7	5.8	5.8
29	9200	529	498	257	85	109	5.2	5.7	5.9
34	5600	1070	1350	331	132	179	5.8	6.0	6.0
38	6500	136	446	227	73	73	4.9	5.9	5.9
43	10000	3850	5800	413	156	197	5.3	6.1	6.7
46	11000	7110	5210	318	250	207	5.5	5.9	6.1
49	11000	6150	6670	551	171	179	4.4	6.4	5.2
52	20000	7920	16400	699	340	443	4.1	6.5	6.2
57	15000	791	1670	581	98	78	5.5	6.1	5.7
60	21000	631	1550	473	150	198	5.9	6.1	6.1
64	320	83	85	38	39	76	4.7	5.3	5.6
71	450	194	538	40	33	39	5.1	5.7	5.7
76	400	91	710	146	60	252	5.7	5.4	6.3
97	1100	1060	3290	37	59	147	4.3	5.7	5.7
103	510	311	683	43	39	49	4.4	4.7	5.0

Table 3. Comparison of Seep Line Below 643-E Measurements of Tritium, Conductivity, and pH in December 1992, March 1993, and June 1993.

Location	Tritium (pCi/mL)			Conductivity (μS/cm)			pH (- log H)		
	Dec 92	Mar 93	June 93	Dec 92	Mar 93	June 93	Dec 92	Mar 93	June 93
1	178	387	639	53	60	66	5.4	5.8	5.6
2	20	37	30	36	40	87	5.6	5.2	5.7
3	871	682	563	46	52	52	5.5	5.7	5.2
4	658	175	596	44	51	48	5.0	4.8	4.8
5	464	263	585	35	29	45	5.5	5.4	5.5
6	151	217	346	37	45	52	5.6	5.5	5.5
8	161	134	316	29	29	30	5.2	5.2	4.9
12	16617	12000	15300	—	37	30	—	5.4	5.3
13	13587	2860	7920	—	47	28	—	5.1	5.2
14	1700	1150	1230	—	77	44	—	5.3	5.0
15	—	29	91	—	185	232	—	6.0	6.5
16	—	306	1140	—	88	339	—	6.2	6.6
17	—	14100	31400	—	60	56	—	5.5	5.5
18	—	44000	57500	—	110	114	—	5.6	5.6
19	—	546	4170	—	52	46	—	4.4	4.9
20	—	38	40	—	35	46	—	5.0	5.2

Table 4. Four Mile Creek Measurements of Tritium, Conductivity, and pH.

Location	Tritium (pCi/mL)			Conductivity (μ S/cm)			pH (-log H)		
	Dec 92	Mar 93	June 93	Dec 92	Mar 93	June 93	Dec 92	Mar 93	June 93
1F	455	425	563	68	56	101	6.2	6.3	5.9
1H	55	47	61	55	46	121	6.6	6.4	7.2
2H	2050	104	120	61	40	104	6.7	6.3	6.7

DATE

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6/16/94

END