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EARTH SCIENCES WASTE DISPOSAL INVESTIGATIONS JULY - DECEMBER, 1965

AUTHOR

Jay R. Eliason

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JULY - DECEMBER, 1965

AUTHOR

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EARTH SCIENCES WASTE DISPOSAL INVESTIGATIONS JULY - DECEMBER, 1965

April, 1966

By
Jay R. Eliason

PACIFIC NORTHWEST LABORATORY
RICHLAND, WASHINGTON
operated by
BATTELLE MEMORIAL INSTITUTE
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EARTH SCIENCES WASTE DISPOSAL INVESTIGATIONS JULY - DECEMBER, 1965

INTRODUCTION

The Hanford Project has over 500 wells which are used for the surveillance of radionuclides in the ground resulting from waste disposal. Wells are located at disposal sites to monitor the migration of radionuclides in the soil and to determine when a disposal facility is to be abandoned. Outside of the immediate disposal areas, wells are sampled to determine the movement of contaminants in the ground water zone. The spread of wastes in unconfined ground water aquifers is followed by routine sampling, and the confined aquifers in the area are sampled frequently where possible.

This report is prepared semi-annually by the Earth Sciences Section to give an evaluation of ground water contamination resulting from disposal of plant effluents. Maps of gross beta and tritium concentrations in the ground water are presented to define contamination spread from the disposal areas. The data presented in this report were collected during the last six months of 1965; the preceding report in this series is BNWL-CC-285.[1]

All ground water samples were collected by the Environmental Monitoring Unit and analyzed by the Radiological Analysis Unit.

Analytical results are presented for gross beta activity in the unconfined ground water aquifer, gross beta activity at depths, and tritium concentrations in the ground water in Tables I, II, and III, respectively, in the Appendix. Results are given where concentrations of radionuclides are above the routine detection limits, which are 0.08 pc/cc for gross beta and 2.0 pc/cc for tritium. The average concentrations detected during the previous report period are listed for comparison. The locations of wells referred to in this report may be found by referring to the well location maps published in the latest Hanford Wells document.[2]

EVALUATION OF GROUND WATER MONITORING DATA

Ground water samples are routinely analyzed for gross beta; this is generally calculated as Ru^{106}-Rh^{106} because isotopic analyses have shown that Ru^{106}-Rh^{106} is the primary beta emitter in the ground water. Other analyses are made at specific sites for gross alpha, Sr^{90}, Cs^{137}, and other critical isotopes. The gross beta and tritium results are plotted on water table contour maps and iso-concentration lines are drawn to show the two-dimensional extent and direction of contamination spread. Figure 1 shows the extent of ground water gross beta contamination, and Figure 2 shows the extent of ground water tritium contamination as of December 31, 1965. The eastward extent of the Gable Mountain anticline above the water table is shown to be less than that on previous maps as a result of resurveys of wells. Ground water contours and basalt outcrops also reflect other minor changes from the previous water table base map.

Special analyses of several well samples for organic liquids in the ground water were made, and concentrations up to a maximum of 14 ppm were detected. The highest concentration was found in a well 200 feet from the abandoned organic waste crib (216-A-2). Wells monitoring other disposal sites near the 216-A-2 crib were found to contain < 0.5 ppm which is approaching the detection limit of 0.2 ppm. Two wells outside of the immediate disposal area had detectable concentrations of organic; wells 699-34-39A, 2.2 ppm and 699-24-33, 0.5 ppm. These wells are approximately 2 and 4 miles, respectively, from disposal sites. Analyses are being made in an attempt to identify positively the composition of the organic in the ground water.

200-East Area

Beta emitter concentrations in the ground water beneath 200-East Area have shown no significant change during this report period. Gross beta activity in the 200-East Area wells is tabulated in Table I of the Appendix.

Analyses were made for specific isotopes beneath some inactive and all of the active disposal sites in 200-East Area. Ground water beneath the 216-BY crib site contained Co^{60} concentrations averaging 5 pc/cc during this report period, which is slightly lower than the concentrations observed during the last report period. Concentrations of Sr^{90} just above the routine detection limit of 0.01 pc/cc were observed in wells monitoring the 216-A-30, 216-A-10, and 216-A-24 cribs. The continued detection of Sr^{90} and Cs^{137} beneath the 216-A-24 crib indicates that the soil column beneath the crib may be approaching breakthrough. Flow to the 216-A-24 crib has been one-thirteenth of the design flow during the past five years; because of this, the last two sections of the crib have had little or no use. The waste is now diverted to the last two sections of the crib, which is expected to appreciably extend the life of this facility. Alpha emitters were detected in the ground water beneath the 216-A-10 crib, but the concentrations were too low to provide an accurate isotopic analysis.

200-West Area

Minor changes in beta concentrations beneath 200-West Area were observed in the last six months. Gross beta activity in 200-West Area wells is tabulated in Table I of the Appendix. Due to the replacement of the 216-S-7 crib with the 216-S-9 crib, a drop in beta activity was observed in well 299-W22-14 which monitors the ground water beneath the 216-S-7 crib. There has been an increase in the beta activity beneath the 216-S-9 crib, attributable to Ru^{106} reaching the water table. Also, a rise in beta activity observed beneath the 216-T-28 crib was associated with breakthrough of other isotopes into the ground water. The 216-T-28 crib has been abandoned due to positive identification of Cs^{137} in the ground water at a maximum concentration of 15.4 pc/cc, which is just slightly below the recommended ground water limit of 20 pc/cc. The wastes which were discharged to the 216-T-28 crib (T-plant decontamination and 300 Area) are now routed to the 216-T-27 and 216-Z-7 cribs respectively. Isotopic analysis of ground water beneath the abandoned 216-S-1 and 2 cribs showed Sr^{90} concentrations averaging 33 pc/cc. It appears that this facility is still draining into the ground water. Strontium-90 also continued to be detected beneath the abandoned 216-S-7 crib. Alpha contamination appeared in wells monitoring the 216-Z-12 crib in concentrations just above the dectection limit of 0.01 pc/cc. An accurate isotopic analysis of the alpha emitter has not been possible at these concentrations.

600-Area Beta Contamination

Beta activity detected in 600-Area wells is tabulated in Table I of the Appendix, and the extent of beta contamination in the ground water is shown in Figure 1.

The beta contamination pattern has not changed significantly in the past six months, but due to changes in the base map and detection of activity in several wells, the zones previously shown as isolated contaminated patches near Gable Mountain have been included in the major contaminated zone spreading from 200-East Area. The beta contamination plume appears to be forking, a trend which has been observed in previous reports and which may be accounted for by several perme able channels in the Ringold Formation. Erratic results in wells near the river were reported previously and are believed to be due to river recharge.

600-Area Tritium Contamination

The tritium activity detected in 600-Area wells is tabulated in Table III of the Appendix, and the extent of tritium contamination in the ground water is shown in Figure 2.

Tritium contamination patterns during the past six months emphasize the forking of the contaminated plum from 200-East Area. The detection of tritium in several wells which were not previously above the detection limit leads to the general extension of the 2-10 pc/cc zone on the map. This zone may be reflecting not only fission product tritium in the ground water but also the spread of tritium that is in river water which is used in the 200 areas. The present background tritium concentration in river water is 2-4 pc/cc which is above the routine detection limit.

CONTAMINATION IN CONFINED AQUIFERS

Beta emitter concentrations detected in samples taken at various depths, and in some instances from confined aquifers, below the water table are listed in Table II of the Appendix.

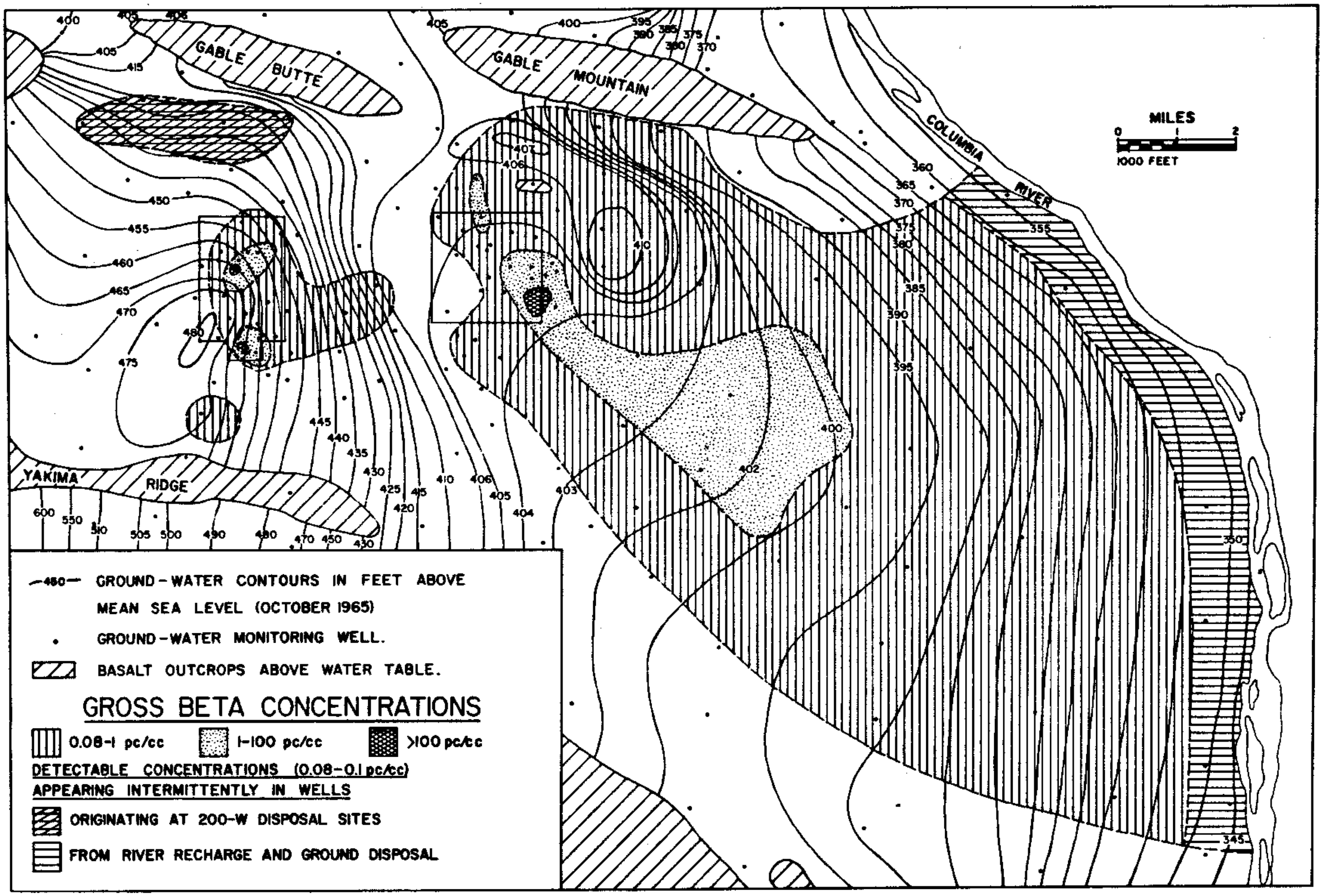

FIGURE 1

Extent of Ground Water Gross Beta Contamination

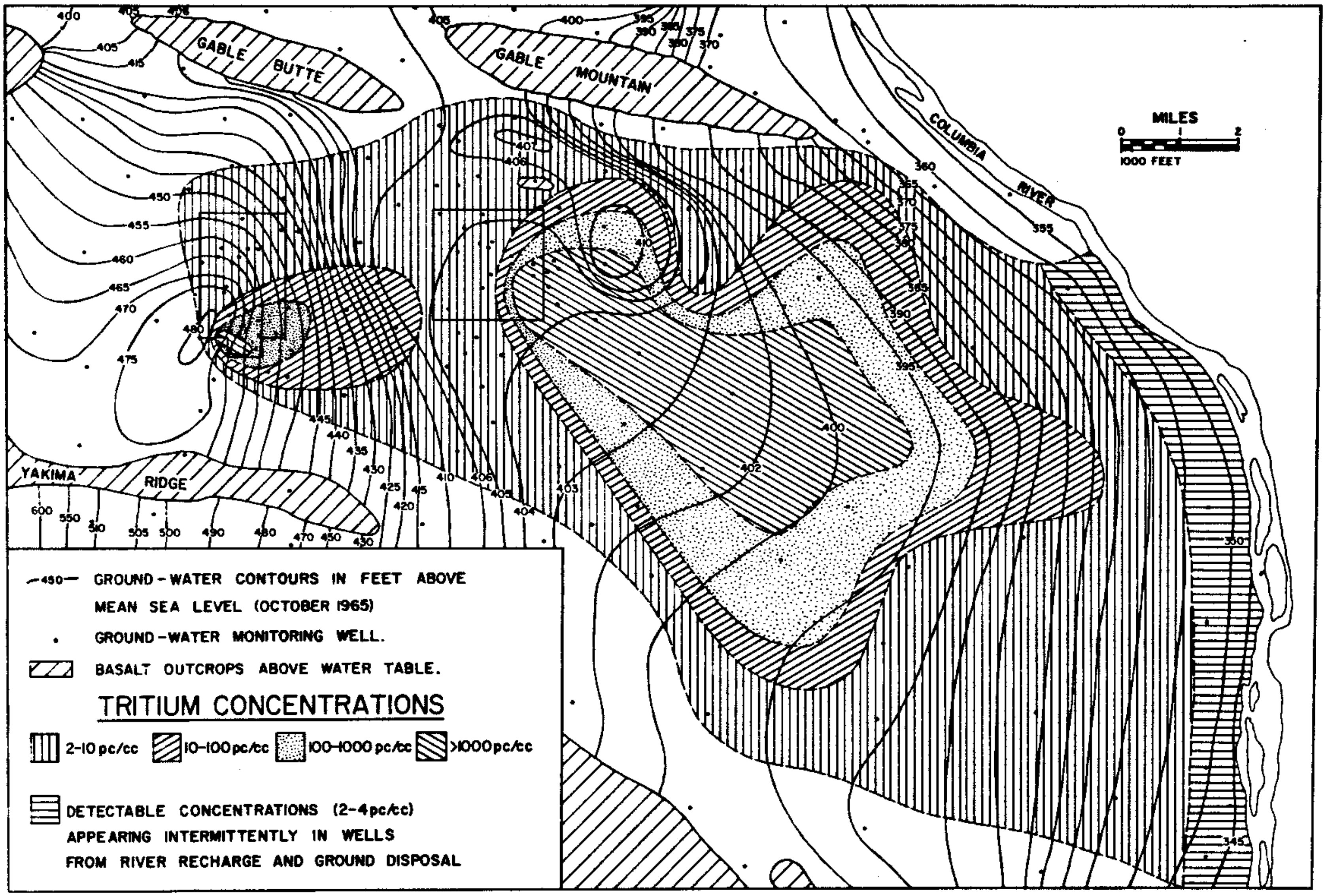

FIGURE 2

EXTENT OF GROUND WATER TRITIUM CONTAMINATION

Depth sampling in wells and samples taken from specific aquifers over the past years have shown that some activity is being carried into the confined aquifers beneath the project. The extent of waste spread in confined aquifers is difficult to evaluate because of the limited points at which they can be sampled. Increases in beta activity in several of the confined zones were observed during the past six months. Wells along the river have shown gross beta concentrations above the detection limit in the confined zones.

The maximum tritium concentration observed in a confined aquifer, 2,500 pc/cc, was observed in 699-30-31R at a depth of 300 feet. This well is located 3 miles from the 200-East Area and approximately 9 miles from the river. The maximum tritium result observed in a confined aquifer during the previous report period was 2,300 pc/cc in this well. Several wells along the river showed detectable tritium in confined aquifers during the past six months.

Wells are being drilled at several locations to provide access to confined aquifers which are believed to be potentially contaminated. These wells should help determine which of the confined zones contain wastes. Data from these wells, which should be available during the next report period, may help clarify the extent of waste spread in the confined zones.

WELL DRILLING

Well drilling project CAC-159 (Isochem) which is to provide monitoring access to the confined aquifers southeast of 200-East Area is approximately 36% completed as of February 1966. This project provides for the drilling of a total of 23 small diameter monitoring wells at 5 sites; three groups of 5 wells and 2 groups of 4 wells.

Two monitoring wells were completed near a new disposal facility in 200-West Area. Wells are being drilled around several disposal sites for the inventory of activity above the ground water table in connection with the Ben Franklin Dam study. Many of these wells will be available for ground water monitoring purposes.

REFERENCES

1. D. J. Brown. Chemical Effluents Technology Waste Disposal Investigations, January-June 1965, BNWL-CC-285. July 28, 1965.

2. D. J. Brown and V. L. McGhan. Hanford Wells, HW-44355 Rev. 2, January 1963.

APPENDIX

TABLE I. Radiological Monitoring Data from Ground Water Samples, July-December, 1965 Gross Beta Activity (Unconfined Ground Water Aquifer)

Well Designation	Avg. Conc., pCiβ/cm³	Max. Conc. pCiβ/cm³	Conc. In Latest Sample pCiβ/cm³	Avg. Conc. Jan.-June, 1965 pCiβ/cm³
200-East Area				
Wells Monitoring 216-A Disposal Facilities				
299-E16-2	0.29	0.39	0.34	0.31
299-E17-1	181.00	222.00	168.00	460.00
299-E17-2	42.6	57.00	40.00	88.00
299-E17-3	64.0	97.00	57.00	220.00
299-E17-4	10.0	60.00	57.00	--
299-E17-5	76.0	99.00	99.00	--
299-E17-6	18.0	29.00	29.00	--
299-E24-1	69.0	108.00	56.6	150.00
299-E24-2	242.00	484.00	189.0	310.00
299-E24-9	121.00	169.00	157.0	270.00
299-E25-2	0.38	0.81	0.29	--
299-E25-3	1.8	2.7	1.9	--
299-E25-10	2.4	2.9	2.5	--
299-E25-11	0.80	0.93	0.87	0.92
299-E25-12	0.32	0.64	0.64	0.66
299-E26-2	1.14	2.1	1.14	7.2
299-E26-3	2.1	3.5	1.7	8.8
299-E26-4	4.0	5.4	3.3	6.7
299-E26-5	1.5	1.55	1.55	1.6
Wells Monitoring 216-C Disposal Facilities				
299-E32-1	<.08	0.12	<.08	0.13
299-E33-3	1.6	1.6	1.6	3.9
299-E33-6	0.33	1.0	0.70	0.92
299-E33-8	0.12	0.21	<.08	0.10
299-E33-10	<.08	0.09	0.09	--
299-E33-13	2.0	2.8	2.8	2.1
299-E33-15	3.9	4.0	3.99	8.9
299-E33-18	9.3	9.3	9.3	--
299-E34-1	<.08	0.08	0.08	0.08

TABLE I. (Continued)

Well Designation	Avg. Conc., pCiβ/cm3	Max. Conc., pCiβ/cm3	Conc. In Latest Sample pCiβ/cm3	Avg. Conc. Jan.-June, 1965 pCiβ/cm3
Wells Monitoring 216-BC Disposal Facilities				
299-E13-13	0.10	0.10	0.10	0.17
299-E13-16	<0.08	0.14	<0.08	0.17
299-E13-20	0.22	0.52	<0.08	0.17
Wells Monitoring 200 East Area Outside Specific Disposal Sites				
299-E19-1	0.23	0.53	0.12	--
299-E23-1	0.09	0.21	0.21	--
299-E23-2	0.14	0.22	0.22	--
299-E24-7	0.19	0.71	0.10	--
299-E25-1	1.2	1.7	1.0	--
299-E26-1	<0.08	0.11	<0.08	--
299-E27-1	3.6	4.3	3.23	--
299-E28-4	0.12	0.20	0.13	--
299-E28-5	0.22	0.37	0.24	--
299-E28-7	0.22	0.55	0.55	--
299-E28-8	<0.08	0.09	0.09	--
200-West Area				
Well Monitoring 216-S Disposal Facilities				
299-W22-1	154.0	202.0	157.0	84.0
299-W22-7	0.15	0.19	0.14	--
299-W22-8	<0.08	0.12	0.12	--
299-W22-9	3.8	3.8	3.8	--
299-W22-14	396.0	396.0	396.0	1300.0
299-W22-19	<0.08	<0.08	<0.08	4.6
299-W22-20	1.1	1.7	0.93	1.3
299-W22-25	1.6	4.4	0.16	--
299-W22-26	19.0	48.0	0.08	--
299-W22-27	4.3	13.3	2.1	--
299-W22-28	0.13	0.22	0.13	--
299-W23-2	0.15	0.15	0.15	--
299-W23-4	0.30	0.38	0.38	1.1

TABLE I. (Continued)

Well Designation	Avg. Conc., pCiβ/cm^3	Max. Conc., pCiβ/cm^3	Latest Sample pCiβ/cm^3	Jan.-June, 1965 pCiβ/cm^3
Wells Monitoring 216-U Disposal Facilities				
299-W19-2	0.08	0.08	0.08	--
299-W19-3	0.2	0.2	0.2	--
299-W21-1	0.08	0.13	0.13	0.09
299-W22-22	0.08	0.12	0.1	0.09
Wells Monitoring 216-T Disposal Facilities				
299-W6-1	0.11	0.12	0.12	--
299-W11-10	0.12	0.15	0.08	0.09
299-W11-13	0.50	0.50	0.50	--
299-W12-1	0.08	0.09	0.08	--
299-W14-3	5466.0	5466.0	5466.0	--
299-W15-3	0.37	0.37	0.37	--
299-W15-4	1.6	1.6	1.6	--
Wells Monitoring 216-Z Disposal Facilities				
299-W15-2	<0.08	0.08	0.08	--
299-W18-1	0.29	0.41	0.25	0.25
299-W18-7	0.17	0.17	0.17	0.11
600 Area Wells				
699-S18-E2	<0.08	0.11	0.09	--
699-S12-3	<0.08	0.09	0.09	--
699-S12-29	<0.08	<0.08	<0.08	0.09
699-S6-E15	0.09	0.09	0.09	--
699-S6-E4C	0.12	0.13	0.13	<0.08
699-S3-E12	0.10	0.13	<0.08	<0.08
699-1-18	0.09	0.16	0.16	<0.08
699-2-3	<0.08	0.10	0.10	--
699-8-17	0.09	0.14	0.13	--
699-8-32	<0.08	0.10	0.10	<0.08
699-9-E2	0.10	0.10	0.10	--
699-10-E12	0.12	0.21	0.21	<0.08
699-15-15	<0.08	0.10	0.10	<0.08
699-15-26	0.43	0.59	0.59	0.35
699-17-5	0.12	0.14	0.14	<0.08
699-20-20	0.15	0.28	0.28	0.14
699-20-E12	<0.08	0.09	0.09	--
699-24-46	<0.08	<0.08	<0.08	0.08

TABLE I. (Continued)

Well Designation	Avg. Conc., pCiβ/cm^3	Max. Conc., pCiβ/cm^3	Conc. In Latest Sample pCiβ/cm^3	Avg. Conc. Jan.-June, 1965 pCiβ/cm^3
699-25-55	<0.08	0.12	<0.08	<0.08
699-26-15	0.34	0.41	0.41	0.39
699-27-8	0.13	0.15	0.10	--
699-28-40	0.26	0.36	0.23	0.26
699-29-78	0.11	0.17	0.09	0.12
699-31-65	<0.08	0.08	0.08	--
699-32-70	<0.08	0.10	<0.08	0.25
699-32-72	<0.08	<0.08	<0.08	0.09
699-32-77	<0.08	0.1	0.1	--
699-33-56	<0.08	0.19	<0.08	--
699 34-39A	17.0	24.0	14.0	15.00
699-34-88	<0.08	0.13	0.08	--
699-35-66	<0.08	0.12	<0.08	<0.08
699-37-82A	<0.08	0.08	0.08	<0.08
699-37-82B	<0.08	0.13	<0.08	0.08
699 38-70	<0.08	0.13	<0.08	<0.08
699-40-1	0.16	0.30	0.10	--
699-41-23	0.28	0.56	0.34	0.19
699-42-12	<0.08	<0.08	<0.08	0.09
699-42-42	<0.08	0.13	<0.08	0.46
699-44-64	<0.08	0.14	0.10	--
699-47-35	0.14	0.21	0.21	0.20
699-49-55	0.17	0.48	0.08	<0.08
699-49-79	<0.08	0.10	0.10	--
699-50-30	0.08	0.13	0.08	--
699-50-53	6.2	8.2	3.8	6.5
699-51-75	<0.08	0.08	<0.08	<0.08
699-53-55	<0.08	0.08	<0.08	<0.08
699-54-37	0.39	0.68	0.11	--
699-55-50A	0.33	0.35	0.33	--
699-55-76	<0.08	0.17	<0.08	0.43
699-55-89	0.09	0.21	<0.08	--
699-56-22	0.08	0.08	0.08	<0.08
699-57-83	<0.08	0.08	<0.08	--
699-59-80B	<0.08	0.09	<0.08	--
699-60-60	<0.08	<0.08	<0.08	0.13
699-63-90	<0.08	0.10	<0.08	0.10
Hanford 6	0.16	0.38	<0.08	--

Other wells were sampled and found to be below the routine detection limit of 0.08 pCiβ/cm^3

TABLE II. Radiological Monitoring Data from Ground Water Samples, July-December, 1965 Tritium Concentrations

Well or Piezometer Designation	Avg. Conc pCiβ/cm^3	Max. Conc. pCiβ/cm^3	Conc. In Latest Sample pCiβ/cm^3	Avg. Conc. Jan. -June, 1965 pCiβ/cm^3
200-East Area				
299-E17-1	29,000	36,000	36,000	--
299-E17-3	9,860	12,000	7,600	--
299-E17-6	2,821	8,200	190	--
299-E24-2	13,000	13,000	13,000	25,000
299-E25-11	470	640	640	570
299-E26-5	1,800	1,800	1,800	2,800
299-E27-5	40	75	75	--
200-West Area				
299-W6-1	2.4	2.9	2.7	<1
299-W10-1	2.2	2.2	2.2	2.5
299-W12-1	5.4	12	2.2	400
299-W14-1	310	310	310	--
299-W15-2	1.9	2.2	2.2	--
299-W18-1	2.3	2.3	2.2	--
299-W19-1	5.6	7.5	3.6	--
299-W19-4	5.7	8.4	8.4	--
299-W21-1	2	2.1	2.0	360
299-W22-19	6,600	7,000	6,500	17,000
299-W22-20	350	420	220	--
299-W22-22	2.3	3.0	3.0	--
299-W22-25	2.6	2.8	2.2	--
299-W22-26	2.3	3.2	2.5	--
299-W23-4	18,000	18,000	18,000	57,000
600 Area				
699-1-18	2.4	3.5	3.5	1.9
699-2-3	3.3	5.6	2.9	<1
699-2-33	2.1	2.1	2.1	--
699-S3-E12	3.2	4.5	2.7	<1
699-S6-E4	2.8	2.8	2.8	--
699-S6-E4C	12.0	12.0	12.0	--
699-S6-E4P	3.0	3.3	2.9	--
699-S6-E15	8.6	37.0	2.9	2.5

TABLE II. (Continued)

Well or Piezometer Designation	Avg. Conc. pCiβ/cm^3	Max. Conc. pCiβ/cm^3	Conc. In Latest Sample pCiβ/cm^3	Avg. Conc. Jan.-June, 1965 pCiβ/cm^3
699-S6-E15P	3.2	3.3	3.1	--
699-8-17	3.2	4.5	2.1	<1
699-8-32	2.6	2.6	2.6	--
699-9E-2	3.0	4.5	2.9	--
699-10E-12	<1.3	<1.3	<1.3	2
699-10E-12S	1.9	1.9	1.9	1.5
699-S11-E12	3.6	6.2	2.9	<1
699-S11-E12P	2.9	2.9	2.9	--
699-14-38	2.1	2.1	2.1	--
699-15-15	2.6	2.9	2.1	1.5
699-15-15T	2.8	2.9	2.8	2.0
699-15-26	450	480	430	390
699-17-5	3.9	6.2	2.9	<1
699-20-E12	2.8	5.6	1.7	1.5
699-20-E12S	1.6	1.9	1.3	1.5
699-20-E12P	3.0	3.3	2.7	--
699-20-20	400	510	510	500
699-25-55	3.1	4.2	2.9	<1
699-26-15	1,050	1,100	1,000	1,100
699-27-8	60.5	81	81	43
699-28-40	82	95	95	81
699-28-52	4.4	6.2	2.6	6.0
699-30-31	1,969	3,000	3,000	2,600
699-30-31S	50	50	50	67
699-30-31R	2,500	2,500	2,500	2,100
699-30-31P	43	43	43	130
699-31-53B	4.8	5.6	4.4	2.0
699-31-65	3.5	5.0	5.0	2.0
699-32-70	52	55	50	55
699-32-72	9	9.6	10	8
699-34-39A	2,300	2,600	2,600	2,200
699-34-51	2.1	2.1	2.1	--
699-35-9	3.0	3.4	3.4	<1
699-38-70	310	430	390	400
699-40-1	2.5	2.7	2.9	<1
699-40-33	3.8	6.2	3.4	<1
699-41-23	395	400	390	290
699-42-12	2.9	4.5	3.4	<1
699-42-42	1,200	1,300	1,000	2,300
699-42-42P	170	190	190	--
699-45-20	4.0	4.2	3.4	<1

TABLE II. (Continued)

Well or Piezometer Designation	Avg. Conc. pCiβ/cm^3	Max. Conc. pCiβ/cm^3	Conc. In Latest Sample pCiβ/cm^3	Avg. Conc. Jan.-June, 1965 pCiβ/cm^3
699-45-42	262	280	280	220
699-45-69	3.8	5.6	3.4	<1
699-47-35	4.4	6.2	3.4	<1
699-48-71	4.3	4.3	4.3	<1
699-49-79	2.9	2.9	2.9	--
699-50-28	4.1	6.2	3.4	<1
699-50-30	3.6	3.9	3.4	<1
699-50-42	5.9	6.2	6.2	8
699-50-53	15	28	28	21
699-51-63	3.7	5.6	4.3	--
699-53-55	4.0	5.6	3.6	<1
699-53-55R	2.7	2.7	2.7	<1
699-54-42	<1.6	<1.6	<1.6	<1
699-54-57	4.3	5.6	3.6	<1

TABLE III. Radiological Monitoring Data from Confined Ground Water Aquifers, July-December, 1965, Gross Beta Activity

Piezometer Tube Designation	Depth Below Water Table	Avg. Conc. pCiβ/cm^3	Max. Conc. pCiβ/cm^3	Conc. In Latest Sample pCiβ/cm^3	Avg. Conc. Jan.-June, 1965 pCiβ/cm^3
600 Area					
699-S31-1P	141	.44	1.6	1.6	--
699-S18-E2P	168	2.5	13.0	.66	--
699-S12-29P	84	<.08	.08	.08	--
699-S11-E12P	206	.16	.40	<.08	--
699-S6-E14P	178	.89	3.5	.63	<.08
699-S6-E14Q	103	.82	4.1	.67	<.08
699-S6-E4P	377	.40	1.2	.23	<.08
699-2-33Q	181	.09	.09	.09	--
699-10-E12P	283	.22	.38	.17	.12
699-10-E12Q	223	.11	.11	.11	<.08
699-10-E12R	163	.28	.32	.20	.08
699-15-15R	305	<.08	<.08	<.08	<.08
699-20-E12Q	137	.12	.12	.12	<.08
699-30-31P	503	.10	.27	<.08	.14
699-30-31R	333	.33	.59	.59	.43
699-30-31S	243	.37	.55	.25	.15
699-42-42P	106	.10	.19	<.08	--
699-55-50P	55	.87	.95	.78	--