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CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS

JULY - DECEMBER 1962

by

Donald J. Brown

Chemical Effluents Technology
CHEMICAL LABORATORY

#26

HANFORD LABORATORIES

January 31, 1963

MASTER

HANFORD ATOMIC PRODUCTS OPERATION

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CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS

JULY - DECEMBER 1962

I. INTRODUCTION

The Chemical Effluents Technology Operation performs research to investigate the chemical and physical aspects of environmental contemination 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 contamination in the ground water arising from waste disposal operations in the Separations Areas.

Four maps are included in this report. One shows the extent to which gross beta-emitters are distributed in the ground water. Changes in the ground water contamination pattern, found by comparing the most recent map with that for the previous report period, are noted and where possible are interpreted in consideration of waste disposal practices and the latest geological and hydrological knowledge of the region. A second map shows the tritium contamination distribution in the ground water. The third map shows the extent of nitrate ion contamination in the ground water where it exists in concentrations greater than 10 ppm. Also delineated on this map is the zone where the concentration exceeds the U. S. Public Health Service drinking water standard of 45 ppm(1). The fourth map is an isothermal map of the water table encompassing only that area covered by the other three maps. For comparison, the maps issued during the last report period can be found in Document HW-74915 RD.

Where possible the contamination in the ground water is identified with a particular source area or crib. In some cases, however, the contaminants have migrated far enough from the source area that such definition is no longer possible.

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 specific wells generally in the chronological order in which they were drilled. In the 600 Area the second and third groups of numbers express in thousands of feet the nearest plant coordinates; the north coordinate is the second group of numbers and the west coordinate is 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 seven 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.

TABLE I

RADIOISOTOPIC ANALYSES OF SPECIAL MONITORING WELL SAMPLES

(Concentrations in units of 10^{-8} μc/cc)

Isotope	699-96-49	699-20-E12	699-74-60	699-67-86	699-34-51	299-E13-13	199-F5-1	MPCw*
Total α	< 0.5	< 0.7	4.2±3.1	< 0.7	< 2.4	< 2.4	< 0.8	--
Total β	1,100	1.5±0.8	**	**	21	8.6	74	--
Total Sr	< 1.2	< 0.9	< 1.0	< 0.5	8.1	3.2	< 0.6	100 (Sr^{90})
Ce^{144}-Pr^{144}	--	--	--	--	< 2.2	< 6.2		10,000
Ru^{106}	--	--	--	--	< 3.7	3.2±3.2	--	10,000
Cs^{137}	--	--	--	--	< 0.8	< 1.4	--	20,000
Pm^{147}	--	--	--	--	< 5.7	< 6.7	--	200,000
Co^{60}	< 1.2	< 1.1	< 1.1	< 1.2	< 1.2	< 1.2	< 1.1	50,000
Cr^{51}	780	< 11	< 16	< 11	--	--	< 13	2,000,000
Zn^{65}	< 23	< 17	< 19	< 25	--	--	< 17	100,000
S^{35}	55	--	--	--	--	--	73	60,000
RE+Y	< 11	< 13	< 28	< 12	1.5±0.7	2.0	< 18	20,000

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

**Total beta results are qualitative due to the absence of a predominant nuclide on which the counting efficiency might be based.

Detectable concentrations of alpha emitters were reported in well 699-74-60. This well is located approximately two miles southeast of the 100-K Area near the central fire station. No logical explanation can be found to account for alpha activity in the ground water in this region. Therefore, the well will be resampled and if the original analytical results are confirmed, an attempt will be made to determine the specific radionuclide present and its source.

The total beta result for well 699-20-E12 indicates that contamination is present in the ground water at this site in concentrations lower than the routine detection limit of 8×10^{-8} µc/cc. 08 µc/l The gross beta contamination map, Figure 1, shows this well just outside the zone of detectable contamination near the Columbia River at the point marked A on the map. It is anticipated that the concentration in this well may increase to above the routine detection limit during the next six months.

Well 299-E13-13 continues to show the presence of Sr^{90} in the ground water. Isotopic analyses of five ground water samples taken from this well during this report period show, however, that the Sr^{90} concentration is gradually decreasing from a high of 1.1×10^{-7} µc/cc to the present low of 3.2×10^{-8} µc/cc. During this period well 699-34-51, located 2000 feet east of well 299-E13-13, showed a detectable concentration of Sr^{90} in the ground water which was confirmed by analyses of three separate resamples. The latest sample result indicates that the Sr^{90} concentration in this well has decreased to 3.0×10^{-8} µc/cc. The source of the Sr^{90} in both of these wells is believed to be the 216-BC cribs. The 216-BC scavenged waste disposal site was removed from active service about

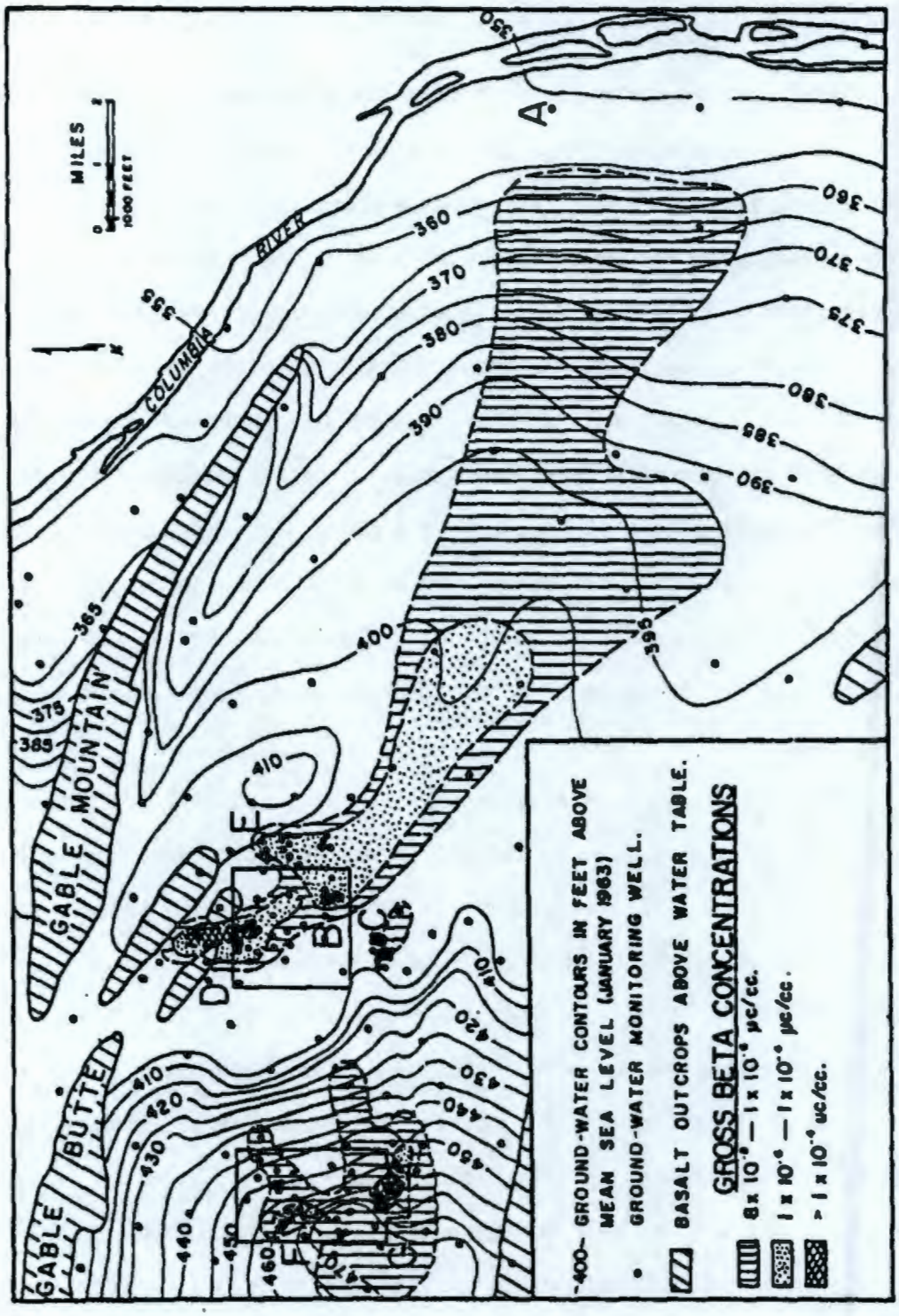

FIGURE 1.

Probable Extent Of Ground Water Gross Beta Contamination

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five years ago. Evidently some of the radioisotopes have continued to drain from the sediments below the cribs (and possibly trenches) into the ground water. Investigation of the depth of penetration of radiocontaminants in the vadose zone at this site will be made with the in-well gamma scintillation probe in the near future.

Results from two wells, 699-96-49 and 199-F5-1, located in the region of the reactor areas, showed S^{35} present in the ground water in concentrations ranging from 5 to 7 x 10^{-7} μc/cc. The source of this contaminant is believed to be reactor effluent cooling water.

200-East Area

Figure 1 is a map of the 200 Areas showing the extent of detectable ground water gross beta contamination as indicated by analyses of routine samples collected during the period July - December, 1962.

During the period from August to November, 1962, the gross beta concentration in the ground water beneath the 216-A-10 crib, Site B, Figure 1, showed a gradual increase from 1.5 x 10^{-5} to 5.0 x 10^{-5} μc/cc. In December the concentration increased more than tenfold to 8.2 x 10^{-4} μc/cc. This rapid increase in radioactivity in the ground water beneath the crib is the direct result of an increase in the radioactive material content of the waste sent to this facility in December. Ground water at this site is being sampled and analyzed frequently for significant long-lived isotopes known to be present in this waste. Samples obtained in January and early February, 1963, did not contain Sr^{90} or Cs^{137} in concentrations greater than the routine detection limits of 7 x 10^{-8} μc Sr^{90}/cc and 5 x 10^{-7} μc Cs^{137}/cc.

The contamination status of the only two wells (299-E13-13 and 699-34-51) showing detectable concentrations of gross beta activity at Site C, Figure 1, was discussed in the previous section.

No significant changes were noted in the contaminated ground water zones at Site D, Figure 1, during the current report period. All wells at this site show decreasing Co^{60} concentrations. The maximum concentration of Co^{60}, 1.9×10^{-5} µc/cc, was reported in well 699-50-53, which is located three-quarters of a mile north of the 216-BY cribs. These abandoned cribs are the source of the radionuclides present in the ground water in this monitoring well.

200-West Area

Two major areas of ground-water contamination in 200-West Area are shown on Figure 1 as Sites F and G. Only minor changes were noted in the areal extent of contaminated ground water under 200-West Area.

Average gross beta-emitter concentrations for the two sites in 200-West Area were calculated and their maximum values are reported below together with the maximum values for the previous six months.

TABLE II

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

Site	Well Number	January - June, 1962	July - December, 1962
F	299-W15-4	6.0×10^{-6} µc/cc	3.5×10^{-6} µc/cc
G	299-W22-12	6.8×10^{-3} µc/cc	3.2×10^{-3} µc/cc

Detectable concentrations of Sr^{90} and Cs^{137} were reported to be appearing

intermittently in the ground water beneath the 216-S-7 crib during the past six months. The ground water beneath this cribsite is now being sampled on a more frequent schedule to obtain more positive evidence concerning the presence of these long-lived radioisotopes. Strontium-90 is still present in well 299-W22-2 which is located approximately 800 feet northwest of the 216-S-7 crib.

III. FISSION PRODUCT TRITIUM IN THE GROUND WATER(2)

The ground-water tritium contamination map, Figure 2, shows patterns resulting from the disposal of wastes to ground in the 200 Areas. In the 200-West Area there is good agreement with the gross beta contamination map for the same period, See Figure 1. It appears that the tritium contamination does not extend as far as the gross beta contamination even though tritium moves at a faster rate with the ground water than other beta emitters. The difference is that the patterns shown in Figures 1 and 2 have been developed with gross beta analyses proportionately more sensitive than tritium analyses. When much more sensitive tritium analytical techniques are in operation (expected within the next six months), the tritium pattern will lead the gross beta pattern.

The presence of tritium in the ground water south of Gable Mountain, Site B, Figure 2, is attributable to the B-swamp which receives acid fractionator condensate in addition to condenser cooling water from the Purex plant. No significant change has occurred in the contamination pattern at this site since the last report period.

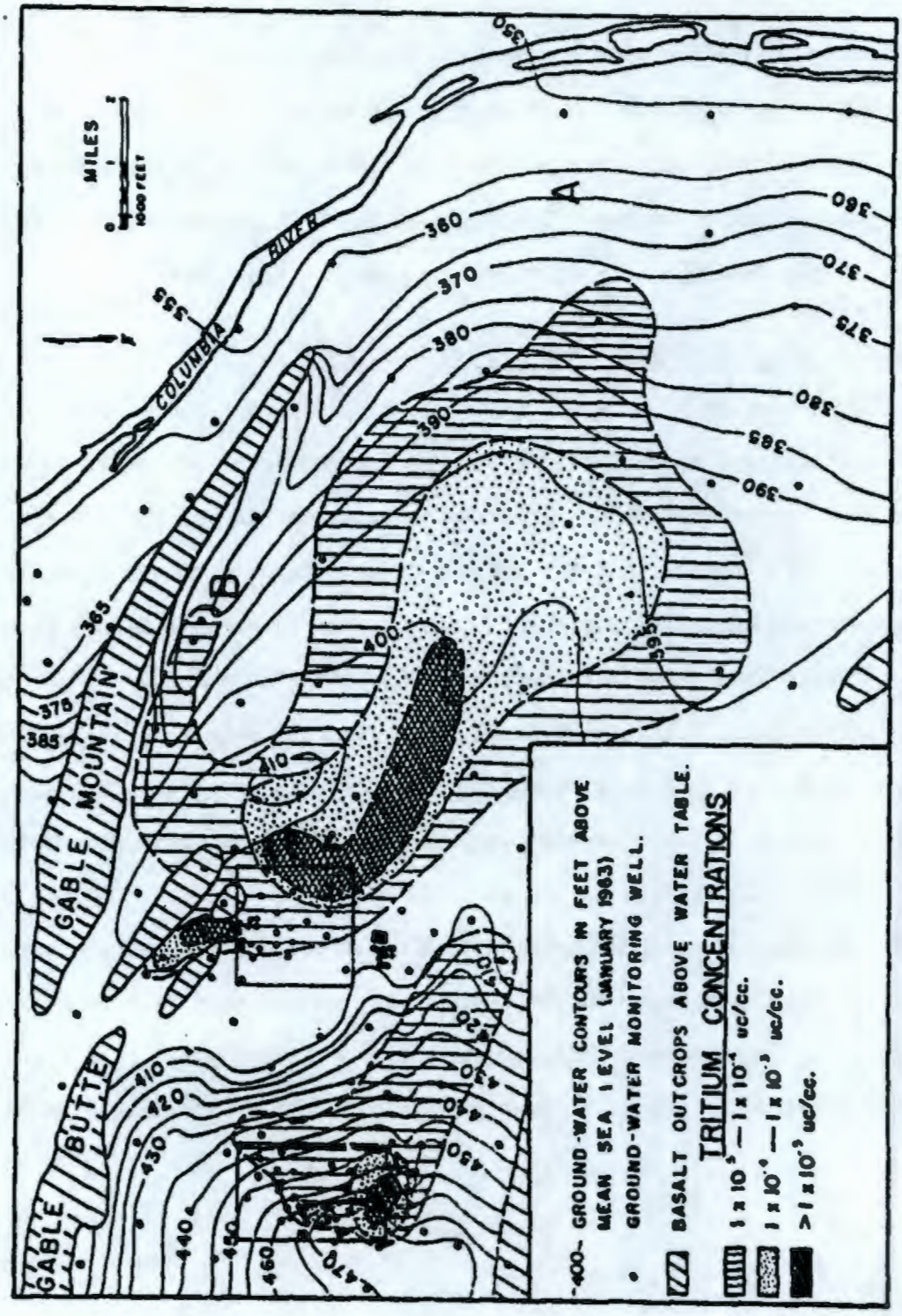

FIGURE 2.

Probable Extent Of Ground Water Tritium Contamination

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IV. CONTAMINATION OF THE GROUND WATER BY NITRATE ION

Figure 3 is a map of the Separations Areas showing the extent to which the ground water is contaminated by nitrate ion. The limit of 45 ppm was established as the recommended drinking water limit by the U. S. Public Health Service in March, 1962(1). The background concentration of nitrate ion in the ground water beneath the Hanford Project is between 2 and 4 ppm. Concentrations above the background value have been traced eastward from the Separations Areas to regions near the Columbia River. A fairly steady decrease in nitrate ion concentrations in the ground water southeast of 200-East Area has been experienced over the past several years. Much of the nitrate which has been detected routinely is attributable to scavenged waste discharged to the 216-BY cribsite from 1954-1956. Nitrate ion concentration in scavenged waste were exceedingly high (100,000 - 300,000 ppm); and although the total volume of waste by present-day standards was relatively low (several million gallons), the movement of this waste in the ground water probably accounted for much of the nitrate ion reported in wells southeast of 200-East Area over the last few years. Also, one of the preferential paths of ground water movement from the 216-BY cribsite was under the Purex plant thereby making it difficult to distinguish between nitrate ion from scavenged waste disposals and that from Purex process condensate disposals in samples from monitoring wells in the vicinity of the Purex plant. The source of the nitrate ion shown on the present map appears to be the Purex process condensate cribs (216-A-5 and A-10) with the exception of small area of nitrate ion concentrations > 10 ppm at Site A, Figure 3. This is probably a remnant high concentration from the earlier disposed scavenged waste. This zone is expected to move slowly to the

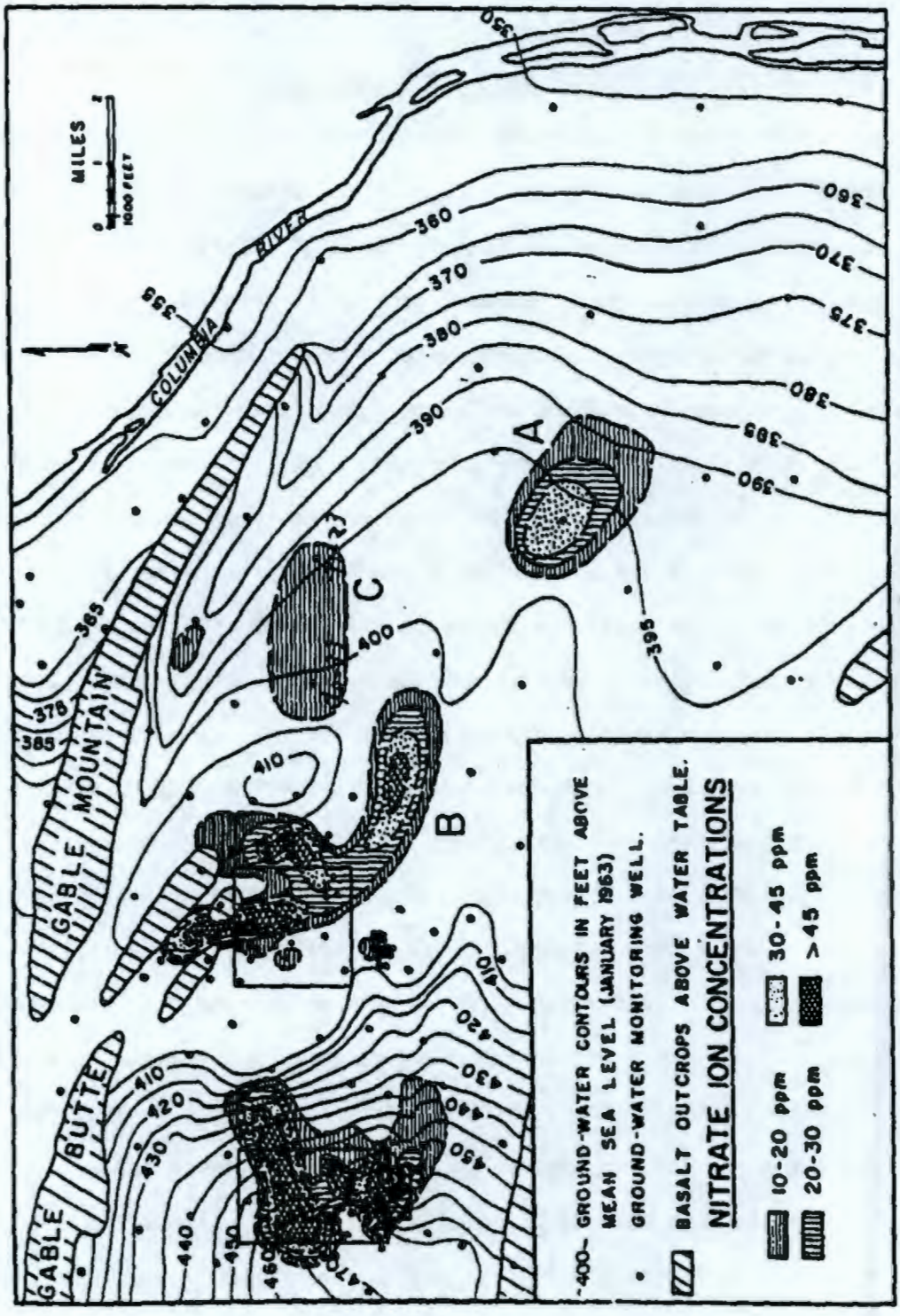

FIGURE 3. Probable Extent Of Ground Water Nitrate Ion Contamination

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southeast and diminish in concentration due to dispersive mechanisms. The two zones north of Site C are probably the result of low concentrations of nitrate ion in the vacuum acid fractionator overheads which are discharged to the B-swamp via the chemical sewer.

The nitrate ion contamination pattern in the ground water beneath 200-West Area is similar in shape to the tritium and gross beta contamination patterns. This is to be expected because of the slow rate of ground water movement beneath this area.

V. GROUND WATER TEMPERATURE SURVEY

An isothermal map of the water table beneath the Separations Areas was made from data obtained during July - December, 1962. The temperature data were adjusted on the basis of the regional geothermal gradient to correspond to readings which might be expected at an elevation of 350 feet above mean sea level. This map is shown in Figure 4.

No significant changes were noted in the temperature of the ground water at the water table in the region shown in Figure 4, with the exception of the three wells near the Columbia River indicated on the map as A, B, and C. The well at Site A, like those at Sites B and C, showed anomalously high temperatures during the previous report period. During the present report period several piezometer tubes were sealed into this well at different depths. The results of this work showed the hydraulic head in the bottom aquifer to be 25 feet greater than the head in the top aquifer. This positive head causes warm water at depth to flow up the well casing and out through the perforations higher up in the casing opposite

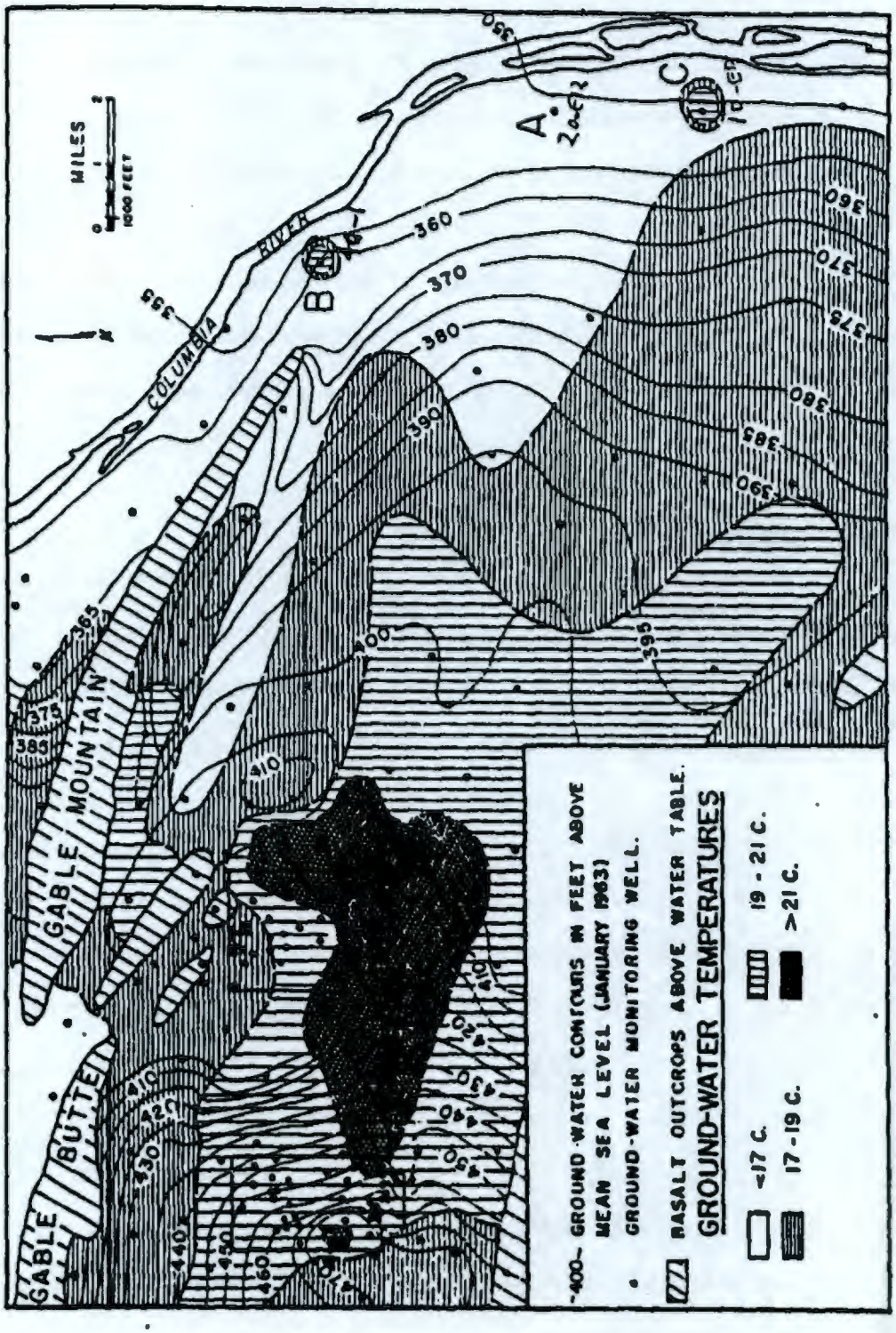

FIGURE 4.

Isothermal Map Of The Ground Water Table

July - Dec. 1962

the upper aquifer. Following the sealing of the piezometer tubes in the well, the water temperature in the upper part of the casing decreased four degrees Centigrade. It is believed that conditions similar to those found in the well at Site A exist in the other two wells at Sites B and C. When the lower aquifers in these wells are sealed-off the temperature of the ground water at the water table is also expected to return to a background value of between 16 and 17 degrees Centigrade. The presence of thermally hot water in the lowermost aquifer penetrated by these wells is partly the result of the natural geothermal gradient, 1°C/140 feet of depth, and partly due to the movement of thermally hot water from the Separations Areas through the lower aquifer.

The region where the ground water appears to be the hottest thermally is beneath the 216-WR cribsite. The temperature of the ground water in this locality is 55°C. The maximum temperature in the ground water beneath 200-East Area was noted in wells adjacent to the 216-A-10 crib; the temperature there is 40°C.

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

Wells drilled at Hanford provide radiologic, hydrologic and related geologic data on the regional ground water. Information obtained from wells is applied in maintaining surveillance of wastes in the ground water and in establishing waste management and disposal criteria.

Two wells were drilled for the Chemical Processing Department for ground water sampling facilities adjacent to new waste cribs. The first well, 299-E27-5, was drilled by the Earl A. Smith and Sons Well Drilling Co. of Pasco under Project

CGC-948, Contract AT(45-1)-1681. The second well, 299-W11-14, was drilled by the Haden Drilling Co. of Pasco on an extension (W. O. No. C15503) of Project CAH-963, Contract AT(45-1)-1679.

The Chemical Effluents Technology FY-1963 drilling project (CAH-963), contracted to the Haden Drilling Co. of Pasco as Contract No. AT(45-1)-1679, was completed during this report period.

The wells drilled under these projects are listed below.

Well	Feet Drilled	Date Completed	Total Depth	To Water?	To Basalt?
299-E27-5	335	9-27-62	335	Yes	No
299-W11-14	315	12-21-62	315	Yes	No
699-10-E12	368	8-17-62	368	Yes	Yes
1199-49-E16	219	8- 8-62	219	Yes	Yes
699-S6-E14	10	7- 9-62	212	Yes	Yes
699-S11-E12	None	11-30-62	282	Yes	Yes
699-67-86	467	10-12-62	467	Yes	No
199-B5-1	150	8-27-62	150	Yes	No
699-71-77	300	9-11-62	300	Yes	No
699-74-60	150	9-17-62	150	Yes	No
699-81-58	150	9-24-62	150	Yes	No
699-96-49	100	10-17-62	100	Yes	No
699-97-43	100	10-16-62	100	Yes	No
699-84-35	370	10- 5-62	370	Yes	Yes
699-74-48	150	10-18-62	150	Yes	No
699-66-38	150	10-19-62	150	Yes	No
699-26-89	500	12-11-62	500	Yes	Yes
699-29-78	598	11-19-62	598	Yes	Yes
699-22-70	373	11-27-62	373	Yes	Yes
699- 3-45	175	11- 1-62	175	Yes	Yes
699-S12-30	190	10-25-62	190	Yes	Yes

VII. REFERENCES

1. U. S. Public Health Service, Drinking Water Standards. Federal Register, Rules and Regulations, Title 42, Chapter 1, Part 72, Subpart J. U. S. Printing Office, Washington, D. C. March 6, 1962.

2. Haney, W. A., et al. "Fission Product Tritium in Separations Wastes and in the Ground Water," HW-74536. August 1, 1962.

VIII. APPENDIX

TABLE III

AVERAGE CONCENTRATIONS OF GROSS BETA EMITTERS, JULY - DECEMBER, 1962

[Detection Limit is 8 x 10^{-8} μc/cc at 95% C.L.]

Well (200-East Area (prefixed by 299))	Concentration (Units of 10^{-8} μc/cc)	Well	Concentration (Units of 10^{-8} μc/cc)
E28-1	14	E13-6	< 8
E28-2	23	E25-2	500
E28-3	< 8	E24-1	1,900
E28-4	24	E25-3	700
E28-5	49	E25-4	200
E28-6	< 8	E24-4	230
E27-1	1,500	E24-5	1,500
E23-1	< 8	E17-1	10,000
E28-7	11	E24-2	15,000
E26-1	< 8	E25-1	300
E33-16	4,400	E33-19	2,600
E33-15	28,000	E33-20	3,100
E33-12	14,000	E13-7	< 8
E33-17	24,000	E13-8	< 8
E33-13	900	E13-9	< 8
E33-14	4,400	E13-10	< 8
E33-11	5,100	E13-11	< 8
E33-9	8,900	E13-12	< 8
E33-8	150	E13-13	13
E33-1	650	E13-14	< 8
E33-2	1,200	E24-7	8
E33-3	5,500	E25-5	48
E33-4	4,400	E25-6	270
E33-7	100	E25-9	98
E33-10	< 8	E24-3	10
E33-6	450	E13-16	< 8
E33-5	200	E25-7	2,600
E33-18	2,300	E25-8	1,600
E13-1	< 8	E13-15	< 8
E13-2	< 8	E13-17	< 8
E13-3	< 8	E13-18	< 8
E13-4	< 8	E13-19	< 8
E13-5	< 8	E33-21	< 8

VIII. APPENDIX (contd.)

TABLE III (contd.)

Well (200-East Area, prefixed by 299)	Concentration (Units of 10^{-8} µc/cc)	Well	Concentration (Units of 10^{-8} µc/cc)
E24-8	700		
E28-8	< 8	E17-2	1,400
E28-9	< 8	E17-3	1,800
E32-1	< 8	E26-6	8
E19-1	< 8	E25-11	900
E26-5	1,100	E25-12	2,600
E13-20	< 8	E16-2	1,300
E26-4	220	E16-1	< 8
E26-2	15	E28-10	20
E26-3	240	E23-2	< 8
E25-10	950	E34-1	< 8
200-West Area (prefixed by 299)			
W11-1	< 8	W15-4	350
W11-2	< 8	W15-1	< 8
W11-3	< 8	W23-1	< 8
W11-4	< 8	W22-4	88
W11-5	< 8	W22-18	10,000
W11-6	< 8	W22-5	5,400
W11-7	< 8	W22-6	< 8
W11-8	< 8	W22-7	15
W11-9	< 8	W22-8	< 8
W11-10	< 8	W22-9	540
W12-1	< 8	W22-10	400
W10-3	95	W22-11	< 8
W10-4	140	W22-15	5,000
W11-11	220	W22-16	18
W11-12	95	W23-2	< 8
W14-1	14	W23-3	11
W10-5	< 8	W22-12	320,000
W15-2	< 8	W22-13	140,000
W10-1	< 8	W22-14	320,000
W10-2	not sampled	W26-3	not sampled
W15-3	80	W22-17	160
W14-2	35	W22-1	28
W22-2	90	W18-2	14
W15-5	< 8	W18-5	< 8
W19-1	< 8	W15-6	< 8
W22-19	6,500	W18-1	< 8

VIII. APPENDIX (contd.)

TABLE III (contd.)

Well	Concentration (Units of 10^{-8} µc/cc)	Well	Concentration (Units of 10^{-8} µc/cc)
200-West Area (prefixed by 299)			
W23-4	35	W18-3	not sampled
W22-20	190	W18-4	< 8
W6-1	< 8	W19-4	< 8
W19-2	21	W22-22	< 8
W19-3	25	W22-23	45
W21-1	8	W22-24	< 8
W22-21	19	W11-13	15
		W14-3	48
300 Area Wells (prefixed by 399)			
3-2	not sampled	1-4	14
3-3	not sampled	8-2	< 8
3-1	16	6-1	< 8
2-1	21	4-1	16
1-1	17	5-1	< 8
1-2	18	8-3	< 8
8-1	< 8	4-7	10
1-3	26	5-2	< 8
600 Area Wells (prefixed by 699)			
S27-E14	8	8-17	< 8
34-51	17	S7-34	< 8
25-55	< 8	10-54	< 8
24-33	170	12-64	< 8
19-43	< 8	40-24	8
20-20	23	40-33	< 8
35-9	< 8	54-42	< 8
8-32	< 8	47-60	< 8
S8-19	< 8	60-60	< 8
17-5	< 8	63-90	< 8
2-3	< 8	59-80B	8
S12-3	< 8	43-89	not sampled
S31-1	< 8	34-88	< 8

TABLE III (contd.)

Well 600 Area (Prefixed by 699)	Concentration (Units of 10^{-8} μc/cc)	Well	Concentration (Units of 10^{-8} μc/cc)
25-80	< 8	48-71	< 8
35-70	< 8	51-63	< 8
55-70	< 8	71-30	< 8
49-79	< 8	32-72	< 8
39-79	< 8	32-70	14
35-78	< 8	38-70	10
32-77	< 8	35-66	< 8
36-61A	< 8	31-65	< 8
34-39A	370	51-75	< 8
45-69	< 8	50-84	< 8
45-42	< 8	63-25	< 8
50-30	< 8	77-36	< 8
25-70	< 8	62-43	< 8
55-89	< 8	S6-E4B	< 8
71-52	< 8	S6-E4D	< 8
70-68	8	S6-E4E	< 8
40-62	< 8	S6-E4F	< 8
50-42	< 8	S6-E4G	< 8
68-30	< 8	S6-E4H	< 8
57-29	< 8	S6-E4J	< 8
15-26	14	78-62	< 8
72-88	not sampled	77-54	< 8
65-72	< 8	1-18	< 8
54-57	< 8	83-47	< 8
62-32	< 8	74-44	< 8
31-30	290	42-12	< 8
49-48	< 8	26-15	21
50-53	15,000	9-E2	10
61-66	< 8	31-53B	< 8
51-18	< 8	28-5[illegible]	< 8
65-50	< 8	19-88	< 8
47-35	< 8	33-56	< 8
45-20	< 8	HAN 9	< 8
38-43	< 8	24-46	< 8
26-40	< 8	2-33	< 8
55-50C	< 8	14-40	< 8
49-57	< 8	19-58	< 8
42-42	< 8	20-82	< 8

VIII. APPENDIX (contd.)

TABLE III (contd.)

Well	Concentration (Units of 10^{-8} µc/cc)	Well	Concentration (Units of 10^{-8} µc/cc)
600 Area (Prefixed by 699)			
17-47	< 8	57-83	< 8
17-70	< 8	20-39	< 8
65-59	< 8	69-45	< 8
55-76	< 8	67-51	< 8
55-95	< 8	49-55	< 8
S14-20	< 8	53-55	< 8
38-65	< 8	47-46	< 8
66-23	< 8	72-92	< 8
44-64	< 8	40-1	< 8
36-61B	< 8	20-E12	< 8
32-62	< 8	72-73	< 8
15-15	< 8	86-60	< 8
S11-E12	< 8	89-35	< 8
S3-E12	< 8	S18-E2	< 8
37-82A	< 8	43-104	not sampled
37-82B	12	54-37	not sampled
67-98	< 8	36-93	< 8
27-8	< 8		
3000 Area Wells (prefixed by 3099)			
47-18	< 8		
45-18	< 8		
45-16	< 8		
49-16	< 8		

VIII. APPENDIX (contd.)

TABLE IV

AVERAGE TRITIUM CONCENTRATION IN WELL WATER SAMPLES, JULY - DECEMBER, 1962

[Detection limit is 1.0 x 10^{-5} µc/cc at 90% C.L.]

Well	Concentration (Units of 10^{-5} µc/cc)	Well	Concentration (Units of 10^{-5} µc/cc)
200-West Area (Prefixed by 299)			
W10-1	< 1	W19-2	90
W11-7	< 1	W22-14	15,000
W11-11	4	W22-19	5,000
W15-4	100	W23-4	5,600
		W22-18	1,200
		W22-12	20,000
		W22-10	1,200
200-East Area (prefixed by 299)			
E24-1	1,000	E26-4	75
E25-3	100		
E25-6	180		
E25-12	7		
600 Area (prefixed by 699)			
17-5	1	35-9	< 1
20-20	21		
20-E12	< 1	37-42	54
24-33	65		
25-55	1	38-70	58
25-70	< 1	40-1	< 1
26-15	36	40-24	1
27-8	< 1	40-33	1
30-31	270	42-12	< 1

VIII. APPENDIX (contd.)

TABLE IV (contd.)

Well 600 Area (Prefixed by 699)	Concentration (Units of 10^{-5} μc/cc)	Well	Concentration (Units of 10^{-5} μc/cc)
		42-42	44
		45-20	< 1
34-39A	324	45-42	30
45-69	5		
2-3	< 1	51-75	< 1
8-17	< 1	53-55	10
8-32	2	54-42	2
15-15	2	28-40	1
15-26	14	35-78	< 1
47-35	< 1	19-43	< 1
47-46	< 1	54-57	< 1
48-71	< 1	77-60	< 1
49-55	< 1		
49-79	< 1		
50-28	5		
50-30	< 1		
50-53	510		