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DEVELOPMENT DIVISION
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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS

HANFORD TECHNICAL RECORD

FOR THE PERIOD
OCTOBER, NOVEMBER, DECEMBER
[redacted] 1950

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD OCTOBER, NOVEMBER, DECEMBER, 1950

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by

H. J. Paas
Development Division
Health Instrument Divisions

July 13, 1951

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ABSTRACT

RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS

FOR THE PERIOD OCTOBER, NOVEMBER, DECEMBER, 1950

This document summarizes the results obtained during a three month period of monitoring to determine the magnitude and extent of radioactive contamination in the environs of the Hanford Works. A review and discussion of these measurements for various phases of this program is presented in separate sections of this report; an abstract of these data appears below.

SECTION I:- METEOROLOGICAL DATA:

Accumulated observations for a total of 1,187 hours during which irradiated metal was dissolved in the separation areas shows that the wind prevailed from the northwest 39 percent of the time at the 200 West Area. Westerly components contributed 70 percent of the wind during the period. The south direction prevailed at the 100-D and 100-F Areas and the west direction prevailed at Richland. Tabular summations and graphic portrayals showing this variation are included.

SECTION II:- RADIOACTIVE CONTAMINATION ON VEGETATION:

A general increase was noted in the average activity density from 8 day iodine on vegetation collected from the environs. In general, this increase was on the order of a factor of 2 to 4 and exceeded a factor of 10 in extreme cases. Samples collected during December were generally higher than those collected during October and November. The predominance of fog over the region during December, along with a 10 percent increase in the amount of I-131 involved during the dissolution of metal and the reduction in the cooling period of irradiated uranium accounted for this increase. Twenty-four stack samples obtained before the installation of the silver reactor in the 200 West Area indicated that an average of 5.9 curies of I-131 were emitted daily. The maximum activity density from I-131 on vegetation was 1.3×10^{-2} µc/gram at a location near the 200 West Area gatehouse. Individual samples indicated values on the order of 2.0 to 5.0×10^{-3} µc/gram in the Redox Construction Area and in the vicinity of the Batch Plant; quarterly averages at these locations were 3.3×10^{-4} and 6.2×10^{-4} µc/gram, respectively. Increases by factors of 4 to 7 were observed in the residential areas where the average activity density from I-131 ranged from 1.0 to 3.0×10^{-5} µc/gram. Off area surveys which were confined to the early part of the quarter indicated negligible activity in the region bounded by Pendleton, Oregon, Weiser, Idaho, and Lewiston, Idaho.

SECTION III:- RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE:

Airborne radiation levels and dosage rates showed increases which approached significance in the region within a radius of 10 miles of the 200 Areas. The mean radiation level within a five mile radius of the stacks was 1.02 mrep/24 hours as compared with a previous average of 0.81 mrep/24 hours; monitoring stations located beyond 5 miles but within 10 miles showed a comparable increase from a previous 0.69 mrep/24 hours to 0.93 mrep/24 hours. Maximum measurements showed an average of 2.6 mrep/24 hours between the 200 Areas during December. Two fold increases were also noted in the average activity density from filterable beta emitters at many locations near the 100 and 200 Areas. The maximum activity density was measured inside the separation areas where the quarterly averages were 5.3 and 4.8×10^{-12} µc/cc in 200 East and 200 West Area, respectively. The maximum weekly average was 1.6×10^{-11} µc/cc at the 200 West gatehouse. Increases in the average activity

from I-131 in the atmosphere which were noted during the latter part of the previous quarter continued at nearly all outlying locations but tended to diminish at locations in the immediate vicinity of the 200 Areas. Maximum concentrations were observed in the 200 East Area where the average activity density from I-131 during October was 2.6×10^{-11} µc/cc with a maximum concentration over a 24 hour period of 2.1×10^{-10} µc/cc. Portable scrubber samples collected during periods of peak concentration at ground level indicated the maximum activity density from I-131 to be on the order of 3×10^{-9} µc/cc with an over all mean on the order of 10^{-10} µc/cc. A probable increase in the number of active particles in the atmosphere was indicated at several locations; however, a review of the over all data indicated that the majority of results were within the order expected when compared to previous measurements. Average particle concentrations remained below 1×10^{-2} particles/meter^3 at most locations near the 200 Areas and below 1×10^{-3} particles/meter^3 at all residential areas.

SECTION IV:- RADIOACTIVE CONTAMINATION IN THE HANFORD WASTES:

The average activity density from gross beta emitters in the 107 effluent water increased by a factor of nearly two at all pile areas during the quarter. Maximum measurements obtained during December ranged from 1.0 to 1.6×10^{-3} µc/cc in the 100-B, 100-D, and 100-DR Areas and from 3.3 to 3.9×10^{-3} µc/cc at the 100-F and 100-H Areas. Monitoring of the Biology Farm wastes indicated that approximately 6 milli-curies of I-131 were discharged to the Columbia River daily. Special surveys were conducted in respect to the leak in the 107-H basin and the break in the 107-D effluent pipe. The results obtained from monitoring the open waste zones in the 200 and 300 Areas are included; all measurements were in reasonably good agreement with the results of the previous quarter. Detailed surveys of the 300 Area waste ponds indicated that 100 pounds of uranium was in the liquid portion of the new pond. Detailed discussion and graphic portrayals of the distribution of this activity are included in the text.

SECTION V:- RADIOACTIVE CONTAMINATION IN THE COLUMBIA AND YAKIMA RIVERS:

A significant decrease in the flow rate of the Columbia River from a peak flow of over four million gallons/second in July, 1950 to a mean flow rate of 590,000 gallons/second during the present period contributed to a general increase in the activity density from gross beta emitters at nearly all river sampling locations. The startup of the 100-DR pile during October 1950 also contributed to this increase. The maximum activity density prevailed along the south bank of the river in the vicinity of Hanford where the average activity density was 3.7×10^{-6} µc/cc including a maximum individual measurement of 9.5×10^{-6} µc/cc. In general, the activity density was on the order of 10^{-6} µc/cc at all locations between 100-D and Richland. Cross section distribution studies indicated that the average activity density was approximately 3 times greater along the south bank at Hanford than it was along the north bank. Special surveys designed to determine if the activity discharged at the pile areas followed the same channel as that of ferro-floc discharged from the filter basins indicated significant correlations at six down stream locations. Tables and graphs which define this relationship are included. Radiochemical analyses for the activity density from alpha and beta emitters in mud along the shore of the river was not indicative of any change or trend. Increases were noted in the activity density from gross beta emitters in raw water supplies and were attributed to the higher activity density from beta emitters in the Columbia River during this period.

SECTION VI:- RADIOACTIVE CONTAMINATION IN RAIN:

The activity density of gross beta emitters in rain averaged 3.4×10^{-5} µc/cc in the 200 Areas and less than 1×10^{-6} µc/cc in residential areas. Maximum measurements were on the order of 6.0×10^{-4} µc/cc. Analyses for the activity density of alpha emitters indicated negligible activity from this source.

SECTION VII:- RADIOACTIVE CONTAMINATION IN DRINKING WATER AND TEST WELLS:

Radiochemical analyses for the activity density from alpha emitters in drinking water indicated detectable quantities in the supplies of Richland and Benton City. Maximum measurements were found in a sample from the Benton City Store well which indicated the activity density from alpha emitters to be 46 dis/min/liter with uranium measurements by fluorophotometer analyses showing 21 µg U/liter. Indications of uranium were noted in each of the Richland wells; the average activity was about 5 µg U/liter. The only wells showing detectable quantities of beta activity were those having the Columbia River as a source of supply. Maximum measurements in the drinking water supplies of Pasco and Kennewick were on the order of 3×10^{-7} µc/cc; samples of backwash material obtained at the Pasco Filter Plant showed an average activity density of 2.1×10^{-3} µc/gram in the solid material and 5.8×10^{-7} µc/cc in the liquid. Tables are included which summarize the results of all analyses performed on drinking water supplies during the period.

SECTION I

METEOROLOGICAL DATA--HANFORD WORKS AREA

The meteorological observations and recordings summarized for the months of October, November, December, 1950, represent data obtained during the periods in which irradiated metal was dissolved in the separation areas at the Hanford Works. These data were summarized from the hourly measurements which were obtained by the Meteorological Group of the Health Instrument Development Division. Meteorological observations were obtained at several locations on the project; the main meteorology station near the 200 West Area provided the bulk of the data and was supplemented by recorded measurements at each of the 100 Areas and Richland.

The data obtained from the Meteorology station represented meteorological conditions recorded at the 200' level of the Meteorology Tower; these observations were believed most representative of the conditions under which the radioactive gases were admitted to the atmosphere as this height closely represents the elevation of the stacks in the separation areas. Data obtained from perimeter stations were believed representative of those conditions which caused wide-spread deposition of trace activity in such regions as the Wahluke Slope and Tri-City Area. The data obtained at outlying stations represented recordings obtained at an elevation of approximately 50 feet.

The following discussion represents accumulated observations for a total of 1,187 hours during which time uranium was dissolved; the dissolving process was in effect approximately 54 percent of the time during the 3 month period as compared with 45 percent of the time during the period July, August, and September, 1950.

A review of the wind direction data indicates that prevailing wind conditions during the current period closely parallel similar observations noted in the past. The prevailing direction was northwest, which existed 39 percent of the time during this period as compared with 47 percent of the time during the previous quarter. Westerly components contributed 70 percent of the wind as compared with 84 percent during the previous quarter , and 67 percent during the same quarterly period in

1949. As in the past, the amount of wind from the easterly direction was not significant when reviewed in respect to the deposition and distribution pattern of contamination in the environs; however, the amount of wind from these directions showed small increases when reviewed in comparison with measurements from the previous quarter. Figure 1 summarizes the three month average wind direction data as recorded on an eight point compass. The effect of these data on the contamination pattern in the environs may be appraised by comparing this portrayal with the estimated distribution pattern of I-131 on vegetation (Figure 6, Section II.))

A review of the month to month variation in wind direction at the Meteorology Tower indicates that the prevailing wind direction showed little change within the period. The data summarized for the months of October and December were nearly identical, whereas slight differences were noted during the month of November in respect to the southwest and northwest directions. A two fold increase in the amount of wind from the southwest during the month of November was accompanied by a near two-fold decrease in amount of wind from the northwest direction. A graphic presentation showing the month to month variation in amount of wind from each of eight directions as recorded at the Meteorology Tower station is presented in Figure 2.

A more detailed study of the variation in wind direction as recorded at perimeter stations showed that the wind directions at these locations was greatly different than that observed at the Meteorology Station. The significance of the small variation noted at the Meteorology Tower tends to minimize when reviewing similar data from perimeter locations. A tabular summary showing the percent of time the wind prevailed from the eight directions at the various recording stations is presented in Table I.

TABLE I
PREVAILING WIND DIRECTIONS AT METEOROLOGY STATIONS
HANFORD WORKS
OCTOBER, NOVEMBER, DECEMBER
1950

Units in percent of time observed

Location	Wind Directions								
	N	NE	E	SE	S	SW	W	NW	CALM
200 West	9	3	4	5	7	14	17	39	2
100-B	10	4	7	8	11	15	32	8	5
100-D	10	3	8	2	21	9	15	2	30
100-F	7	2	5	8	16	14	14	6	28
Richland	13	7	11	4	12	7	20	4	22

Among the more significant differences noted when comparing the data tabulated at the various stations listed above were the following:

1. The Meteorology Station near the 200 West Area was the only station which showed the prevailing wind direction to be northwest.

2. The prevalence of the northwest direction appears insignificant at the perimeter locations.

3. The amount of wind from the south at the perimeter meteorology stations was highly significant, and in many cases tended to be the prevailing direction.

4. Although the calm condition accounted for only 2 percent of the wind near the separation areas, this condition existed between 20 and 30 percent of the time at the 100-D and 100-F Areas and in Richland.

In contrast to the differences mentioned above, rather good agreement was noted when reviewing the amount of wind contributed from easterly components. Although the amount of wind from the easterly directions appears to have very little importance on the over all deposition pattern, it can be assumed that the effect of this direction was apparently uniform throughout the environs of the Hanford Works.

Table II summarizes the month to month variation in wind direction as observed at the various stations.

TABLE II
MONTH TO MONTH VARIATION IN WIND DIRECTION
OCTOBER, NOVEMBER, DECEMBER
1950

Units in percent of time observed

Location Area	Month	N	NE	E	SE	S	SW	W	NW	CALM
		Wind Direction								
200 West	Oct.	8	3	5	6	5	11	19	43	0
	Nov.	10	3	5	7	12	22	15	25	1
	Dec.	9	3	3	4	4	8	16	50	3
100-B	Oct.	12	4	6	6	9	16	33	10	4
	Nov.	10	4	8	11	18	17	20	9	3
	Dec.	10	4	7	5	7	11	44	5	7
100-D	Oct.	10	5	4	1	17	10	14	2	37
	Nov.	10	3	11	2	24	8	12	2	28
	Dec.	10	2	9	2	20	10	17	3	27
100-F	Oct.	7	1	7	15	11	12	16	7	24
	Nov.	8	0	4	4	28	17	12	5	22
	Dec.	7	2	5	7	8	11	16	7	37
Richland	Oct.	12	14	9	3	6	7	22	4	22
	Nov.	19	5	12	6	11	7	23	3	14
	Dec.	7	3	11	4	17	6	16	5	31

The data summarized in Table II above showed about the same number of differences noted when reviewing the average conditions for the quarterly period. In general, the month to month variation appears to be a negligible factor when reviewed in respect to the significant differences which were noted when comparing the over all data at various locations.

The variations in wind directions noted around the project tend to account for the deposition of trace quantities of radioactive contamination at remote locations such as the Wahluke Slope, Ringold, Kennewick Highlands, etc. The predominance of the northwest direction near the separation areas tends to elongate the main deposition pattern to the southeast in the direction of Richland. In conjunction with related meteorological observations, several prominant topographical features such as Rattlesnake Mountain, the Saddle Mountains, Gable Mountain, and the gorge of the Columbia River tend to influence the over all deposition pattern. The general effect of these features along with the meteorological measurements may be correlated favorably when reviewing the iso activity maps which show the average deposition of eight day I-131 on the vegetation in this region. (Figure 6 , Section II.)

The dilution ratios of the air to the emitted gases were reviewed for the period. As these data continued to reflect good consistency when compared with similar measurements observed during previous quarterly periods, very little significance was attached to the effect these ratios may have on the deposition and distribution patterns for the activity density from I-131. Briefly, dilution ratios in excess of 2000:1 prevailed 45 percent of the dissolving hours; in contrast, a dilution ratio of less than 500:1 was observed only 6 percent of the dissolving time. Figure 3 is a graphic summary of the wind dilution data for the quarterly period.

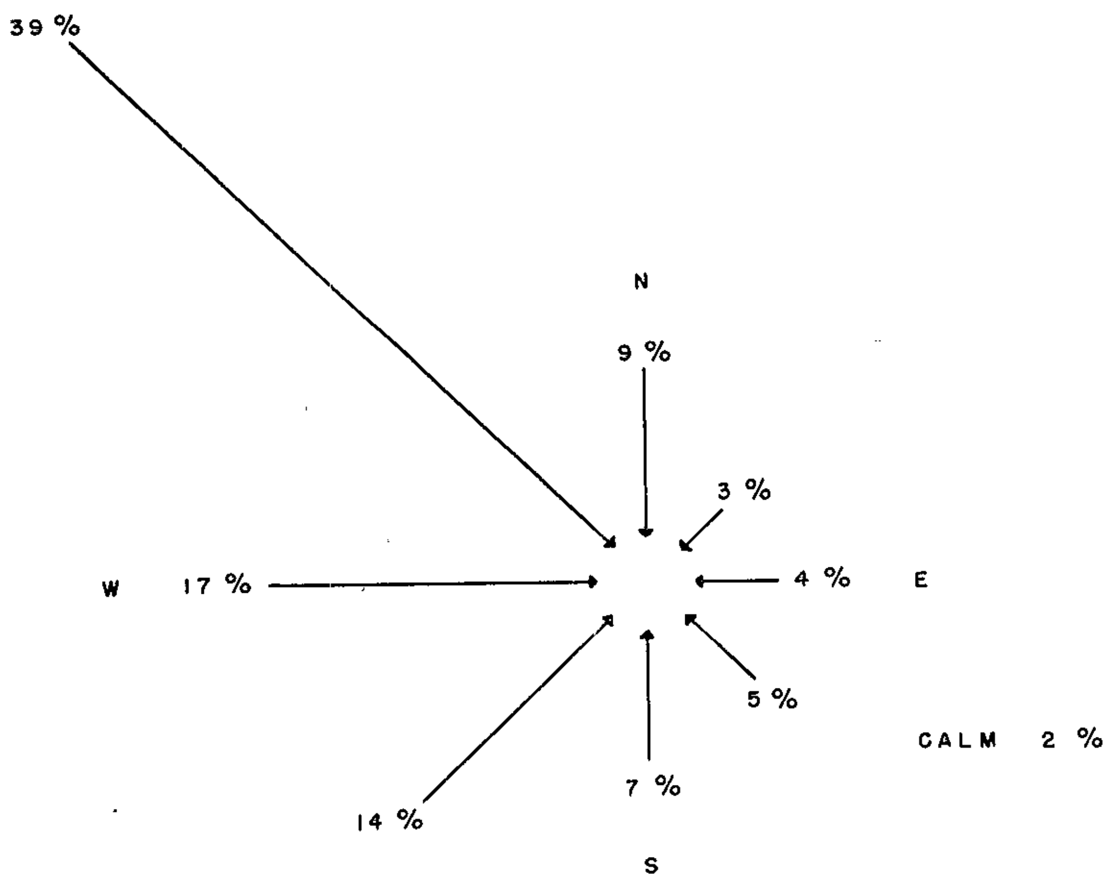
A more detailed review of meteorological conditions recorded at various stations at the Hanford Works may be obtained by reviewing the monthly meteorological summaries which are published by the Synoptic Meteorology Group of the Control Functions Section of the Health Instrument Development Division. These summaries cover hourly observations on the basis of a 24 hour day.

SECTION I

(Please refer to Figures 1, 2, and 3.)

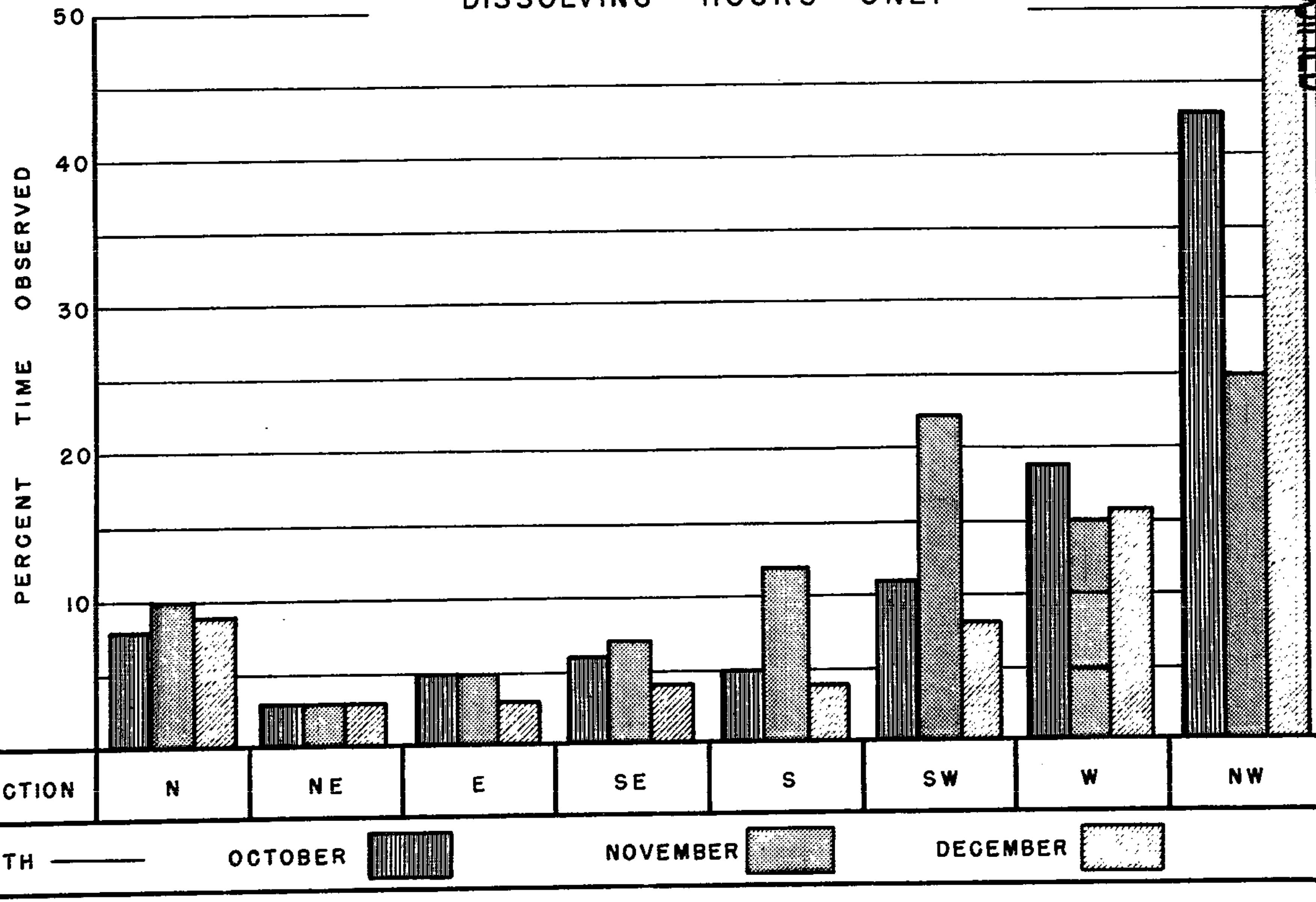
SUMMARY WIND DIRECTIONS 200 — W
DISSOLVING HOURS ONLY
OCTOBER —— NOVEMBER —— DECEMBER
1950

FIGURE — 1



SUMMARY AIR CONDITIONS —— 200-W
OCTOBER —— NOVEMBER —— DECEMBER
1950
WIND DIRECTIONS
DISSOLVING HOURS ONLY

FIGURE — 2



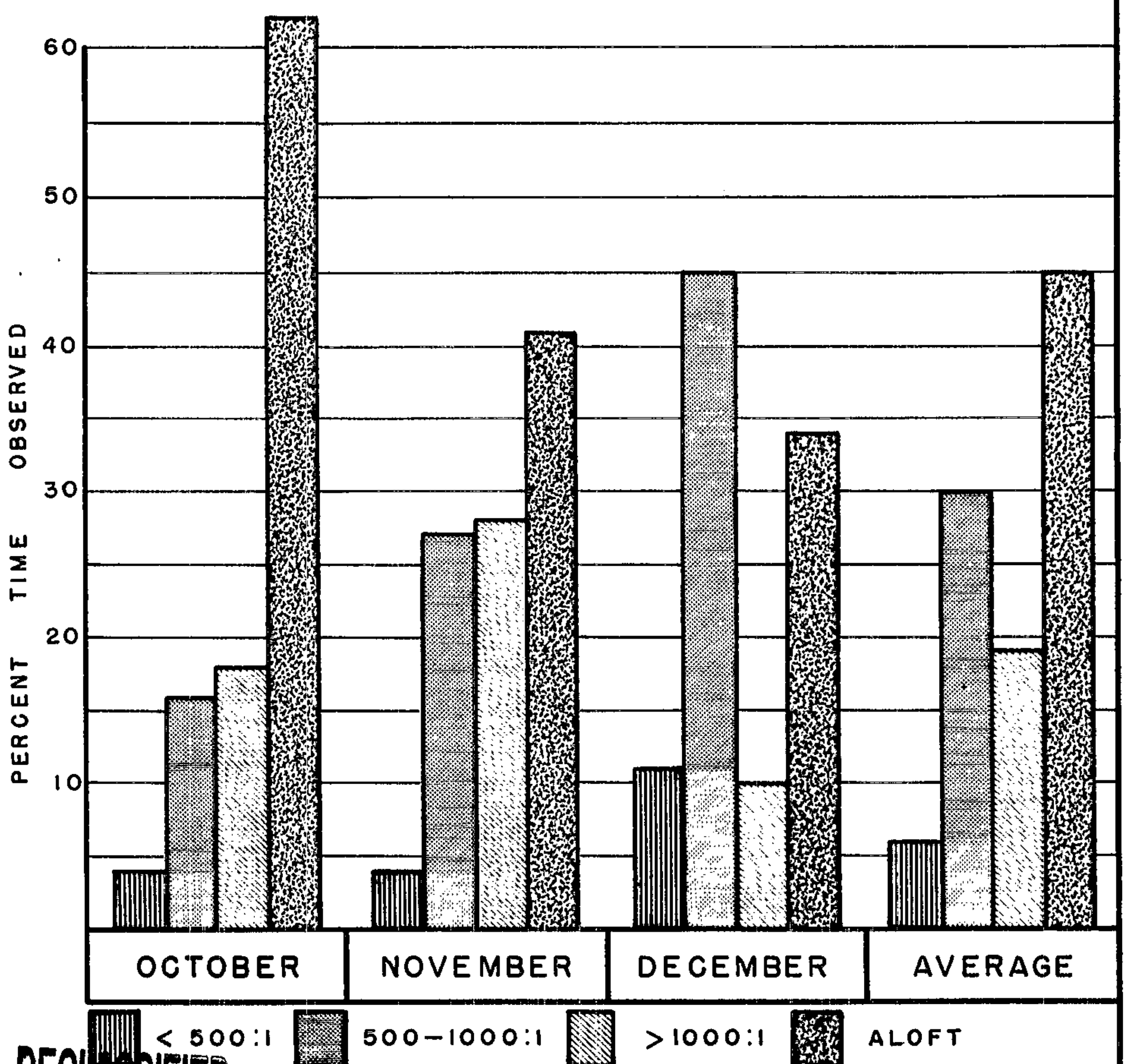
WIND DILUTION ANALYSIS

622 BLDG. — 200-W AREA

DISSOLVING HOURS ONLY

OCTOBER — NOVEMBER — DECEMBER

1950 FIGURE — 3



SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

The magnitude and extent of the deposition of radioactive contamination in the environs of the Hanford Works was determined by measuring the activity density of beta emitters on approximately 2,300 vegetation samples. Specific determinations as described in previous documents HW-14243 and HW-15743 were performed for the activity density from 8-day iodine (I-131), the predominant contaminant, and for the activity density from non-volatile emitters from the longer half-lived fission products. The detection limits for these analyses were 3×10^{-6} μc/gram and 1×10^{-5} μc/cc for I-131 and non-volatile emitters, respectively. The latter analyses includes an evaluation of the activity density from naturally occurring isotopes of potassium, uranium, etc., in vegetation. A summary of the results of these analyses for samples obtained at representative locations is presented in Table IV.

As indicated in Table IV, a rather general average increase in the activity density of 8-day iodine on vegetation collected within the Hanford Works was experienced at nearly all sampling locations. This increase was on the order of a factor of 2 to 4 and in extreme cases exceeded a factor of 10. A review of the month to month average activity density of I-131 indicates that the over all increase was weighted considerably by the results obtained during the month of December. Although a study of results of similar measurements during previous years (HW-19625) indicates that the month of December usually shows higher deposition concentrations of radioactive contamination as a result of the meteorological conditions (in which fog persists rather consistently in this region,) several significant changes in operating procedures which were effected during this period tended to contribute to the higher measurements during December. These factors are discussed below.

An increase of 10 percent to the amount of I-131 involved in the dissolution occurred during the period of October, November, and December, 1950. This increase was weighted toward the end of the period and was caused by the use of a short cooling time before metal dissolution. Table I, "Calculated I-131 in the Dissolvers," and Table II, "Range of Cooling Period for the Irradiated Uranium," summarize this data. A silver reactor was put into operation (December 12, 1950) in the 200 West Area concurrently with the use of the hotter metal and should eliminate any significant increase in amount of I-131 emitted.

TABLE I
CALCULATED I-131 INVOLVED IN DISSOLVERS
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Units - Curies

Month	200 East Area	200 West Area	Total
October	3073	1661	4734
November	1723	2311	4034
December	3601	2222	5823
Total	8397	6194	14591

TABLE II
RANGE OF COOLING PERIOD FOR IRRADIATED URANIUM
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0
Units - Days

Month	200 East Area		200 West Area	
	Maximum	Minimum	Maximum	Minimum
October	79	64	80	72
November	96	70	77	64
December	82	70	84	52

The amount of I-131 admitted to the atmosphere was estimated by monitoring the effluent leaving the stack at the 200 West Area. Samples of this effluent were obtained at the 50 foot level of the stack by employing a caustic scrubber and filter in series with an air flow of 0.3 cfm. Twenty-four samples were obtained in this manner previous to the installation of the silver reactor in the off-gas line of cell 3-5R in December, 1950. The mean result indicated than an average of 5.9 curies of I-131 were emitted daily. The average cooling period of the metal which was dissolved during these measurements was 76 days. On the basis of theoretical calculations it was estimated that an average of 12.2 percent of the dissolved I-131 was emitted to the atmosphere. Table III briefly summarizes the range of values obtained from this monitoring program.

TABLE III
SUMMARY OF STACK MONITORING PROGRAM
200 WEST AREA
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

	Measured I-131 Emitted Curies	Cooling Time Days	Calculated I-131 Dissolved Curies	Percent of Dissolved I-131 Emitted
Maximum	23.4	79	128	39.7
Average	5.9	76	57	12.2
Minimum	0.1	71	5	0.8

In addition to the measurements summarized above, three similar measurements were obtained after the installation of the silver reactor. Although these measurements represent 24 hour collection periods, only one of the samples were representative of a period during which metal was dissolved. The latter sample indicated that 3.9 percent of the dissolved I-131 was admitted to the atmosphere. This result indicated that the silver reactor apparently had reduced the I-131 emission considerably; however, definite conclusions were withheld pending subsequent measurements.

Forty-five percent of the time that dissolving operation was in progress during December, the atmospheric dilution ratio was between 500 and 1000:1. The latter factor occurred because many of the dissolvings were carried on during daylight hours in contrast to former procedures, which weighted the dissolving to the late evening and early morning hours when dilution ratios in excess of 2000:1 tend to prevail. In general, it appears that the over all effects of the increased dissolving and adverse meteorological conditions tended to influence the deposition pattern to a greater extent than did the installation of the silver reactors as was shown by increased activity density on vegetation.

A summary of the results obtained from the radiochemical analyses for the activity density from I-131 and non-volatile emitters on vegetation in the environs is presented in Table IV.

TABLE IV
RADIOACTIVE CONTAMINATION ON VEGETATION
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

		I-131 Activity Density x 10^6 µc/gm			Non-Volatile Activity Density x 10^6 µc/gm		
Location	Samples	Maximum	Average	Previous Average	Maximum	Average	Previous Average
North of 200 Areas	197	310	44	8	30	< 10	11
Near the 200 Areas	166	1300	131	37	80	13	11
Route 3	23	1300	365	414	50	15	16
200 West Gate	122	13259	1854	1054	287	35	25
200 E Tower #16	125	1878	386	455	95	26	29
Batch Plant	122	3437	333	245	129	15	11
Meteorology Tower	12	825	401	258	55	14	13
South of 200 Areas	249	445	42	14	40	10	11
Richland	64	136	30	4	29	< 10	11
Pasco	56	66	14	4	21	< 10	11
Kennewick	56	79	18	3	26	< 10	10
Benton City	35	56	14	9	20	< 10	12
Richland "Y"	13	58	26	4	31	< 10	12
Hanford	26	103	28	14	23	< 10	14
200 East Area	47	2283	345	180	52	20	16
200 West Area	59	5060	338	212	86	16	18
Redox Construction Area	90	5168	615	129	1461	18	14
Wahluke Slope	299	163	14	10	36	< 10	< 10
Goose Egg Hill	92	1240	240	22	62	12	10
Rattlesnake Mountain	61	47	15	12	20	10	< 10
Benton Gap	70	11	4	3	---	--	--
Off Area Sampling							
Pasco, Ringold, Eltopia, Mesa Area	82	105	22	5	58	< 10	10
Yakima Barricade to Ellensburg	17	26	7	5	16	11	< 10
Patterson Ferry to Kiona	7	16	6	---	--	--	--
Hanford, Moses Lake, Connell Area	32	18	5	---	--	--	--
Lewiston, Baker, Walla Walla Pendleton Area	69	3	3	4	--	--	< 10

The highest average activity density of I-131 on vegetation measured during this period was 1.9×10^{-3} µc/gram in a small region located immediately outside the 200 West Area gatehouse. The maximum individual activity density of I-131 on vegetation was also noted at this location on a sample which showed 1.3×10^{-2} µc/gram. The area in which the higher measurements prevailed was nearly identical to the region which has consistently shown the highest deposition of I-131; current averages represented an increase by a factor of nearly 2 when compared with those of the previous quarter when the average activity density of I-131 was 1.1×10^{-3} μc/gram. High samples were also obtained at several other locations inside the 200 West Area, in the Redox Construction Area, and in the vicinity of the Batch Plant; the order of magnitude of these measurements was 2.0 to 5.0×10^{-3} μc/gram. The average activity density of I-131 at these three locations ranged from 3.4 to 6.2×10^{-4} μc/gram with the higher measurements prevailing in the vicinity of the Redox Construction Area. A five-fold increase was noted in the deposition of I-131 at the Redox area. A special survey which consisted of obtaining samples at intervals of 1/2 mile over an area of 32 square miles which included the 200 East and 200 West Areas showed that the activity density of I-131 ranged from 1×10^{-3} to 5×10^{-3} μc/gram in an area approximately 2.5 miles long and 1.5 miles wide located due east of the 200 West Area. This area of maximum deposition was elongated toward the southeast in a pattern which correlated favorably with the prevailing northwest wind in respect to the point of emission. The results obtained from this survey represented some of the maximum measurements obtained during the year 1950. Figure 4 shows the estimated distribution pattern of the iodine as determined from this survey.

Weekly samples obtained from representative locations in residential areas adjacent to the site showed that the average activity density of I-131 increased by a factor of 4 to 7 during the quarter. Again, this increase was most significant during the month of December at which time the average activity density of I-131 on vegetation at Richland and near the Richland "Y" was on the order of 5×10^{-5} μc/gram. Quarterly averages at locations in the populated region ranged from 1.0 to 3.0×10^{-5} μc/gram in contrast to the previous quarter's average which barely exceeded the sensitivity limit of the analyses (3×10^{-6} μc/gram.) The maximum measurement in residential communities was 1.4×10^{-4} μc/gram on a sample collected in Richland during December. Figure 5 is presented as a graphic portrayal which shows the increase in activity density of I-131 at several residential communities and includes the trend of the cooling period and increased dissolving for correlation purposes.

An estimated iso-activity map showing the magnitude and extent of the deposition and distribution of eight day I-131 on vegetation in the immediate environs is presented in Figure 7 . This portrayal represents a composite of individual monthly iso-portrayals presented in related publications. (HW-19332, HW-19625, HW-19896)

The majority of off area surveys performed during this period were completed during the early part of the quarter before the adverse weather hindered long distance travel. As a consequence, the far majority of results which represented off area monitoring probably indicated measurements which were somewhat lower than those that apparently prevailed toward the end of the period. Surveys during October included the region bounded by Pendleton, Oregon; Weiser, Idaho; Lewiston, Idaho; and Walla Walla Washington; the activity density of I-131 at this time averaged less than 3×10^{-6} μc/gram and less than 10 percent of all samples showed an indication of trace beta particle emission. A week later a survey in the Connell-Moses Lake region in the state of Washington showed the average activity density of I-131 to be 5×10^{-6} μc/gram including a maximum measurement of 1.8×10^{-5} μc/gram obtained near Othello. Figures 7 and 8 may be referred to as sampling location maps which identify the location of all positive measurements obtained in these two surveys. The last off area survey completed during the quarter included the region between the Yakimr Barricade and Ellensburg. The activity density from I-131 averaged 7×10^{-6} μc/gram with maximum measurements on the order of 2.5×10^{-5} μc/gram prevailing in the region immediately adjacent to the plant barricade.

On October 6, 1950, twenty-six samples of various crops and fruits were collected from ranches along the northwest perimeter of the Hanford project. The activity density of I-131 on samples of apples, quince, walnuts, tomatoes and watermelons indicated less than 3×10^{-6} μc/gram. The highest activity density measured in any sample was on a sample of quince; the activity density on the skin was 6.8×10^{-6} μc/gram and 6.4×10^{-6} μc/gram in the meat. Analyses of several cantaloupe obtained from Ford's Ranch during early October indicated the activity density of I-131 to be less than 3×10^{-6} μc/gram.

Radiochemical analyses for the activity density of non-volatile emitters on the vegetation in the environs showed no significant change or trend from previous measurements. In general, this activity averaged less than 1×10^{-5} µc/gram at all residential communities and perimeter locations. Maximum averages were on the order of 1.3 to 2.9×10^{-4} µc/gram with one exceptionally high measurement found on a sample obtained from the Redox Area which indicated 1.5×10^{-3} µc/gram. Similar measurements performed on samples obtained from off area locations in the states of Washington and Idaho showed no location to average significantly above the detection limit of the analyses. Small deviations in the range of 1.0 to 2.0×10^{-5} µc/gram were assumed to be due to the varied content of the isotope K-40 which occurs naturally in vegetation.

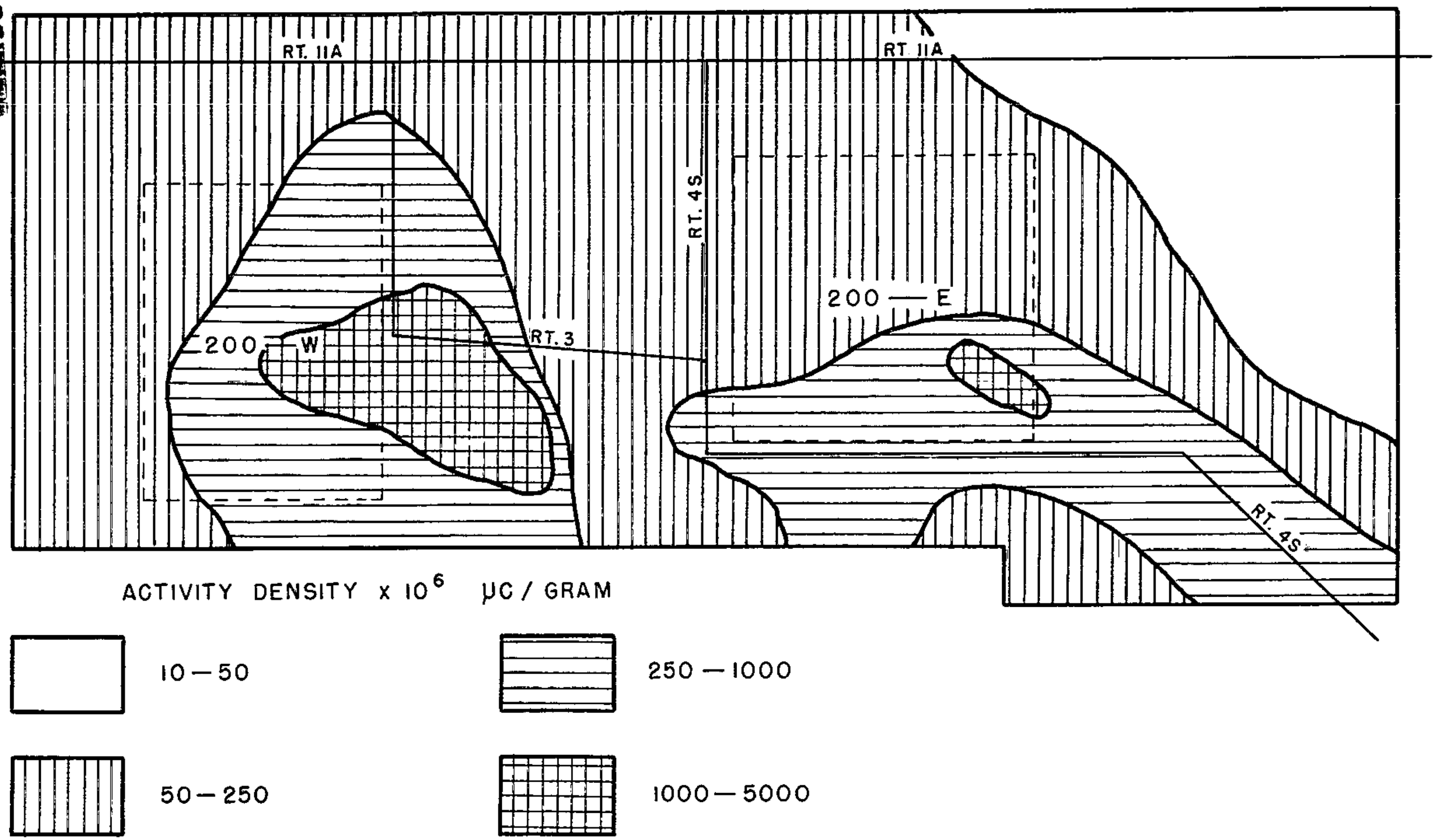
SECTION II

(Please refer to Figures 4, 5, 6, 7, and 8.)

ESTIMATED DISTRIBUTION OF I^{131} ACTIVITY DENSITY ON VEGETATION IN AND NEAR THE 200 AREAS

DECEMBER 7, 8, 1950

FIGURE — 4



DECLASSIFIED

UNCLASSIFIED

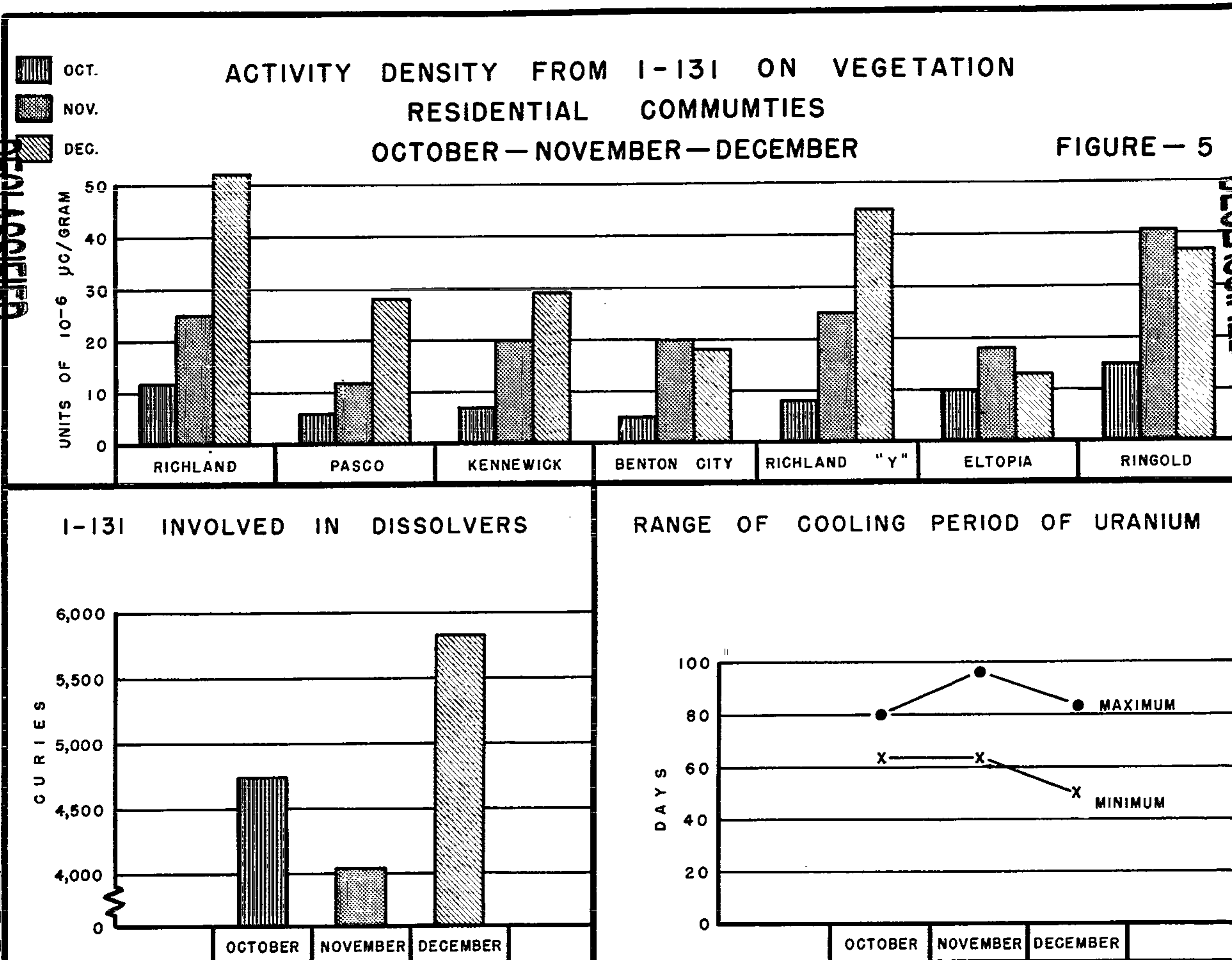
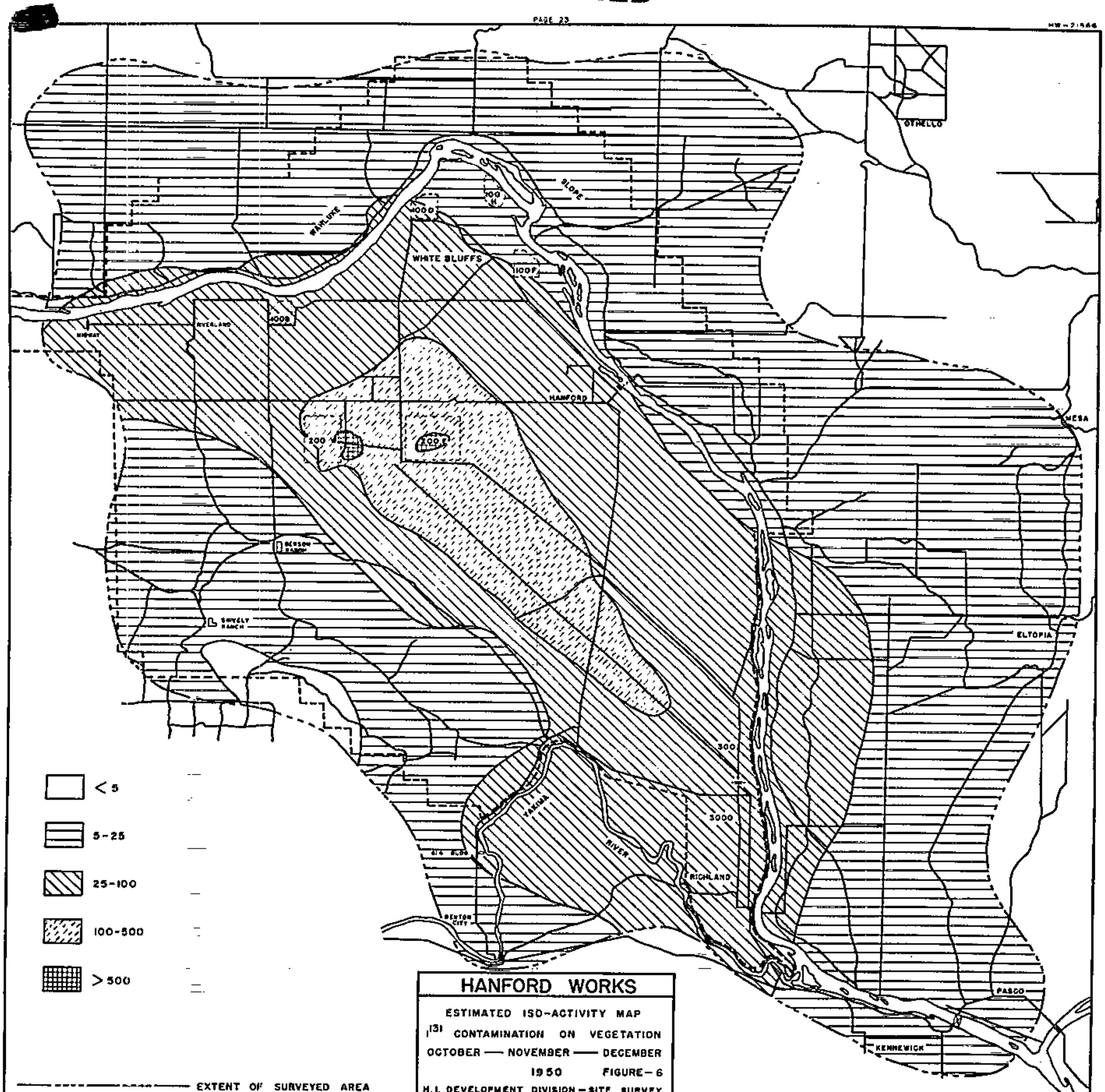

OCT.
NOV.
DEC.
ACTIVITY DENSITY FROM I-131 ON VEGETATION
RESIDENTIAL COMMUMTIES
OCTOBER — NOVEMBER — DECEMBER
UNITS OF 10-6 μc/GRAM
50
40
30
20
10
0
RICHLAND
PASCO
KENNEWICK
BENTON CITY
RICHLAND "Y"
ELTOPIA
RINGOLD
I-131 INVOLVED IN DISSOLVERS
CURIES
6,000
5,500
5,000
4,500
4,000
0
OCTOBER
NOVEMBER
DECEMBER
RANGE OF COOLING PERIOD OF URANIUM
DAYS
100
80
60
40
20
0
MAXIMUM
MINIMUM
OCTOBER
NOVEMBER
DECEMBER

FIGURE — 5



HANFORD WORKS

ESTIMATED ISO-ACTIVITY MAP

I^{131} CONTAMINATION ON VEGETATION

OCTOBER — NOVEMBER — DECEMBER

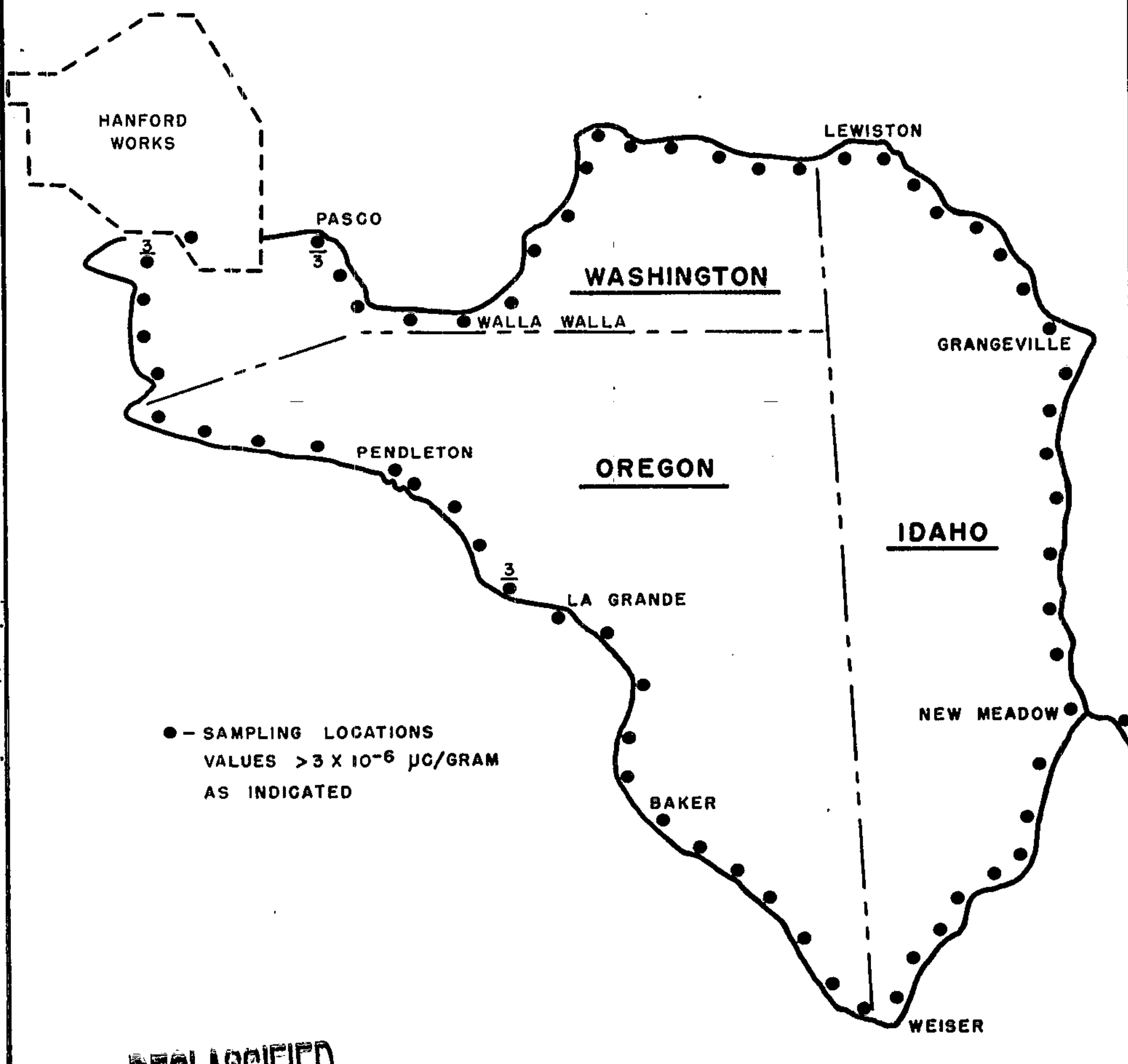
1950 FIGURE-6

H.I. DEVELOPMENT DIVISION—SITE SURVEY

I^{131} CONTAMINATION ON VEGETATION OFF AREA

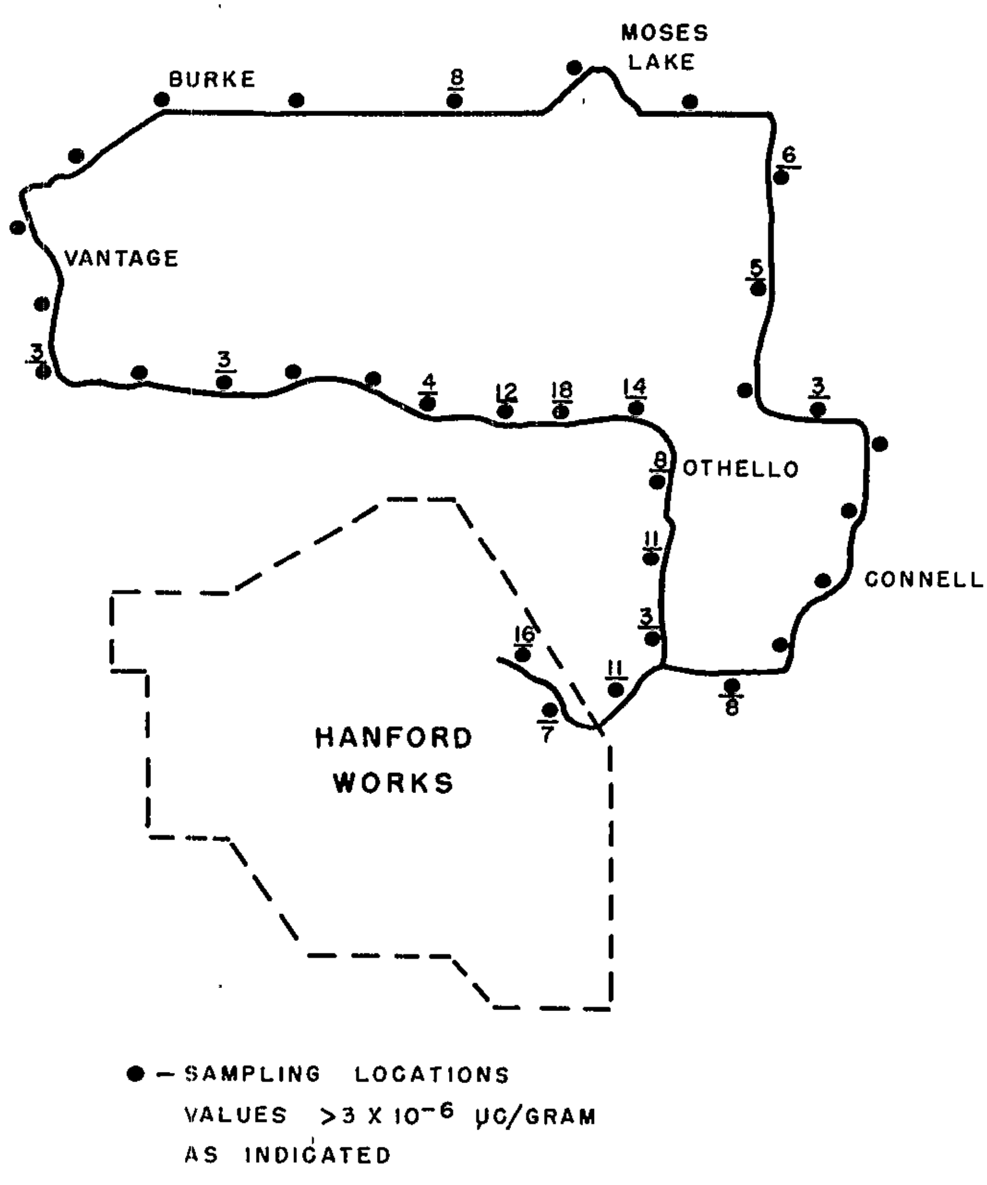
OCTOBER —— 1950

FIGURE – 7



I^{131} CONTAMINATION ON VEGETATION OFF AREA OCTOBER — 1950

FIGURE — 8



SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Various types of monitoring equipment were employed at representative air monitoring stations to determine the activity density of beta emitters in the atmosphere and air borne radiation dosage rates. These stations were located within the Hanford operating areas and in the residential communities around the project perimeter. Several stations were maintained at remote locations in neighboring states to evaluate background and natural activity in the atmosphere. The remote stations were also employed to evaluate any activity which may originate from sources other than the Hanford Works. The more common types of monitoring included portable type ionization chambers, air filtering devices, recording types of instruments and air scrubbing devices. In addition to the measurements accomplished at the fixed stations, various types of portable equipment were used at random field locations in the immediate environs. Portable equipment consisted mainly of detachable ionization chambers and manually operated air pumps which propel various volumes of air through filters and scrubbers. A map showing the location of most of the monitoring stations used during this period may be referred to in a previous publication. (HW-18446)

Average radiation dosage rates in the operating areas of the Hanford Works and in nearby residential communities were determined by evaluating readings from the Victoreen integrons which were located at all fixed air monitoring stations. One integron unit was operated in the residential areas and 2 or 3 units were operated simultaneously in the operating areas. Radiation dosage rates were computed for 8 hour intervals throughout the period October, November, December, 1950; the average dosage rate per 24 hour period was computed from the accumulated 8 hour readings at each location. A summary of the average dosage rates determined in this manner is presented in Table I. (The values include the measurement of natural background.)

TABLE I

AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS

OCTOBER, NOVEMBER, DECEMBER

1 9 5 0

units of mrep per 24 hours

Location	Number of units	October	November	December	Quarterly Average
100-B Area	3	0.4	2.4	0.1	1.0
100-D Area	3	*	2.0	0.7	0.9
100-F Area	3	0.3	*	0.4	0.2
100-H Area	3	0.3	0.7	0.3	0.4
200 West Area	2	0.7	1.2	0.3	0.7
200 East Area	3	0.5	0.7	0.5	0.6
Riverland	1	0.1	0.8	0.2	0.4
300 Area	1	0.2	0.5	0.8	0.5
Richland	1	0.8	1.0	0.9	0.9
Pasco	1	0.9	0.8	0.5	0.7
Benton City	1	0.3	0.7	0.8	0.6
North Richland North	1	0.3	0.4	0.5	0.4
North Richland South	1	0.7	1.7	1.0	1.1
Hanford 614	1	0.1	0.5	<0.1	0.2

* These readings were voided due to faulty instrumentation.

A review of the data indicates that at the 14 locations summarized above, decreases occurred at 8 stations and increases were noted in 5 instances. The increases tended to be weighted by the higher readings which occurred during the month of November. In general, small but significant increases were noted at practically all stations during the middle of the quarter; these higher readings were not associated with any significant change in plant operation but were attributed to meteorological conditions which were accompanied by a considerable amount of fog over this region during this period. Similar increases have been noted during other years when fog persists and tends to confine the aerosol activity near the ground level. Some of the higher readings noted at 100-B and 100-D during November may not be quite as pronounced as indicated by the data as some question was assigned to the operating conditions of the instruments in these areas; readings which appeared questionable when examining the data were included in the averages in all cases. With the exception of the November data, the average dosage rates observed during the remaining months were not indicative of any change or trend from expected or previous measurements.

"C" type detachable ionization chambers were exposed at each of the air monitoring stations to confirm the recorded data from the Victoreen integrons. Radiation dosage rates were evaluated by using the minimum reading of two chambers; erroneous readings which may have been attributed to faulty chamber construction or excessive leakage were deleted.

TABLE II
"C" TYPE DETACHABLE IONIZATION CHAMBER MONITORING
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

(mrep per 24 hours)

Location	October	November	December	Quarterly Average
100-B Area	0.3	0.3	0.4	0.3
100-D Area	0.5	0.5	0.6	0.5
100-F Area	0.4	0.4	0.4	0.4
200 West Area	0.4	0.3	0.4	0.4
200 East Area	0.6	0.6	0.6	0.6

The dosage rates computed from the readings of "C" type ionization chambers during the current period were nearly identical to those observed during the previous quarter. Maximum deviations noted when comparing the averages for the two periods did not exceed 0.1 mrep/24 hours at any location. Fluctuations on this order of magnitude were well within the variation expected in the range of natural background in this region.

The air borne radiation levels at intermediate field locations in the immediate environs were evaluated from the readings obtained from detachable "M" and "S" type ionization chambers. The chambers were exposed on wooden stands about 5 feet above ground level. Two chambers were used at each location and minimum readings were used in a manner similar to that used for the "C" type chambers. The frequency of reading these chambers varied with location and chamber capacity; normal frequency was on the order of 2 to 3 readings per week. Table III summarizes the results obtained from this monitoring program at representative locations during the period October, November, December, 1950.

[redacted]

TABLE III
RADIATION LEVEL OBSERVED WITH
"M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

units - mrep per 24 hours

Location	October	November	December	Quarterly Average
100 Area & Environs				
Rt. 1, Mile 8	0.44	0.52	0.67	0.54
Rt. 2N, Mile 10	0.37	0.41	0.46	0.41
Rt. 2N, Mile 5	0.38	0.42	0.47	0.42
White Bluffs	0.39	0.41	0.45	0.42
Rt. 11 A, Mile 1	0.66	1.05	1.23	0.98
Hanford 614 Building.	0.43	0.50	1.23	0.72
Intersection Rt. 1 & 4N	0.36	0.41	0.47	0.41
Hanford 101 Area	0.39	0.43	0.49	0.44
100-H Area	0.43	0.43	0.48	0.45
P-11 Area	0.16	0.44	0.45	0.35
100 DR Waterworks	0.56	0.52	----	0.54
Within 5 Miles of 200 East				
Rt. 4S, Mile 6	0.69	0.96	1.38	1.01
Batch Plant	0.48	0.78	0.02	0.76
Rt. 11-A, Mile 6	0.71	0.84	0.40	0.65
Rt. 3, Mile 1	0.59	0.80	1.20	0.86
Meteorology, 200'	1.26	1.18	1.26	1.23
Rt. 4S, Mile 2.5	1.15	0.79	2.58	1.51
Redox Area	1.20	1.12	1.10	1.14
Within 10 Miles of 200 East				
Rt. 4S, Mile 10	0.37	1.28	1.69	1.11
Rt. 10, Mile 1	0.44	0.99	0.80	0.74
Rt. 10, Mile 3	0.47	0.67	0.88	0.67
Rt. 2S, Mile 4	1.02	1.70	0.82	1.18
Near 300 Area				
Rt. 4S, Mile 16	0.38	0.53	0.95	0.62
Rt. 4S, Mile 22	0.40	0.79	0.67	0.62
North Richland North	0.26	0.40	0.43	0.36
North Richland South	0.09	0.38	0.57	0.35
300 Area	0.50	0.21	0.44	0.38
Outlying				
Richland	0.24	0.51	0.53	0.43
Benton City	0.46	0.51	0.39	0.45

A review of the data summarized in Table III indicates that increases approaching significance occurred in the region within a 10 mile radius of the 200 Areas. The average radiation level computed from seven stations located within a 5 mile radius of the stacks was 1.02 mrep/24 hours as compared with a previous average of

[redacted]

.81 mrep/24 hours. Four stations located beyond 5 miles but within 10 miles of the stacks showed a comparable increase from a previous 0.69 mrep/24 hours to 0.93 mrep/24 hours. Maximum measurements were noted at Route 4S, Mile 2.5 (between the 200 Areas)where the average dosage rate over the 3 month period was 1.5 mrep/24 hours; during December, this location showed an average of 2.6 mrep/24 hours. The latter measurement was one of the highest observed on the site by this method of monitoring during the year 1950. A review of the data on a month to month basis indicates that the dosage rates increased rather steadily throughout the period; December measurements represented a two fold increase over October averages in many cases. The above mentioned increase was not nearly as pronounced in the vicinity of the 100 and 300 Areas although an increasing trend was indicated at several locations throughout the period. Averages at several selected locations showed two fold increases when comparing October data to that of December; however, a comparison of quarterly averages for all locations within the immediate environs of the 100 and 300 Areas indicates no significant change. Monitoring at outlying locations in the vicinity of Richland and Benton City indicate that the radiation levels were within the normal fluctuation of natural background and essentially remained on the same order of magnitude as observed during previous quarters.

The increasing trend observed throughout the quarter was attributed to a general increase in the amount of I-131 involved in the dissolvers (see discussion in Section II) and also to the fog which prevailed over the environs during this period of the year. Similar increases which have been much smaller in magnitude were observed during this season in former years.

Small air filtering devices through which the air flow was 2.0 or 2.5 cfm were used to evaluate the activity density from filterable beta emitters in the atmospnere; CWS #6 filter paper was used and the exposed areas of the filter was 1.8 square inches. These small filters were exposed at a location for a period of one week after which they were held for several days to allow for decay of the daughter products of radon and thoron. The counting rates were determined using thin mica window tubes in which the window thickness varied from 3 to 5 mg/cm^2. The actual volume of air passing through a given filter was metered by using running time meters in conjunction with precalibrated motoair pumps. A summary of the results obtained from the measurements performed during the period October, November, and December, 1950 is presented in Table IV.

TABLE IV
AVERAGE FILTERABLE BETA ACTIVITY IN AIR
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Beta Emitters - Average Activity Density x 10^{14} µc/cc

Location	Maximum Week	October	November	December	Quarterly Average
200 Areas & Vicinity					
200 ESE	537	339	218	146	233
200 East Tower #16	1152	597	477	---	530
200 West Gatehouse*	1639	556	592	310	479
200 West Tower #14	978	117	289	391	277
Gable Mountain	368	135	73	61	90
Redox Construction Area	1059	27	440	443	314
2707 EA Twin Scaler #1	1153	---	519	187	377
2707 EA Twin Scaler #2	865	---	366	104	278
100 Areas & Vicinity					
100-D Area	199	82	112	77	89
100-H Area	178	116	71	74	86
Hanford 101 Building	175	41	72	69	61
Hanford 614 Building	607	24	33	193	79
White Bluffs	199	57	103	90	85
300 Area 614 Building	84	19	16	37	23
Outlying					
Richland	46	32	16	19	22
North Richland	255	124	49	73	79
Pasco	48	8	14	33	19
Benton City	161	17	25	52	31
Riverland	98	20	54	24	34

* This data does not include the results from the dual scaler unit at this location.

A review of the data summarized above indicates a general increase occurred in the average activity density from filterable beta emitters at many locations during this period. The magnitude of this increase varied throughout the project; two-fold increases were noted at many locations in the vicinity of the 100 and 200 Areas and in one extreme instance at Pasco the average activity increased from 1 x 10^{-14} uc/cc to 1.9 x 10^{-13} µc/cc. The maximum activity density was observed inside the separation areas where quarterly averages were 5.3 and 4.8 x 10^{-12} μc/cc at locations inside the 200 East and 200 West Areas, respectively. Maximum conditions over a one week period on the order of 1.0 to 1.6 x 10^{-11} μc/cc were observed at locations near the 200 West Gatehouse and the southeast corner of 200 East Area and inside the Redox Construction Area. The magnitude of these measurements represented significant increases over previous data at all locations except at the location in the southeast corner of the 200 East Area. It is of interest to note that all stations which show high results were located down wind from the separation areas stacks when reviewing in respect to the prevailing wind conditions. (Northwest 39 percent.) The current period represented the third consecutive quarter during which the maximum activity density from filterable beta emitters prevailed in the southeast corner of the 200 East Area. Monitoring in the vicinity of the 100 Areas indicated that maximum concentrations existed near Hanford where a result which was for a one week period showed an average of 6.1 x 10^{-12} μc/cc. On an over all basis, the average activity density in the immediate environs in the 100 Areas was 8.0 x 10^{-12} μc/cc. In residential areas, the highest quarterly average was noted at North Richland where an average of 7.9 x 10^{-13} μc/cc was comparable to a previous value of 5.4 x 10^{-13} μc/cc. This location also showed the maximum measurement for a one week period (2.6 x 10^{-12} μc/cc.) Small increases were also noted when comparing the results of Richland, Pasco, Benton City, and Riverland; however, the only significant change was noted when comparing the Pasco data.

A review of the above data on a month to month basis indicated no significant trend of change throughout the period. Considerable variation was noted between the various locations for the different periods and in general was attributed to the varying meteorological conditions previously discussed.

New air monitoring stations were established inside the Redox Construction Area and at the proposed site of the Semi-Works in the 200 East Area. Preliminary measurements indicate that the activity density from filterable beta emitters inside the Redox Area were among the highest measurements on the site, whereas the measurements performed at the Semi-Works indicate that the magnitude of activity is considerably lower than found at other locations in the 200 East Area.

Specific measurement for the activity density from I-131 was accomplished by placing caustic scrubbers in series with the air filters at representative locations. The caustic scrubbers consisted of approximately 2 liters of solution which contained 4 grams of sodium hydroxide and 1.6 grams of sodium carbonate to which a small quantity of sodium iodide was added as a carrier. Table V summarizes the results obtained from the measurement of the activity density of I-131 in the atmosphere by this method during the period October, November, December, 1950.

TABLE V
AVERAGE ACTIVITY DENSITY FROM I-131 DETECTED IN SCRUBBERS
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Location	Activity Density x 10^{14} µc/cc				
	Maximum Week	October	November	December	Quarterly Average
200 Areas & Vicinity					
200 West Gatehouse	2601	1171	386	549	678
200 ESE	1265	817	363	314	487
200 East Tower #16	20610	2630	258	660	1395
Gable Mountain	423	200	73	74	122
BY-SE	2330	786	607	---	697
Outlying					
100-H Area	177	62	29	59	49
300 Area	215	104	42	42	59
Richland	322	39	24	150	67
North Richland	88	45	8	51	34
Benton City	75	32	16	33	26

The increase in the activity density of I-131 which was noted toward the latter part of the previous quarter continued to prevail at nearly all the outlying monitoring stations, but tended to diminish somewhat at locations in the immediate vicinity of the 200 Areas. The latter fact was most noticeable in the 200 East Area where a station located in Guard Tower #16 indicated a decrease from a previous average of 7.6×10^{-11} µc/cc to a current average activity density of 1.4×10^{-11} µc/cc. Maximum concentrations were detected at this same location in October, during which period the average activity density from I-131 was 2.6×10^{-11} µc/cc including an average concentration over a 24 hour period of 2.1×10^{-10} µc/cc. In general, all maximum measurements noted during the quarter were observed during the month of October.

Weekly concentrations on the order of 2.2×10^{-12} µc/cc in the 300 Area and 3.2×10^{-12} µc/cc at Richland during October were nearly 10 times greater than the average noted during the period July, August, and September. In general, a comparison of the average activity density from I-131 in the atmosphere at representative locations with similar data obtained during the same period in 1949 when a batch of 20 day metal was dissolved at Hanford (HW-17003 & HW-17381) indicates that a number of present values were higher than those during the previous year. For example, during December of 1949, the average activity density from I-131 was 4.6×10^{-12} µc/cc in the southeast corner of the 200 East Area as compared with an average of 8.2×10^{-12} µc/cc during October of 1950.

In Richland in December the average of 1.5×10^{-12} µc/cc represented a five-fold increase over the average activity density measured at this location during the month of December, 1949.

Control sampling was maintained on a daily basis in the 200 East Area for the purpose of evaluating daily concentrations of 8 day iodine in the atmosphere. Scrubber samples were collected over a 16 hour period from 4:00 p.m. of one day to 8:00 a.m. of the following day; this interval was representative of the bulk of the dissolving during any given day. Twenty-two samples obtained in this manner during October showed the average activity density from I-131 to be 2.6×10^{-11} µc/cc with maximum measurements as high as 2.1×10^{-10} µc/cc. Eleven measurements during the month of November which were made after the installation of the silver reactor indicated an average of 2.2×10^{-12} µc/cc, or roughly a decrease by a factor of 10 when compared to pre-reactor measurements. During the month of December, some of the dissolving was performed in the cell in which the reactor was installed and the remaining batches were dissolved in a cell which did not have a reactor in the off-gas line. Twelve samples were collected when the silver reactor was not in use and seven were taken while the reactor was in operation. During the periods when the reactor was not used, the average activity density from I-131 was 8.4×10^{-12} μc/cc, excluding one extreme maximum measurement of 1.9×10^{-10} μc/cc. The next highest value in this group of measurements was 3.6×10^{-11} μc/cc. Samples collected while the silver reactor was in use showed an average activity density of 3.7×10^{-12} μc/cc including a maximum measurement of 1×10^{-11} μc/cc. This comparison offered the first opportunity to evaluate the true efficiency of the silver reactor in respect to the mean concentration of I-131 in the atmosphere. Preliminary measurements indicated that the reactor reduced the amount of I-131 in the atmosphere by a factor on the order of two, however, the comparison does not account for the effect of the variable meteorological conditions at the time the samples were obtained.

Fifty-three portable scrubber samples were obtained to evaluate peak I-131 concentrations during dissolving periods in October and November. These samples represented a volume of 10 liters of air which was propelled manually by means of a MSA pump through a small scrubber solution which did not exceed a volume of 50 cc. The composition of the scrubber solution was identical to that used in the fixed scrubbers discussed previously. Thirty-four samples obtained during October indicated an average activity density of 3.0×10^{-10} μc/cc. During November, 19 samples indicated an average of 3.2×10^{-10} μc/cc including a maximum measurement of 2.9×10^{-9} μc/cc. Maximum values ranging from 2.0 to 3.0×10^{-10} μc/cc tended to prevail when the sampling locations were with the separation areas. Lower values on the order of 10^{-13} μc/cc were obtained in the vicinity of Hanford and 100-F Area.

Another means of evaluating the activity density of I-131 during periods of dissolving consisted of using a large scrubber at a location directly down wind from the separation area stacks. Portable mobile equipment was used to establish the location and provide the power to operate motoair pumps at a rate of 2.5 cfm. The sampling periods for this type of monitoring varied from 30 minutes to 3 hours; the interval being dependent upon the duration of the dissolving period along with the duration of the prevailing wind in a fixed direction. The maximum measurement noted when analyzing the results from over 70 samples obtained in this manner indicated that the activity density of I-131 was 1.6×10^{-8} µc/cc for a one hour period in the 200 East Area. This sample was obtained during a light snow fall while the dilution ratio averaged about 650:1. The mean wind velocity was 5 mph and the sample was collected about an hour after the dissolving startup. This sample was especially high when compared with the remaining measurements. The next highest measurement noted indicated the activity density to be 8.2×10^{-10} µc/cc. This value was obtained at a location 6000 feet southwest of the 200 East stack during a period when the atmospheric dilution ratio was 1500:1 with the wind prevailing from the northeast at a velocity varying from 20 to 25 mph. VGM readings were 160 c/m above background at this time. Another sample obtained in a similar manner at a location about 8000 feet southwest of the 200 West stack about 2 hours later indicated a value of 7.6×10^{-10} µc/cc. VGM readings at this time were 140 c/m above background. The latter two samples discussed above were obtained about 4 hours after the startup of the dissolving operation in the 200 Areas. A review of all mobile scrubber results excluding the one high result indicated that the mean measurement was on the order of 10^{-10} µc/cc; the average activity density was 8.4×10^{-10}, 6.4×10^{-9}, and 3.3×10^{-12} µc/cc during the months of October, November, and December, 1950, respectively.

The small air filters which were obtained from the locations indicated in Table IV were radioautographed about a week after they were counted to determine the number of active particles in the atmosphere. These filters were exposed to type K X-ray film for 168 hours using a sheet of polythene as the only shield between the filter and the film. The number of active particles on a filter was determined by visually counting the number of darkened spots on the developed film. The sensitivity of this method of measurement as determined by control standards which consisted of small particles of resin which were soaked in activated solutions, was on the order of 5 dis/min/particle. Table VI summarizes the results obtained from this program for all locations which indicated a detectable number of particles during

TABLE VI
SUMMARY OF PARTICLE DEPOSITION ON SMALL FILTERS
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Units of 10^{-3} particles/meter^3 air sampled

Location	Total Air Sampled m^3	October Average	November Average	December Average	Quarterly Average
200 Areas & Vicinity					
ESE Decade Filter	8274	0.9	2.8	6.9	3.2
2707 EA #1	1812	---	8.3	9.9	9.4
2707 EA #2	2164	---	9.7	3.0	5.5
200 East Tower #16	6173	7.2	0.9	6.4	4.8
200 WEC Decade	8573	3.9	9.3	8.3	6.9
WEC Twin #1	747	---	---	34.8	34.8
WEC Twin #2	618	---	---	46.9	46.9
200 West Tower #15	5144	< 1.6	1.2	2.5	1.7
200 West Tower #4	6131	6.5	1.3	0.6	3.3
Gable Mountain	8430	1.6	2.1	<0.5	1.3
Hanford 101 Building	8994	< 0.4	< 0.4	0.4	0.1
100-HSE	7367	0.7	< 0.4	2.2	1.0
100-D	9172	0.6	0.7	< 0.4	0.7
Hanford 614 Building	8891	< 0.4	< 0.4	1.1	0.3
White Bluffs	8930	0.4	1.1	1.4	1.2
300 Area Decade	7664	0.4	1.8	< 0.4	1.2
Outlying Locations					
Benton City	6575	< 0.4	< 0.7	1.7	0.6
Pasco	8838	< 0.4	0.4	0.7	0.5
North Richland North	7177	< 0.4	0.4	< 0.5	0.3
Riverland 614 Building	9049	< 0.3	1.4	< 0.4	0.4
Richland 614 Building	6937	< 0.5	< 0.4	0.4	0.1

any part of the period October, November, December, 1950.

A review of the above summary indicates that with few exceptions, the number of particles in the atmosphere was well within the order of magnitude expected. The installation of dual air monitors in the 200 WEC 614 building (near the 200 West gatehouse) provided a new monitoring location and the results obtained from the first measurements during December indicated values which were approximately 5 times greater than those observed at nearby locations. No assignable cause would account for this increase and continuation of this type of monitoring at this location will indicate whether these measurements represent mean values or whether they are outstandingly high for the period. Generally speaking, the average particle concentration in the atmosphere remained on the order of 10^{-3} particles/meter^3 at locations in the immediate environs of the 200 Areas and continued to average less than 1.0 x 10^{-3} at outlying locations and in residential communities.

The monitoring program which was designed for the specific purpose of determining the active particle concentration in the atmosphere at representative locations in the environs and at remote locations was continued during this period. Large filters of CWS #6 type paper (4" x 7") were used in conjunction with an air flow of 2 or 10 cfm. The filters were changed at weekly intervals and were exposed within one week of their removal at locations in the immediate environs and within 2 weeks of their removal at outlying locations in the states of Washington, Idaho, Oregon, and Montana. These filters were exposed to type K X-ray film for a period of 168 hours using a thin sheet of polythene (.002 inches) as a cushion. The number of particles deposited on the filters was determined by counting the number of darkened spots on the developed film. These values were used along with the total air flow as determined by the number of metered hours of operation on a pre-calibrated pump, to determine the concentration of radioactive particles in the atmosphere. Table VII summarizes the results obtained from this monitoring program during the period October, November, December, 1950.

The data summarized in Table VII indicates that a probable increase occurred in the number of active particles present in the atmosphere at many locations. Filters which were located at elevations between 150 and 400 feet on the Meteorology Tower indicate definite increases which approach a factor of five and represent the most significant increases noted during the period for this type of monotoring. Other increases appeared at random locations in the immediate environs of the 200 Areas; however, the magnitude of these results was on the order expected when compared to measurements obtained during previous periods in the year 1950.

The results obtained from particle monitoring inside the 200 East and 200 West B and T exclusion areas at the laboratory buildings indicate that the maximum number of particles in the atmosphere in the environs of the Hanford Works exist inside the

TABLE VII
SUMMARY OF PARTICLE DEPOSITION
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Units of 10^{-3} particles/meter^3

Location	Total Air Sampled m^3	October Average	November Average	December Average	Quarterly Average
200 East Vicinity					
2704 Outside	8,655	1.4	0.7	4.0	2.1
H. I. Garden	9,166	7.2	1.1	3.3	4.0
BY-SE	7,969	66.5	53.8	577.6	257.7
BY-NE	9,168	2.4	4.3	14.9	7.1
"B" Gate	8,998	16.0	1.4	11.3	9.9
222-B Outside	5,023	17.9	12.4	39.8	27.5
2701 Outside	6,460	3.7	1.5	13.5	5.4
2704 Inside	9,193	2.4	5.3	18.6	8.6
221-B	9,061	10.0	29.4	40.4	26.2
222-B Hall	9,171	29.7	13.1	66.2	36.6
222-B Lab.	7,411	223.1	720.5	480.6	421.4
2701 Outside	8,649	2.3	2.2	12.1	5.4
200 West Vicinity					
2701 Outside	8,806	6.0	6.0	6.4	6.1
2722	8,651	19.3	7.8	9.2	12.0
"T" Gate	9,159	4.8	8.9	6.6	6.7
222-T Outside	9,172	62.1	12.4	28.4	46.7
231	6,845	3.1	5.2	11.6	6.7
South Guard Tower	5,434	1.2	0.4	7.3	2.6
"U" Gate	5,026	3.5	2.7	------	3.2
West Guard Tower	9,138	1.5	0.7	4.3	2.2
2701 Inside	9,114	8.7	5.0	24.0	12.7
272	8,673	4.6	8.9	9.6	7.7
222-T Hall	9,133	83.9	27.7	169.7	95.1
222-T Lab	9,164	382.0	338.5	490.9	404.5
Meteorology Tower					
3'	33,116	1.8	1.3	1.3	1.5
50'	33,116	1.8	1.4	1.5	1.5
100'	26,297	2.3	1.5	1.7	1.9
150'	22,983	40.9	6.3	1.6	16.0
200'	21,230	26.4	1.2	1.9	10.0
250'	19,411	30.0	3.6	2.3	11.0
300'	19,410	17.3	1.4	1.9	6.1
350'	10,717	6.9	2.0	*	5.1
400'	13,243	10.5	4.1	1.1	5.3

* Filters representing this period were lost in process.
The values reported above are determined by dividing the number of particles detected by the total volume of air passed through the filters. If no active particles are found on the filters, a value of one particle is assumed and this is then divided by the total air flow to determine the detection limit of the particular measurement. Quarterly averages were computed by using the total volume of air and the total number of particles and do not represent the mean average of the three values represented for the months involved.

222 buildings. The average number of particles exceeded 0.4 particles/meter^3 in room 7 of each of the laboratory buildings; filtering units located in the hallways which adjoin these rooms showed 0.04 and 0.1 particles/meter^3 at the 222-B and 222-T buildings, respectively. Monitoring directly outside of these buildings indicated values on the order of 0.03 to 0.05 particles/meter^3. The higher values detected at each of these locations tend to confirm observations noted in the past; however, the current measurements were indicative of a significant increase at each area.

Table VIII summarizes results obtained from the particle monitoring program which was used at locations around the project perimeter, in nearby residential communities, and at remote stations in Washington and adjoining states.

A review of the data summarized in Table VIII indicates that the results obtained during the present period were not indicative of any significant trend or deviation from previous measurements. Particle concentrations in the atmosphere were less than 1.0×10^{-3} particles/meter^3 at all remote locations and in all residential communities during each of the months during the quarter. Random particles were detected at the 300 Area and at the 100-D Area; however, the magnitude was well within normal fluctuations experienced in this type of monitoring.

TABLE VIII
SUMMARY OF PARTICLE DEPOSITION
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Units of 10^{-3} particles/meter^3

Location	Total Air Sampled m^3	October Average	November Average	December Average	Quarterly Averages Fourth	Third
Area Locations						
100-B Area	26452	0.3	0.7	0.6	0.5	0.3
100-D Area	35241	0.4	1.8	2.4	1.5	0.6
White Bluffs	32810	0.1	0.1	0.7	0.3	0.2
100-F Area	36414	0.1	1.1	1.0	0.6	0.6
300 Area	35683	0.6	3.9	1.3	1.6	0.8
Foster Ranch	21573	---	0.3	0.6	0.5	---
Off Area Locations						
Benton City, Wash.	36512	0.1	0.1	0.5	0.2	<0.1
Pasco, Wash.	34340	0.1	<0.1	0.4	0.2	0.2
Richland, Wash.	35853	0.1	0.1	0.2	0.1	<0.1
Boise, Idaho	9051	0.4	0.4	<0.4	0.2	<0.2
Klamath Falls, Ore.	7108	<0.5	<0.9	<0.3	<0.2	<0.2
Stampede Pass, Wash.	12911	<0.3	<0.3	<0.3	<0.1	<0.1
Great Falls, Mont.	9525	<0.3	<0.4	<0.4	<0.2	<0.2
Walla Walla, Wash.	12906	<0.3	<0.2	<0.3	<0.1	<0.1
Meacham, Ore.	9294	<0.3	<0.4	<0.4	<0.2	<0.1
Lewiston, Idaho	12839	<0.2	<0.3	<0.3	<0.1	<0.1
Spokane, Wash.	34289	<0.1	<0.1	<0.2	<0.1	<0.1

SECTION III

SECTION IV

RADIOACTIVE CONTAMINATION IN THE HANFORD WASTES

The determination of the magnitude and extent of radioactive contamination in Hanford Wastes was accomplished by obtaining samples of the liquid and solid wastes material and analyzing for the activity density of the alpha and beta emitters; radiation levels at open waste areas and over the nearby terrain were determined by using portable instrumentation such as VGM's and CP meters. The results obtained from this monitoring program for the period October, November, December, 1950 are summarized separately for the 100, 200, and 300 Areas.

100 AREA WASTES:

Two hundred and sixty-seven samples were obtained from the outlet side of the 107 basins at the 5 pile areas of the Hanford Works. The methods and techniques employed in the radiochemical analyses to determine the activity density of the alpha and beta emitters in this waste material were identical to those presented in previous documents of this series.[HW-20700] A summary of the results obtained is presented in Table I; this tabulation represents the activity density during normal operating periods in the 100 Areas. In every case, the samples were analyzed on the same day that they were collected, thereby eliminating the application of exorbitant decay corrections to the counting results.

A general increase approaching a factor of two was noted in the activity density of the beta emitters at all pile areas during this quarter. This increase was weighted during the month of December during which period all of the maximum values tabulated above were measured. The current increase in the power levels of the pile areas was the only assignable cause for the increase in the activity density of gross beta emitters. A review of the operating data indicates that general increases in power levels were noted at each of the operating areas; a significant change occurred when the 100-DR Area started up during early October and reached maximum power level before the expiration of the quarterly period.

TABLE I
RADIOACTIVE CONTAMINATION IN THE 107 BASINS
DURING PERIODS OF NORMAL PILE OPERATION
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Location	No. Samples	Alpha Emitters Average Activity Density dis/min/liter	Beta Emitters Activity Density x 10^4 μc/cc Maximum	Beta Emitters Activity Density x 10^4 μc/cc Average
100-B Area	51	8	15.9	6.9
100-D Area	56	8	10.0	5.8
100-DR Area*	47	8	16.1	7.1
100-F Area	59	8	33.0	9.1
100-H Area	54	8	38.5	7.4

* The 100-DR pile started up on October 3, 1950; evaluation of the activity density from alpha emitters and beta emitters in this effluent water will be included in all future reports.

The activity density of alpha emitters averaged less than 8 dis/min/liter at each area; however, several spot samples indicated detectable alpha activity; 3 samples from the 100-B retention basin obtained during October showed the activity density from the alpha emitter of plutonium to be 8, 12, and 25 dis/min/liter, respectively. Another sample obtained from the 107-D basin indicated alpha activity from plutonium of 12 dis/min/liter. Resamples obtained within 24 hours after the initial measurement did not confirm the original positive values and tend to allow some consideration to the possibility of cross contamination in the laboratory. Several spot samples were obtained from each of the 107 basins for the specific measurement of the activity density from polonium with all results indicating less than 6 dis/min/liter from this source.

During the course of a river survey opposite the 100-D Area a leak was observed bubbling from the 107 effluent pipe which passes through an island located in the Columbia River. Radiochemical analyses of several samples of this water indicated that the activity density of gross beta emitters ranged from 3.0 to 5.5 x 10^{-4} μc/cc. The magnitude of this activity correlated favorably with that noted in the basin water (averaged 6.6 x 10^{-4} μc/cc during November) and indicated that the source of the liquid was an apparent break in the effluent pipe. Several samples of floating material were obtained from dormant waters along the shore of the island; the activity density of gross beta emitters in this solid material was on the order of 6×10^{-2} µc/gram with a range of values between 4 and 8×10^{-2} µc/gram.

Investigation of a temporary leak at the 107-H basin during November showed radiation levels on the order of 500 c/m (VGM) at points below the spillway and along the shore of the Columbia River. Seepage was observed as far down stream as 600 feet below the spillway. Radiochemical analyses of samples obtained from various locations in this region indicated that the activity density of gross beta emitters ranged from 4.3×10^{-6} µc/cc to 5.5×10^{-6} µc/cc along the shore of the river between the 100-H Area spillway and a point approximately 400 feet below the spillway. The activity density was 3.9×10^{-6} µc/cc about 500 feet below the spillway where the seepage from the basin formed a small stream flowing into the river proper. At points greater than 600 feet below the spillway, surface samples of the river obtained near the Benton County shore ranged between 9.9×10^{-7} µc/cc and 2.1×10^{-6} µc/cc. The latter values did not represent highly significant deviations from the normal activity density found in the Columbia River and the possible effect of this leak was not observed in samples taken from the 100-F Area inlet water. Down stream sampling did not indicate any significant change from normal anticipated activity levels. A mud sample collected about 350 feet below the 100-H Area spillway showed the activity density of beta emitters to be 6×10^{-5} µc/gram; this value represented an increase by about a factor of 5 when compared with normal measurements.

One hundred and fifty-three samples were obtained from the sump tank in the waste line at the Biology Farm in the 100-F Area. Two representative samples were obtained during each twenty-four hour period. A sample obtained immediately before flushing represented the normal activity in the sump, whereas the after flushing samples indicated the peak concentration emitted to the river when the accumulated waste is washed into the effluent line. The results obtained from the analyses of these samples indicated that the average activity density of I-131 in the sump previous to flushing was 1.2×10^{-5} µc/cc. The average value for the after flushing period was 6.2 x 10^{-5} μc/cc. Maximum measurements as indicated in the after flushing samples showed peak concentrations to be on the order of 5.5 x 10^{-4} μc/cc. The above values represent about a three fold increase over the averages measured during the previous quarterly period. It was estimated that approximately 6 milli-curies of I-131 were discharged into the Columbia River on a daily basis.

Weekly samples were obtained from a location along the Benton County shore near the Hanford Ferry for the purpose of determining the activity density of I-131 in the Columbia River. Although many of these samples indicated that the activity density was below the detectable limit of 5 x 10^{-8} μc/cc, the over all average for the 3 month period was 8 x 10^{-8} μc/cc. Maximum measurements were on the order of 1.9 x 10^{-7} μc/cc. This magnitude of activity was in reasonable agreement with similar measurements obtained during September, 1950, when the average activity density of I-131 in the Columbia River at this location was 1 x 10^{-7} μc/cc.

200 AREA WASTES:

Nearly four hundred samples of water and mud were obtained from various open waste zones in and near the 200 Areas. Table II summarizes the results obtained from the radiochemical analyses for the activity density of alpha and beta emitters in these samples. (Refer to Table II on the following page.)

The radioactive contamination measured in the 200 Area waste systems was comparable in magnitude to that detected during earlier surveys. With the exception of one or two isolated individual measurements, the results tabulated in Table II did not differ significantly from the order of magnitude expected. Two of the beta measurements obtained in samples from the Laundry Ditch and U Swamp (2.4 and 3.1 x 10^{-6} uc/cc) were exceptionally high for these locations; however, the inability to duplicate the measurement by resampling tend to invalidate these results.

[redacted]

TABLE II

RADIOACTIVE CONTAMINATION IN THE 200 AREA WASTE SYSTEMS

OCTOBER, NOVEMBER, DECEMBER

1 9 5 0

Location	No. Samples	LIQUID SAMPLES Alpha Emitters Activity Density dis/min/liter		Beta Emitters Activity Density x 10^7 µc/cc	
		Maximum	Average	Maximum	Average
T Swamp	36	110	8	4	1
U Swamp	22	39	15	31*	<1
Laundry Ditch	24	250	40	24*	1
231 Ditch	24	81	18	1	<1
200 E "B" Ditch	34	28	< 6	66	14
200 E "B" Swamp	22	17	< 6	27	8
234-35 Ditch	13	76	14	1	1
200 E Retention Pond	46	58	< 6	100	17
200 W Retention Pond	37	9	< 6	7	2
234 Retention Pond	5	70	20	--	--
Laundry Rinse Water	9	4000	1300	72	26
		SOLID SAMPLES dis/min/gram		Activity Density x 10^5 µc/gram	
T Swamp	26	970	160	15	5
Laundry Ditch	13	38	10	16	4
200 E "B" Ditch	35	69	< 6	410	120
200 E "B" Swamp	24	7	< 6	260	59
234-35 Ditch	12	89	45	2	1
Laundry Lint	13	690	180	160	31

* These results were the maximum results for the year and were not included in the average.

Periodic analyses for the activity density of the alpha emitter from uranium in waste indicated the majority of results to be less than 4 µg U/liter. As in the past, samples obtained from the Laundry Ditch indicated significant quantities of uranium; individual measurements showed 33 µg U/liter in the water and 130 µg U/gram in the mud. Some of this activity was also noted at the U Swamp in lesser quantities.

In addition to the analyses for alpha emitters by the ether extraction and the fluorophotometer methods, specific measurements for the activity density of the alpha emitter of plutonium indicated detectable activity in the T Swamp and 234-235 ditch. Maximum measurements were 550 dis/min/liter and 410 dis/min/gram in the water and mud from the T Swamp, and 100 dis/min/gram in the mud along the shore of the 234-235 ditch.

[redacted] [redacted]

Five representative aliquots of composite samples which represent a number of small samples obtained from each batch of retention water at the 234-235 area showed the average activity density of alpha emitters to be 20 dis/min/liter including a maximum of 70 dis/min/liter.

Portable instrument surveys (VGM) over open terrain and along the edge of open waste areas indicated that radiation levels on the order of 200 to 500 c/m above background prevailed at most locations. In extreme cases, instrument monitoring showed readings of 10,000 c/m above background along the 200 East Area B ditch and swamp and 3200 c/m above background along the Laundry Ditch in the 200 West Area. Radiation levels in the vicinity of the 200 North Area ditches approached 125 mrep/hour at the North Ditch. Maximum readings at the P and R ditches were 40,000 and 30,000 c/m, (VGM) respectively.

300 AREA WASTES:

Table III summarizes the results obtained from the measurement of the activity density of alpha and beta emitters in the 300 Area waste ponds during October, November, and December, 1950.

TABLE III
RADIOACTIVE CONTAMINATION IN 300 AREA WASTES
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Location	No. Samples	Beta Emitters Activity Density x 10^7 µc/cc		Alpha Emitters Activity Density dis/min/liter		µg U/liter	
		Maximum	Average	Maximum	Average	Maximum	Average
Old Pond Inlet Liquid	11	24	9	12000	5000	21000	3000
New Pond Inlet Liquid	11	9	3	5000	1200	3100	970
300 Area Waste Line	61	69	4	6000	1200	3600	730
		Activity Density x 10^3 µc/gram		Activity Density dis/min/gram		µg U/gram	
Old Pond Inlet	10	3.9	0.5	2300	600	1200	420

A review of the above data indicated very little change or trend when comparing the results with those measured during the previous quarter. In general, the analyses for the activity density of alpha emitters by the ether extraction method showed significant quantities of this activity in nearly every sample analyzed from the ponds. This activity was identified as uranium in nearly all cases.

Forty-seven of the samples that were obtained directly from the 300 Area waste line were analyzed for the activity density of the alpha emitter from plutonium. Although a considerable number of these samples indicated this activity to be less than 6 dis/min/liter, several isolated samples showed quantities ranging from 20 to 160 dis/min/liter. The average of all samples analyzed was 10 dis/min/liter. The latter figure was nearly identical to the average of 11 dis/min/liter which was found during the previous quarterly period.

The amount of uranium in the two 300 Area waste ponds was estimated from the results of surveys performed on December 18 and 19, 1950. The surveys of these two waste regions included the measurement of the pond area, depth soundings, estimations of the total liquid volume in each of the ponds and the obtaining of liquid samples at various depths along with mud samples for the subsequent readichemical analysis of the activity density from the alpha emitters. All samples were analyzed by the fluorophotometer method to determine the activity density of the alpha emitter of uranium.

Forty water samples and twenty-five mud samples were obtained from the new pond. These samples were obtained in a cross-section manner at intervals of approximately 200 feet across the surface of the pond. Representative depth samples were taken below each of the surface sample locations and mud samples were obtained from the bottom of the pond immediately below these depth samples. Figure 9 shows the general lay out of the pond as measured on this date and also indicates the location from which each series of samples were obtained. The results obtained from the analyses of 250 cc samples from the new pond showed no significant difference at the various depths. On this basis, all results were combined and an over-all average activity density for the alpha emitter of uranium was determined. The average activity density from uranium in the water of the new pond was 670 µg U/liter; the general order of magnitude of the individual samples ranges from 300 µg U/liter to 1200 µg U/liter.

The total liquid volume in the new pond was determined from the measured area and the results of the depth soundings; this volume on December 18 was 17.8 x 10^6 gallon. Assuming the average activity density as determined from the analyses of 40 water samples to be reasonably representative of the amount of uranium in the water of the new pond, it was computed that approximately 100 pounds of uranium is in the liquid of the new pond.

A further analysis of the activity density in the water of the new pond showed a representative pattern when these results were plotted over the area from which the samples were obtained. The higher activity density from uranium was found at and around the inlet where a small region showed the activity to be greater than 900 µg U/liter; the activity density tended to diminish from this maximum region to the far extremes of the pond proper where a general level of the order of 600 µg U/liter prevailed. An estimated distribution of the activity density from uranium in this water is presented in Figure 10.

Analyses of one-gram samples of mud obtained from the locations indicated in Figure 9 showed the average activity density from the alpha emitter of uranium to be 3280 µg U/gram in the solid material at the base of the pond. As expected, considerable variation was observed in the activity density found in the various samples; the maximum result was 37,700 µg/gram. An estimation of the total amount of uranium deposited at the base of the pond would be extremely difficult due to the wide variation noted in the individual samples and due to the lack of means to measure the actual depth of the deposition at the base of the pond. Visual observations indicated that the mud and algae at the bottom of the new pond did not exceed one inch in any case and apparently averaged on the order of 1/2 inch throughout the entire survey. Most of the mud samples contained small amounts of sand from the base of the pond proper.

On December 19, the old pond was surveyed in a manner similar to that described above. The frequency of sampling was somewhat reduced because a tule growth prevailed over much of the surface of the old pond. Representative sampling locations were established at intervals of approximately 200 feet at the locations indicated on Figure 11 . The extent of the tule growth in the old pond may also be appraised from a review of Figure 11 . The liquid volume in the old pond on December 19 was 5.5×10^6 gallon. The average activity density from the alpha emitter of uranium was 570 μg/liter ranging from a minimum of about 300 μg U/liter. Assuming the average activity density as computed from the 30 samples to be representative of the entire volume, the amount of uranium in the water of the old pond was estimated to be about 27 pounds.

Twenty mud samples obtained from the locations indicated in Figure 11 showed the average activity density from uranium to be 2650 μg U/gram. Again, the variation between individual mud samples was wide; the maximum activity density in mud was 7000 μg U/gram and the minimum was 50 μg U/gram. The total amount of uranium at the base of the pond was not estimated due to the wide variation in individual results and the lack of means of determining the exact depth of mud deposition at the base of the pond.

For purposes of evaluating the hazard which would occur in the event that the new pond were drained into the waters of the Columbia River, assuming a river flow of 600,000 gallons/second, and a drainage interval of eight hours, the activity density from uranium in the Columbia River at the time that the pond volume is equally dispersed in the Columbia would be less than 1.0 μg U/liter of river water.

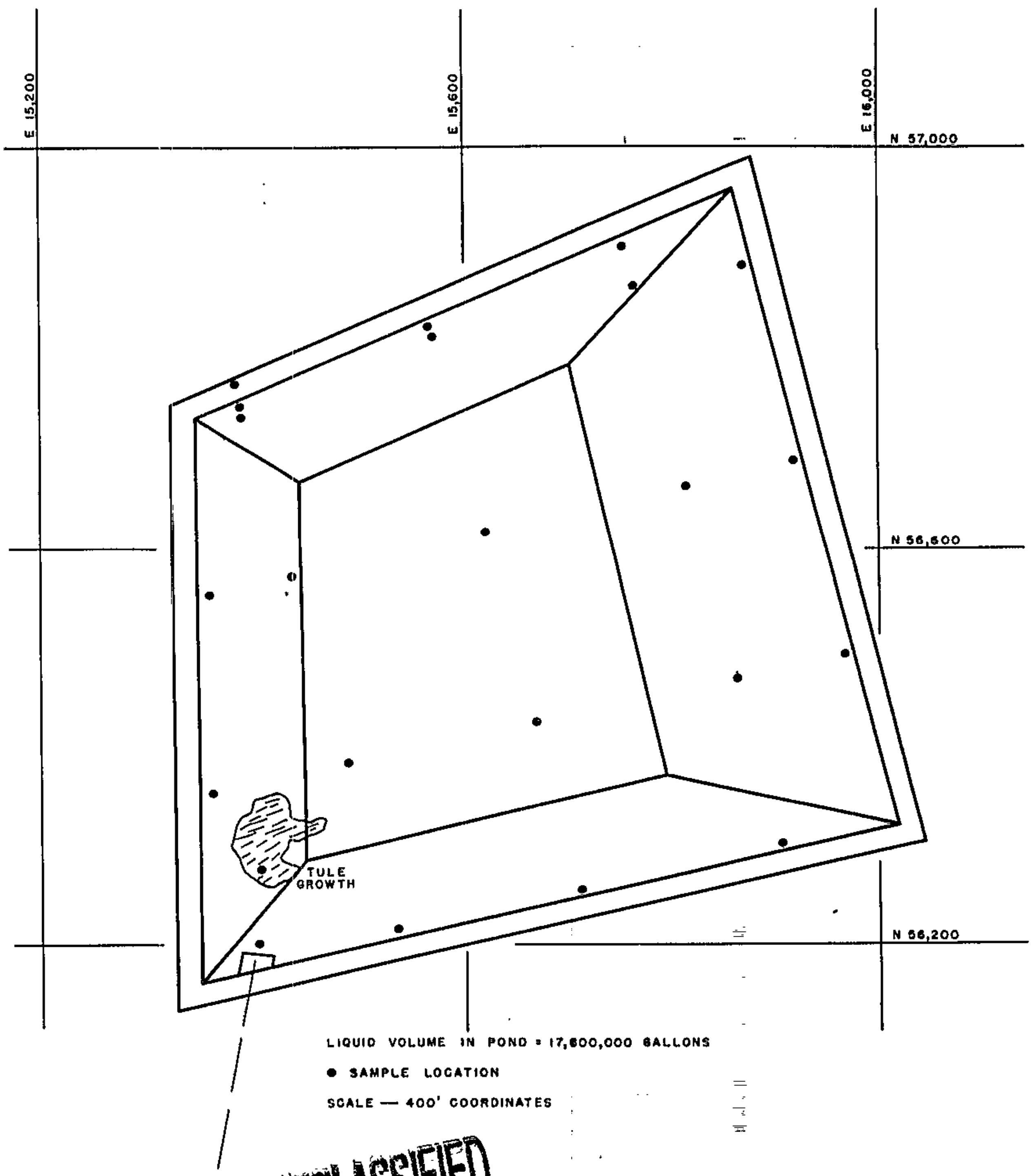
SECTION IV

(Please refer to Figures 9, 10, and 11.)

NEW 300 AREA WASTE POND

DECEMBER 18, 1950

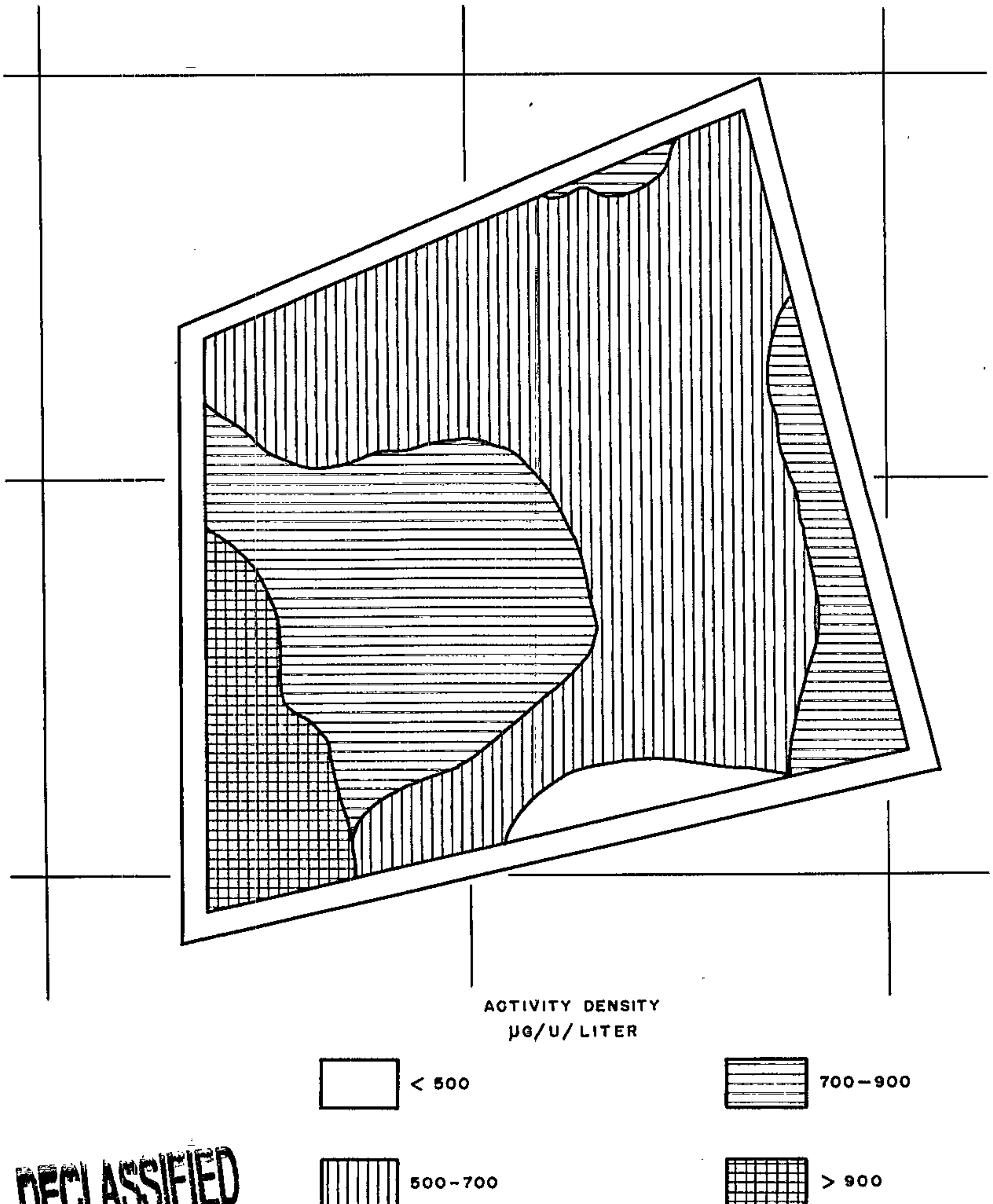
FIGURE— 9



[redacted]

ESTIMATED DISTRIBUTION OF URANIUM
NEW WASTE POND ——— 300 AREA
DECEMBER 18, ——— 1950

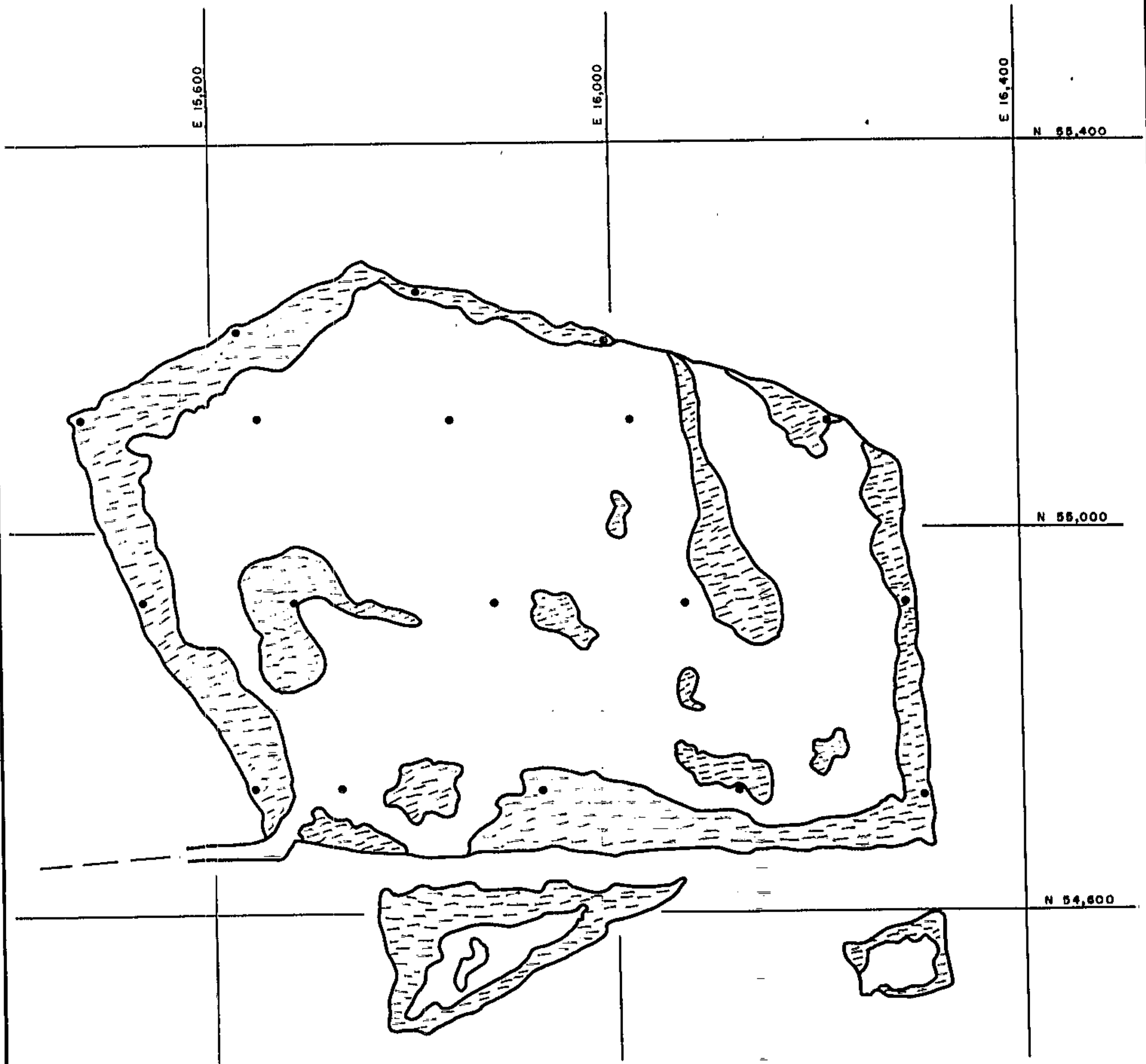
FIGURE—10



OLD 300 AREA WASTE POND

DECEMBER 19, 1950

FIGURE— 11



LIQUID VOLUME IN POND = 5,500,000

● SAMPLE LOCATION

SCALE — 400 COORDINATES

TULE GROWTH

[redacted]

SECTION V

RADIOACTIVE CONATMINATION IN THE COLUMBIA AND YAKIMA RIVERS

The determination of the activity density from alpha and beta emitters in the Columbia River was accomplished by analyzing water samples from representative locations at the river. In general, weekly samples were obtained from about 17 locations between the five pile areas of the Hanford Works and the Pasco-Kennewick Bridge; this area represents about 50 miles of river. These data were supplemented with spot samples obtained from several down stream locations such as McNary Dam and Bonneville Dam and with special studies performed to determine distribution and dispersion patterns. Control sampling was maintained on a daily basis at a location near the Hanford Ferry and cross section distribution studies were maintained on a weekly basis at the point where the Ferry crosses the river.

The sampling techniques and procedures applied for the radiochemical analyses of gross beta and alpha emitters were identical to those outlined in previous documents of this series. (HW-19454) Periodic measurements for the activity density of the alpha emitter of uranium was performed by the lanthanum fluoride method; this determination was completed on at least one sample from each location during each month of the quarter and was performed on every sample which indicated that the activity density from gross alpha emitters exceeded 6 dis/min/liter.

In contrast to the measurements performed during the previous quarter, the current data was obtained during a period in which the river flow was relatively constant. The mean river flow during the 3 month period was 590,000 gallons/second; the flow rate varied from a minimum of 488,000 gallons/second to a maximum of 893,000 gallons/second. The latter two measurements represented extreme conditions in respect to the over all data; the normal weekly differences throughout the period were on the order of 20,000 to 30,000 gallons/second. A review of the week to week variation in flow rate (Figure 12) does not indicate any significant trend occurring throughout the period; however, a comparison with the measurements obtained during the previous period show that the volume of water passing down the Columbia River during this period was significantly lower than that measured during the period July, August, and September, 1950. The maximum measured flow rate during the previous period was in excess of 4,000,000 gallons/second. Figure 12 summarizes the trend of the measured flow rate over the six month period discussed above.

A tabular summary of the results obtained from the radiochemical analyses for the activity density of gross beta emitters at representative locations in the Columbia River is presented in Table I.

TABLE I
AVERAGE ACTIVITY DENSITY OF GRESS BETA EMITTERS
IN THE COLUMBIA RIVER
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Location	Activity Density x 10^8 μc/cc					
	October Average	November Average	December Average	Quarter Average	Previous Quarter Average	Maximum This Quarter
Wills Ranch	< 5	< 5	< 5	< 5	< 5	8
100-B Area 181 Building	< 5	15	< 5	8	< 5	54
Allard Pumping Station	65	10	23	35	7	132
100-D Area 181 Building	17	74	85	63	23	119
100-H Area 181 Building	68	117	135	111	40	152
Below 100-H	167	197	351	239	209	528
100-F Area 181 Building	92	279	278	262	111	457
Below 100-F	284	390	327	333	139	456
Foster Ranch	86	96	229	116	28	373
Hanford South Bank	356	372	395	374	159	949
Hanford Middle	293	216	413	300	67	724
Hanford North Bank	95	123	107	110	37	273
300 Area	111	153	212	158	68	268
Richland	113	117	178	131	45	228
Highlands Pumping Station	80	107	96	93	33	165
Pasco Bridge (Kenn. Side)	60	74	76	70	33	102
Pasco Bridge (Pasco Side)	72	86	90	83	25	166
Yakima River Mouth	< 5	< 5	< 5	< 5	< 5	< 5

A review of the data summarized in Table I shows that the activity density from gross beta emitters increased at all locations during this period. This increase was attributed to 2 factors; namely, the lower dilution ratio of the Columbia River to the activity admitted at each of the five 100 Areas, and secondly, the start-up of the fifth pile area at 100-DR on October 3, 1950. The over all effect of the start-up of the 100-DR Area was reflected when reviewing the month to month increase in activity density throughout the quarterly period. These increases were noted during the time when the river flow remained relatively constant.

Natural background in the Columbia River as evaluated from samples obtained at Wills Ranch above the 100-B Area showed the average activity density from beta emitters to be less than 5×10^{-8} µc/cc. As in the past, the maximum activity density from gross beta emitters prevailed along the south bank at Hanford where the average activity density was 3.7×10^{-6} µc/cc throuhout the quarter. The maximum measurement of 9.5×10^{-6} µc/cc was also obtained at this location. In general, the activity density from beta emitters was on the order of 10^{-6} µc/cc at all sampling locations between the 100-D Area and Richland. A comparison of the average values obtained at Richland, Highlands pumping station, Pasco and Kennewick with those measured during the previous quarterly period indicate that the average activity density increased by about a factor of 3 at these locations. As indicated by the general increase in monthly averages between October and December, the bulk of the maximum values summarized in Table I were obtained from samples collected during the month of December.

The cross-section distribution of activity on the surface of the river at the Hanford Ferry location again indicated that the bulk of the activity passed the south shore; quarterly averages indicated that the activity density along the south bank (3.7×10^{-6} µc/cc) was over 3 times greater than that measured along the north bank (1.1×10^{-6} µc/cc) of the river.

The daily results obtained from the measurement of the activity density from gross beta emitters along the south bank of the river at Hanford were analyzed in respect to the flow rate of the Columbia River and the power levels at each of the operating areas. Favorable correlations were indicated in each of the studies and when tested statistically showed highly significant correlations with operating conditions at the 100 Areas and significant correlations with the change of flow rate in the Columbia River. The correlation coefficients obtained from the latter study were somewhat lower than those observed in a similar study several months ago; however, the magnitude of flow change during this period was very small when compared to the flow rate changes noted during the previous study.

A special survey was performed on December 11, 1950 to determine if there was any correlation between activity measurements and the turbidity of ferro-floc as discharged into the Columbia River when cleaning the filter basins in the water purification system at the 100 Areas. This study was similar to that performed during September, 1950, at which time a series of aerial photographs indicated a defined channelling of the ferro-floc along the south bank of the Columbia River (HW-19046) A sampling program was designed whereby duplicate samples would be obtained from the surface of the river at several cross-section locations below the point of admission; these samples were analyzed for iron concentrations, turbidity, and for the activity density from gross beta emitters. A coordinated program by the Power Division of the 100 Areas allowed the flushing of settling basins in the 100-F and 100-H Areas simultaneously, thereby extending the area over which the survey could be performed. Cross-section sampling locations were established at points 0.1, 0.6, and 2.9 miles below the 100-H Area and 0.4, 2.3, and 3.3 miles below the 100-F Area. A total of 213 samples were collected for the entire study.

An analysis of the results obtained from each of the three types of measurements discussed above indicated a highly significant correlation between the three variables at nearly all locations at which measurable quantities of ferro-floc were obtained. Table II summarizes the results of these correlation studies.

The data presented in Table II shows highly significant relationship between activity and iron at each cross-section location; this relationship indicates that the activity admitted at the 100-F and 100-H Areas essentially follows the same pattern as observed for the ferro-floc in the aerial photographs from the previous study. Graphs showing relationship between the activity, turbidity, and iron have been published in a previous document, (HW-19896) for each of the cross-section locations; Figure 13 which accompanies this document is a reprint of a previously published graph and is representative of the results obtained for each separate cross-section study.

TABLE II
COLUMBIA RIVER SURVEY CORRELATION RESULTS
PERFORMED DECEMBER 11, 1950

Miles Below 100-H Area	N	Activity to Iron r	Activity to Iron T		Turbidity to Iron r	Turbidity to Iron T		Activity to Turbidity r	Activity to Turbidity T	
0.1	(36)	0.90	11.86	(h.s)	0.80	7.73	(h.s)	0.79	7.5	(h.s)
0.6	(33)	0.92	13.1	(h.s)	0.65	4.76	(h.s)	0.72	5.8	(h.s)
2.9	(28)	0.56	3.44	(h.s)	0.23	1.23	(h.s)	0.22	1.23	(h.s)
Miles Below 100-F Area										
0.4	(27)	0.92	11.8	(h.s)	0.47	2.67	(q.s)	0.53	3.12	(h.s)
2.3 Plant Side*	(17)	0.84	6.02	(h.s)	0.36	1.50	(n.s)	0.29	1.17	(n.s)
2.3 Far Side*	(21)	-0.66	-3.94	(h.s)	-0.46	-2.25	(q.s)	-0.15	-0.67	(n.s)
3.3	(22)	0.55	2.94	(h.s)	0.04	0.18	(n.s)	0.22	1.01	(n.s)

* An island diverts the flow of the river at this location.

The definite channelling of the activity below each of the areas may be appraised by reviewing Figures 14 and 15 which show the width of the channel at each of the sampling locations below the 100-F Area. It was interesting to note that the activity channel did not follow the estimated channel from U. S. C. and G. S. soundings, but rather tended to deviate toward the Benton County shore at a point about 2 miles below the 100-F Area. An island predominates in the river at this location, and the activity tends to follow the shore side rather than adhere to the main volume of water which passes on the Franklin County side of the island. Previous indications of this fact have been observed during earlier cross-section studies; however, the current correlation between the ferro-floc and the activity at this location tend to establish this fact on a definite basis.

Several depth samples were obtained at each of the six downstream locations to determine the magnitude of difference in activity on a verticle plane. With the exception of the location 0.05 miles below the effluent pipe at 100-H Area, the results indicated that the activity was uniformly dispersed depthwise. The results obtained immediately below the 100-H outlet showed a difference on the order of a factor of 9 between the samples obtained from the surface and a depth of two meters (2.5×10^{-6} μc/cc on surface and 2.2×10^{-5} μc/cc at two meters.) The difference noted when comparing the results from the remaining downstream locations did not exceed a factor of 1.5 in any case. The latter studies cover a range of depths to 9 meters. A graphic comparison showing the variation of the activity density measurements with depth is presented in Figure 16.

The samples obtained from locations summarized in Table I were also analyzed for the activity density of the alpha emitters of uranium and/or plutonium. Although the average activity from these sources was less than 6 dis/min/liter over the entire quarter, several indications of trace quantities of alpha emission were noted in individual samples. With the exception of samples obtained from the 300 Area locations, subsequent samples did not tend to confirm detectable activity. Two samples obtained near the 300 Area during October and November indicated 22 and 33 dis/min/liter, respectively.

Nearly 400 samples of mud were obtained from locations on the shores of rivers adjoining the Hanford Works. Samples were obtained from along the shore at the waters edge and from below the surface of the water about 5' out from the shore line each time the location was monitored. The results obtained from the radiochemical analyses of these samples for the activity density from gross beta emitters during October, November, and December, 1950 is presented in Table III, on the following page.

A comparison of the averages summarized in Table III with those during the previous period indicates no significant change or trend. Minor fluctuations noted on a month to month basis were not deemed significant in any case. Maximum measurements obtained during the period were also well within the normal range of fluctuations expected for this type of monitoring.

Samples from each of the locations summarized in Table IV were analyzed for the activity density from the alpha emitter of uranium at a frequency of at least one analyses per month from each location. The results of these measurements indicated that the activity density was less than 2 μg U/gram of mud analyzed.

TABLE III
RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER MUD SAMPLES
OCTOBER, NOVEMBER, DECEMBER
1950

Location	BETA EMITTERS - ACTIVITY DENSITY x 10^5 µc/gram					
	October Average	November Average	December Average	Quarter Average	Previous Quarter Average	Maximum This Quarter
Wills Ranch, shore	<1.0	1.7	1.2	1.3	1.4	2.2
5' out	1.2	2.4	1.6	1.8	1.3	5.7
Allard Station, shore	1.9	1.3	1.5	1.6	1.2	4.1
5' out	1.5	1.4	1.5	1.5	1.2	1.9
100-H Area, shore	1.4	1.9	1.6	1.6	1.7	2.3
5' out	1.7	1.4	1.8	1.6	2.0	2.9
Below 100-F Area, shore	1.7	2.4	2.1	2.9	2.0	2.8
5' out	1.8	2.0	2.0	2.0	1.6	3.1
Hanford Ferry, shore	2.4	1.9	2.6	2.3	1.6	5.5
5' out	2.0	2.4	1.9	2.1	1.9	4.6
Below 300 Area, shore	1.7	1.8	1.5	1.7	1.4	2.5
5' out	1.8	4.3	1.5	2.5	1.6	9.4
Richland Dock, shore	2.1	1.6	1.7	1.8	1.5	3.7
5' out	2.3	2.9	1.5	2.1	1.8	5.0
Highland Pumping Sta., shore	1.8	1.2	2.2	2.0	1.3	5.6
5' out	1.9	2.5	2.5	2.3	1.7	5.1
Yakima Horn, shore	<1.0	1.1	<1.0	<1.0	<1.0	1.4
5' out	<1.0	<1.0	<1.0	<1.0	1.0	1.2
Pasco Bridge (Kenn. side)	1.5	2.2	1.3	1.6	1.3	3.5
5' out	1.8	1.6	1.3	1.6	1.4	2.6
Pasco Bridge (Pasco side)	1.5	1.6	1.5	1.5	1.4	2.2
5' out	1.9	2.2	1.5	1.8	1.3	3.2

Four samples of river water, mud, and algae were obtained from Bonneville Dam during the quarter. The activity density from beta emitters in the river water was less than 5 x 10^{-8} µc/cc in each sample analyzed. The activity density from alpha emitters averaged less than 2 dis/min/liter; however, one sample indicated the activity to be 4 dis/min/liter. One sample of mud obtained from the base of the dam showed the activity density from beta emitters to be 2.4 x 10^{-5} µc/gram; the remaining measurements were on the order of 1.2 x 10^{-5} µc/gram. Alpha activity in this mud was less than 6 dis/min/gram in all samples. One sample of algae obtained during October indicated the activity density from beta emitters to be 9.1 x 10^{-5} µc/gram; this measurement represented the maximum activity noted in algae from this location during 1950.

Weekly samples were obtained from each of the raw water supplies at the 183 and 283 buildings of the 100 and 200 Areas. This water originates directly from the Columbia River at one of the 100 Areas and is transported to the remaining areas for drinking purposes. These samples represent the water as received from the river water export line previous to the final filtration and chlorination in the consuming areas. Radiochemical analyses for the activity density of gross beta and alpha emitters in this water were performed according to procedures and techniques described in previous documents of this series. A review of the current measurements indicates that an over all increase occurred in the activity density of beta emitters during this period. Increases by a factor from 3 to 6 occurred in many instances and were assigned to the decrease in flow rate of the Columbia River (Figure 12,) which tends to increase this activity at the pumping source in the 100 Areas. The magnitude of increase noted during the period was expected and was not deemed significant when compared to the measurements obtained in this same three month period during previous years. A summary of the results obtained from the measurement of the activity density from beta emitters in raw water during this period appears in Table IV.

TABLE IV
RADIOACTIVE CONTAMINATION IN RAW WATER - RIVER EXPORT LINE
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

BETA EMITTERS - ACTIVITY DENSITY x 10^8 µc/cc

Location	October Average	November Average	December Average	Quarter Average	Previous Quarter Average	Maximum This Quarter
183 Building 100-B Area	<5	<5	<5	<5	<5	<5
183 Building 100-D Area	<5	10	19	12	<5	26
183 Building 100-H Area	13	25	57	33	6	150
183 Building 100-F Area	65	45	45	47	13	173
283 Building 200 East Area	14	<5	<5	6	<5	21
283 Building 200 West Area	14	<5	<5	7	<5	25

The activity density from alpha emitters in samples of raw water obtained from the above locations averaged less than 6 dis/min/liter at all locations during this quarter.

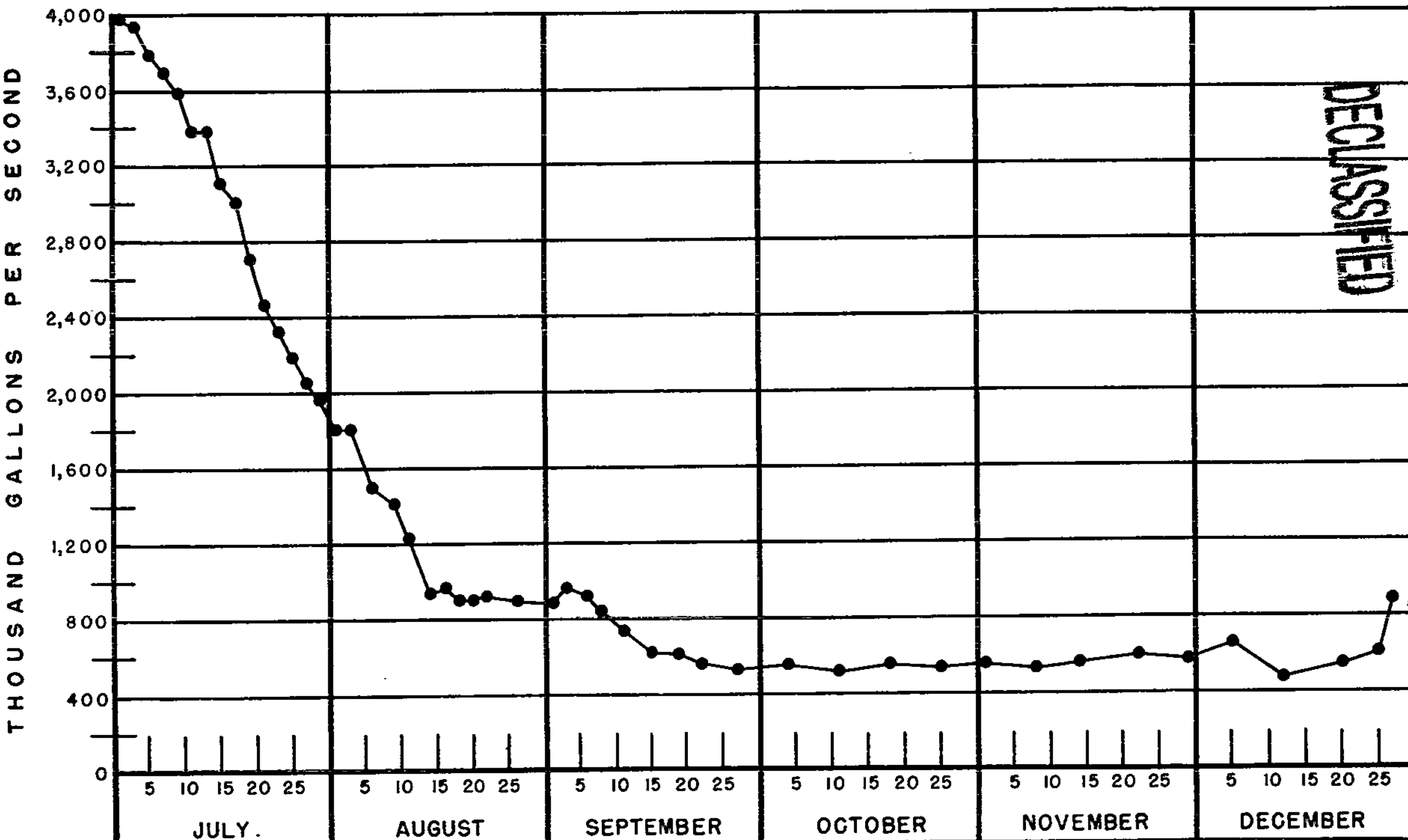
Twenty-one samples were obtained directly from the raw water retention ponds in the 200 Areas. The activity density from gross beta emitters in this water averaged 8 x 10^{-8} μc/cc at the 200 East Area and 9 x 10^{-8} μc/cc at the 200 West Area. Maximum measurements were on the order of 2.0 to 3.0 x 10^{-7} μc/cc at each basin. The activity density from alpha emitters in this water averaged less than 6 dis/min/liter throughout the quarter; one sample obtained in the 200 East Area during the month of October indicated 9 dis/min/liter.

SECTION V

(Please refer to Figures 12, 13, 14, and 15.)

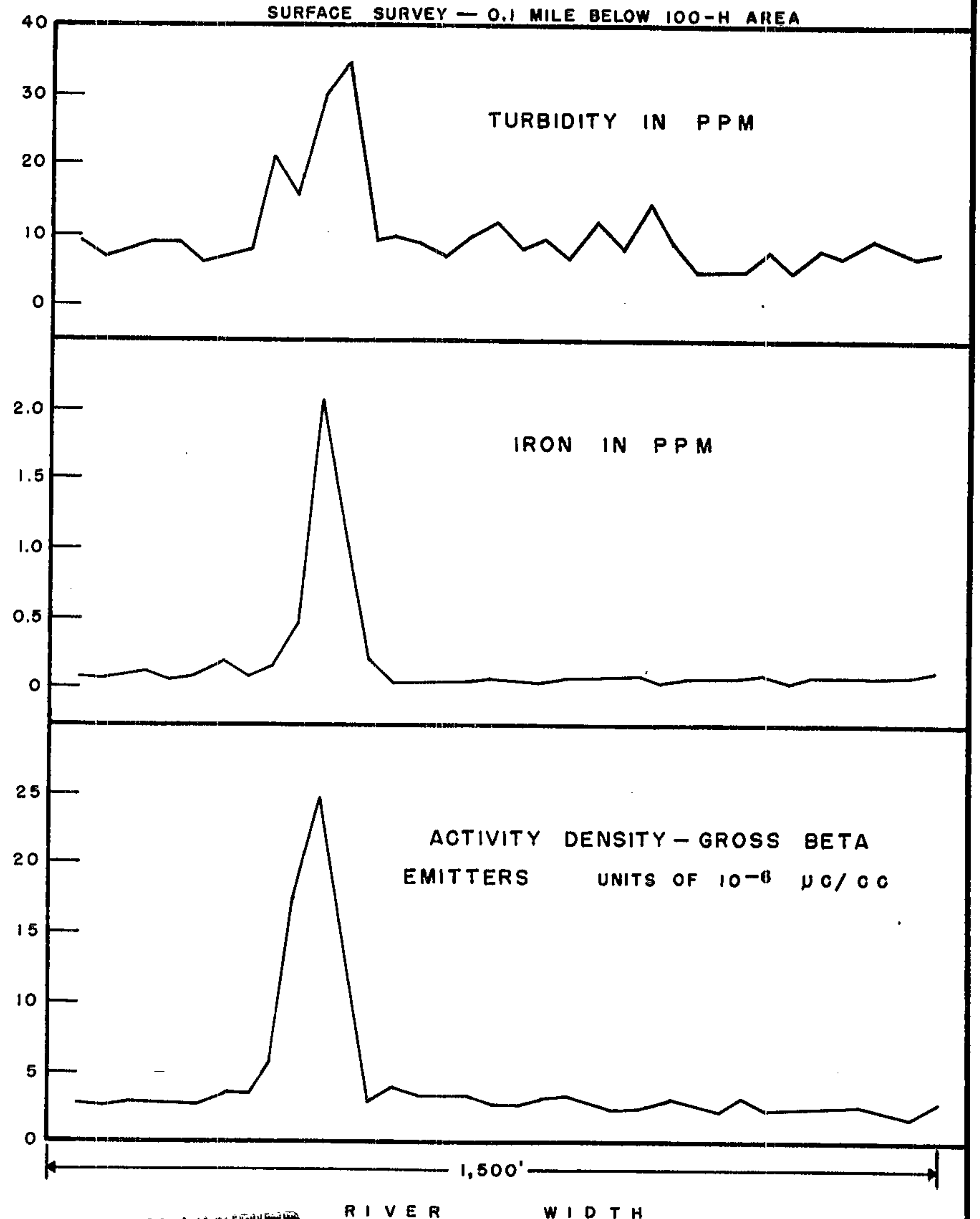
COLUMBIA RIVER FLOW
OCTOBER-NOVEMBER-DECEMBER
1950

FIGURE — 12



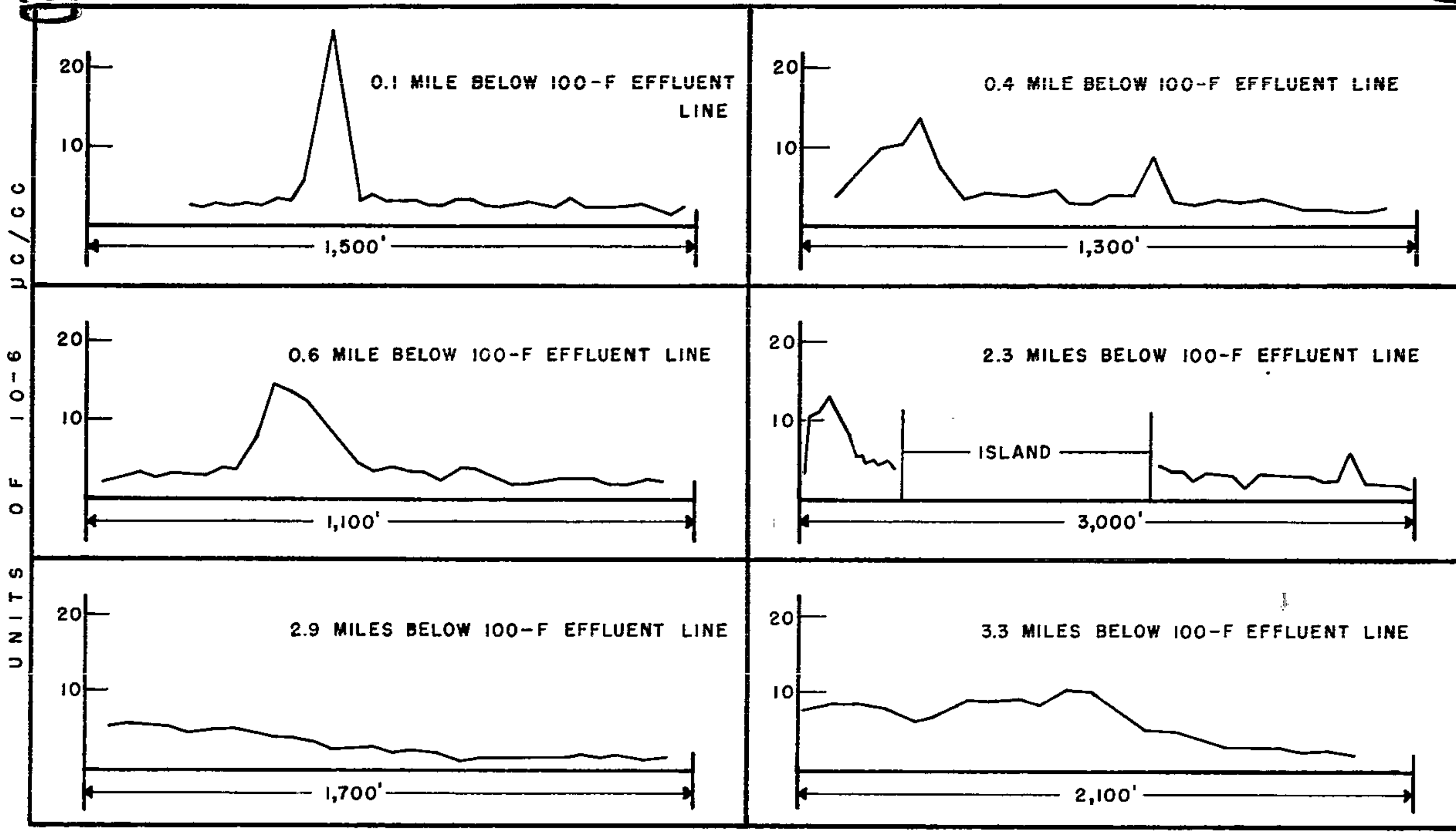
CORRELATION STUDY OF RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER WITH IRON AND TURBIDITY

FIGURE-13



ESTIMATED DISPERSION OF ACTIVITY DENSITY
IN COLUMBIA RIVER SURFACE SAMPLES
(GROSS BETA EMITTERS)
DECEMBER 11, 1950

FIGURE



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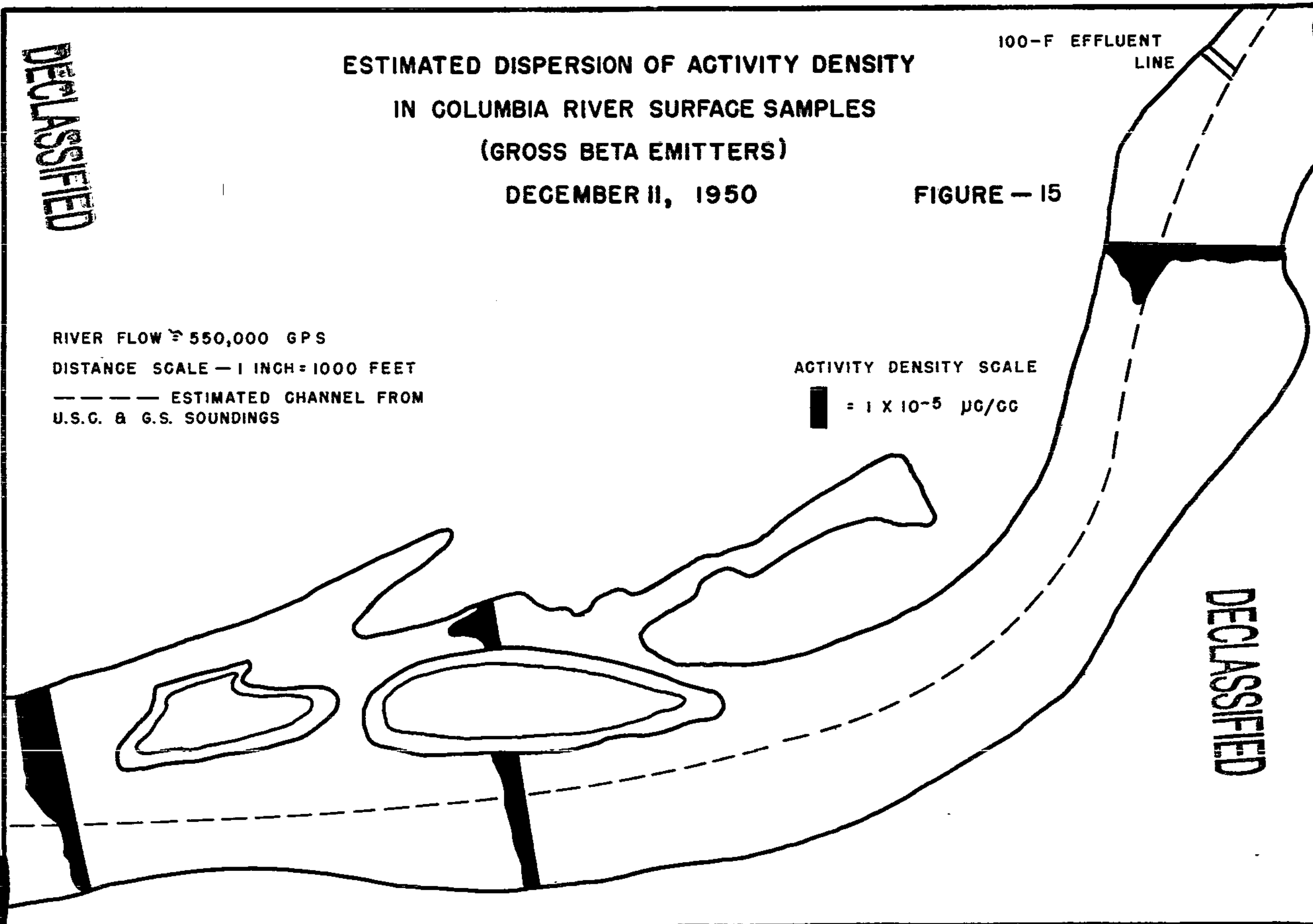


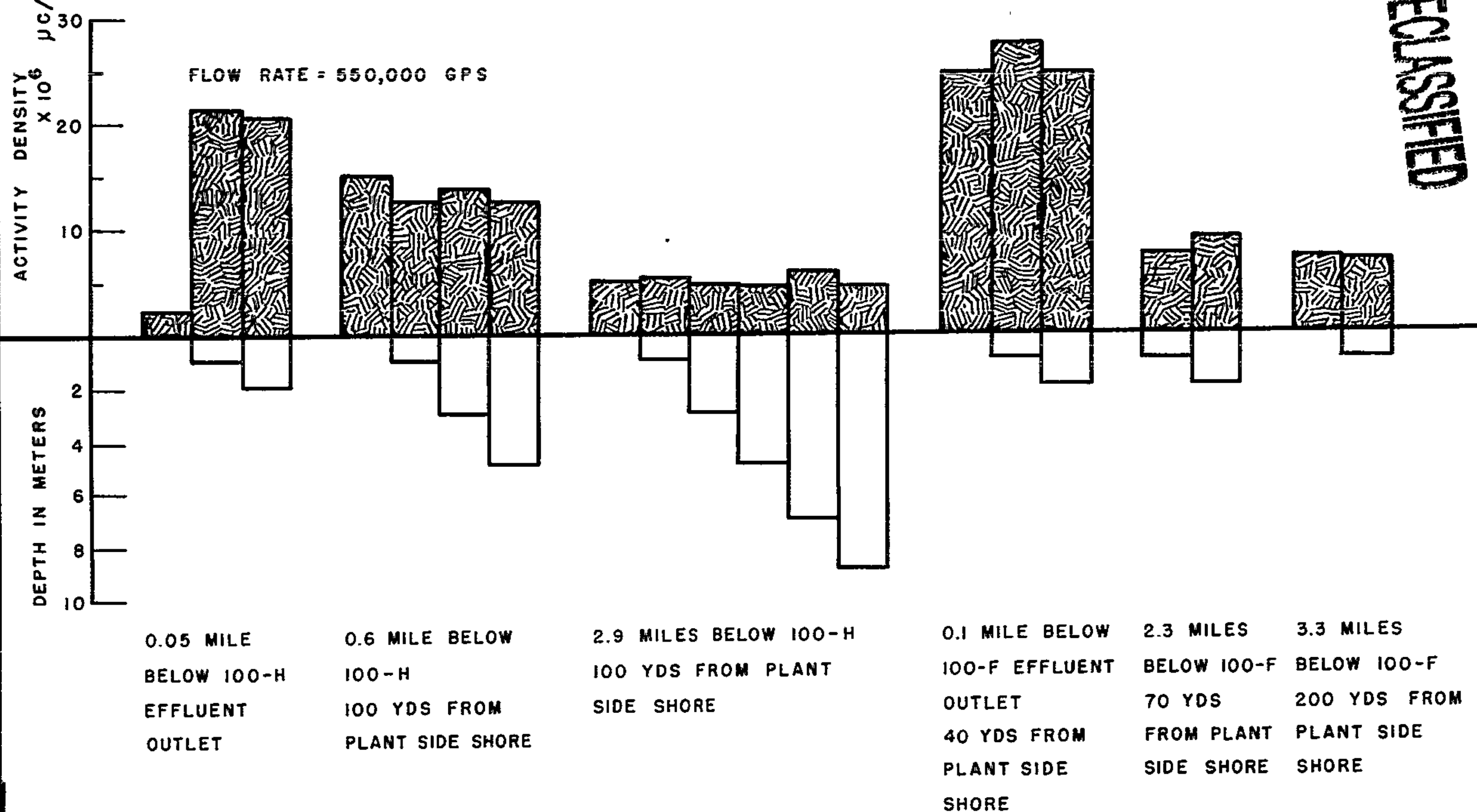
ESTIMATED DISPERSION OF ACTIVITY DENSITY IN COLUMBIA RIVER SURFACE SAMPLES (GROSS BETA EMITTERS) DECEMBER 11, 1950

FIGURE — 15

COMPARISON OF ACTIVITY DENSITY OF GROSS BETA EMITTERS IN COLUMBIA RIVER WITH RIVER DEPTH

DECEMBER 11, 1950

FIGURE – 16



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SECTION VI

RADIOACTIVE CONTAMINATION IN RAINFALL

Qualitative estimations of the activity density from gross beta emitters in the atmosphere during periods of precipitation were obtained by analyzing samples of rainfall collected from representative locations on and adjacent to the Hanford Works. Two hundred and seventy-one rain samples were collected from twenty-seven monitoring stations during the period October, November, December, 1950. This number of samples was exceptionally high for the period due to the abnormal amount of rainfall during the month of October. The total of 2.46 inches measured during October exceeded the previous mean rainfall for this three month period. A summary of the rainfall data as measured at the Meteorology Station near the 200 West Area is presented in Table I. Measurements for the previous two years are also included.

TABLE I
PRECIPITATION MEASURED AT HANFORD WORKS
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0
units - inches

Year	October	November	December	Quarterly Total
1948	0.45	0.95	1.11	2.51
1949	0.10	1.47	0.16	1.73
1950	2.46	0.55	0.97	3.98

A further review of previous observations in comparison to the above data indicates that the 35 year average rainfall during the 3 month period was 2.31 inches; the average rainfall for the month of October was 0.58 inches. In accordance with the above rainfall data, the bulk of the samples obtained during the quarterly period were representative of airborne activity concentrations during October.

The rain samples were analyzed according to standard procedures and techniques used for drinking water and river water. In addition to determining the activity density from beta emitters in each sample, several samples were also analyzed for the activity density from alpha emitters and spot samples were radioautographed to determine the presence of radioactive particles.

A summary of the results of the activity density measurement for beta emitters in rain samples is presented in Table II.

TABLE II
ACTIVITY DENSITY FROM GROSS BETA EMITTERS IN RAIN *
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Location	Number Samples	Activity Density x 10^6 μc/cc Maximum	Average
In 200 East Area			
250' East of stack	9	35	7
2000' East of stack	10	73	11
750' SE of stack	11	614	70
3500' SE of stack	10	306	35
In 200 West Area			
1000' East of stack	9	40	17
7000' East of stack	9	135	24
8000' SE of stack	10	550	76
4900' SE of stack	9	70	21
Redox Area	8	21	5
100 Area Environs			
100-BSE	9	21	3
100-DSW	9	45	6
100-FSW	9	1	<1
Hanford 614	10	1	<1
Hanford 101	9	1	<1
White Bluffs	8	1	<1
100-HSE	9	1	<1
Perimeter Locations			
Richland	10	1	<1
Pasco H & R	10	1	<1
Benton City	11	3	<1
Riverland	11	8	1
North Richland North	10	11	1
Intermediate Locations			
Route 4S, Mile 6	9	11	4
300 Area 614	11	3	<1
200 North 614	7	7	3
Gable Mountain	10	5	2
Batch Plant	9	31	5
622 Building	34	71	9

* The measurements summarized above represent samples in which the total collected volume exceeded 10 ml.

As indicated in Table II the average activity density from beta emitters in rainfall was nearly identical in the 200 East Area and 200 West Area. The average activity density in all samples collected in 200 East Area was 3.2×10^{-5} μc/cc; in 200 West Area the average was 3.6×10^{-5} μc/cc. Maximum measurements were observed due southeast of the stack in each area and were on the order of 6×10^{-4} µc/cc. These measurements represented an increase by about a factor of 10 when compared to data from the previous quarter at which time the maximum measurement was 5.1×10^{-5} µc/cc. In general, nearly all of the current measurements were higher than those obtained during previous periods; the over all increase was attributed to operating changes such as the increased amount of dissolving and the reduced cooling period of the irradiated metal.

The average activity density from beta emitters averaged less than 1×10^{-6} µc/cc at nearly all stations located in the residential areas and around the project perimeter. The maximum measurement obtained in the residential areas was at North Richland where a sample indicated 1.1×10^{-5} µc/cc.

Continuation of the rain monitoring program in the construction areas at the Batch Plant and in the Redox Area indicated that the activity in these regions remained considerably below that noted around the perimeter of the nearby 200 Areas. All measurements obtained in the construction region around White Bluffs showed the activity density of beta emitters to be less than 1×10^{-6} µc/cc.

The results obtained from the analyses of several selected samples for the activity density from alpha emitters indicated negligible activity from this source. Some of the samples analyzed represented volumes in excess of 5 gallons; the large volume samples represented the water-shed from the roofs of buildings in the 200 East Area, 300 Area, and Richland.

Several of the evaporated rain samples which indicated the activity density of gross beta emitters to exceed 1×10^{-4} µc/cc were radioautographed for a period of 168 hours to determine the number of radioactive particles in the collected sample. The results of these measurements indicated that a few radioactive particles (2 or 3 particles per sample) were present. The samples which contained particles were collected inside the separation areas and the number of particles found were well within the range expected as based on the results of the air filter particle monitoring program.

SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER SUPPLIES AND TEST WELLS

Nearly 1,000 potable water and test well samples were taken from the environs of the Hanford Works during the period October, November, and December, 1950. Sampling frequencies at the various locations varied from daily to monthly; the frequency of a given location is based on the probability of the contamination, the hazards involved, and the current trend of the activity density measurement. These samples were analyzed for the activity density of gross beta emitters and for the activity density of alpha emitters from uranium and/or plutonium by techniques outlined in HW-20700. Sample volumes were 500 ml. or 12 liters; the former sample size was used to determine the activity density of gross beta emitters and alpha emitters and the larger volumes were used when increased sensitivity of analyses was desired. A review of the results obtained from the measurement of the activity density of alpha emitters in drinking water supplies during this period shows no significant change or trend in magnitude when compared with measurements performed during the previous quarter. In general, the wells showing measurable alpha activity were nearly identical to those indicating this activity in the past and were confined to the Richland and Benton City areas.

The maximum activity density from alpha emitters in drinking water supplies was 46 dis/min/liter at the Benton City Store well. This well showed an average of 19 dis/min/liter with uranium measurement by fluorophotometer showing a maximum of 21 µg U/liter and an average of 10 µg U/liter. Other samples from Benton City had an average activity density of alpha emitters of comparable magnitude. Maximum measurement obtained from wells in the Richland system was 25 dis/min/liter in Well #8. In general, the average activity density of alpha emitters in the wells of the Richland system range from 6 to 14 dis/min/liter with the maximum measurement on the order of 20 to 25 dis/min/liter. Indications of uranium were noted in each of the Richland wells, with the average activity about 5 µg U/liter and the maximum measurement of 9 µg U/liter. Table I summarizes the locations at which the 500 ml.

samples indicated the activity density from alpha emitters to average above the detectable limit of 6 dis/min/liter throughout the quarter.

TABLE I
ACTIVITY DENSITY IN DRINKING WATER
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Location	No. Samples	500 ml. samples Ether Extraction dis/min/liter Maximum	Average	No. Samples	Fluorophotometer µg U/liter Maximum	Average
Richland Well #2	4	15	8	5	7	5
Richland Well #4	54	23	13	42	9	5
Richland Well #12	9	25	10	9	8	5
Richland Well #13	6	10	8	6	7	4
Richland Well #14	4	8	6	5	5	4
Richland Well #15	3	15	14	3	8	6
Richland Well #18	6	25	11	6	5	4
Benton City Store Well	12	46	19	11	21	10
Benton City Water Co.	12	40	23	10	29	17
Pistol Range	12	13	6	14	8	3

Several individual samples of drinking water supplies obtained from locations other than those listed in Table I above indicated trace quantities of alpha emission. For the most part, the magnitude of this activity barely exceeded the sensitivity limit of an individual analyses and was not confirmed by resampling. Table II summarizes the activity measurements for those locations which indicated trace amounts of alpha emission in 500 ml. samples at any time during the period October, November, and December, 1950.

In addition to the measurements summarized in Tables I and II, one hundred and thirty-six 12 liter samples were analyzed to determine the activity density of alpha emitters in drinking water. The results obtained from the large volume sampling program were in very good agreement with the measurements indicated in the smaller volume analyses; detectable activity was indicated in nearly all samples obtained from wells of the Richland and Benton City systems. A summary of the results of all large volume samples analyzed during the quarterly period is presented in Table III.

TABLE II
SUMMARY OF ALPHA AND BETA EMITTERS MEASURED IN WATER SUPPLIES
500 ml. samples
OCTOBER, NOVEMBER, DECEMBER
1950

Location	No. Samples	Alpha Emitters Activity Density dis/min/liter		Beta Emitters Activity Density x 10^8 μc/cc	
		Maximum	Average	Maximum	Average
Foster's Ranch	10	6	3	<1	<1
Headgate Well	13	6	2	<1	<1
Richland Well #2	4	15	8	<1	<1
Richland Well #4	54	23	13	4	<1
Richland Well #5	12	8	4	1	<1
Richland Well #12	9	15	10	6	<1
Richland Well #13	6	10	8	2	<1
Richland Well #15	3	15	14	<1	<1
Richland Well #18	6	25	11	<1	<1
Tract House J-685	12	12	4	2	<1
North Richland Well "A"	12	12	4	1	<1
North Richland Well "B"	12	7	4	1	<1
North Richland Well "C"	10	9	4	1	<1
North Richland Well "D"	8	7	4	3	<1
North Richland Well "E"	12	7	4	2	<1
North Richland Well Durand #5	12	6	4	2	<1
Hanford Well #1	12	6	3	1	<1
Hanford Well #4	12	11	3	1	<1
Hanford Well #7 San.	62	9	3	7	<1
Hanford Well #7 Raw	12	6	3	1	<1
Benton City Store	12	46	19	2	<1
Benton City Water Co.	12	40	23	2	<1
Cobb's Corner	12	25	4	3	<1
Enterprise Well	12	5	2	3	<1
Kennewick Highlands	3	3	<2	37	23
Kennewick Standard Station	14	5	3	7	3
Kennewick Well #1	1	2	2	1	<1
Kennewick Well #2	2	6	4	<1	<1
Riverland	12	7	3	1	<1
Midway Well	11	6	3	2	<1
Wills Ranch	11	8	3	2	<1
Columbia Field Well "A"	10	8	3	1	<1
Columbia Field Well "B"	12	4	<2	2	<1
Columbia Field Well "C"	12	9	3	<1	<1
P-11 Well	14	9	4	<1	<1
Richland Well #8	13	10	3	6	<1
Segerson's Ranch	4	6	2	<1	<1
Pistol Range	12	13	6	2	<1
300 Area Sanitary Water	26	12	5	3	<1
White Bluffs Ice House	12	9	3	22	7
Redox Administration Building	11	8	3	15	5
251 Building Sanitary	13	11	4	1	<1
Clover Island Raw	2	2	2	2	1

TABLE II con't.

SUMMARY OF ALPHA AND BETA EMITTERS MEASURED IN WATER SUPPLIES

OCTOBER, NOVEMBER, DECEMBER

1 9 5 0

500 ml. samples

Location	No. Samples	Alpha Emitters Activity Density dis/min/liter		Beta Emitters Activity Denxity x 10^8 µc/cc	
		Maximum	Average	Maximum	Average
100-B Sanitary	12	4	<2	3	<1
100-D Sanitary	12	6	3	7	2
100-F Sanitary	12	4	<2	29	11
100-H Sanitary	12	10	3	14	7
200 East Sanitary	14	7	2	7	2
200 West Sanitary	14	9	3	8	3

Richland Durand #4 was maintained as a control sample location throughout the period. As in the past, the results were used to evaluate the efficienty of laboratory procedures and the ability to duplicate sampling techniques. The analyses of 42 samples indicated the activity density of uranium to average 5 µg U/liter with a maximum of 9 µg U/liter; 54 samples analyzed for the activity density of alpha emitters indicated an average of 13 dis/min/liter including a maximum measurement of 23 dis/min/liter. The variation noted between individual measurements was about on the same order as that observed at control locations during previous periods and in general, were not indicative of abnormal deviations in procedures and techniques.

Radiochemical analyses for the activity density of gross beta emitters in drinking water supplies indicated that this activity did not exceed 5×10^{-8} µc/cc at any location except those which were directly related to the Columbia River as their source of supply. Of the six locations which showed measurable activity, four of them represented drinking water supplies in Hanford Works Operating Areas; each of these drinking water supplies originated from the Columbia River and were transported to the Areas via the raw water river export line. The maximum activity density from beta emitters in this water was 2.9×10^{-7} µc/cc at the 100-F Area; the average at this same location was 1.1×10^{-7} µc/cc. Positive averages were also noted at White Bluffs, 100-H Area, and the Redox Construction Area; the mean

TABLE III
SUMMARY OF ALPHA EMITTERS MEASURED IN DRINKING WATER
12 liter samples
Activity Density - Units - dis/min/liter
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

Location	No. Samples	Maximum	Average
Foster's Ranch	3	4	2
Headgate Well	2	3	< 2
Richland Well #2	1	3	3
Richland Well #4	1	10	10
Richland Well #5	4	10	6
Richland Well #12	3	17	13
Richland Well #13	1	9	9
Richland Well #14	3	7	4
Richland Well #15	1	3	3
Richland Well #18	2	8	7
Tract House J-685	3	8	5
Hanford Well #1	3	7	4
Hanford Well #4	5	3	<2
North Richland Well "A"	3	3	2
North Richland Well "C"	3	5	3
North Richland Well "D"	3	3	3
North Richland Well "E"	4	4	<2
North Richland Durand #5	4	4	2
North Richland Pond Inlet	3	4	3
Columbia Field Well "A"	5	3	<2
Columbia Field Well "B"	5	4	<2
Columbia Field Well "C"	4	5	2
Richland Well #8	4	4	<2
Benton City Store	3	34	23
Benton City Water Co.	3	20	9
Cobb's Corner	3	8	3
Kennewick Highlands	2	2	<2
Kennewick Standard Station	3	5	3
Enterprise Well	3	22	8
Riverland	3	3	<2
Midway	2	2	<2
Pistol Range	4	3	3
White Bluffs Ice House	4	4	<2

activity density at these locations was 7.0, 7.0, and 5.0 x 10^{-8} µc/cc, respectively.

With the exception of measurements at the Pasco Filter Plant, the only location outside the operating areas which showed positive activity density from gross beta emitters was the drinking water in the Kennewick Highlands where the current average of 2.3 x 10^{-7} µc/cc represented a three-fold increase over the previous quarterly average of 7.0 x 10^{-8} µc/cc. The maximum activity noted at this location was 3.7 x 10^{-7} µc/cc. The increase noted when comparing these results with those of the previous quarter was attributed to the decrease in flow rate of the Columbia River during the period. The drinking water used in the Kennewick Highlands was pumped directly from the Columbia River and the magnitude of the activity depends on the dilution ratio of the Columbia River to the activity density of the beta emitters in the 100 Area wastes which are admitted to the river at each of the five 100 Areas.

Samples of water and filtering media obtained at the Pasco Filter Plant indicated that considerable beta activity was being retained in the solid material in the filters and that detectable activity was retained in the sanitary water which was consumed by the residents of Pasco. The activity density of gross beta emitters in the sanitary water which was sampled as the water was leaving the filter plant indicated an average of 1.7×10^{-7} μc/cc with maximum measurements on the order of 3.0×10^{-7} μc/cc. Twelve samples of sand obtained from the surface of the filter basins showed the average activity density to be 2.2×10^{-5} μc/gram; the maximum measurement was 5.5×10^{-5} μc/gram. Twelve samples were obtained from the backwash material at the time that the filter beds were being flushed. These samples contained varying quantities of solid material along with the water which was used during the flushing process. The samples were filtered prior to analyses and separate determinations of the activity density of gross beta emitters were performed for the solid material and the liquid material. The average activity density in solid material was 2.1×10^{-3} μc/gram including a maximum measurement of 7.2×10^{-3} μc/gram. The liquid portion of the sample contained an average of 5.8×10^{-7} μc/cc with individual samples as high as 1.4×10^{-6} μc/cc.

One hundred and forty-five samples were obtained from test wells on and adjacent to the project. The majority of these samples were 500 ml.; however, several 12 liter samples were analyzed when the measurements indicated activity which barely exceeded the detection limit of smaller volume analyses. The four 300 Area wells were the only test wells which continually indicated that the activity density of alpha emitters was above the detection limit of 6 dis/min/liter. Maximum results indicated 400 dis/min/liter in a sample from well #2; this same well showed a quarterly average of 218 dis/min/liter. Wells #1, #3, and #4 showed averages of 99, 48, and 136 dis/min/liter, respectively. Significant quantities of uranium were found in each of the 300 Area well samples. The amount of uranium exceeded 200 μg U/liter in extreme cases and averaged 132 μg U/liter at well #2. Uranium measurements indicated averages of 58, 18, and 61 μg U/liter at wells #1, #3, and #4, respectively. In general, these measurements were lower by a factor of 2 when compared with those obtained during the previous period. This decrease was expected as the magnitude of alpha activity found in these wells tends to correlate with the flow rate of the Columbia River. Table IV summarizes the results obtained from the analyses for the activity density of alpha emitters in the 300 Area well system.

TABLE IV
ACTIVITY DENSITY IN TEST WELLS
OCTOBER, NOVEMBER, DECEMBER
1950

Location	No. Samples	Alpha Activity Density dis/min/liter		No. Samples	Uranium Activity Density μg U/liter	
		Maximum	Average		Maximum	Average
300 Area Well #1	10	170	99	8	136	58
300 Area Well #2	23	418	218	21	205	132
300 Area Well #3	19	168	48	18	36	18
300 Area Well #4	9	204	136	9	100	61

In addition to the measurements summarized above, several individual samples from other test wells periodically indicated trace activity density from alpha emitters. In general, these results tended to appear at random and were not confirmed by subsequent resampling. A complete tabulation of the activity density of alpha and beta emitters at all test well locations which indicated positive measurements in any 500 ml. sample during the period appears in Table V.

TABLE V
SUMMARY OF ALPHA AND BETA EMITTERS MEASURED IN TEST WELLS
OCTOBER, NOVEMBER, DECEMBER
1 9 5 0

500-ml. samples

Location	No.	Alpha Emitters Activity Density dis/min/liter		Beta Emitters Activity Density x 10^{-8} µc/cc	
		Maximum	Average	Maximum	Average
300 Area Well #1	10	170	99	1	<1
300 Area Well #2	23	418	218	3	<1
300 Area Well #3	19	168	48	2	<1
300 Area Well #4	9	204	136	2	<1
Snively Ranch	2	10	7	<1	<1
B-Y Well	12	12	6	<1	<1
Spring #13	8	5	2	<1	<1
Rattlesnake Spring	2	5	3	<1	<1
200 North Well #5	9	7	4	<1	<1
McGee Well	12	10	4	2	<1
Ford Well	12	19	4	2	<1
Meeker Well	12	4	<2	<1	<1

Several of the locations summarized above indicated trace quantities of alpha emission which were somewhat questionable when compared with previous measurements as the outlying wells normally indicate this activity to average less than 2 dis/min/liter. Several 12 liter samples were obtained from these random locations in an effort to increase the sensitivity of the analyses and thereby determine whether the initial results were valid. The results obtained from the analyses of these samples are presented in Table VI.

The magnitude of the values summarized in Table VI do not represent any significance as they do not differ materially from the sensitifity limit of 2 dis/min/liter.

In addition to the sampling from various drinking water supplies in the environs, several samples were obtained from various irrigation outlets and springs which were used for irrigation purposes. Radiochemical analyses indicated that the activity of alpha and beta emitters in these sundry supplies did not exceed 6 dis/min/liter or 1 x 10^{-8} µc/cc, respectively.

TABLE VI
ACTIVITY DENSITY OF ALPHA EMITTERS IN TEST WELLS
OCTOBER, NOVEMBER, DECEMBER
1950

12 liter samples

Units - dis/min/liter

Location	No. Samples	Maximum	Average
B-Y Well	3	5	4
Snively Ranch	1	2	2
Rattlesnake Spring	1	2	2
Ford Well	4	2	<2
Meeker Well	3	8	3

SECTION VI

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HEALTH INSTRUMENT DIVISIONS
DEVELOPMENT DIVISION

DECLASSIFIED [redacted]

[redacted]

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