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JULY - DECEMBER, 1961

AUTHOR

D. J. Brown

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CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS

July - December, 1961

Prepared by Members of the

Chemical Effluents Technology Operation

Edited by: D. J. Brown

February, 1962

Chemical Research and Development Operation
HANFORD LABORATORIES OPERATION

HANFORD ATOMIC PRODUCTS OPERATION
Richland, Washington

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CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS

July - December, 1961

I. INTRODUCTION

The Chemical Effluents Technology Operation performs research to investigate the chemical and physical aspects of environmental contamination resulting from the disposal of plant effluents or from potential process incidents. This is a semi-annual report published to give the latest information on the status of radio-contaminants in the ground water. A ground-water contamination map is presented to show the extent to which the contamination patterns have changed over those of the previous report period (HW-70806 RD). Where possible the contamination in the ground water is identified with a particular source area or crib.

A section previously included in this report titled "Plant Waste Disposal Practice" will be discontinued. Data and conclusions relating to the specific problems which were included in this section will be found in Chemical Research and Development Operation monthly reports and in formal and informal topical reports.

Ground-water monitoring results utilized in this report were obtained from samples collected routinely by the Environmental Studies and Evaluation Operation and analyzed by the Radiological Chemical Analysis Operation.

Well structures at Hanford are identified according to their location on the plant. The first group of numbers (199, 299, 699) identifies the general area (100, 200, 600) in which the well is located. In the 100 and 200 Areas the second group of numbers (B3, E24, W22) identifies the particular area and

the sheet map encompassing that portion of the area in which the well is located. The third group of numbers identifies the particular well, generally in the chronological order in which they were drilled. In the 600-Area the second and third group of numbers express in thousands of feet the nearest plant coordinates, the north coordinate being the second group of numbers and the west coordinate being the third group. Wells located south and east of the origin of the plant coordinate system are identified by the letters "S" and "E" in front of the coordinates.

II. INTERPRETATION OF GROUND-WATER MONITORING DATA (D. J. Brown).

Special Monitoring Well Samples

During this report period large volume samples from five selected wells were obtained and given special analytical processing to further detail the radionuclides which are included in routine gross beta determinations. The results of these analyses appear in Table I. Good agreement exists between the gross beta results of these analyses and those noted for recent routine samples (APPENDIX). The major radiocontaminants in the ground water are Ru^{106}-Rh^{106}. The source of the long-lived isotopes shown to be present in well 299-E25-3 still has not been definitely traced to either the 216-A-6 crib, which it monitors, or to the decaying animal(s) known to have fallen into this well. The Biology Operation reports that animals in the vicinity have sufficiently high concentrations of isotopes in their bodies possibly to account for the activity in this well.

200-East Area

Figure 1 is a map of the 200 Areas showing the extent of detectable groundwater contamination as indicated by analyses of routine samples collected during the period July - December, 1961.

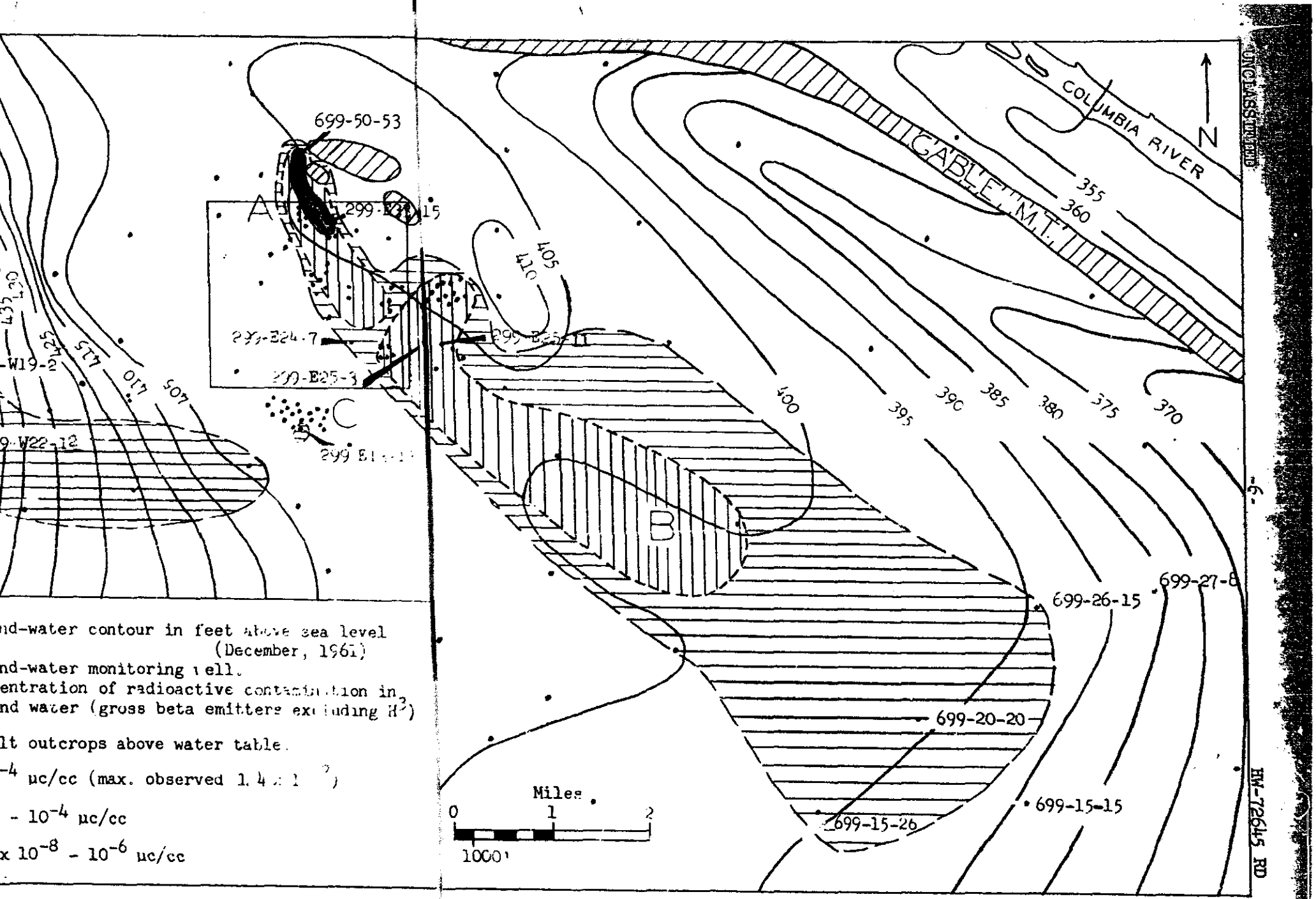
TABLE I

RADIOISOTOPIC ANALYSES OF SPECIAL MONITORING WELL SAMPLES

(Concentrations in $\mu c/ml \times 10^{-8}$)

Isotope	699-20-20	699-59-80B	299-E25-11	299-E24-7	299-E25-3	MPC_w*
Total alpha	< 2.7	< 3.3	< 5.8	< 3.2	< 1.8	--
Gross beta	6.4	4.0	1500	--	460	--
Cs^{137}	< 1.0	< 0.8	< 3.6	< 1.0	6.0 ± 4.6	20,000
Total Sr	< 2.4	< 2.2	< 2.1	< 2.2	6.1	100 (Sr^{90})
Ce^{144}-Pr^{144}	< 0.6	< 1.1	< 0.8	< 0.6	37	10,000
Pm^{147}	< 6.6	< 2.8	< 4.9	< 3.5	11 ± 2.1	200,000
Co^{60}	< 0.9	< 0.9	< 6.6	< 1.2	< 2.0	50,000
Ru^{106}	5.6 ± 4.9	< 9.8	1600	< 7.9	300	10,000
Zr^{95}-Nb^{95}	< 5.2	< 6.4	< 6.1	< 5.8	< 6.6	60,000

* Recommended maximum permissible concentration in drinking water for continuous occupational exposure. U. S. Dept. of Comm. N. B. S. Handbook 69.



nd-water contour in feet above sea level (December, 1961)

nd-water monitoring well.

entration of radioactive contamination in nd water (gross beta emitters excluding H^3)

lt outcrops above water table.

$^{-4}$ µc/cc (max. observed 1.4 : 1 $^{?}$)

$- 10^{-4}$ µc/cc

$\times 10^{-8} - 10^{-6}$ µc/cc

FIGURE 1 -- Map of Separations Area Showing Probable Extent of Ground-Water Contamination, December, 1961

Only minor changes were noted in the contaminated ground-water pattern which results from the discharge of radioactive liquid wastes into cribs located in and about the 200-East Area. At Site B, Figure 1, analyses of the ground water continue to show positive concentrations of radiocontaminants in wells 699-26-15 and 699-20-20. This plume of contaminated ground water moving southeast from 200-East Area is now starting to fan out along the leading edge as indicated by the inclusion of well 699-15-26 into the zone of detectable contamination.

No contamination was detected in the ground water beneath the 216-BC cribs, at Site C, Figure 1. One year ago four monitoring wells adjacent to these cribs routinely showed detectable contamination in the ground water. The only well to now show concentrations of radionuclides above the detection limit, at Site C, is 299-E13-13, located adjacent to the 216-BC-15 specific retention trench. The average gross beta-emitter concentration found in this well was 1.5×10^{-6} μc/cc. The average concentration reported in well 299-E13-13 at the end of the last reporting period was $< 8 \times 10^{-8}$ μc/cc beta emitters. This significant increase in activity may indicate that some wastes from the trench have reached the water table. Future analytical results from this and surrounding wells will be watched with particular interest for possible evidence of breakthrough.

No significant changes were noted in the contaminated ground-water zones at Site A, Figure 1, during the current report period. The maximum average gross beta-emitter concentration at Site A was detected in well 299-E33-15, 4.7×10^{-4} μc/cc. The maximum Co^{60} concentration, 1.7×10^{-4} μc/cc, was detected in well 699-50-53, located three quarters of a mile north of the 216-BY cribs. These cribs are believed to be the source of the radioactivity present in the ground water

in this monitoring well.

Well 699-62-43, located north of Gable Mountain and situated in a region of relatively rapid ground-water movement, contained low but detectable concentrations of beta emitters. This well has shown trace amounts of contaminants intermittently for the past several years. The Separations Areas or perhaps the 100-B Area may be the source of this contamination; further radioisotopic analyses are planned in an effort to define the source.

Fission product tritium, which is discharged to the ground in the Separations plants condensate streams, has been analyzed at concentrations from 0.05 to 1.5 μc/cc. Analyses for this isotope in samples from 55 monitoring wells are now done routinely as an aid to definitions of ground-water movement paths and rates. The tritium contamination pattern is quite similar to the gross beta pattern and has, in fact, extended our knowledge of the probable future direction of movement of the other gross-beta emitters in the ground water. The area of immediate interest with regard to tritium is the contamination plume extending southeast from the Purex plant, Figure 1, Site B. The initial sampling results from wells in this area show concentrations of 5×10^{-2} μc/cc tritium in well 699-34-39A, which is about two miles from the plant, decreasing to 4×10^{-5} μc/cc tritium in well 699-27-8, 7.5 miles southeast of the Purex plant. The maximum permissible concentration for continuous occupational exposure to tritium in drinking water is given as 3×10^{-2} μc/cc in N.B.S Handbook 69. Recent well-water tritium analyses are presented in Table IV, Appendix.

200-West Area

Three major areas of ground-water contamination in 200-West Area are shown on Figure 1 as Sites D, E, and F. Only minor changes were noted in the areal extent

of contaminated ground water under 200-West Area.

Maximum gross beta-emitter concentrations for the three sites in 200-West Area for this report period, together with concentration averages for the previous six months, are presented in the following table:

TABLE II

AVERAGE CONCENTRATIONS OF GROSS BETA ACTIVITY IN 200-WEST AREA WELLS

Site	Well Number	July - December, 1961	January - June, 1961
D	299-W15-4	5.0×10^{-6} μc/cc	4.0×10^{-6} μc/cc
E	299-W19-2	1.6×10^{-6} μc/cc	2.1×10^{-6} μc/cc
F	299-W22-12	1.4×10^{-2} μc/cc	1.8×10^{-2} μc/cc

Only one well in 200-West Area contains concentrations of long-lived fission products greater than routine detection limits. Well 299-W22-2 continues to show the presence of Sr^{90}; the maximum concentration detected this period was 6.0×10^{-7} μc/cc which is the same concentration detected from January - June, 1961. The source of the Sr^{90} is the 216-S-1 and 2 cribs which were abandoned in 1956.

III. WELL DRILLING SUMMARY (R. E. Brown)

Wells are drilled on the Hanford Project to provide monitoring access to the ground water and to obtain geological and hydrological data in support of waste disposal operations and investigations. The following wells were drilled during this report period by the Jannsen Drilling Company of Aloha, Oregon, under Project AT-(45-1)-1639, Contract CAH-921.

Well Drilling Summary (contd.)

Well	Feet drilled	Date completed	Total feet	To water	To basalt
299-W11-13	213	7-17-61	495	yes	yes
699-49-55	149	7-28-61	149	"	"
699-53-55	455	8-24-61	455	"	"
699-47-46	207	8-11-61	207	"	"
299-E28-10	325	8-24-61	325	"	"
699-72-92	200	9-11-61	200	"	no
299-E23-2	456	9-12-61	456	"	yes
699-72-73	200	9-21-61	200	"	no
699-86-60	531	10- 2-61	531	"	yes
699-89-35	75	9-29-61	75	"	no
699-40-1	420	11- 2-61	420	"	yes
699-66-23	100	10- 6-61	100	"	no
699-20-E8	357	11- 7-61	357	"	yes
699-S18-E2	260	11-18-61	260	"	"
699-36-93	562			"	"
399-4-7	156	11-26-61	156	"	no
299-W14-3	270	12-28-61	270	"	no

APPENDIX

TABLE III

AVERAGE CONCENTRATIONS OF GROSS BETA-EMITTERS, JULY - DECEMBER, 1961

(Detection Limit is 8×10^{-8} μc/cc at 95% C. L.)

Well	Concentration (μc/cc)	Well	Concentration (μc/cc)
200 East Area (prefixed by 299)			
		E13-1	< detection
E28-1	2.9×10^{-7}	E13-2	" " "
E28-2	5.9×10^{-6}	E13-3	" " "
E28-3	< detection	E13-4	" " "
E28-4	1.2×10^{-6}	E13-5	" " "
E28-5	2.7×10^{-6}	E13-6	" " "
E28-6	3.3×10^{-7}	E25-2	3.5×10^{-6}
E27-1	2.6×10^{-5}	E24-1	4.3×10^{-6}
E23-1	1.1×10^{-7}	E25-3	9.0×10^{-6}
E28-7	1.3×10^{-7}	E25-4	2.0×10^{-6}
E26-1	< detection	E24-4	2.5×10^{-6}
E33-16	1.2×10^{-4}	E24-5	4.2×10^{-6}
E33-15	4.7×10^{-4}	E17-1	1.1×10^{-5}
E33-12	2.9×10^{-4}	E24-2	7.2×10^{-6}
E33-17	4.2×10^{-4}	E25-1	1.9×10^{-6}
E33-13	1.6×10^{-5}	E33-19	8.8×10^{-5}
E33-14	8.8×10^{-5}	E33-20	8.5×10^{-5}
E33-11	9.6×10^{-5}	E13-7	< detection
E33-9	1.3×10^{-4}	E13-8	" " " "
E33-8	5.5×10^{-6}	E13-9	" " " "
E33-1	4.5×10^{-6}	E13-10	" " " "
E33-2	2.6×10^{-5}	E13-11	" " " "
E33-3	1.0×10^{-4}	E13-12	" " " "
E33-4	1.0×10^{-4}	E13-13	1.5×10^{-6}
E33-7	2.0×10^{-6}	E13-14	< detection
E33-10	< detection	E24-7	2.2×10^{-7}
E33-6	4.5×10^{-6}	E25-5	6.5×10^{-7}
E33-5	6.5×10^{-6}	E25-6	9.0×10^{-6}
E33-18	5.0×10^{-5}	E25-9	1.6×10^{-6}
E24-3	< detection	E19-1	< detection
E13-16	" " " "	E26-5	3.0×10^{-6}
E25-7	5.1×10^{-5}	E13-20	< detection
E25-8	3.2×10^{-5}	E26-4	1.9×10^{-5}
E13-15	< detection	E25-10	2.2×10^{-5}
E13-17	" " " "	E26-2	8.5×10^{-7}

APPENDIX

TABLE III (continued)

Well	Concentration (μc/cc)	Well	Concentration (μc/cc)
200 East Area (prefixed by 299)			
E13-18	< detection	E26-3	1.7×10^{-5}
E13-19	" "	E27-3	1.2×10^{-6}
E33-21	" "	E17-2	1.2×10^{-5}
E24-8	2.2×10^{-5}	E17-3	6.8×10^{-6}
E28-8	< detection	E25-11	3.3×10^{-5}
E28-9	" "	E25-12	1.3 x 10-7
E23-2	8.0×10^{-8}	E27-4	7.6×10^{-5}
E28-10	3.1×10^{-7}	E16-2	< detection
E32-1	< detection	L16-1	" "
E34-1	" "		
200 West Area (prefixed by 299)			
W11-1	" detection	W22-10	8.0×10^{-6}
W11-2	" "	W22-11	< detection
W11-3	" "	W22-15	--
W11-4	" "	W22-16	7.0×10^{-7}
W11-5	" "	W23-2	< detection
W11-6	" "	W23-3	2.7×10^{-7}
W11-7	" "	W22-12	1.4×10^{-2}
W11-8	" "	W22-13	2.1×10^{-3}
W11-9	" "	W22-14	1.1×10^{-2}
W11-10	" "	W26-3	7.1×10^{-7}
W12-1	" "	W22-17	1.7×10^{-6}
W10-3	1.7×10^{-6}	W22-1	2.4×10^{-7}
W10-4	2.1×10^{-6}	W22-2	1.9×10^{-6}
W11-11	3.6×10^{-7}	W15-5	< detection
W11-12	1.2×10^{-6}	W19-1	" "
W14-1	1.5×10^{-7}	W22-19	3.1×10^{-5}
W10-5	< detection	W23-4	7.5×10^{-7}
W15-2	" "	W22-20	6.0×10^{-6}
W10-1	" "	W 6-1	< detection
W10-2	--	W19-2	1.6×10^{-6}
W15-3	1.5×10^{-6}	W19-3	3.8×10^{-7}
W14-2	1.9×10^{-7}	W21-1	1.6×10^{-7}

APPENDIX

TABLE III (continued)

Well	Concentration (μc/cc)	Well	Concentration (μc/cc)
200 West Area (Prefixed by 299)			
W15-4	5.0×10^{-6}	W22-21	3.0×10^{-7}
W15-1	8.0×10^{-7}	W18-2	--
W23-1	2.0×10^{-7}	W18-5	< detection
W22-4	< detection	W15-6	" " " "
W22-18	1.7×10^{-4}	W18-1	" " " "
W22-5	8.0×10^{-5}	W18-3	" " " "
W22-6	--	W18-4	--
W22-7	3.2×10^{-7}	W19-4	< detection
W22-8	1.6×10^{-7}	W22-22	" " " "
W22-9	4.4×10^{-6}	W22-23	" " " "
W11-13	1.8×10^{-7}	W22-24	< " " "
300 Area Wells			
399-3-2	--	399-1-3	1.7×10^{-7}
399-3-3	--	399-1-4	1.1×10^{-7}
399-3-1	1.7×10^{-7}	399-8-2	< detection
399-2-1	2.6×10^{-7}	399-6-1	" " " "
399-1-1	1.7×10^{-7}	399-4-1	1.2×10^{-7}
399-1-2	1.5×10^{-7}	399-5-1	< detection
399-8-1	< detection	399-8-3	8.0×10^{-8}
600 Area Wells (Prefixed by 699)			
		S 8-19	< detection
S27-E14	< detection	17-5	" " "
34-51	" " "	2-3	" " "
25-55	" " "	S12-3	" " "
24-33	8.5×10^{-7}	S31-1	" " "
19-43	< detection	8-17	" " "
20-20	1.2×10^{-7}	S 7-34	" " "
35-9	< detection	10-54	" " "
8-32	" " "	50-53	3.7×10^{-4}
40-33	8.0×10^{-8}	61-66	< detection
54-42	< detection	51-18	" " "
47-60	" " "	65-50	" " "
60-60	" " "	47-35	" " "
63-90	" " "	45-20	" " "

APPENDIX

TABLE III (continued)

Well	Concentration (μc/cc)	Well	Concentration (μc/cc)
600 Area Wells (contd.) (Prefixed by 699)			
59-80B	< detection	37-42	< detection
43-89	" " "	28-41	" " "
34-88	" " "	55-50C	" " "
25-80	--	49-57	" " "
35-70	< detection	42-42	" " "
55-70	" " "	48-71	" " "
49-79	" " "	51-63	" " "
39-79	" " "	71-30	" " "
35-78	" " "	32-72	" " "
32-77	" " "	32-70	2.4×10^{-7}
36-61A	" " "	38-70	2.0×10^{-7}
34-39A	4.4×10^{-6}	35-66	< detection
45-69	< detection	31-65	" " "
45-42	" " "	51-75	" " "
50-30	" " "	50-84	" " "
25-70	" " "		--
55-89	" " "	63-25	" " "
71-52	" " "	77-36	" " "
70-68	--	62-43	9.0×10^{-8}
41-62	" " "	S 6-E4B	< detection
50-42	" " "	S 6-E4D	" " "
15-26	9.0×10^{-8}	S 6-E4E	" " "
72-88	< detection	S 6 E4F	" " "
65-72	"	S 6 E4G	" " "
54-57	" " "	78-62	" " "
31-30	3.4×10^{-6}	1-18	" " "
49-48	--	83-47	" " "
42-12	--	74-44	" " "
26-15	8.0×10^{-8}	55-76	" " "
9E- 2	< detection	55-95	" " "
31-53B	" " "	S15-20	" " "
28-52	" " "	38-65	" " "
19-88	" " "	44-64	" " "
33-56	8.0×10^{-8}	36-61B	" " "
24-46	< detection	32-62	" " "
2-33	" " "	S11-E12	" " "
14-40	" " "	S 3-E12	" " "
19-58	8.0×10^{-8}	37-82A	" " "
20-82	" " "	37-82B	2.3×10^{-7}
17-47	" " "	66-98	< detection

APPENDIX

TABLE III (continued)

Well	Concentration (μc/cc)	Well	Concentration (μc/cc)
600 Area Wells (contd.) (Prefixed by 699)			
17-70	< detection	26- 8	< detection
65-59	" " "	57-83	" " "
22-38	" " "	15-15	" " "
69-45	" " "	67-51	" " "
77-54	--	49-55	" " "
53-55	< detection	47-46	" " "
72-92	" " "	40-1	" " "
20-E8	" " "	40 24	" " "

TABLE IV

TRITIUM ANALYSES OF SPECIAL MONITORING WELL SAMPLES

(Concentrations in μc/ml x 10^{-5})

Well (prefixed by 699)	Concentration
59-80B	< 1
57-83	< 1
55-50	< 1
55-76	< 1
54-57	< 1
54-42	< 1
51-75	< 1
53-55	2
50-85	< 1
50-53	6
50-42	2
50-30	2
50-28	1
47-46	2
49-55	52
45-42	11
45-20	1
45-69	7
49-57	< 1
47-35	< 1
49-79	< 1
12-64	< detection

TABLE IV (continued)

Well (Prefixed by 699)	Concentration
48-71	< 1
43-89	< 1
34-39A	5,000
30-31	4,400
37-42	620
38-70	56
32-70	< 1
20-20	17
24-33	87
24-39	4,800
25-70	6
26-15	11
28-40	< 1
27-8	4
20-E8	< 1
15-15	< 1
15-26	< 1
17-5	< 1
8-17	< 1
2-3	< 1
1-18	< 1
9-E2	< 1
S3-E12	< 1
S12-E3	< 1