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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS

FOR THE PERIOD
JULY, AUGUST, SEPTEMBER, 1950

APRIL 6, 1951

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD JULY, AUGUST, SEPTEMBER, 1950

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by

H. J. Paas and W. Singlevich
Development Division
Health Instrument Divisions

April 6, 1951

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS

FOR THE PERIOD JULY, AUGUST, SEPTEMBER, 1950

The results of monitoring for radioactive contamination in the Hanford Environs for the above period are reviewed and discussed. The monitoring data are compiled in sections which include meteorological measurements, radioactive contamination measurements in vegetations, the atmosphere, Hanford Waste systems, Columbia and Yakima Rivers, and in rain. An abstract of the results of these surveys follows:

SECTION I - METEOROLOGICAL DATA:

The wind prevailed from the northwest direction at 200 West Area and from the west at the 100 Areas and Richland during this period. Tables and graphs are included which summarize variations in wind directions as measured at five different recording stations.

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION:

Approximately 12 times as much I-131 was formed this quarter as compared with the previous quarter; I-131 is the most abundant radioactive contaminant found on the vegetation of this area. The increase was a function of decreased cooling time of the metal prior to dissolution steps. Measurements indicated a ten-fold increase of deposited I-131 over the last period near the separations area; the maximum activity density measured was 3.8×10^{-3} µc/gram as sampled near the gate house of 200 West area. The average activity density at the point of maximum deposition near the 200 West area was 1.1×10^{-3} µc/gram and 4.6×10^{-4} µc/gram at the point of maximum deposition near the 200 East area; the values inside the West and East Areas were 2.1×10^{-4} µc/gram and 1.8×10^{-4} µc/gram, respectively. The average activity density of I-131 measured in the Tri-City area was 4×10^{-6} µc/gram with an individual maximum of 5.1×10^{-5} µc/gram; during the last reported period, the average was 3×10^{-6} µc/gram in the above area. Similar increases were observed in surveys made of the Wahluke Plateau and Rattlesnake Mountain. Off-Area surveys taken during the latter portion of this period which included cities within a 100 mile radius of the Hanford Works indicated trace quantities of deposited I-131. The results of surveys made of common crops growing in the vicinity of Hanford Works are included; trace quantities of I-131 were measured on all samples taken in the Hanford-Ringold area and to a lesser degree on crops surveyed in the Tri-City Area and in the vicinity of Benton City. Tables and graphs are included giving detailed summations of the results of all measurements.

SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE:

Dosage rates were evaluated by means of detachable ionization chambers and fixed integrons. No outstanding changes from the previous period were noted although minor increases were apparent. The average dosage rate measured within 5 miles of the stacks was 0.8 mrep/24 hours; the higher dosage rates were measured towards the end of the period studied. Dosage rates in the Tri-City area averaged about 0.5 mrep/24 hours which is representative of the background of these ionization chambers. An increase in filterable beta emitters in the air approaching a factor of 5 over last quarter's measurements was common. The highest activity density measured was 1.4×10^{-11} µc/cc at the 200 East area monitoring station; the value at Richland was 1.9×10^{-13} µc/cc and 1.0×10^{-14} µc/cc in Pasco. I-131 in air was evaluated by sampling air through a caustic scrubber solution; significant increases in the I-131 concentrations in air were experienced particularly towards the end of the quarter. The maximum activity density measured was 4.3×10^{-10}

$\mu c/cc$ in a sample taken inside the 200 East Area. Average I-131 in the air of Richland and Benton City ranged from 2.5×10^{-13} $\mu c/cc$ with the higher values approaching 1×10^{-12} $\mu c/cc$. There appeared to be a probable increase in the number of active particles in the atmosphere near the operations area but no changes were noted in the Tri-City Area.

SECTION IV - RADIOACTIVE CONTAMINATION IN HANFORD WASTES:

Detailed summaries of measurements for levels of radioactive contamination in the 100, 200, and 300 Area waste systems are included; the current findings were in reasonable agreement with the results of the previous quarter. The average activity density of gross beta emitters in the retention basins of the pile areas varied from 3.5×10^{-4} $\mu c/cc$ to 5.4×10^{-4} $\mu c/cc$; the highest levels were represented by the 100-F Area. It was estimated that 3 mc I-131/day were discharged into the Columbia River in operation of the H. I. Biology Farm. Spot tests of 100-F Area stack gas indicated gross beta emitters of approximately 1 to 3×10^{-6} $\mu c/cc$; 110 minute argon was the principal component.

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

The flow of water down the Columbia during this period decreased from 4×10^6 gal/sec as measured in June to 5.3×10^5 gal/sec in September. As anticipated, because of lower dilutions, the activity density of the beta emitters in the Columbia increased throughout the quarter. The maximum average activity density measured was 2.1×10^{-6} $\mu c/cc$ in samples taken just below 100-H Area; the values at Kennewick and Pasco averaged about 2 to 3×10^{-7} $\mu c/cc$. The activity density of alpha emitters from uranium and/or plutonium in the river was less than 6 dis/min/liter. A cross section sampling point in the river at Hanford indicated definite channelling effects; the activity was highest near the south bank of the river where the average was 1.6×10^{-6} $\mu c/cc$. The values in the middle of the river and near the opposite bank were 6.7×10^{-7} $\mu c/cc$ and 3.7×10^{-7} $\mu c/cc$, respectively. The activity density in river samples taken from Bonneville Dam was less than 5×10^{-8} $\mu c/cc$. The activity density of alpha and beta emitters in the Yakima River was less than 6 dis/min/liter and less than 10^{-8} $\mu c/cc$, respectively. A change in the channel of the radioactive contamination discharged from the 100-H Area during high water level is discussed. Distribution studies of radioactive effluent in the river are discussed. Data pertaining to radioactive contamination in raw river water and in the 100 and 200 Area Sanitary system are also included.

SECTION VI- RADIOACTIVE CONTAMINATION IN RAIN:

Data of monitoring results for activity in rain were limited as only 0.08 inches of rain were measured this quarter. The maximum activity density measured in rain was 5.1×10^{-5} $\mu c/cc$ in a sample collected at the Meteorology Station. A value of 4×10^{-7} $\mu c/cc$ was measured at Pasco and Benton City.

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

Gross beta emitters and alpha emitters in drinking water supplies of the area were evaluated. The maximum activity density of alpha emitters measured was 38 dis/min/liter in a sample from the Benton City Water Company; this emitter was confirmed to be from uranium, presumably occurring naturally, by fluorophotometer analysis. In Richland, the activity density of alpha emitters in wells ranged from 6 to 12 dis/min/liter. Detailed summaries of monitoring data are included in the form of graphs and charts. No outstanding deviations from previous findings were encountered.

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SECTION I

METEOROLOGICAL DATA - HANFORD WORKS AREA

The analyses of the meteorological data compiled during the three month period of July, August, and September, 1950, were confined to those hours which were representative of the times during which irradiated metal was dissolved in the separations area of the Hanford Works. The meteorological measurements from which these data were extracted were taken by the Meteorological Group of the Health Instrument Divisions. The representative data were reviewed with respect to the meteorological effects on the distribution and deposition patterns of the radioactive materials emitted from the stacks of the separations areas.

The meteorological data recorded at the Meteorology Tower station located near the 200 West Area were most representative of the conditions under which the radioactive gases from the separations areas were initially distributed in the environs; similar data obtained from recording stations in each of the 100 Areas and at Richland were used to appraise the variations in wind direction at perimeter locations of the Hanford Works. Meteorological data were obtained from elevations at 50 foot intervals between ground level and 400 feet at the 200 West Area and at an elevation of approximately 50 feet above ground level at the remaining stations. The meteorological data summarized in the following discussion represents accumulated observations for 983 hours during which dissolving of uranium was taking place. The dissolving process was in effect approximately 45 percent of the time during this quarter.

A review of the wind direction data showed that the prevailing wind conditions during the current period were nearly identical to those which prevailed during the period April, May and June, 1950. The major difference observed when comparing the two sets of data was noted in the amount of wind which prevailed from the northwest direction. Forty-seven percent of the wind came from the northwest during this period as compared with forty-three percent during the previous quarter. The variations in the amount of time which the remaining directions prevailed

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were negligible; the maximum deviation observed when reviewing the remaining directions was less than 2 percent. As in the past, the amount of wind recorded from the east, northeast, and southeast directions was not significant. Figure 1 is a summary of the three months average wind direction data as recorded on an eight-point compass from observations made at the 200 foot level at the Meteorology Tower station. The data presented in Figure 1 may be correlated favorably with the deposition pattern of I-131 on the vegetation in the environs of the Hanford Works (Section II, Figure 5 .)

Figure 2 is a graphic presentation showing the month to month variation in wind direction observed at the Meteorology Tower station. With the exception of two isolated cases, the prevalence of wind from a given direction showed little variation between months. During September, 11 percent of the wind was observed from the north direction as compared with 5 percent during July and August; during the month of August, the southwest direction prevailed 14 percent of the time as compared with 4 and 5 percent during the months of July and September. The differences noted in these two isolated cases were not deemed significant when reviewing the over-all deposition pattern. The maximum amount of wind observed during any one month occurred during the month of July when 58 percent of the wind prevailed from the northwest direction.

The significance of the small differences noted in the month to month variation in wind direction at the Meteorology station was minimized when the variation noted between the various stations was reviewed. Table I summarizes the prevailing wind direction data which were recorded at all stations operated during this period.

TABLE I
PREVAILING WIND DIRECTIONS AT METEOROLOGY STATIONS
HANFORD WORKS
JULY-AUGUST-SEPTEMBER
1 9 5 0

units in percent of time observed

Location	WIND DIRECTIONS N	NE	E	SE	S	SW	W	NW	CALM
200 West	7	2	3	2	2	9	28	47	0
100-B	7	3	4	3	4	12	51	10	6
100-D	8	4	6	1	11	18	29	2	21
100-F	3	2	11	10	8	9	28	9	20
700 Area	11	14	6	5	8	6	26	8	16

A review of the data indicates that the wind directions within the perimeter of Hanford vary considerably. Among the more significant differences noted when comparing these data were the following:

1. The prevailing wind direction at each of the 100 Areas and at Richland was from the west, whereas the prevailing direction at the Meteorology Tower was northwest.

2. The amount of wind recorded from the northwest direction did not exceed 10 percent at any of the 100 Area stations or at Richland.

3. The calm condition prevailed about 20 percent of the time at the 100-D and 100 F Areas as compared with only 6 percent at the 100-B Area and less than 1 percent at the Meteorology Tower near the 200 West Area.

4. The amount of wind recorded from the easterly components was negligible at all stations; however, the northeast direction approached significance at Richland where it prevailed 14 percent of the time during the quarter.

5. Only 2 percent of the wind prevailed from the northwest at the 100-D Area as compared with 47 percent of the wind from the northwest at the 200 West Area.

The differences summarized above were highly significant when reviewed in respect to the data confined to this quarterly period. However, the variations were nearly identical to those observed during the period April, May, and June, 1950.

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The recurrence of the significant variations in wind direction around the project perimeter tends to confirm the effect of some of the topography such as the Columbia River Gorge, and the mountainous terrain in the vicinity of Rattlesnake, Saddle, and Gable Mountain. The trace activity density of beta emitters from I-131 on vegetation at remote locations such as Ringold, Mesa, Wahluke Slope, and Eltopia was attributed to the variation in wind direction discussed above. The deposition pattern which is elongated to the southeast in the immediate environs of the two separation areas was directly associated with the predominance of wind from the northwest direction as recorded at the Meteorology Tower. 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
HANFORD WORKS METEOROLOGY STATIONS
JULY AUGUST SEPTEMBER
1 9 5 0

units in percent of time observed

Location	Month	N	NE	E	SE	S	SW	W	NW	CALM
200 W	July	4	1	1	2	2	4	28	58	0
	Aug.	5	1	3	2	2	14	30	41	1
	Sept.	11	4	4	3	3	5	24	47	0
100-B	July	4	2	1	2	4	8	56	19	4
	Aug.	7	2	3	1	3	16	56	7	5
	Sept.	11	3	7	4	4	10	42	8	10
100-D	July	5	3	4	1	7	22	45	2	11
	Aug.	8	3	4	1	12	21	26	1	24
	Sept.	11	8	9	1	12	11	19	3	26
100-F	July	2	1	15	1	2	2	46	14	18
	Aug.	1	3	6	13	10	17	27	8	15
	Sept	6	3	13	14	11	5	17	5	27
700 Area	July	14	16	7	3	7	7	29	9	8
	Aug.	9	11	3	4	6	6	33	9	19
	Sept.	9	15	9	9	13	6	14	6	18

Figure 3 is a graphic summation of the data presented in Table II as based on an eight point compass which does not include the portrayal of the calm wind condition.

A more detailed summary of the meteorological conditions which represent hourly recordings throughout the entire quarterly period may be referred to in the monthly

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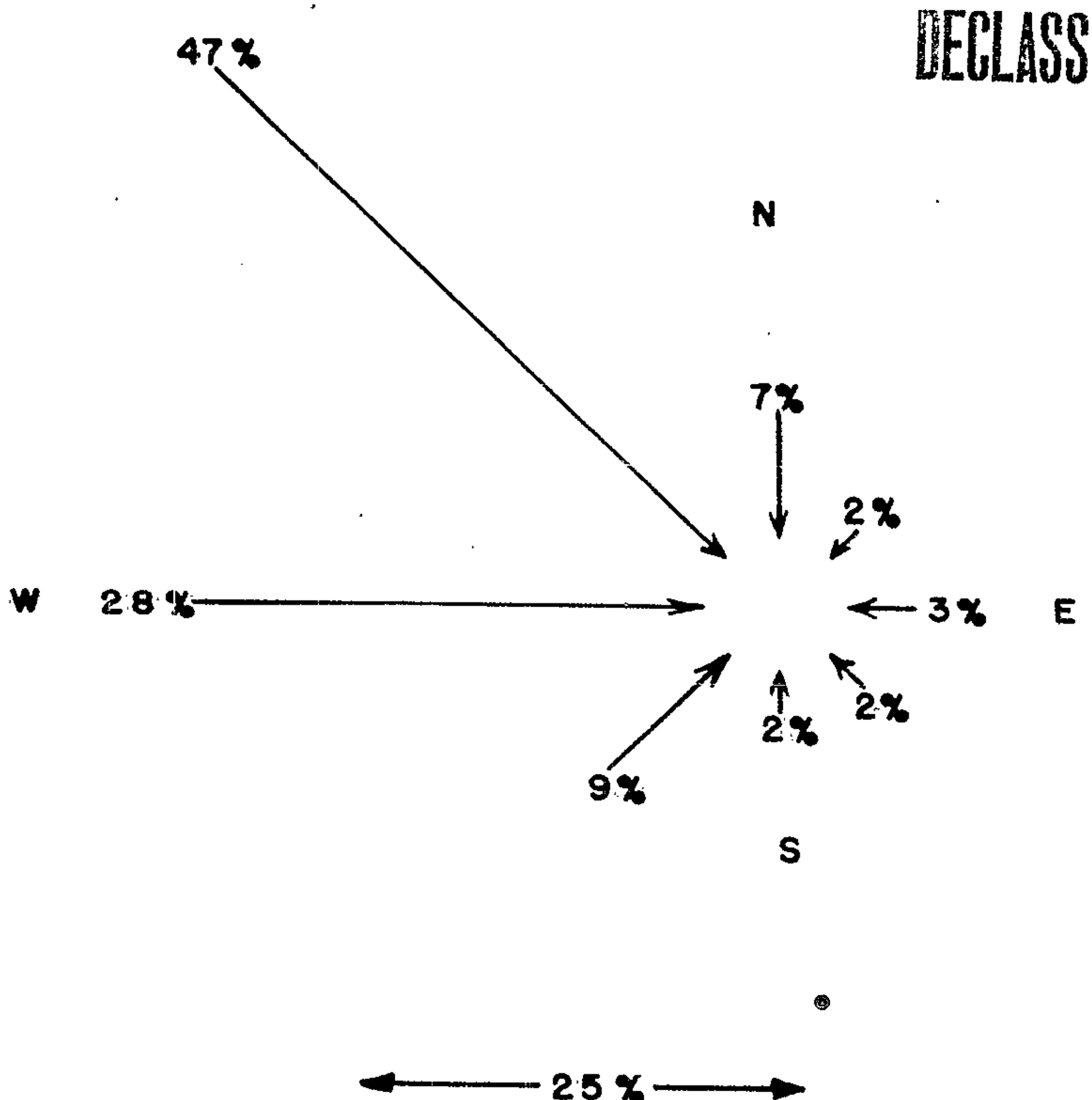
summaries issued by the Meteorological Group of the Health Instrument Divisions.[1]

SECTION I

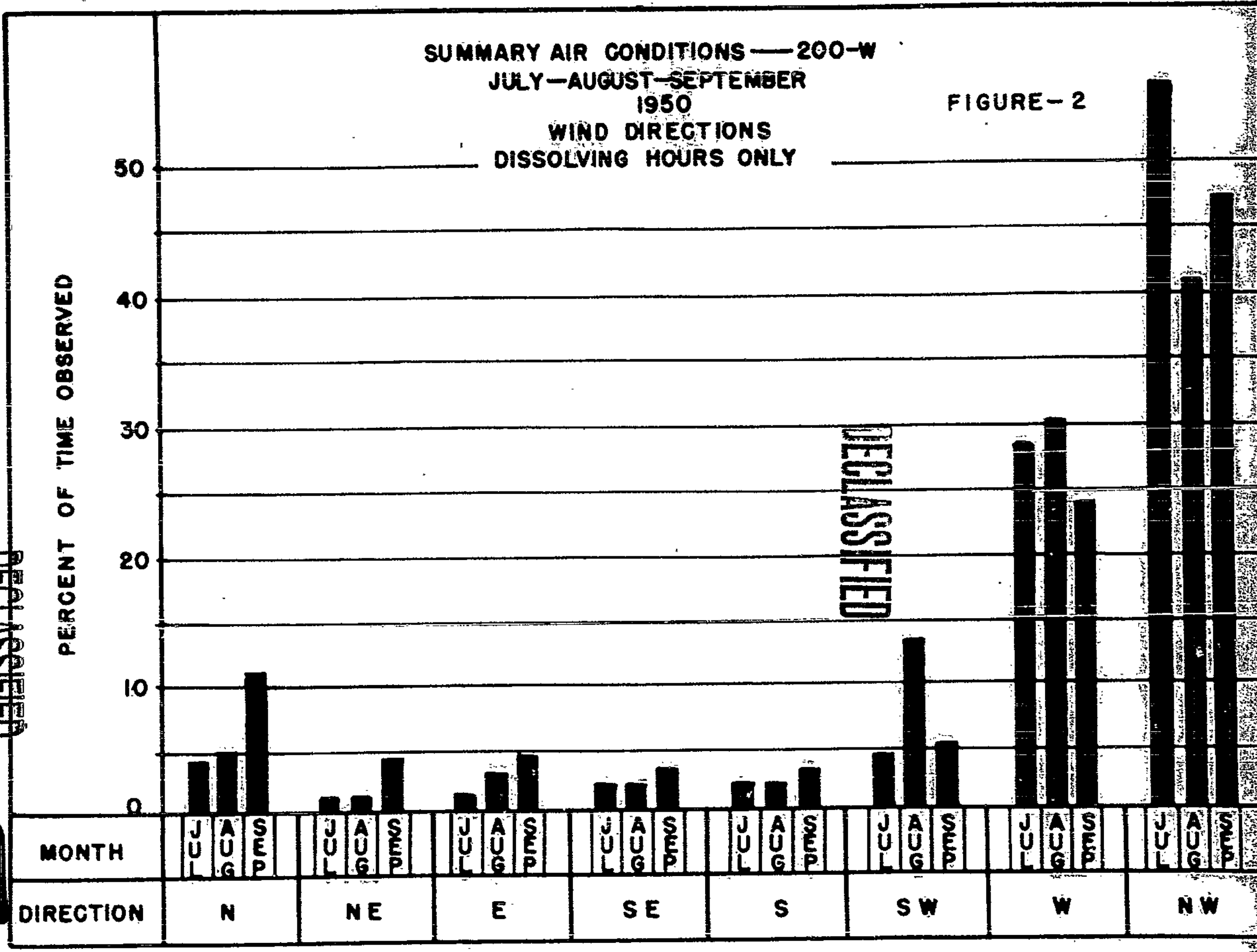
(Please refer to Figures 1, 2, and 3.)

SUMMARY WIND DIRECTIONS 200—W
DISSOLVING HOURS ONLY
JULY—AUGUST— SEPTEMBER
1950

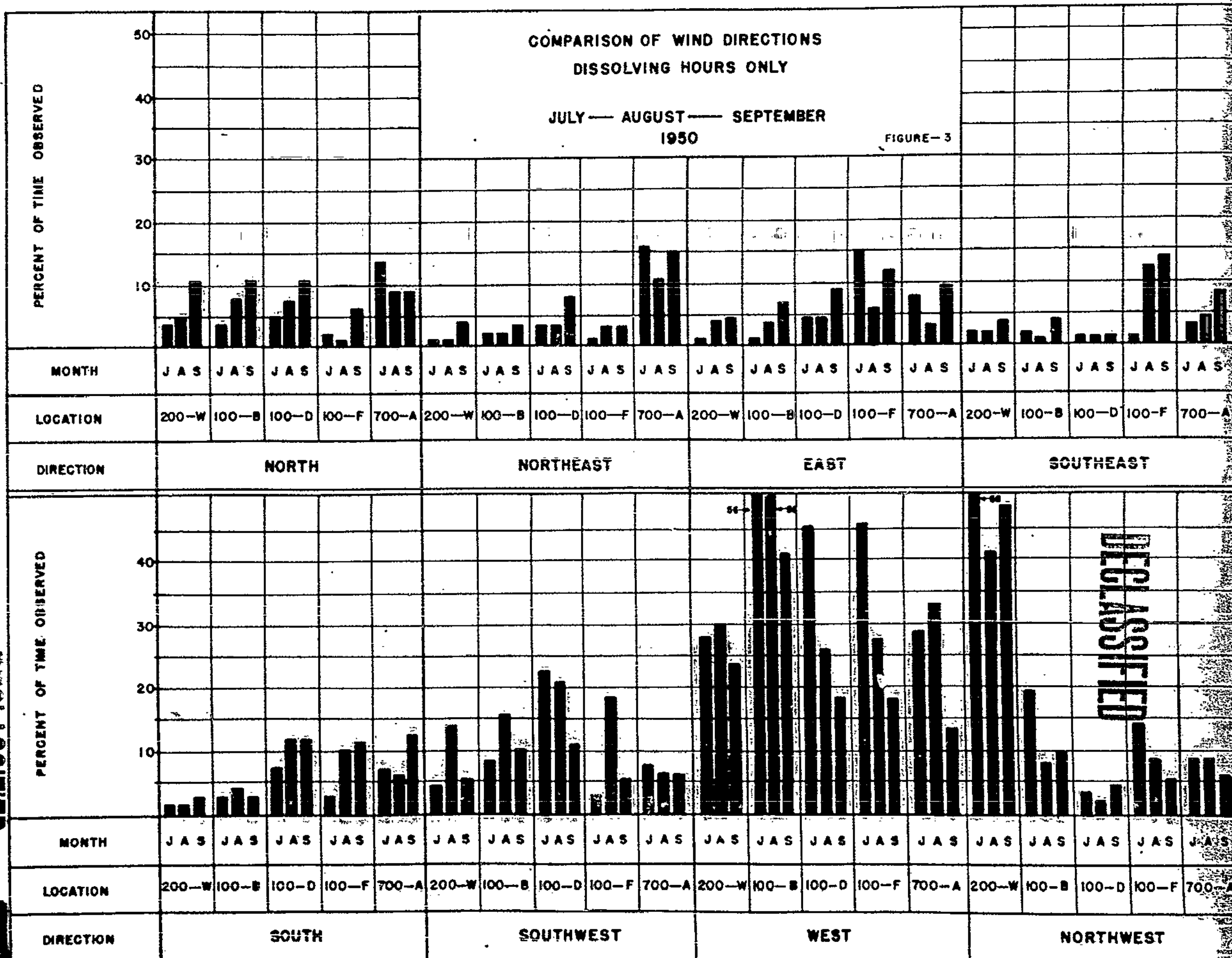
FIGURE - I



PERCENT OF TIME OBSERVED


SUMMARY AIR CONDITIONS —— 200-W
JULY—AUGUST—SEPTEMBER
1950
WIND DIRECTIONS
DISSOLVING HOURS ONLY
FIGURE-2
PERCENT OF TIME OBSERVED
0
10
20
30
40
50
MONTH
JUL AUG SEP
DIRECTION
N
NE
E
SE
S
SW
W
NW

[redacted]


COMPARISON OF WIND DIRECTIONS
DISSOLVING HOURS ONLY
JULY —— AUGUST —— SEPTEMBER
1950
FIGURE-3
PERCENT OF TIME OBSERVED
50
40
30
20
10
MONTH
J A S
LOCATION
200—W
100—B
100—D
100—F
700—A
DIRECTION
NORTH
NORTHEAST
EAST
SOUTHEAST
PERCENT OF TIME OBSERVED
40
30
20
10
56
50
SOUTH
SOUTHWEST
WEST
NORTHWEST

SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

Measurements for the activity density of beta emitters on the vegetation in the environs of the Hanford Works were made to evaluate the magnitude and extent of the environmental hazard which resulted from the emanation of radioactive materials from the separations area stacks. The predominant contaminant found on the vegetation is radioactive iodine (I-131 - half-life of eight days.) Non-volatile beta emitters from the longer half-lived fission product isotopes also deposit on the vegetation in small quantities. The measurement for the activity density of the latter group included activity from the naturally occurring isotope of potassium (K-40) present in vegetation.

During the period July, August, and September, 1950, it was estimated that about 12 times as much I-131 was involved during metal dissolution as compared with the previous three month period. The increase in the dissolving schedule was weighted toward the end of the period when a significant reduction in the cooling time of the irradiated metal was initiated. A summary of the number of curies of I-131 calculated to be involved in the dissolvers during the three month period under discussion is presented in Table I. The actual quantity emitted from the stack is currently estimated to be about 15 percent of values quoted in the table below.

TABLE I
CALCULATED I-131 INVOLVED IN DISSOLVERS
JULY AUGUST SEPTEMBER
1 9 5 0

Month	200 East Area	200 West Area	Total
July	247	287	534
August	2467	2609	5076
September	3676	3502	7178
Total	6390	6398	12788

The increase in the amount of I-131 formed during this period was a result of two causes; 1.) the reduction of the cooling period of the uranium previous to dissolving; and 2.) increases in power level of the 100 Area piles. The effect of the latter was small when compared with the effect of the reduction of the cooling period. Table II summarizes the cooling period data for the quarterly period.

[redacted]

TABLE II
RANGE OF COOLING PERIOD FOR IRRADIATED URANIUM
JULY AUGUST SEPTEMBER
1950

Month	200 East Area		200 West Area	
	Minimum	Maximum	Minimum	Maximum
July	84	105	81	94
August	63	86	62	86
September	63	73	63	74

In monitoring for the deposition patterns of this I-131 on vegetation, two thousand and thirty-six vegetation samples were collected from locations in the environs of the Hanford Works. These samples were analyzed for the activity density of beta emitters from eight-day I-131 and from the non-volatile, longer half-lived fission product isotopes. The methods used for the radiochemical analysis of each of these emitters may be referred to in detailed discussions which appeared in earlier publications.(2)(3) A summary of the results of these analyses for samples obtained at representative locations is presented in Table III; the previous quarter's averages are included for comparison.

[redacted]

TABLE III
RADIOACTIVE CONTAMINATION ON VEGETATION
JULY AUGUST SEPTEMBER - THIRD QUARTER
1 9 5 0

Location	No. Samples	I-131 Activity Density x 10^6 μc/gram Maximum	Average	Second Quarter Average	Non-Volatile Beta Emitters Activity Density x 10^6 μc/gram Maximum	Average	Second Quarter Average
North of 200 Areas	212	86	8	<3	56	11	11
Near the 200 Areas	176	458	37	6	36	11	13
Route 3	24	1395	414	53	38	16	28
200 West Gate	47	3826	1054	92	81	25	61
200 East Tower #16	34	1833	455	--	90	29	--
Batch Plant	34	437	245	--	26	11	--
Meteorology Tower	12	884	258	32	34	13	23
South of 200 Areas	275	156	14	<3	62	11	11
Richland	67	19	4	<3	30	11	<10
Pasco	51	17	4	<3	21	11	10
Kennewick	51	19	3	<3	32	10	<10
Benton City	35	51	9	<3	35	12	<10
Richland "Y"	13	19	4	<3	32	12	12
Hanford	20	87	14	<3	34	14	11
200 East Area	32	1061	180	15	49	16	19
200 West Area	40	2947	212	20	86	18	17
Redox Construction Area	79	800	129	23	50	14	16
Wahluke Slope	189	46	10	<3	26	<10	<10
Rattlesnake M. P. Posts	43	32	12	<3	18	<10	11
Goose Egg Hill	38	155	22	7	24	10	16
Benton Gap	70	11	<3	<3	--	--	11
In and Near 200 Areas	284	763	60	15	59	13	14
Off Area Sampling							
Pasco to Eltopia	18	12	3	<3	19	10	10
Pasco to Ringold	36	28	6	<3	20	10	10
Yakima Barricade to Ellensburg	28	9	5	<3	17	<10	12
Yakima Barricade to Bonneville Dam to Kennewick	32	19	<3	<3	--	--	<10
Pasco to Mesa to Hanford	7	21	9	--	--	--	--
Pasco to Meacham, Ore.	22	3	<3	--	21	11	--
Pasco to Walla Walla to Pendleton	39	12	[illegible]	--	11	<10	--
Hanford to Spokane	35	[illegible]	3	--	23	<10	--

A review of the data presented in Table III indicates that a highly significant increase was observed at nearly all locations when comparing the average activity density from I-131 with earlier data. The higher averages were weighted considerably by the results obtained during the month of September when the maximum cooling period for the metal was 74 days. The effect of the shorter cooling period on the magnitude of activity measured at several representative locations may be evaluated by referring to Figure 4. In general, the locations at which the activity density from I-131 was below the detection limit of 3 x 10^{-6} µc/gram during the month of July showed measurable activity during August and September at which time the cooling period of the irradiated uranium was below 75 days.

As in the past, the maximum activity density of I-131 on vegetation was measured on samples collected from the area outside the 200 West Area gate-house; the average activity density at this location was 1.1 x 10^{-3} µc/gram including a maximum measurement of 3.8 x 10^{-3} µc/gram. The activity density of beta emitters from 8 day iodine at this location represented a ten-fold increase over the previous quarterly average which was 9.2 x 10^{-5} µc/gram. In the 200 East Area, the maximum deposition was observed at the southeast corner of the area where the activity density of I-131 on vegetation averaged 4.6 x 10^{-4} µc/gram; the deposition in this region was nearly identical to that along Route 3 adjacent to the 200 West Area where the average during the quarter was 4.1 x 10^{-4} µc/gram. The activity density from I-131 inside the separation areas was considerably lower; the quarterly averages for the 200 East and 200 West areas were 1.8 x 10^{-4} and 2.1 x 10^{-4} µc/gram, respectively. Frequent sampling in the vicinity of the nearby construction areas which included the Batch Plant and the Redox Construction project showed the activity density from I-131 to average on the order of 1.0 to 3.0 x 10^{-4} µc/gram; the maximum activity density measured on a vegetation sample from the Redox Construction Zone was 8.0 x 10^{-4} µc/gram.

Weekly samples obtained from the residential areas adjacent to the plant showed the average activity density from I-131 to be slightly above the sensitivity limit of the analysis; in Richland, Pasco, and at the Richland "Y" the average activity density was 4 x 10^{-6} µc/gram, whereas in Benton City, the average was 9 x 10^{-6} µc/gram during this period. The maximum activity detected in the residential communities was 5.1 x 10^{-5} µc/gram in a sample obtained from Benton City. All measurements of samples obtained from the populated regions near the plant represented increases over the previous quarterly averages. During the period April,

 [redacted]

May, and June, 1950, the average activity density from I-131 was less than 3×10^{-6} μc/gram in each of these areas.

Similar increases in the activity density were observed in non-populated regions around the project perimeter. One hundred and eighty-nine samples obtained from Wahluke Slope showed the activity density to average 1.0×10^{-5} μc/gram as compared with a previous average of less than 3×10^{-6} μc/gram. Forty-three samples obtained from the vicinity of Rattlesnake Mountain showed an average of 1.2×10^{-5} μc/gram including a maximum result of 3.2×10^{-5} μc/gram. Again, the activity density from I-131 was less than 3×10^{-6} μc/gram at these locations during the previous quarter.

An estimated distribution of the deposition pattern of the activity density from I-131 based on average measurements for the quarterly period may be referred to in an iso activity map presented as Figure 5.

Over 200 samples of vegetation were obtained from locations outside of the immediate environs of the Hanford project during the period July, August, September, 1950. The activity density on the vegetation in the outlying regions reflected the same trend as that observed when comparing the results of measurements from samples obtained in the immediate environs; the activity density of I-131 increased throughout the period with all maximum measurements being recorded during the months of August and September. The magnitude of this activity was dependent upon the date of survey in a particular region; surveys during the earlier part of the period showed negligible activity, whereas, those on later dates indicated positive results at nearly all locations within 100 miles of the site. During early July, a survey which included the area between the project perimeter and Meacham, Oregon (close to the summit of the Blue Mountains) showed the maximum activity density from I-131 to be 3.0×10^{-5} μc/gram with an over all average for the entire survey of less than 3×10^{-6} μc/gram. On August 17, a survey which included much of the same region in the vicinity of Walla Walla and Pendleton showed an average activity density of 4×10^{-6} μc/gram including a maximum of 8×10^{-6} μc/gram. On this survey, 14 of the 17 samples analyzed showed a positive result (greater than 3 x 10^{-6} μc/gram.) On September 18, a survey in the same region including Walla Walla, Pendleton and Boardman showed the average activity density to be 6 x 10^{-6} μc/gram including a maximum of 1.2 x 10^{-5} μc/gram. On this survey, 21 of the 22 samples indicated results of greater than 3 x 10^{-6} μc/gram. Figure 6 shows the locations from which samples were obtained on the latter two surveys; positive results are indicated in each instance.

Surveys to the northwest of the plant during August included the Area between Sunnyside, Ellensburg and Yakima; the average activity was 5 x 10^{-6} μc/gram based on the analysis of 28 roadside samples. During the latter part of August, vegetation samples were obtained from along the gorge of the Columbia River between Kennewick, Washington and Bonneville Dam. The activity density of I-131 on vegetation in this region was negligible when compared with measurements in other localities in the same period; the average activity density of I-131 in this region was less than 3 x 10^{-6} μc/gram with the few positive results occurring at random locations. Samples obtained between Goldendale and Moxie City also showed negligible activity during this period. Figure 7 shows the locations from which samples were obtained on the Bonneville, Goldendale, and Ellensburg surveys; samples which indicated positive activity are indicated as such.

The measurement of the activity density of I-131 on the predominant vegetation in the environs during this period was supplemented with a series of surveys which included the sampling of common crops which were grown adjacent to the site. Previous to August 10, 1950, the activity density from I-131 measured in the fruits and crops averaged less than 3 x 10^{-6} μc/gram at all locations. On August 10, four wheat samples obtained from the fields in the Ringold region showed an average activity density of 2.4 x 10^{-5} μc/gram, including a maximum measurement of 5.7 x 10^{-5} μc/gram. These samples were obtained at the same time that a predominant vegetation survey in the nearby Connell-Lind region indicated deposition of detectable I-131. These fields were resampled on August 17 at which time the activity density from I-131 averaged 5×10^{-6} µc/gram with a maximum measurement of 1.4×10^{-5} µc/gram. Samples of other crops such as cabbage, alfalfa, beets, and strawberries were also obtained during the later survey; in general, the activity density of I-131 varied from 5×10^{-6} µc/gram to 2.5×10^{-5} µc/gram. The maximum activity was measured in a sample of green beans from the Hanford-Ringold area which indicated an activity density of 3.5×10^{-5} µc/gram.

In contrast to the samples obtained from crops grown in 1950, several samples of the 1949 wheat crops were obtained from storage at Connell and LaCross; radiochemical analysis indicated the activity density from I-131 to be less than 3×10^{-6} µc/gram in this material. One sample of 1949 wheat obtained from an open storage pile showed the activity density to be 7×10^{-6} µc/gram; this sample was obtained near LaCross.

Table IV is a detailed summary of the results obtained from the samples of common crops during August, 1950.

TABLE IV
I-131 ACTIVITY DENSITY ON CROPS
HANFORD WORKS ENVIRONS
AUGUST 1950

Location and Variety	Date Sampled	Number Samples	Activity Density x 10^6 uc/gm Maximum	Activity Density x 10^6 uc/gm Average	Location of Maximum Activity
Rattlesnake Mountain					
Wheat	7/31/50	20	6	<3	Green Kernels
Benton City					
Corn	8/1/50	12	6	<3	Kernel
Wheat	8/1/50	4	4	<3	Stem
Prune	8/1/50	4	<3	<3	Meat
Apple	8/1/50	4	3	<3	Skin
Grape	8/1/50	4	<3	<3	----
Kennewick					
Mint	8/2/50	6	4	<3	Stem
Prune	8/2/50	4	<3	<3	Skin
Grape	8/2/50	8	6	<3	Meat
Oat	8/2/50	4	9	<3	Stem
Berries	8/2/50	12	<3	<3	----
Potato	8/2/50	9	<3	<3	----
Apple	8/2/50	4	<3	<3	----
Corn	8/2/50	1[illegible]	<3	<3	----
Sycamore	8/2/50	3	3	<3	Stem
Pasco-Ringold					
Corn	8/2/50	11	4	<3	Silk
Wheat	8/2/50	4	5	<3	Kernel
Connell & Vicinity					
Wheat	8/10/50	4	57	24	
Wheat	8/17/50	10	14	5	Kernel
Hanford-Ringold					
Corn	8/17/50	11	13	5	Husk
Cabbage	8/17/50	2	20	14	Leaf
Green Beans	8/17/50	2	35	25	Bean
Alfalfa	8/17/50	1	17	17	Leaf
Beets	8/17/50	2	10	9	Beet
Strawbeery	8/17/50	2	9	8	Berry

Measurement for the activity density of the non-volatile beta emitters on vegetation was included for the majority of samples collected during this period. A review of current averages in comparison with those observed during the previous quarter indicated no outstanding changes. The maximum activity density of the non-volatile emitters was on the order of 2.0 to 3.0 x 10^{-5} uc/gram and was measured in the same region that the maximum activity density from I-131 was measured.

With the exception of measurements made on samples taken near the separations areas, the average activity density from non-volatile beta emitters barely exceeded the sensitivity limit of the analysis (1.0×10^{-5} µc/gram.) The maximum activity density of the non-volatile beta emitters was on the order of 8 to 9 x 10^{-6} µc/gram in samples taken inside and immediately adjacent to the 200 Areas. Table III summarizes the results of the activity density measurements for representative locations and areas.

A program designed to evaluate the concentration of potassium (K-40) which occurs naturally in vegetation was extended during this period. The work performed by L. C. Schwendiman of the Health Instrument Development Division indicates that the potassium contained in sage and grass varies with the season; peak concentrations were encountered during the latter part of April and throughout the month of May. The measurements indicate that a gram of vegetation contains from 20 to 30 mgs. of potassium during the peak concentration season. Approximately 0.012 percent of this total potassium is radioactive K-40. Table V summarizes the maximum average values for the potassium measured in the sage and grass samples collected from representative locations during the period March through August, 1950.

TABLE V
POTASSIUM IN VEGETATION
1 9 5 0

Location & Type Vegetation	MAXIMUM AVERAGE IN ANY MONTH mgs K/gm Vegetation					
	March	April	May	June	July	August
Riverland:						
Sage	14	28	31	16	17	12
Grass	10	22	11	4	10	6
Intersection of Route 4S and Route 10:						
Sage	8	21	30	31	21	12
Grass	3	35	12	4	3	2
100-B Area:						
Sage	10	25	23	31	20	15
Grass	2	26	16	7	4	4
200 West Gate:						
Sage	10	25	25	21	16	19
Grass	4	16	22	6	10	2
Pasco:						
Sage	10	25	26	23	21	16
Grass	1	25	22	6	6	3

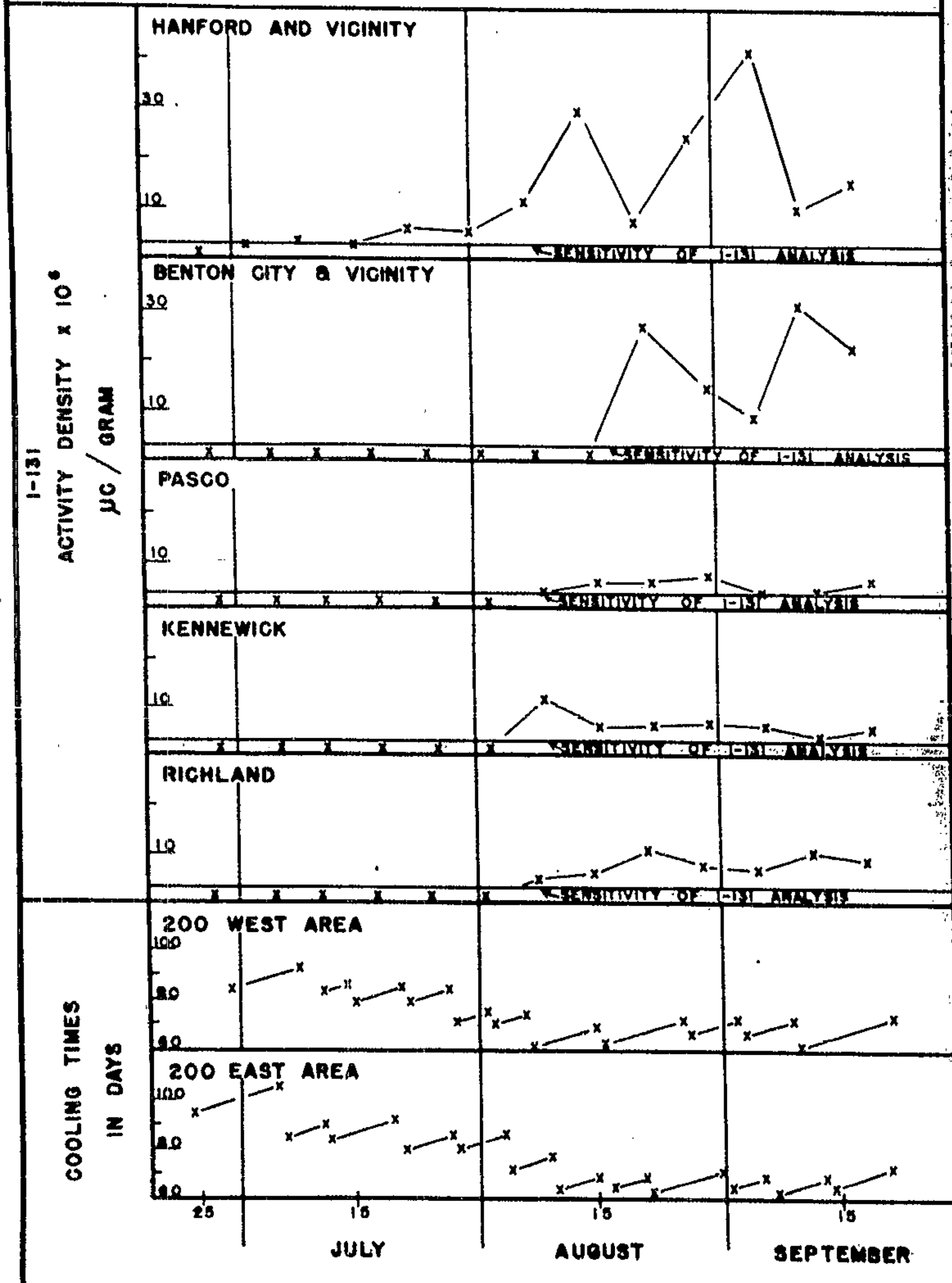
SECTION II

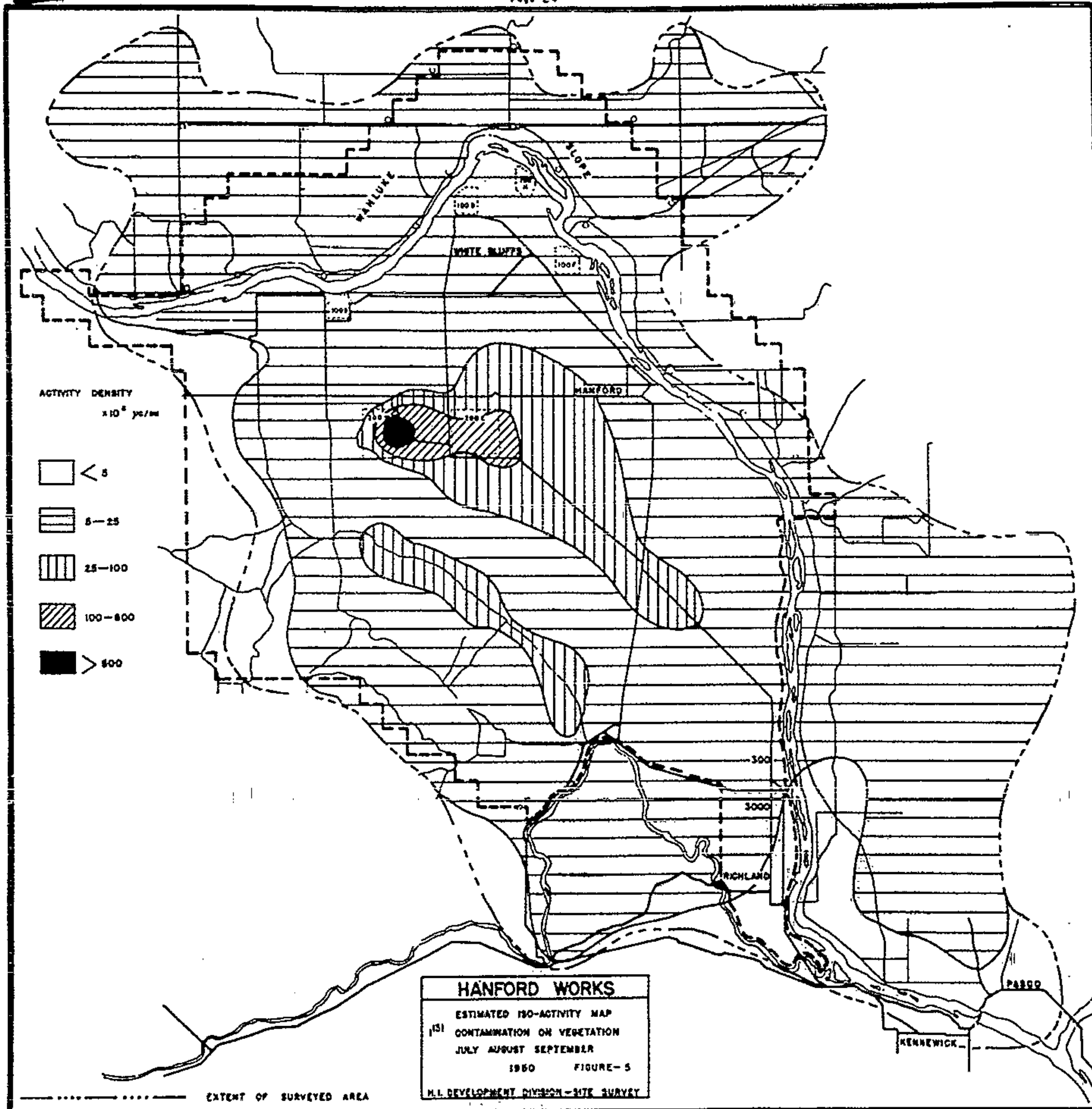
(Please Refer to Figures 4, 5, 6, and 7.)

 [redacted]

ACTIVITY DENSITY MEASURED ON VEGETATION COMPARED WITH COOLING TIMES OF IRRADIATED URANIUM JULY-AUGUST-SEPTEMBER 1950

FIGURE-4





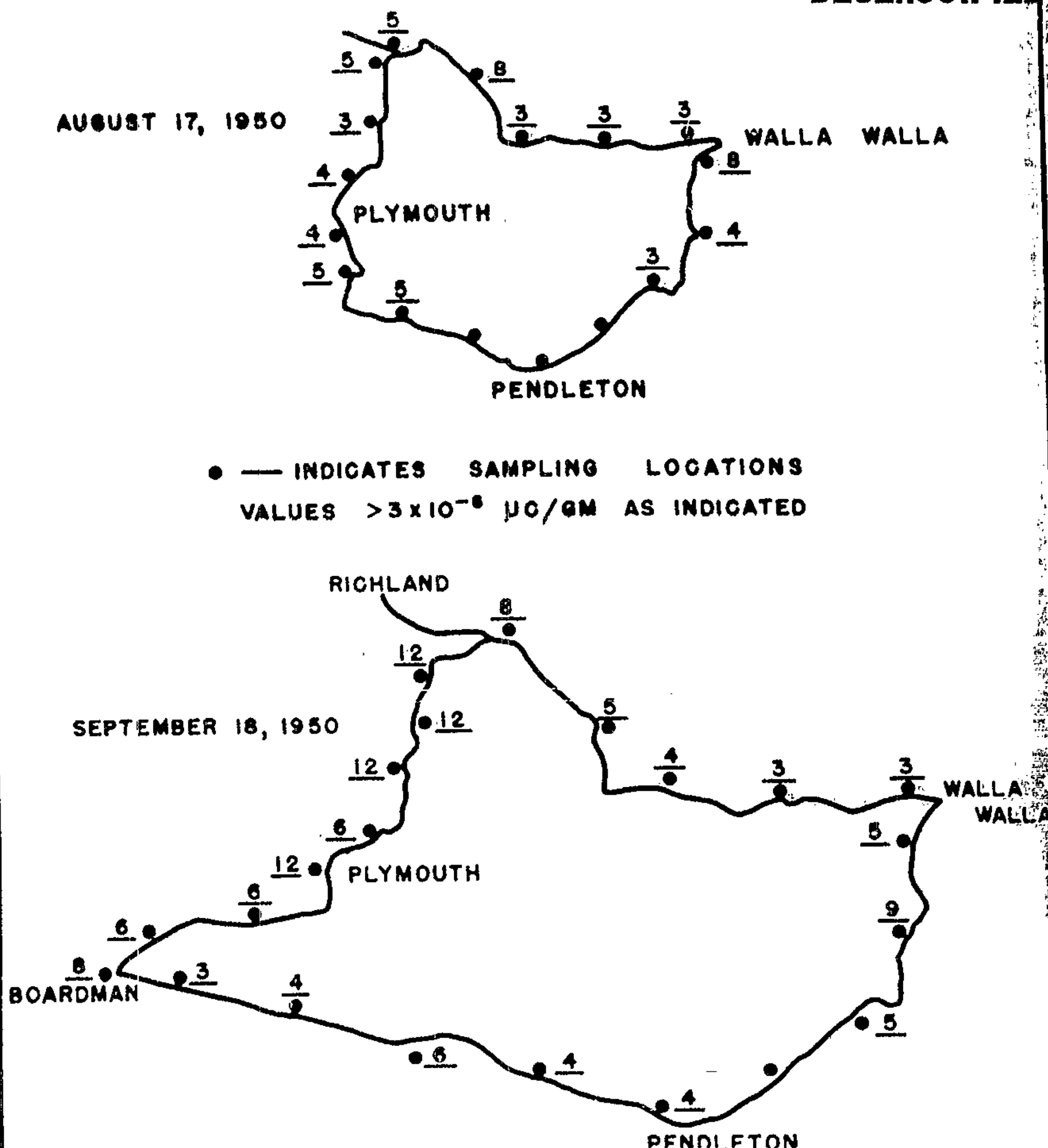
HANFORD WORKS

ESTIMATED ISO-ACTIVITY MAP
I131 CONTAMINATION ON VEGETATION
JULY AUGUST SEPTEMBER
1950 FIGURE-5

H.I. DEVELOPMENT DIVISION-SITE SURVEY

FIGURE — 6

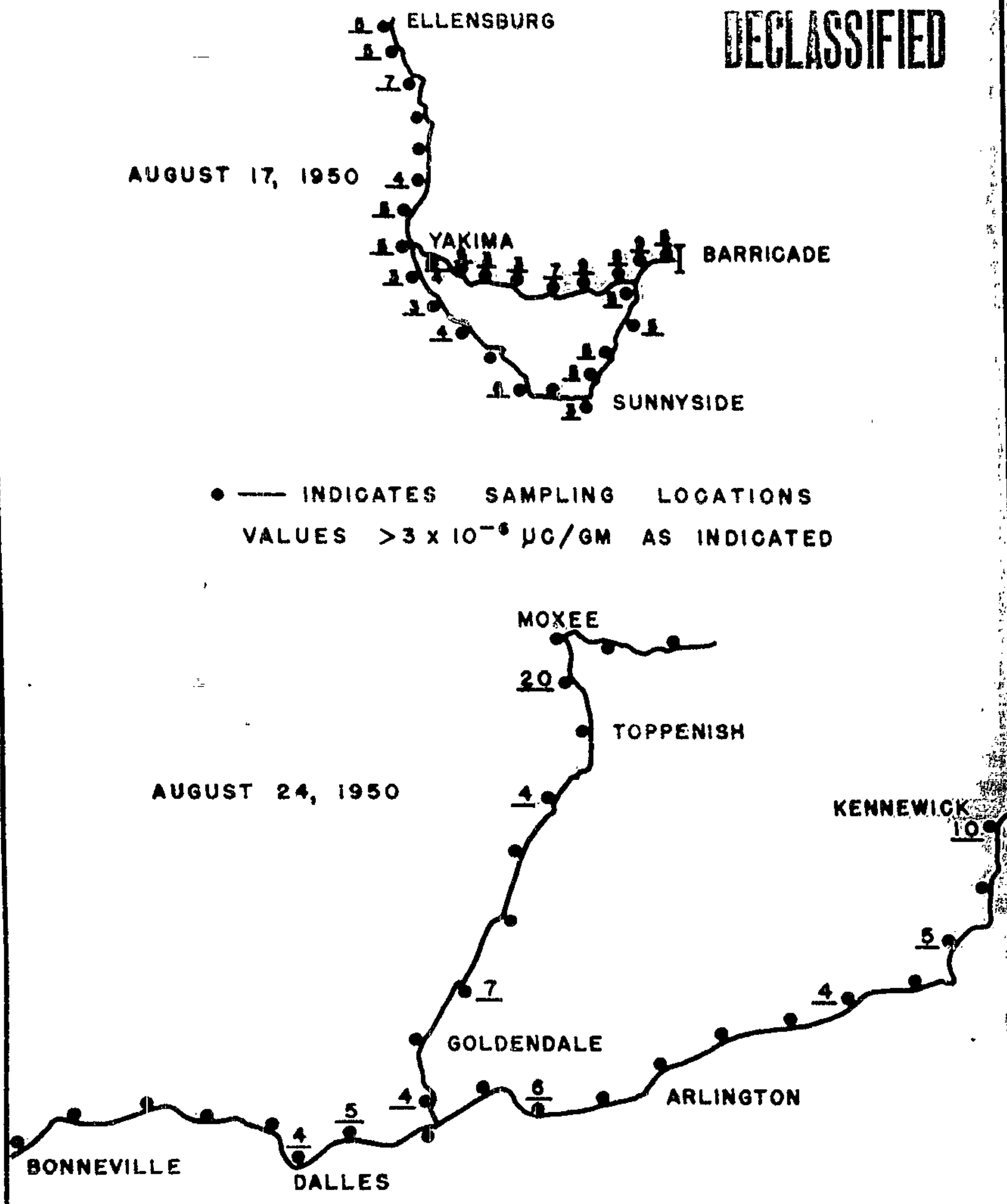
I^{131} CONTAMINATION ON VEGETATION OFF AREA



 [redacted]

FIGURE — 7

I^{131} CONTAMINATION ON VEGETATION OFF AREA



SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

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The activity density of beta emitters in air and the determination of atmospheric radiation dosage rates were accomplished by using various types of fixed and portable electronic equipment and filter and scrubber collection devices. The selection of the type of equipment used for any specific measurement was largely dependent on the source and type of activity which was measured. The bulk of the monitoring equipment was located within the perimeter boundaries of the Hanford Works; however, representative measurements were maintained in each of the nearby residential communities such as Pasco, Richland, and Benton City. Several units were operated at remote locations in the states of Washington, Oregon, Montana, and Idaho for the specific purpose of evaluating the background radioactivity in the atmosphere.

Average radiation dosage rates were evaluated by computing the recorded readings from Victoreen integrons which were located around the perimeter fence in the Hanford Works operating areas and in the residential communities adjacent to the Hanford Works. In most cases, 2 or 3 integron units were operated simultaneously at the area locations and only one integron unit was maintained in a residential community. Table I summarizes the average dosage rates computed for each month and for the quarter.

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TABLE I

AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS

JULY AUGUST SEPTEMBER

1 9 5 0

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units - mrep per 24 hours

Location	Number of units	Average Dosage as mrep per 24 hours July	August	September	Quarter
100-B Area	3	0.7	0.7	1.0	0.8
100-D Area	3	0.5	0.5	0.2	0.4
100-F Area	3	0.3	0.8	0.6	0.6
100-H Area *	3	0.4	0.3	0.7	0.5
200 West	2	0.7	0.6	1.7	1.0
200 East	3	0.4	0.7	0.7	0.6
Riverland	1	0.1	0.1	0.1	0.1
300 Area	1	1.4	0.3	1.1	0.9
700 Area	1	0.5	1.4	1.1	1.0
Pasco	1	1.1	1.5	0.9	1.2
Benton City	1	0.3	0.3	0.6	0.4
3000 Area North	1	0.1	0.7	0.8	0.5
3000 Area South	1	0.3	0.1	0.5	0.3
Hanford	1	0.5	1.0	0.5	0.7

* mr/24 hours. H. M. Chambers are used at this station.

A review of the above data indicate that the average dosage rates during the period July, August, September were slightly above the instrument background (0.3 to 0.5 mrep/24 hours.) Comparison of these data with the results from similar measurements during the previous quarter show a small general increase in dosage rate during this period. In the 14 general locations summarized in Table I, the average dosage rate showed an increase in 9 instances and essentially no change at 4 locations. A further review of the data indicate that the above mentioned increase was somewhat weighted towards the end of the period when the cooling period for the uranium dissolved in the separation areas was materially reduced.

Detachable "C" type ionization chambers were exposed inside the 614 Buildings in a manner that would reasonably correlate with the measurements recorded from the Victoreen integrons. The radiation levels were evaluated by using the minimum reading from one of the two chambers which were employed at each location; readings which were attributed to faulty chambers or known leakage were deleted from the appraisal. Table II summarizes the average radiation levels in the atmosphere as measured by "C" type detachable ionization chambers.

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TABLE II
RADIATION LEVEL OBSERVED
WITH DETACHABLE IONIZATION CHAMBERS
JULY AUGUST SEPTEMBER
1 9 5 0
(mrep per 24 hours)

Location	July	August	September	Quarterly Average
Within 100-B Area	0.3	0.3	0.5	0.4
Within 100-D Area	0.4	0.4	0.4	0.4
Within 100-F Area	0.3	0.3	0.4	0.3
Within 200 W Area	0.3	0.3	0.4	0.3
Within 200 E Area	0.5	0.6	0.7	0.6
Within 300 Area	0.5	0.5	0.5	0.5

A review of the above data and a comparison with measurements performed during previous periods showed no significant difference in average dosage rate when comparing the individual months or when comparing the quarterly averages. The small fluctuations noted are well within the expected range of the background variation and were not attributed to any associated change in measureable air radiation level by the operation of the Hanford Works.

Detachable M and S type ionization chambers were employed for evaluating the dosage rates at intermediate locations outside of the immediate environs of the Hanford Works operating areas. These chambers were located on the top of wooden stands about 5 feet above the ground level. The dosage rates obtained in this manner included the natural background measurement and possibly trace amounts of emission from the ground deposition in the immediate vicinity. Two chambers were used at each location; the minimum readings were used to compute the dosage and those readings which were attributed to leakage and faulty chambers were deleted from the summary. The frequency of reading was dependent on the capacity and location of the chamber; normally, each location was checked at least two times per week. Table III summarizes the average radiation levels observed at representative locations during July, August, and September, 1950.

A review of the data presented in Table III indicates that a significant increase in the measured radiation level in the region within five miles of the 200 East Area occurred during this period.

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TABLE III
RADIATION LEVEL OBSERVED WITH
"M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS
JULY-AUGUST-SEPTEMBER - 1950

units mrep per 24 hours

Location	JULY	AUGUST	SEPTEMBER	QUARTERLY AVERAGE	GROUP AVERAGE
100 Area and Environs					
Route 1, Mile 8 (M)	0.40	0.36	0.47	0.41	
Route 2N, Mile 10 (M)	0.36	0.33	0.41	0.37	0.41
Route 2N, Mile 5 (M)	0.37	0.36	0.49	0.41	
At White Bluffs (M)	0.42	0.35	0.41	0.39	
Route 11 A, Mile 1 (S)	0.38	0.51	0.57	0.49	
At Hanford 614 (S)	0.39	0.29	0.32	0.33	
Intersection Rt. 1 and Rt. 4N (M)	0.32	0.34	0.51	0.39	
At Hanford 101 (M)	0.38	0.38	0.44	0.40	
At 100-H Area (M)	0.37	0.37	0.43	0.39	
P-11 Area (M)	0.35	0.36	0.48	0.40	
100-DR Waterworks (M)	0.45	0.46	0.59	0.50	
Within 5 Miles 200 East Area					
Route 4S, Mile 6 (S)	0.45	0.80	0.82	0.69	0.81
Batch Plant (M)	0.41	0.59	0.82	0.61	
Route 11 A, Mile 6 (S)	0.60	0.59	1.44	0.88	
Route 3, Mile 1 (S)	0.93	1.14	0.82	0.96	
Meteorology twr. 200' (S)	0.70	0.90	1.38	0.99	
Route 4S, Mile 25 (S)	0.51	0.98	0.97	0.82	
Redox Area (S)	0.62	0.65	0.98	0.75	
Within 10 Miles of 200 East Area					
Route 4S, Mile 10 (S)	0.60	0.64	0.53	0.59	0.69
Route 10, Mile 1 (S)	1.76	0.83	0.51	1.03	
Route 10, Mile 3 (S)	0.46	0.51	0.51	0.49	
Route 2S, Mile 4 (S)	0.64	**	**	0.64	
Near 300 Area					
Route 4S, Mile 16 (S)	0.65	0.79	0.77	0.77	0.48
Route 4S, Mile 22 (S)	0.42	0.49	0.51	0.47	
3000 Area North (S)	0.29	0.27	0.30	0.29	
3000 Area South (S)	0.41	0.40	0.35	0.39	
Outlying Zone					
Richland (S)	0.43	0.71	0.41	0.52	0.45
Benton City (S)	0.41	0.42	0.32	0.38	

* These readings were voided due to faulty chambers.

At 7 locations, the average radiation level for the quarter ranged from 0.6 mrep/24 hours; the mean average for all locations within a five mile radius of the stacks was 0.81 mrep/24 hours. This dosage rate represented an over all increase of 0.14 mrep/24 hours over the previous quarterly average which was 0.67 mrep/24 hours.

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The observed difference was also noted as an increasing trend toward the end of the period. This trend correlated favorably with a change in the cooling periods for the metal dissolved in the 200 Areas. For example, the monthly average dosage rate observed at the 200 foot level of the Meteorology Tower was 0.70, 0.90, and 1.38, mrep/24 hours for the months of July, August, and September, respectively. Increases of comparable magnitude were also observed at the Batch Plant, which is located between the two 200 Areas and at the Redox Construction Area. These two locations represent areas in which construction personnel are employed.

The atmospheric radiation dosage rate showed very little change at those locations which were at a distance of more than 10 miles from the 200 Areas. Small fluctuations observed at isolated locations were attributed to varying meteorological conditions; the wide variation in prevailing wind directions recorded at perimeter meteorology stations (Sec. I, Figure 3) presumably was the main contributing factor causing changes in dosage rates at remote locations. In the outlying zone which includes Richland and Benton City, the over all average dosage rate was 0.45 mrep/24 hours; this figure is within the natural background fluctuation which varies between 0.3 and 0.5 mrep/24 hours in this region.

The activity density from filterable beta emitters in the atmosphere was measured by exposing small CWS #6 filters to an air flow of 2.0 or 2.5 cubic feet per minute. The exposed surface of these filters is 1.8 square inches; the air was drawn through the filter by a one quarter horsepower motoair pump. These filters were changed on a weekly basis at representative locations on and adjacent to the Hanford Works. The filters were allowed to stand for two or three days after removal to allow for decay of the daughter products of radon and thoron before being counted using thin mica-window counters. The counting rates determined in this manner were representative of an air volume on the order of 20 thousand cubic feet. In those instances in which the motor or pump failed during the period of filter exposure, the volume of air sampled was corrected by using the number of operating hours recorded by a running time meter which was attached in the primary line of each motor.

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Table IV summarizes the monthly and quarterly average activity density from beta emitters measured in the atmosphere in this manner. The maximum activity density measured at each location during a one week period is also included in this summation.

TABLE IV
AVERAGE FILTERABLE BETA EMITTERS IN AIR
JULY AUGUST SEPTEMBER
1 9 5 0

Location	Beta Emitters - Average Activity Density x 10^{14} $\mu c/cc$				
	July	August	September	Quarterly Average	Maximum Week
200 Areas and Vicinity					
200 East Southeast	114	257	446	339	445
200 East Tower #16	290	575	620	501	1370
200 West Tower #15	12	31	156	65	242
200 West Gatehouse	200	301	220	246	770
200 West Tower #4	8	46	241	94	446
Gable Mountain	19	70	218	103	545
100- Areas and Vicinity					
100-D Area	9	31	87	41	172
100-H Area	8	33	61	34	117
Hanford 101 Building	8	61	62	45	179
Hanford 614 Building	8	36	133	57	353
White Bluffs	3	40	24	24	98
300 Area					
614 Building	10	27	77	206	332
Outlying					
Richland	5	27	24	19	47
North Richland	12	47	106	54	209
Pasco	1	1	1	1	2
Benton City	5	21	52	25	129
Riverland	25	15	69	32	186

A comparison of the quarterly averages with similar measurements obtained during the period April, May, and June indicate a significant over all increase in the average filterable beta activity in the atmosphere during this period. The magnitude of this increase was on the order of a factor of 5 in most instances; however, in the extreme case at the 300 area, it measured an increase by a factor of 17 The data indicated a significant trend when reviewing and comparing the individual monthly averages for July, August, and September. During July, the average activity density in the atmosphere was comparable with that measured during June. A very definite increase in activity density occurred during the month of August

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and continued during September. Thus the significant increase in the quarterly average was weighted considerably by the increased activity density in the atmosphere during August and September. The increase in activity during the latter part of the quarter was directly associated with an operating change in the separations areas.

The maximum average filterable activity density of beta emitters measured during a given week was observed in the 200 East Area where the station located in Tower #16 showed the average to be 1.4×10^{-11} μc/cc. During the previous quarter, the maximum activity was also measured at this location; the value at that time was 4.9×10^{-12} μc/cc. The highest quarterly average was also found at this location where the average of 5.0×10^{-12} μc/cc was approximately $2\frac{1}{2}$ times greater than that observed during the previous period. In the vicinity of the 200 West Area, the maximum activity density was found at the gatehouse where the quarterly average was 2.5×10^{-12} μc/cc including a maximum measurement of 7.7×10^{-12} μc/cc. The measurements at the 200 West area gatehouse represented an eight-fold increase over the previous quarter.

Similar increases in the average activity density of beta emitters were observed at representative locations in the vicinity of the 100 areas. In general, the magnitude of increases was by a factor of 4 or 5 when compared with the previous record. The maximum concentration in the atmosphere in this region was observed at the Hanford Airport where the average activity density was 5.7×10^{-13} μc/cc including a maximum mean weekly measurement of 3.[illegible] $\times 10^{-12}$ μc/cc.

The maximum activity density measured at a location outside the perimeter of the project was at North Richland where the average activity density for a one week period was 2.1×10^{-12} μc/cc. The quarterly average at North Richland was 5.4×10^{-13} μc/cc. The activity density from filterable beta emitters averaged 1.9×10^{-13} μc/cc in Richland while similar measurements at Pasco showed the average activity to be on the order of the detection limit of the counter (1.0×10^{-14} μc/cc.)

A new air monitoring station for the detection of filterable beta activity was established at Riverland during this period. The results obtained at this location were comparable with those observed in the immediate environs of the 100 Areas;

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the Riverland location is approximately 4 miles above the 100-B Area and is situated along the Columbia River amid terrain comparable to the operating 100 Areas.

The activity density of I-131 in the atmosphere was monitored for specifically by passing the air stream through a caustic scrubber which was placed in series with the air filters at representative locations. The scrubbing solution consisted of approximately two liters of solution which contained 4 grams of sodium hydroxide and 1.6 grams of sodium carbonate; sodium iodide was used as a carrier in this solution. A summary of the activity density of I-131 measured in these scrubber solutions at the air monitoring stations is presented in Table V.

TABLE V
AVERAGE I-131 ACTIVITY DENSITY MEASURED IN SCRUBBER SOLUTIONS
JULY AUGUST SEPTEMBER
1 9 5 0

Location	July Average	August Average	September Average	Quarterly Average	Maximum Weekly Average
	Activity Density x 10^{14} µc/cc of air				
200 Areas & Vicinity					
200 West Gatehouse	797	1719	608	1134	4230
200 ESE	33	719	587	467	1900
200 E Tower #16 *	124	4350	9600	7560	42700
Gable Mountain	3	54	286	111	624
Outlying Locations					
100-H Area	4	45	101	46	167
300 Area	8	[illegible]	43	21	82
Richland	6	39	29	26	83
North Richland	5	62	77	49	137
Benton City	[illegible]	26	1019	321	2320

* Control sampling on a daily basis was maintained at this location during the latter part of the period. Please refer to discussion.

The above measurements indicate that during the latter part of the quarter significant increases in the activity density of I-131 in the atmosphere were observed at all locations. This increase was again attributed to the increased dissolving of irradiated metal for which the cooling time had been significantly reduced. The maximum concentration of I-131 measured in any scrubber solution was 4.3×10^{-10} µc/cc in a sample collected at Tower #16 in the 200 East Area. This location was directly down wind with respect to the 200 East Area stack and also in line with the path of the atmospheric gas emitted from the 200 West Area stack. Toward

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the latter part of the period, this air monitoring station was operated on a daily basis; scrubbers were operated between 4:00 p.m. on one day and 8:00 a.m. on the following day. Twenty two collections obtained in this manner showed the average activity density of I-131 in the atmosphere during periods of metal dissolution to be 9.6×10^{-11} μc/cc. Concentrations of I-131 in this order of magnitude were approximately 80 times higher than those during the earlier part of the quarter; for example, during the month of July, the average activity density was only 1.2×10^{-12} μc/cc. The measurements obtained during September represented about a two-fold increase over the August averages at this station.

In the 200 West Area, the maximum activity density from I-131 in the atmosphere was observed at the 200 West Area gatehouse location where the quarterly average was 1.1×10^{-11} μc/cc including a maximum one week average of 4.2×10^{-11} μc/cc. Maximum observations at this location were expected as this general region represented the area in which the maximum deposition of I-131 on vegetation was noted.

Significant increases in the activity density of I-131 were also observed in measurements taken at North Richland, Richland, and Benton City. In general, the average activity density of I-131 in this area was on the order of 2.0 to 6.0 $\times 10^{-13}$ μc/cc during the quarter; during the latter part of the period the mean weekly averages approached 1.0×10^{-12} μc/cc in the residential communities. One extremely high result was observed in a collection at Benton City in which the activity density of I-131 was 2.3×10^{-11} μc/cc.

Considerable effort was directed toward determining maximum concentrations of I-131 in the atmosphere during various meteorological conditions. Twenty-seven scrubber samples were obtained by operating portable mobile equipment at locations which were representative of maximum stack gas concentrations during dissolving. The highest activity density of I-131 measured in this group of samples was 1.4×10^{-7} μc/cc; this sample was collected immediately outside the 271-T Plant exclusion area when an aloft condition was noted with a west northwest wind blowing at approximately 6 miles per hour. Another sample collected under the same conditions at a location about 3000 feet down wind from the stack indicated I-131 activity of 4.4 x 10^{-9} μc/cc. This represents a ground dilution factor of about 30 in traveling a distance of 3000 feet. The average concentration of I-131 measured in all samples collected in the manner described above varied from 1 x 10^{-11} μc/cc to 1 x 10^{-9} μc/cc. Eight of the twenty-seven samples collected indicated that I-131 concentrations in the atmosphere exceeded the maximum permissable contration of 10^{-9} μc/cc. Portable VGM readings observed during these spot collection periods indicated values which vary between 250 and 400 c/m above background.

Figure 8 is a comparison of the activity density of I-131 in the atmosphere with the filterable beta activity measured at several representative locations during the period. The total of these two measurements should represent the total activity density of I-131 and filterable beta emitters in the atmosphere at the indicated locations.

The small air filters which are used for the measurement of the activity density from filterable beta emitters in the atmosphere at locations listed in Table V were radioautographed to determine the number of radioactive particles present in the atmosphere. These filters were exposed to type K X-ray film for a period of 168 hours; the number of particles were determined by visually counting the number of darkened spots on the developed film. The sensitivity of this measurement was determined by exposing control standards previously prepared by soaking small particles of resin in activated solutions and calibrating the sources with mica window counters. The sensitivity of this radioautograph measurement was on the order of 5 dis/min/particle. Blank exposures also accompanied each set of measurements. The results of the number of active particles in the atmosphere determined in this manner are presented in Table VI. Locations at which the radioautograph process did not indicate active particle deposition are deleted from the table.

[redacted]

TABLE VI
SUMMARY OF PARTICLE DEPOSITION ON SMALL FILTERS
JULY AUGUST SEPTEMBER
1 9 5 0

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

Location	Total Air Sampled m^3	July Average	August Average	September Average	Quarterly Average
200 Areas & Vicinity					
200 East Tower #16	6890	12.0	5.3	8.1	8.4
200 East Southeast	6721	4.5	6.9	8.2	6.0
200 West Gatehouse	6307	6.6	5.1	7.0	6.2
200 West Tower #15	4901	1.4	3.0	---	2.2
200 West Tower #4	6973	0.4	5.1	6.7	3.9
Gable Mountain	5372	0.9	2.2	4.8	2.0
Gable Mountain Decade	7635	2.4	<0.6	2.3	1.8
200 WEC Decade	7270	2.9	6.0	9.9	6.2
Outlying Locations					
300 Area	5969	2.2	0.8	1.4	1.5
100-D Area	6996	0.6	0.9	1.0	0.9
Hanford 614	8531	1.1	<0.4	0.3	0.5
Hanford 101	8290	<0.4	0.4	4.1	1.6
Riverland Decade	8721	<0.4	0.6	0.4	0.3
3000 Area North	7012	<0.4	0.4	1.6	0.7
100-H Area L. S.	5710	1.[illegible]	<0.5	0.6	0.5

A comparison of the above results with previous measurements obtained during the period April, May, June, 1950, indicated that the number of particles in the atmosphere apparently increased in the vicinity of the 200 Areas. The only assignable cause to this apparent increase was the increased dissolving schedule of irradiated metal. Varying meteorological conditions have indicated that the number of particles in the atmosphere near the 200 Areas may vary by a factor of two to three during periods in which no significant change in dissolving occurs. As in the past, the locations immediately adjacent to the 200 exclusion areas were the only ones which consistently indicated a particle deposition throughout the period. This concentration was on the order of 2.0 to 8.5 x 10^{-3} particles/meter^3; the more remote locations in the vicinity of the 100 areas and 300 area showed the average concentration to be about 1.0 x 10^{-3} particles/meter^3. No particles were detected on the small air filters which were obtained from locations in the residential communities of Benton City, Pasco, and Richland.

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Air monitoring units were operated for the specific purpose of detecting active particles in the atmosphere at representative locations in the environs of the Hanford Works and at remote locations in the neighboring states of Oregon, Idaho, and Montana. These units consisted of exposing large filter papers (CWS #6, 4" x 7") to an air flow of 2 or 10 cubic feet per minute. These filters were changed at weekly intervals and were exposed to type K X-ray film for 168 hours. The number of active particles were determined by counting the number of darkened spots on the developed film. The filters which represented locations on or adjacent to the site were filmed within one week after their removal; filters which were obtained from the remote locations were usually exposed during the second week after their removal from the monitoring station. The results of monitoring for active particles at locations in the immediate environs of the 200 Areas for the period July, August, and September, 1950, are summarized in Table VII.

During the quarter, apparent increases in the active particles estimated in the atmosphere were observed at nearly all locations in the 200 East and 200 West Areas. The increasing number of particles in the atmosphere was in agreement with increases observed in the activity density of filterable beta emitters and I-131 during this quarter. Again, the changes were associated with the increase in the amount of uranium dissolved during this period.

The increase in the number of active particles appears more pronounced at locations inside the 200 East Area; this was apparently due to meteorological conditions which showed that the winds predominated from the northwest quadrant throughout the period and caused those stations located in the East Area to pick up particles which may have originated from the 200 West Area stack in addition to those emanated from the 200 East Area stack. Apparent increases were observed at the locations which were closest to the exclusion areas such as the "B" Gate and the BY stations in the 200 East Area. The number of particles in the atmosphere measured at the BY SE stations averaged 5.0×10^{-2} particles/meter^3 as compared with a previous average of 1.3×10^{-3} particles/meter^3. This increase was weighted by the measurements made during the month of September during which period the

TABLE VII
SUMMARY OF PARTICLE DEPOSITION
JULY-AUGUST-SEPTEMBER
1 9 5 0

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

Location	Total Air Sampled m^3	July Average	August Average	September Average	Quarterly Average
200 East & Vicinity					
2704 Outside	18,520	1.1	0.6	4.4	1.5
H. I. Garden	18,015	4.9	3.0	14.0	5.7
BY-SE	8,916	3.0	9.6	180.0	50.0
BY-NE	8,450	0.4	1.0	3.3	1.5
"B" Gate	8,391	8.0	3.8	34.0	15.0
222-B Outside	4,035	5.7	25.0	28.0	15.0
2701 Outside	6,114	0.6	2.4	1.8	1.5
2704 Inside	19,958	0.8	2.9	13.0	2.4
221-B	7,661	4.2	6.3	12.0	7.0
222-B Hall	7,928	24.0	28.0	80.0	41.0
222-B Lab.	8,106	210.0	280.0	350.0	280.0
2701 Inside	8,318	2.9	3.1	6.1	4.0
200 West & Vicinity					
2701 Outside	8,458	3.2	9.2	10.0	7.4
2722	4,039	8.1	6.9	5.4	5.9
"T" Gate	9,802	4.7	16.0	13.0	10.0
222-T Outside	8,010	8.5	23.0	82.0	39.0
231	13,861	0.7	0.7	6.3	1.8
South Guard Tower	7,451	2.0	1.8	*	1.6
"U" Gate	5,305	1.6	5.6	6.1	3.8
West Guard Tower	13,019	0.1	<0.3	1.1	0.3
2701 Inside	8,288	6.4	10.0	12.0	9.4
272	7,421	0.5	4.8	11.0	5.5
222-T Hall	8,447	20.0	65.0	90.0	58.0
222-T Lab.	8,543	180.0	310.0	370.0	280.0
Meteorology Tower					
3'	34,323	1.8	1.1	2.5	1.8
50'	34,323	1.1	1.5	3.0	1.5
100'	27,256	1.8	1.4	1.9	1.8
150'	23,822	3.9	1.7	11.5	5.0
200'	22,004	2.3	1.5	3.2	2.5
250'	22,004	1.9	1.1	17.5	7.4
300'	22,004	1.1	1.0	3.2	1.8
350'	20,391	0.4	0.8	1.9	1.1
400'	13,727	0.4	2.0	3.4	2.0

* Unit was temporarily out of service during this period.

average concentration was 0.18 particles/meter^3. At the "B" Gate, the average during the month of September was 3.4×10^{-2} particles/meter^3.

Filtering units which were operated at 50' intervals between ground level and 400' at the Meteorology Tower showed increases in particle concentrations at the at the 150', 200' and 250' elevations. The greatest increase occurred at the 250' level where the current quarterly average of 7.4 particles/meter^3 represented a nine-fold increase over the previous quarterly average of 0.8 particles/meter^3. In agreement with the observations made during several selected periods during the past, the particle deposition rate at elevations between 150' and 250' was approximately five times greater than that observed at either ground level or 400'.

The number of particles measured on filters operating inside the 222-B and 222-T laboratories indicated that these two locations continued to represent the maximum particle hazard. The quarterly averages of 0.28 particles/meter^3 at each of the laboratories were not indicative of any significant change or trend during this period.

A summary of the particle deposition rates at locations on the perimeter of the project, in residential regions adjacent to the project and at remote locations is presented in Table VIII.

With the exception of the 100-D Area and the 100-F Area monitoring locations, the number of particles present in the atmosphere at locations around the project perimeter showed no change from past observations. An average of 6.0 x 10^{-4} particles/meter^3 at the 100-D and 100-F Areas was apparently due to random particles which emanated at the 200 Areas and were carried by the varying winds noted during the period.

The number of particles detected in the atmosphere at monitoring locations in the nearby residential areas and at locations in the states of Oregon, Montana, and Idaho was negligible.

TABLE VIII
SUMMARY OF PARTICLE DEPOSITION
JULY AUGUST SEPTEMBER
1 9 5 0

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

Location	Total Air Sampled m^3	July Average	August Average	September Average	Quarterly Average Third	Quarterly Average Second
Area Locations						
100-B Area	27,795	<0.2	<0.2	0.8	0.3	<0.1
100-D Area	32,028	0.4	0.8	0.5	0.6	0.1
White Bluffs	21,437	0.1	0.2	0.2	0.2	0.2
100-F Area	23,273	0.2	0.5	1.1	0.6	0.1
300 Area *	21,471	---	1.4	0.6	0.8	---
Off-Area Locations						
Benton City, Wash.	31,736	<0.1	<0.2	<0.1	<0.1	<0.1
Pasco, Wash.	28,199	0.2	0.1	0.2	0.2	<0.1
Richland, Wash.	26,099	<0.1	<0.2	<0.2	<0.1	<0.1
Boise, Idaho	8,473	<0.4	<0.4	<0.4	<0.2	<0.2
Klamath Falls, Ore.	7,287	<0.4	<0.5	<0.4	<0.2	<0.1
Stampede Pass, Wash.	13,429	<0.2	<0.3	0.3	<0.2	<0.1
Great Falls, Montana	8,259	<0.4	0.4	<0.4	<0.2	<0.2
Walla Walla, Wash.	10,903	0.3	<0.3	<0.4	0.1	<0.1
Meacham, Ore.	10,308	<0.2	<0.4	0.5	<0.1	<0.1
Lewiston, Idaho	10,933	<0.3	0.3	<0.3	0.1	<0.1
Spokane, Wash.	18,303	<0.3	<0.3	0.1	<0.1	<0.1

* This location was established during August, 1950.

SECTION III

(Please Refer to Figure 8.)

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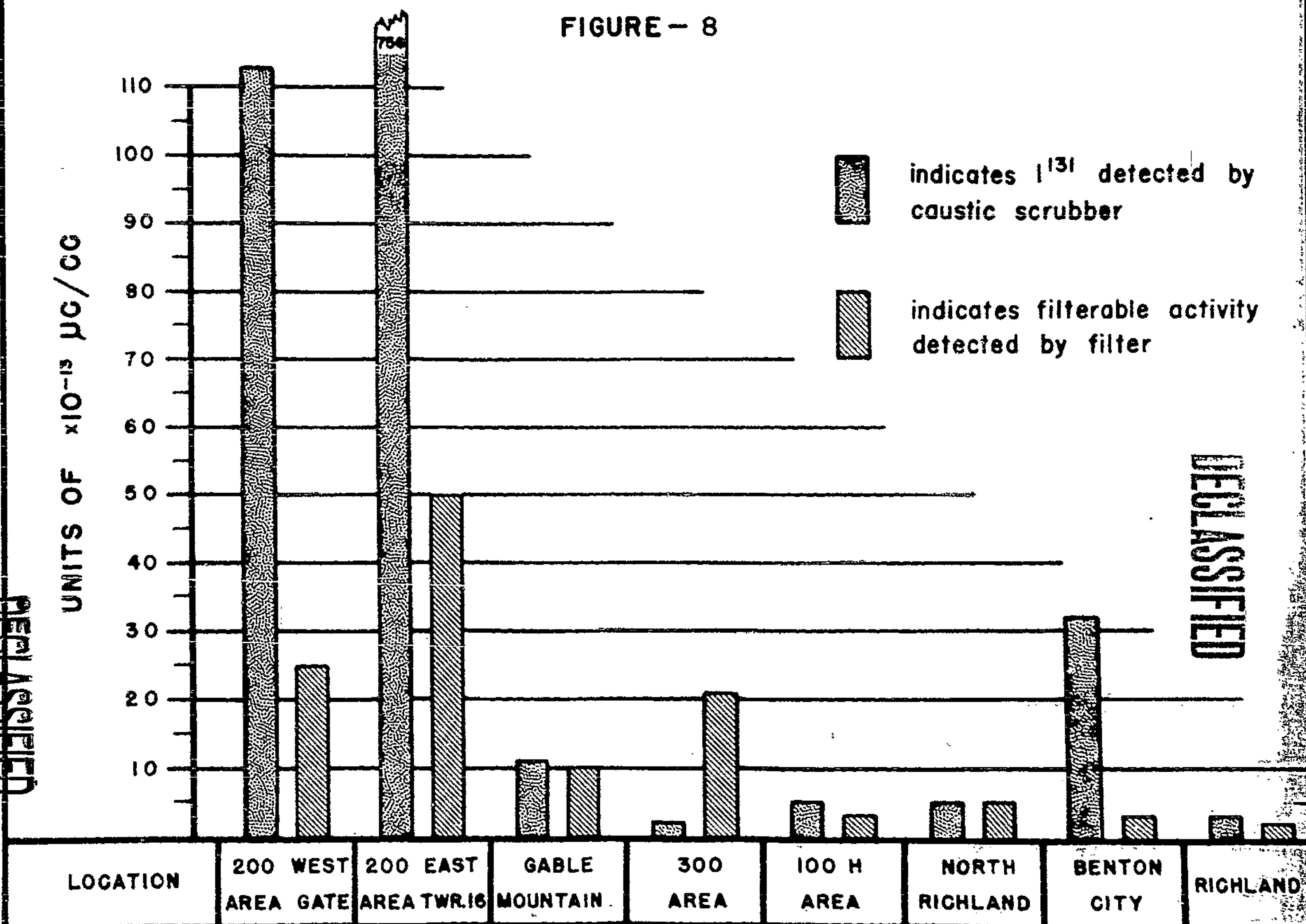
AVERAGE ACTIVITY DENSITY OF BETA EMITTERS DETECTED IN ATMOSPHERE

JULY—AUGUST—SEPTEMBER—1950

FIGURE— 8



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SECTION IV

RADIOACTIVE CONTAMINATION IN HANFORD WASTES

Two hundred and sixty-six samples of radioactive effluent were collected from the outlet side of the 107 retention basins of the four pile areas during July, August, and September, 1950. These samples were analyzed for the activity density of beta emitters and for the activity density of the alpha emitters from uranium and/or plutonium. A summary of the results obtained during this period appears in Table I; these values represent the activity density of beta emitters in the effluent waters during the periods of normal pile operating conditions and do not account for the lower activity in the basins when the piles are not operating. The results summarized in Table I represent those samples which were analyzed on the same day that they were collected, thereby avoiding the use of exorbitant decay corrections which frequently lead to erroneous evaluations.

TABLE I
RADIOACTIVE CONTAMINATION IN THE 107 BASINS
DURING PERIODS OF PILE OPERATION
JULY AUGUST SEPTEMBER
1 9 5 0

Location	Alpha Emitters Average Activity Density dis/min/liter	Beta Emitters Activity Density x 10^4 µc/cc Maximum	Average
100-B	<.8	14.8	3.5
100-D	<.8	9.0	4.7
100-F	<.8	9.8	5.4
100-H	<.8	6.4	4.0

In general, the average activity density of beta emitters in the effluent water appeared to be within the range of fluctuation normally experienced during pile operation. The maximum activity density in the effluent water was somewhat lower at the 100-D and 100-H Areas, whereas that noted at the 100-B and 100-F Area were slightly higher. The power levels of the piles remained the same throughout the period at the 100-B and 100-F areas; the power level at the 100-H Area fluctuated considerably during the month of July and averaged slightly less than

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that maintained during August and September. The 100-D Area pile was not operating during the early part of September; when it started up again during the middle of the month the operation was somewhat intermittent. During July and August, the power level at the 100-D Area remained the same as in the past.

The activity density from alpha emitters averaged less than 8 dis/min/liter at all areas during this period. Several individual samples which indicated activity density from alpha emitters on the order of 20 dis/min/liter were later analyzed for the activity density of the alpha emitter from uranium and plutonium. The results obtained from the latter measurements along with subsequent resampling did not confirm the presence of the alpha emitter of plutonium in the effluent water. Several spot samples were obtained from each basin for the specific measurement of the activity density of polonium. The activity density was less than 6 dis/min/liter in each sample analyzed.

In addition to the samples obtained during periods of normal pile operation, several samples were obtained from the various basins during shut down periods and during periods which were representative of unusual conditions. In only one instance did the activity density measurements indicate abnormal activity; a sample of effluent water obtained from the 100-B Area basin within a day after a shut-down which was accompanied by a purge indicated the activity density of the beta emitters to be 4.2×10^{-3} $\mu c/cc$. This measurement was the highest value noted for any effluent water analyzed during the year 1950.

The program which was initiated during the previous quarter to determine the effective holdup time of the effluent water in the 100 Area basins was extended during this period. This determination was again based on decay studies of samples of the effluent water which were obtained from the inlet and the outlet side of each basin. The samples from the inlet side were placed on decay until such time that the activity density of the beta emitters in the inlet water was equal to the activity density of the beta emitters in the water that was being discharged into the river. The period required to reach equality was taken as the effective holdup time of the basin. All measurements which were performed during the current quarter were on the same order of magnitude as those made during the previous period and indicated that a period of four hours would represent the general overall average holdup time.

A series of the decay curves from each of the pile areas along with a complete chemical analysis of samples from each of the basins were innaugurated during this period in an effort to reevaluate the principal components of the complex isotopes in the pile effluent waters.

Measurements to determine the activity density of I-131 in the waste material discharged to the Columbia River from the H. I. Division Biology Farm at the 100-F Area were continued on a routine basis. Samples of this waste material were obtained from the sump tank both before and after flushing operation of the farm. The after flushing period represented the higher concentration of activity as all of the radioactive wastes which were accumulated in the operation of the farm are washed into the sump tank. Table II summarizes the result of analyses of these samples for the activity density of iodine during the period July, August, and September, 1950.

TABLE II
ANIMAL FARM WASTE SAMPLES
JULY AUGUST SEPTEMBER
1 9 5 0

	No. Samples	Beta Activity - I-131 Activity Density x 10^{6} µc/cc Maximum	Average
Before Flushing	76	70.0	4.7
After Flushing	78	215.2	21.6

The above values represent a slight increase over the values obtained during the previous quarter. Although the increase was attributed to the continued slight accumulation during operation of the Biology Farm, the higher results prevailed during the month of September. During September, the average activity density of I-131 in the samples obtained after the flushing period was 3.3×10^{-5} µc/cc including a maximum measurement of 2.2 x 10^{-4} μc/cc. Samples obtained before flushing during the month of September showed an average activity density of 5.6 x 10^{-6} μc/cc along with a maximum measurement of 7.0 x 10^{-5} μc/cc. On August 15, estimations of the probable quantity of I-131 discharged into the Columbia River were effected by installing running time meters on the pumps which move the water from the sump into the waste line. Using the number of hours of pump operation as determined from the running time meter readings and multiplying by the capacity of each of the pumps the total volume of waste solution discharged into the river was calculated to be 1.5 x 10^{6} gallons. The average activity density of I-131 in all samples taken during this period was 1.9 x 10^{-5} μc/cc; from these values it was then estimated that approximately 3 mc of I-131 were discharged into the river daily during this period.

Samples of Columbia River water were obtained from a location along the south shore of the river for the purpose of determining the activity density of I-131 in the Columbia River water. In general, the average activity density was below the detection limit of the analysis (5 x 10^{-8} μc/cc) during the early part of the quarter; however, the average of nine samples obtained during the month of September indicated the activity density to be 1 x 10^{-7} μc/cc; this level is at the detection limit of the analysis.

Several samples were obtained from the stacks at the 100-F Area for the purpose of evaluating the concentrations and composition of radioactive gases being discharged into the atmosphere from the 100 Area piles. The activity density from beta emitters as determined by using a vibrating reed electrometer appeared to be on the order of 1 to 3 x 10^{-6} μc/cc of stack gas. Decay studies of this material indicated that 110 minute argon predominated along with trace quantities of C-14 and/or S-35.

During early August the dry wells which surround the 107 DR basin in the 100-D Area were surveyed to determine the path of a probable leak from the bottom of the basin. A series of relative counting rates were determined by inserting a GM probe with a long cable and preamplifier into the bottom of the dry well. The counting rate determined in this manner indicated that the dry wells located on the east side of the basin had radiation levels approximately 6 times above background of the instrument. On the east side of the basin, the counting rate varied between 200 and 250 c/m at various depths which ranged from 3 to 35 feet. The maximum counting rate measured in any dry well was 285 c/m measured on the southeast corner of the basin. As a result of this survey, it appeared that a definite leak has occurred at the 107-DR basin and that the probable flow pattern was along the east side of the basin.

200 AREA WASTES:

Over 400 samples of water and mud were obtained from the open waste areas in the 200 Areas. A summary of the results obtained from radiochemical analysis for the activity density of the alpha and beta emitters in these samples appears in Table III.

TABLE III
RADIOACTIVE CONTAMINATION IN 200 AREA WASTES
JULY AUGUST SEPTEMBER
1 9 5 0

Location	No. Samples	Alpha Emitters Activity Density dis/min/liter		Beta Emitters Activity Density x 10^7 µc/cc	
LIQUID SAMPLES		Maximum	Average	Maximum	Average
T Swamp	39	310	20	7	1
U Swamp	26	90	10	<1	<1
Laundry Ditch	25	270	29	5	<1
231 Ditch	26	82	10	<1	<1
200 E "B" Ditch	32	9	<6	140	11
200 E "B" Swamp	18	<6	<6	110	19
234-35 Ditch	13	8	<6	<1	<1
200 E Retention Pond	51	14	<6	55	10
200 W Retention Pond	52	10	<6	10	2
SOLID SAMPLES		dis/min/gram		Activity Density x 10^5 uc/gram	
T Swamp	23	1000	310	18	6
Laundry Ditch	11	160	39	9	4
200 E "B" Ditch	30	11	< 6	350	34
200 E "B" Swamp	18	7	< 6	68	21
234-35 Ditch	12	21	6	2	<1
Laundry Lint	13	1900	320	9	4

In general, the activity density measurements tabulated in Table III indicated no outstanding changes or trends when compared with measurements of the previous quarter. An increase in the activity density from alpha emitters was observed in liquid samples obtained from the Laundry Ditch in the 200 West Area. The current average of 29 dis/min/liter represented a two-fold increase over the previous quarter measurements; one exceptionally high result of 270 dis/min/liter weighted the average, considerably. The maximum measurement of the activity density of alpha emitters in the U swamp of 90 dis/min/liter reflected the higher activity density that was noted in the liquid samples from the Laundry Ditch. The only significant change when comparing the activity measurements of beta emitters in the waste material was observed at the 200 East Area B Ditch and swamp; maximum measurements increased five-fold when comparing the liquid samples obtained during the two periods. The solid sample obtained from the perimeter of the B swamp, which is outside of the perimeter fence of the 200 East Area also showed a five-fold increase; maximum activity density of beta emitters was 3.5×10^{-3} µc/gram as compared with a previous maximum of 7.9×10^{-4} µc/gram.

In addition to the measurements for the alpha emitters by the ether extraction method, nearly all waste samples were analyzed for the activity density of uranium by the fluorophotometer method. Samples showing higher activity were further analyzed for the activity density of the alpha emitter of plutonium by the LaF_3 method. Several indications of the presence of these emitters were obtained during the period; one 10 gram mud sample taken from the south side of the T swamp indicated that the activity density of the alpha emitter from plutonium was 250 dis/min/liter. Fluorophotometer measurements for the activity density from uranium indicated that in nearly all cases, the value was less than 4 µg U/liter; one sample obtained from the Laundry Ditch showed 9 µg U/liter.

Five composite samples of laundry rinse water obtained from the 200 West Area Laundry indicated that the activity density averaged 2.4×10^{-6} µc/cc of beta emitters and 940 dis/min/liter of alpha emitters. The maximum individual result from this source indicated that the activity density from the beta emitters was 3.7×10^{-6} µc/cc and 3000 dis/min/liter for the activity density of the alpha emitters. Composite samples of laundry rinse water were taken while metering the volume of water used for rinsing at the laundry during the month of September.

Basing the calculations on the average activity density of beta emitters which was 1.4×10^{-6} μc/cc in the waste water and the metered volume of water which was 1.1×10^{6} gallons, it can be estimated that the beta emitters flushed from the laundry rinse water approached 6 mc during September, 1950.

Portable instruments (VGM) surveys of the terrain inside the 200 East and 200 West Areas indicated that radiation levels did not exceed 100 c/m above the background of the portable VGM in many cases.. The maximum reading obtained over terrain which was not affected by an open waste area was on the order of 200 to 400 c/m above background; readings on this order of magnitude were confined to the regions downwind from the separations areas stacks and in no case extended further than 500 yards east of the perimeter fences. Instrument readings of 1000 c/m above background were observed near the T ditch and laundry ditch in the 200 West Area; however, the general radiation level was approximately 200 c/m over this region the majority of the period. Similar surveys during September near the B ditch in the 200 East Area indicated values which approached 7000 c/m above background. The general levels of radiation measured in this area were 1000 c/m above background. In one extreme case where a diversion box in the north east corner of the 200 East Area had been opened, a ground reading of 100,000 c/m above background was obtained.

Portable instrument surveys in the vicinity of the 200 north area ditches showed a maximum radiation level of 13,000 c/m at the N & R ditches. Other values ranged slightly lower. In general, the radiation level around the north ditches was considerably lower than that noted during the period March, April, and May of 1950.

300 AREA WASTES:

A summary of the radioactive contamination measured in the 300 Area waste ponds during the quarterly period July, August, and September, 1950, is presented in Table IV:

TABLE IV
RADIOACTIVE CONTAMINATION IN 300 AREA WASTES
JULY AUGUST SEPTEMBER
1950

Location	Alpha Emitters Activity Density dis/min/liter Maximum	Average	Beta Emitters Activity Density x 10^7 µc/cc Maximum	Average
Old Pond Inlet (liquid)	25,400	4,600	110	27
New Pond Inlet	1,500	.500	26	4
	Activity Density dis/min/gram		Activity Density x 10^3 µc/gram	
Old Pond Inlet (mud)	24,400	4,800	2.7	0.8

The maximum and average activity measurements summarized in Table IV were on the order of magnitude expected and showed no deviation from previous results. Measurements for the activity density of uranium in the water of the two 300 Area waste ponds indicated wide variation; the average result was on the order of 500 µg U/liter with the range varying from a minimum of 100 µg U/liter to 23,300 µg U/liter in individual samples. Activity density measurements for the alpha emitter in the mud from the old pond also showed wide variation; the maximum measurement was 5000 µg U/gram.

Fifty-nine samples were obtained directly from the 300 Area waste line. These samples were analyzed for the activity density of the beta and alpha emitters. The average activity density of the beta emitters in this water was 4 x 10^{-7} µc/cc including a maximum measurement of 3.4 x 10^{-6} µc/cc.

These measurements were in reasonable agreement with results obtained during the previous quarter when the average activity density of the beta emitters was 3.? x 10^{-7} µc/cc. The average activity density of alpha emitters as determined by the ether extraction process was 1500 dis/min/liter; maximum measurements were on the order of 23,000 dis/min/liter. Subsequent analysis of these same samples for the activity density of uranium showed an average of 970 µg U/liter, including a maximum measurement on the order of 15,000 µg U/liter. Selected samples were

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analyzed for the activity density of plutonium; the average activity density from this isotope was 11 dis/min/liter with a maximum individual value of 110 dis/min/liter. The majority of the plutonium measurements were below the detection limit of the analysis.

SECTION IV

SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA AND YAKIMA RIVERS

The measurement for the activity density of alpha and beta emitters in the Columbia River was a monitoring method for evaluating the effects of the radioactive effluent of the four pile areas at the Hanford Works. This effluent is discharged into the river after a short holdup period in retention basins at each of the areas; the duration of this holdup period varied from three to four hours at each area. The extent of the river monitoring program is largely determined by the trends observed as evaluated from measurements made at control stations and by significant changes in outside factors such as the operating levels of the piles or the flow rate of the river. Special studies to determine the distribution pattern of the effluent with respect to the width and depth of the river were performed periodically.

The measurement for the activity density of the alpha and beta emitters in the river water was accomplished by analyzing 500 ml. samples; the methods of analyses used during this period were identical to those discussed in detail in a previous publication.(4) In general, the activity density of alpha emitters in the Columbia River was below the detectable limit of 6 dis/min/liter at all locations throughout the period July, August, and September, 1950. The activity density of beta emitters showed considerable variation at all locations; this variation was expected and was in agreement with the decrease in the volume of water flowing during the three month period. The magnitude of activity density in the river during this period was comparable with that observed during the previous quarter during which the flow rate showed a significant increase. The flow rate of the Columbia River was measured by the Power Division at the Lee Boulevard location in Richland. On June 25 the measured flow rate was 4,012,000 gallons/second; this value represented the peak flow of the Columbia River during the high water stage which occurs during the month of June and July each year. The flow rate of the river decreased from this maximum observation to a flow of 563,000 gallons/second measured on September 22, 1950. This decrease in flow rate was highly significant during the month of July when the magnitude of decreases was in excess of two million gallons. Very little change in flow rate was observed after August 15 when the river tended to maintain a flow rate of about 950,000 gallons/second throughout the balance of the month. Figure 9 summarizes the trend of the measured flow rate during this quarter; the data representative of the previous period is included for comparative purposes.

Table I summarizes the results of measurements for the activity density of beta emitters in the Columbia River during this period.

TABLE I
AVERAGE ACTIVITY OF GROSS BETA EMITTERS
IN THE COLUMBIA RIVER
JULY AUGUST SEPTEMBER
1 9 5 0

Location	No. Samples	Activity Density x 10^8 μc/cc July Average	August Average	September Average	Quarter Average	Previous Quarter Average
Wills Ranch	11	<5	<5	<5	<1	<1
Above 100-B Area	2	<5	--	--	<1	<1
100-B Area 181 Building	11	<5	<5	<5	<1	11
Allard Pumping Station	12	<5	<5	24	7	<5
100-D Area 181 Building	11	<5	17	48	23	17
100-F Area 181 Building	13	160	92	87	111	106
Below 100-F Area	13	48	78	269	139	150
100-H Area 181 Building	11	13	42	65	40	41
Below 100-H Area	12	262	73	304	208	146
Hanford South Bank	15	95	155	251	159	197
Hanford Middle	14	23	101	82	67	112
Hanford North Bank	13	13	41	62	37	47
300 Area	12	64	80	65	68	98
Richland	22	14	36	76	46	72
Highlands Pumping Station	14	11	33	49	33	11
Pasco Bridge (Kenn. Side)	13	14	26	44	33	43
Pasco Bridge (Pasco Side)	12	7	21	51	24	43

A review of the data presented in Table I indicate that the activity density from beta emitters increased throughout the quarter; the lower results occurred during the month of July when the high river flow prevailed and the maximum results prevailed during September while the low flow rate was maintained. This significant trend was expected and was in agreement with observations made for a similar period during previous years. A comparison of the quarterly averages with those observed during the previous periods indicates that the average activity density from beta

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emitters was about the same for each three-month period. Although the quarterly averages do not tend to weight the month to month variation which was noted when measuring the activity density, the agreement in the two sets of averages occurs because each of the two periods represented highly significant changes in river flow rate. The increase in flow rate observed during the period April through June, 1950 was on the same order of magnitude as the decrease observed between July and September, 1950. Figure 9 may be referred to for a graphic evaluation of the two trends.

The activity density of beta emitters which occur naturally in the water of the Columbia River was evaluated by analyzing samples which were obtained upstream from the four pile areas on the Hanford Works. Measurement of the activity density at locations in the vicinity of Wills Ranch and above the 100-B Area indicated that counting rates were within the background error of the counters and in terms of activity density indicated less than 1.0×10^{-8} µc/cc.

The first indication of activity density from beta emitters in the Columbia River was observed at the Allard Pumping Station located about a mile below the 100-B Area. The average activity density at this location was 7.0×10^{-8} µc/cc including a maximum measurement of 6.8×10^{-7} µc/cc. The latter result was observed during the month of September when the dilution of the admitted activity to the 100-B Area by the Columbia River was at a minimum. Significant increases in the activity density of beta emitters were observed at successive down stream locations, as far as the Hanford Ferry. These increases were the accumulated effect of the radioactive effluent discharged from the 100-D, 100-H, and 100-F operating areas. The maximum average activity density from beta emitters in the Columbia River was observed immediately below the 100-H Area; the average activity density throughout the quarter was 2.1×10^{-6} µc/cc which included a maximum individual result of 7.6×10^{-6} µc/cc measured during September. The latter sample represented the highest activity measurement in the Columbia River during this period.

Cross-section sampling at the Hanford Ferry was used to determine the surface dispersion pattern of the beta activity in the Columbia River. The dispersion pattern noted at this location, which is approximately 7 miles below the last 100 Area, was very similar to that observed during April, May, and June, 1950; the maximum activity was carried along the south bank where the average activity density during the quarter was 1.6 x 10^{-6} µc/cc. The activity carried along this side of the river was approximately two times greater than that in the middle of the stream where the activity density averaged 6.7 x 10^{-7} µc/cc; the average of samples obtained from the north bank was 3.7 x 10^{-7} µc/cc. The difference noted between the three sampling locations was nearly identical in magnitude to that observed during the previous quarter when averages of 2.0 x 10^{-6}, 1.1 x 10^{-6} and 4.7 x 10^{-7} µc/cc were observed at the south bank, middle, and north bank, respectively.

Measurements for the activity density of the beta emitters along the south portion of the river in the vicinity of the 300 area indicated that the average activity decreased by a factor of 2½ over the activity measured 18 miles upstream. This decrease was attributed to the decay of the short lived sodium (Na-24) and also to better mixing of the activity with river water.

The effect of the entrance of the water of the Yakima River into the Columbia River immediately below Richland was observed when evaluating the activity density measured at the Pasco-Kennewick Bridge; the added dilution caused by the Yakima River showed the average activity density to be 3.3 x 10^{-7} µc/cc and 2.4 x 10^{-7} µc/cc at Kennewick and Pasco, respectively. Samples obtained at the Highlands Pumping Station between Richland and Kennewick showed an average activity density of 3.3 x 10^{-7} µc/cc. A comparison of this figure with the average observed at the Kennewick side location by the Pasco Bridge would tend to indicate that this result may be greater than would normally be expected; however, previous surface dispersion studies in this region showed that the water of the Yakima tends to push the water of the Columbia to the far side of the river in this region and thereby minimize the activity concentration along the far shore of the river.(5)

Four samples of Columbia River water were obtained from Bonneville Dam during this period. The activity density from beta emitters in this water was below the detectable limit for an individual analysis of 5.0×10^{-8} μc/cc (<5.)

Eleven samples were obtained from each of three locations along the Yakima River. The activity density from gross beta emitters in these samples averaged less than 1.0×10^{-8} μc/cc during the quarter.

During the latter part of July, abnormally high activity densities were detected in samples obtained from a high water channel which is located between the 100-H Area and White Bluffs. Surveys in this region were prompted by reports by the Aquatic Biology Group of the Health Instrument Divisions which indicated that high activity were measured in fish which were removed from this channel. Preliminary measurements of the activity density of beta emitters in the water of this channel were made by obtaining 7 samples in a traverse which began at the inlet side of the channel and continued to that point where the channel water re-entered the Columbia River proper. The activity density of beta emitters measured in these samples ranged from 1.1×10^{-5} to 2.5×10^{-5} μc/cc. The magnitude of this activity was higher by a factor of 3 to 5 when compared with activity density measurements in the Columbia River at a point adjacent to this high water channel. The investigation into the source of this abnormal activity indicated that due to the high water in the Columbia at this time, the radioactive effluent of the 100-H Area was being discharged over the spillway directly into the river at a point adjacent to the south shore. Normally, this effluent is discharged through two 60 inch discharge pipes which extend into the river. The admitted activity from the 100-H Area apparently channelled near the south bank of the river and did not tend to disperse into the main channel of the river as normally expected. With the new channel hovering near the shore, the bulk of the activity concentrated in the high water slough formed just below 100-H Area.

A detailed investigation of this high water channel indicated that the length was 6400 feet and the width averaged approximately 800 feet, throughout. A series of water samples were taken from the surface of the channel at 7 locations across the width; these surface samples were supplemented with depth samples which were obtained at varying depths from 2 meters to 7 meters. The results of the analyses of these samples indicated that the higher activity density existed at the entrance of the channel proper; the maximum individual result in the group of samples obtained at the entrance was 6.7×10^{-6} µc/cc. An overall review of the measurements obtained in this manner indicated that the higher activity tended to follow the south or plant side of the channel proper. In many cases, the maximum activity was noted on the surface whereas samples obtained from the middle or bottom of the channel showed negligible activity. In general, the mixing of the activity appeared to be random and the pattern did not indicate a uniform distribution.

A detailed description showing the measurements and locations of this channel may be referred to in Figure 10. This portrayal also shows the estimated distribution of the activity density of gross beta emitters in the water on July 17, 1950. The vertical channelling which is indicated in the esimtated distribution pattern on Figure 10 was in agreement with similar measurements made in the main channel of the Columbia River in the vicinity of Hanford.

Measurement of the activity density of alpha emitters from uranium and/or plutonium in the river water sampled indicated that the average activity density in all river samples was less than 6 dis/min/liter. Occasionally, a river sample would indicate a trace amount of alpha emission; however, subsequent samples would not confirm these values and these isolated cases were attributed to cross contamination in the laboratory.

During early September, arrangements were completed with the Power Division and A. E. C. Security Division to take aerial photographs over the river when the coagulation basins of the water purification system were flushed and cleaned. It was previously observed that during flushing of these basins, a distinct discoloration effect in the Columbia River was noted when the accumulated ferro-floc at the bottom of the retention basin was flushed into the river. The aerial photographs obtained during various stages of this flushing operation were basically intended to be used in setting up experiments to evaluate the true distribution pattern of discharged radioactive effluent. In general, the pattern of distribution of this ferro-floc material in the river as shown by aerial photographs indicated very

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distinct channelling effects with very little mixing the first three miles after discharge from the pile areas. A detailed discussion of the observations, results, including the aerial photographs, and conclusions which were drawn from the aerial photograph studies has been covered in a previous document;(6) this document included reproductions of 10 of the aerial photographs which show the channel as followed by the ferro-floc material. Correlation studies are planned for the next quarter which will incorporate aerial photograph studies and measurements for the activity density of beta emitters along with chemical analysis of the turbidity and iron content in the samples obtained from the river. If possible, a study will be completed in which several of the 100 Areas will simultaneously discharge an appreciable amount of ferro-floc material into the river.

Three hundred and forty samples of mud were obtained from representative locations along the shores of rivers near the Hanford Works. Of this total, 223 samples were obtained from 10 locations along the Columbia River. Two samples were obtained each time a location was monitored; one sample represented the mud along the edge of the river and the second sample was obtained from below the surface of the water at a distance of approximately 5' from the shore line. The activity density of beta emitters was determined by mounting one gram of dry mud on a 1" stainless steel plate and counting directly with thin mica-window counters. The activity density of the alpha emitters from uranium and/or plutonium was determined by ether extracting the previously dried sample and employing a standard alpha counter to determine the counting rate. The specific activity density of the alpha emitter of uranium was determined periodically by the fluorophotometer method; the frequency of this measurement was not less than one analysis per month from each sampling location.

Table IV summarizes the results obtained from the analysis for the activity density of beta emitters in mud samples during the period July, August, and September, 1950:

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TABLE IV
RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER MUD SAMPLES
JULY AUGUST SEPTEMBER
1 9 5 0

Location	No. Samples	Activity Density x 10^5 μc/gram On Shore Maximum	On Shore Average	5' from shore Maximum	5' from shore Average
Near Wills Ranch	11	1.8	1.4	1.8	1.3
Allard Pumping Station	11	2.5	1.2	2.8	1.2
At 100-H Area	12	3.8	1.7	4.9	2.0
Below 100-F Area	12.	3.7	2.0	2.1	1.6
Richland Dock	12	2.7	1.5	3.2	1.8
Below 300 Area	13	2.4	1.4	3.0	1.6
Pasco Bridge (Pasco side)	12	3.7	1.4	1.9	1.3
Pasco Bridge (Kenn. side)	12	2.1	1.3	2.4	1.4
Hanford Ferry	11	11.4	1.7	3.2	1.9
Highlands Pumping Station	11	1.8	1.3	3.2	1.7

A comparison of the results summarized in Table IV indicated that the activity density of beta emitters in mud samples obtained along the Columbia River increased slightly during this period. The magnitude of this increase was within a factor of two in all cases and was not deemed significant when compared with the previous data. A very small increase would normally be expected during this quarter due to the receding flow of the Columbia River.

In general, the magnitude of the activity density of beta emitters in mud along the shore of the Columbia River did not differ significantly from that observed in samples obtained from the shores of rivers which were not contaminated. The activity density of beta emitters in mud obtained from the shore of the Yakima River averaged 1.0 x 10^{-5} μc/gram on the shore proper and 1.1 x 10^{-5} μc/gram at a point below the surface of the water 5' from the shore. The maximum result obtained in Yakima River samples was 1.3 x 10^{-5} μc/gram.

The activity density of beta emitters in a mud sample obtained from the base of the Bonneville Dam was 1.1 x 10^{-5} μc/gram; the activity density of alpha emitters in the sample was less than 6 dis/min/gram. A sample of algae obtained from the vicinity of the Bonneville Dam indicated an average activity density of 2.8 x 10^{-5} μc/gram. Radiochemical analysis to evaluate the activity density of beta emitters

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in the river water obtained from Bonneville indicated all values to be less than 5×10^{-8} µc/cc.

One hundred and fifty-three 500 ml. samples were obtained from the raw water supplies at the 183 and 283 buildings in the 100 and 200 Areas at the Hanford Works during the period July, August, and September, 1950. The raw water was originally pumped from the Columbia River at one of the 100 Areas; each of the areas pumps approximately 25 percent of the total raw water during a 3 month period. This water is transported from the pumping station to the remaining areas via the raw water export line; after additional purification and chlorination this water is used for drinking purposes in the areas.

The measurement for the activity density of gross beta emitters and alpha emitters in this water was performed in a manner identical to that used for water samples as discussed in the Well section (Section VII.) The frequency of sampling was maintained on a weekly basis at the 100 Areas locations; more frequent samples were obtained from the 200 Area locations because wider variations in the activity density of beta emitters have been previously observed. The sampling at the 283 Buildings in the 200 Areas was supplemented by direct sampling from the retention pond basins in these areas. Table V summarizes the results obtained from the measurement of the activity density from beta emitters in the raw water during this period.

TABLE V
RADIOACTIVE CONTAMINATION IN RAW RIVER WATER EXPORT LINE
JULY AUGUST SEPTEMBER
1 9 5 0

Location	No. Samples	BETA EMITTERS-ACTIVITY DENSITY x 10^8* µc/cc	
		Maximum	Average
183 Bldg. 100-B Area	10	<5	<1
183 Bldg. 100-D Area	10	12	3
183 Bldg. 100-F Area	12	27	13
183 Bldg. 100-H Area	10	12	6
283 Bldg. 200 East Area	45	17	2
283 Bldg. 200 West Area	45	15	4

* The reporting limit established for raw water samples is 5×10^{-8} µc/cc; for averages which include four or more samples a reporting level of 1.0×10^{-8} µc/cc is used.

No significant difference was observed when comparing the activity density measurements summarized in Table V with those observed during the previous quarter. The magnitude of this activity measured during the last six months was lower than that observed during the winter months and was attributed to the change in flow of the Columbia River. This trend was expected for this time of the year and was in reasonable agreement with that observed during the summer months in the past. The maximum results summarized in Table V represented measurements of samples obtained during the latter part of the quarter when the flow rate of the Columbia River was at a minimum.

Ten samples were obtained from each of the retention ponds near the 283 buildings in the 200 Areas. The average activity density of beta emitters in this water was less than 5×10^{-8} $\mu c/cc$ in each area and compared favorably with those measurements which represented the raw water at the 283 buildings.

The samples obtained from the locations summarized in Table V were also analyzed for the activity density of alpha emitters from uranium and/or plutonium. The average activity density of alpha emitters was less than 6 dis/min/liter in all areas except the 100-F Area where the quarterly average was 6 dis/min/liter. Occasionally, individual samples indicated the activity density of alpha emitters to be on the order of 10 to 25 dis/min/liter in this water. However, subsequent samples did not tend to confirm the presence of this activity; resamples results from all areas showed less than 6 dis/min/liter.

Two samples were obtained at Clover Island which is the pumping source of Columbia River water in the Kennewick Sanitary supply. The activity density from gross beta emitters and alpha emitters in the samples was less than 5×10^{-8} $\mu c/cc$ and less than 6 dis/min/liter, respectively.

Thirteen samples were obtained at the inlet of the North Richland pond. This water originates in the Yakima River and is transported via the ditches to North Richland; activity density measurements for alpha and beta emitters were below the detectable limits of the analysis in each sample analyzed.

(Please refer to Figures 9 and 10.)

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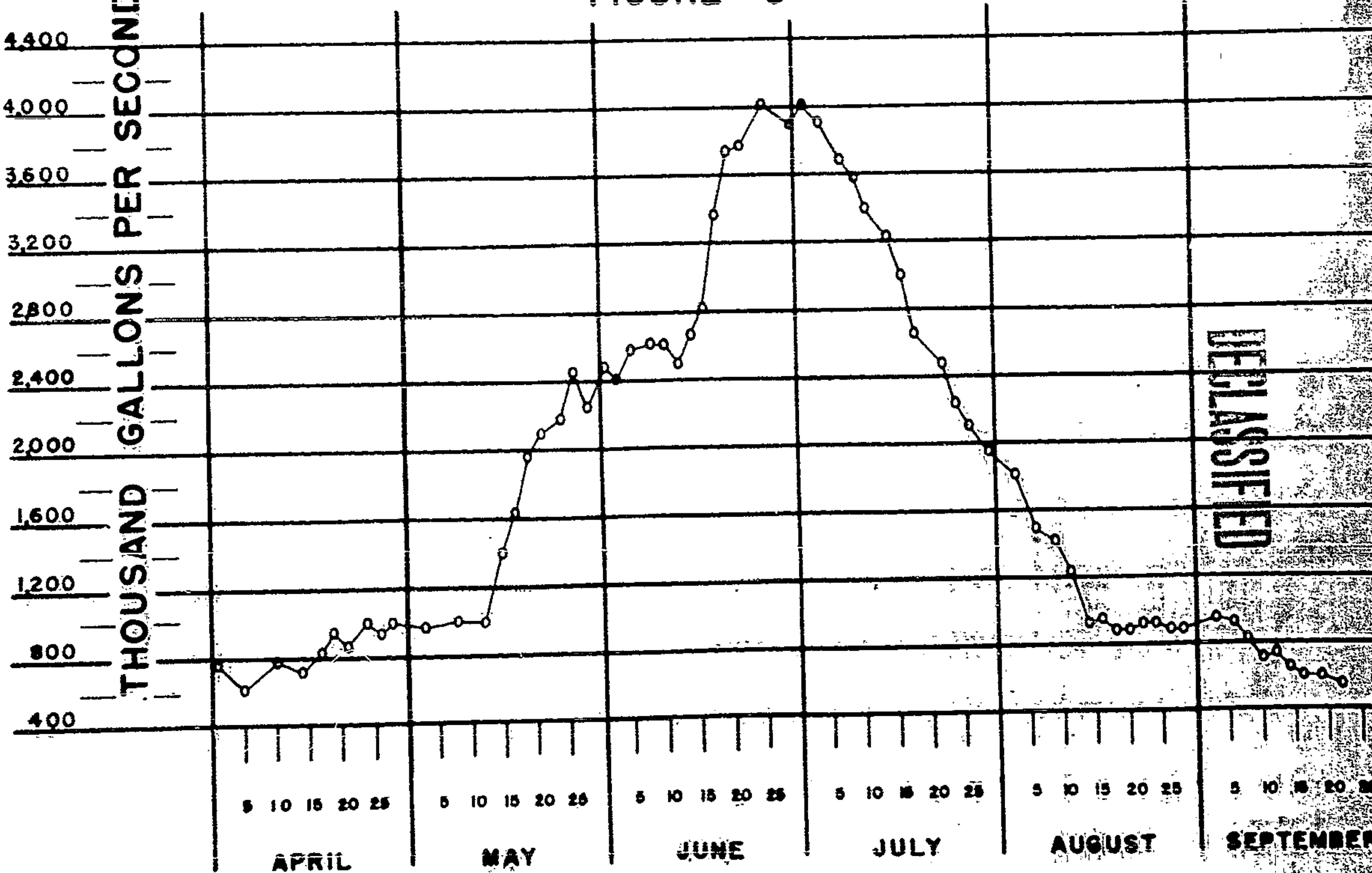
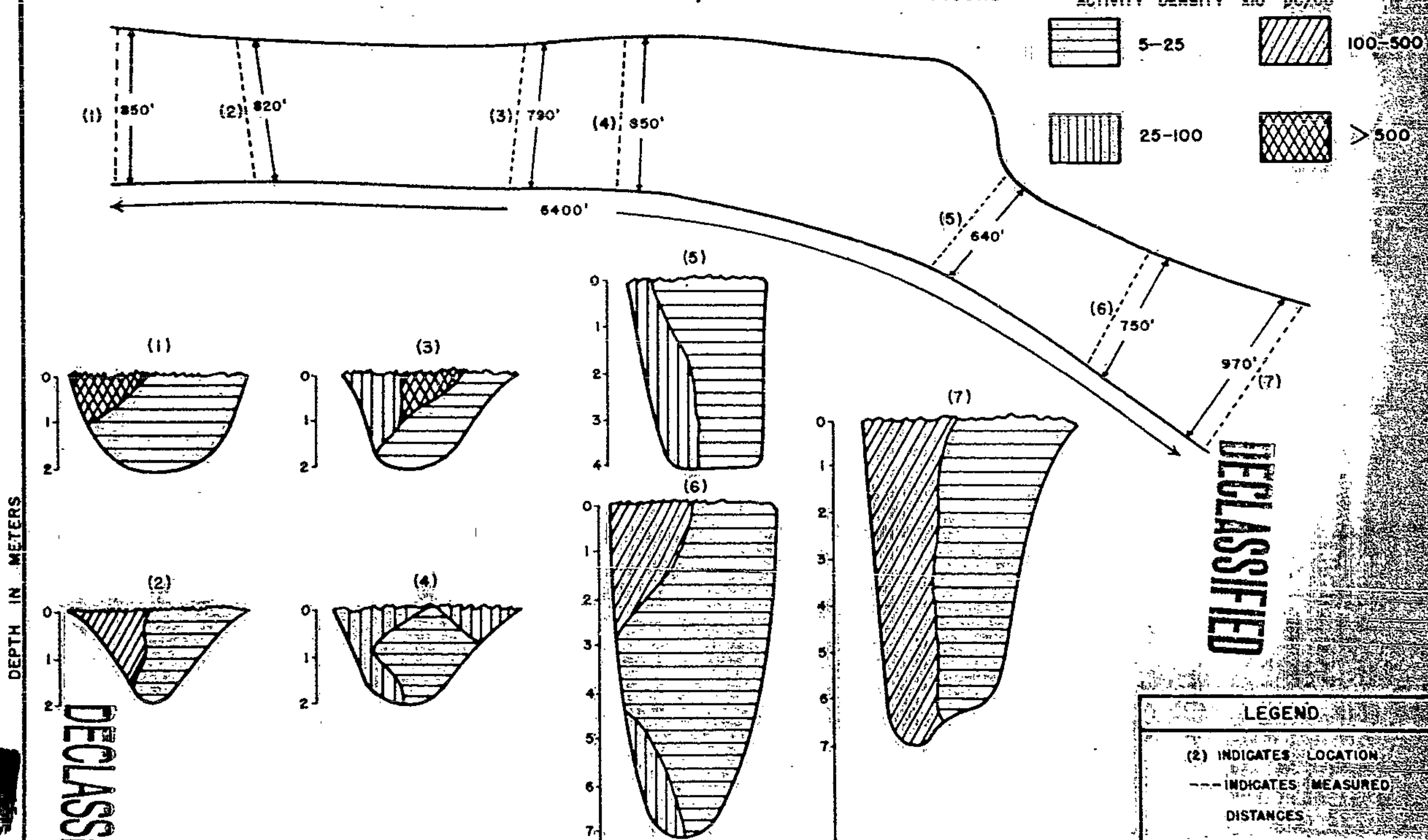
COLUMBIA RIVER FLOW
JULY - AUGUST - SEPTEMBER
1950
FIGURE - 9



ESTIMATED DISTRIBUTION OF ACTIVITY DENSITY OF BETA EMITTERS
100-H HIGH WATER CHANNEL
JULY 17, 1950

FIGURE – 10



SECTION VI

RADIOACTIVE CONTAMINATION IN RAIN

An abnormally dry period during the months of July, August, and September, 1950 provided little opportunity for evaluating the activity density of beta emitters in rainfall at the Hanford Works. A total of only 11 rain samples were obtained from 11 locations at which rain gauge stations were maintained. Rain collectors were maintained at a total of 28 locations on and adjacent to the project; however, no rain was detected at 17 of the locations.

A summary of the rainfall data for the period July, August, and September, 1950, as measured by the Meteorology Group of the Health Instrument Division at the Meteorology Station near the 200 West Area is presented in Table I. Rainfall measurements for the two previous years are also included for comparison.

TABLE I
PRECIPITATION MEASURED AT HANFORD WORKS
JULY AUGUST SEPTEMBER - 1950
units - inches

Year	July	August	September	Quarterly Total
1948	0.40	0.39	0.16	0.95
1949	0.01	0.03	0.23	0.27
1950	0.07	trace*	0.01	0.08

* Trace measurement indicates an amount of precipitation less than 0.01 inches of rainfall.

A review of the data presented in Table I shows that the rainfall during this quarterly period totaled 0.08 inches. This amount was considerably lower than that measured during the two previous years and was lower by a factor of eight when compared with the 34 year average at Hanford which is 0.69 inches for this period. The data also indicate that during the month of July the bulk of the measured rainfall was recorded and as a result the activity density measurement which represents the quarterly period was weighted considerably by the observations made during this month.

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

 [redacted]

TABLE II
ACTIVITY DENSITY OF BETA EMITTERS IN RAIN SAMPLES
JULY AUGUST SEPTEMBER - 1950

LOCATION	ACTIVITY DENSITY x 10^7 μc/cc
Meteorology Tower	25
Meteorology Tower	6
Meteorology Tower	511
200 East Area 4900' east of stack	235
200 East Area 7000' east of stack	73
Route 4S, Mile 6	9
300 Area	<1
Pasco H & R Depot	4
Benton City	4
100-F Area	1
Hanford	1
200 North Area	2
Gable Mountain	5

The maximum activity density from beta emitters in rainfall was 5.1×10^{-5} μc/cc in a sample collected at the Meteorology Tower. This location is in the same general region in which the maximum deposition of I-131 on vegetation was noted. The order of magnitude of this result was in good agreement with the maximum observed during the period April, May, June, 1950, when a sample collected about 7000' east of the 200 East Area stack contained 5.0×10^{-5} μc/cc. With the exception of the isolated samples collected in the immediate environs of the 200 Areas, the activity density from beta emitters in rainfall did not exceed 5×10^{-7} μc/cc in any outlying region.

The activity density of beta emitters measured in the rainfall during this quarterly period was somewhat higher than that observed during the same period a year ago.

SECTION VI

SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER AND TEST WELLS

The sampling and subsequent radiochemical analysis for the activity density of alpha and beta emitters in drinking water supplies were performed to evaluate the radioactive contamination in these sources either as occurring naturally or originating at the Hanford Works. The principal source of Hanford radioactive contamination is that resulting from the discharge of pile area radioactive effluent into the Columbia River which is subsequently used as a source of drinking water.

Nine hundred and ninety samples from drinking water supplies were analyzed during the period July, August, and September, 1950. Eight hundred and twenty-nine of these samples were 500 ml. samples and the remaining ones of 12 liter volume. The radiochemical analyses of the 12 liter samples was confined to the measurement for the activity density of alpha emitters of uranium and/or plutonium. The activity density from beta emitters in drinking water was determined from the analyses of 500 ml. samples; these samples were also used as a source of more frequent spot checks to determine the activity density of alpha emitters. In general, the larger samples were used in those cases where increased sensitivity of analysis was desired.

The drinking water supplies were sampled at various frequencies; these were determined from the current trend of the activity density measurements, and the probability that the well may be contaminated. The slight increase in the number of samples obtained during this period was attributed to the occurrence of several new wells in the region immediately adjacent to the Hanford Works.

The activity density measurements summarized in this document were accomplished by evaporating the indicated volume of water and transferring the residue to a 1" diameter stainless steel plate. The activity density from beta emitters in the residue was counted using thin mica-window counters in which the window thickness varied between 3 and 5 mg/cm^2. The counting rates obtained in this manner were further corrected for the geometry of the counter, backscatter effect, source size, decay when known, and self absorption effects. The residue on the stainless steel plate was then transferred to a beaker and ether extracted using aluminum nitrate as a salting out agent. After final evaporation on a stainless steel plate, the activity density of the alpha emitters from uranium and/or plutonium was evaluated by employing a standard alpha counter. Corrections applied to these counting rates included a 52 percent geometry correction, and a correction for the efficiency of the extraction as determined by the previous analysis of samples to which known quantities of plutonium or uranium were added. Specific measurements for the activity density of uranium was accomplished by the fluorophotometer method. In the few isolated cases where the uranium analysis did not account for the entire activity density from alpha emitters as determined by the ether extraction method, the activity density from plutonium was determined by a double lanthanum fluoride precipitation process.

Drinking water supplies which consistently indicated measurable activity from alpha emitters above the sensitivity limit of an individual analysis (greater than 6 dis/min/liter) were essentially confined to the wells located in the Richland and Benton City areas. The presence and magnitude of the activity density of alpha emitters in the wells in these two localities was in agreement with measurements made during previous periods. The alpha emitter measured in these samples was attributed to uranium which presumably occurs naturally in this region; in the few isolated cases where the total activity density was not accounted for by the alpha emitter from uranium, the variations were small and were attributed to minor changes in sampling techniques and small deviations in the analytical procedures.

As in the past, the maximum activity density from alpha emitters was found in the Benton City region where samples obtained from the Benton City Water Company and Benton City Store wells averaged 28 and 15 dis/min/liter, respectively. Maximum individual measurements in samples obtained from these drinking water supplies were 38 and 30 dis/min/liter. The activity density from the alpha emitter of uranium in the Benton City Water Company well averaged 14 μg U/liter with maximum measurements on the order of 20 μg U/liter. The amount of uranium in this well during this period was about the same as that measured during the previous quarter when the average activity density was 13 µg U/liter including a maximum of 20 ug U/liter.

The activity density from alpha emitters measured in the various Richland wells was considerably lower than that found in the Benton City region. The average activity density varied between 6 and 12 dis/min/liter in these wells; the maximum average was detected at Richland Well #15. The maximum activity density from alpha emitters measured in any individual sample was detected in a sample from Richland Well #13 which contained 19 dis/min/liter. Trace amounts of uranium were detected in each of the wells which showed measurable activity density from alpha emitters; the average uranium content was on the order of 3 to 7 µg U/liter in this water. The maximum uranium measurement was 10 µg U/liter found in a sample obtained from Richland well #15.

Several samples which were obtained from wells located within a few miles of the Richland wells also showed trace activity density of alpha emitters. These locations included two of the North Richland wells and one of the Columbia Field Wells; the average activity density at these locations barely exceeded the sensitivity limit of the analysis; however, several individual samples showed the presence of alpha emitters to be on the order of 20 dis/min/liter.

Table I summarizes the locations at which the 500 ml. samples showed the activity density from alpha emitters to average above the detectable limit of 6 dis/min/liter. A summary of the uranium measurements is also included.

[redacted]

TABLE I
ACTIVITY DENSITY-ALPHA EMITTERS IN DRINKING WATER
JULY AUGUST SEPTEMBER
1 9 5 0
500 ml. samples
units-dis/min/liter*

Location	Samples	ACTIVITY DENSITY Ether Extraction dis/min/liter Maximum	Average	Fluorophotometer μg U/liter Maximum	Average
Richland Well #2	12	17	10	9	5
Richland Well #4	50	16	6	6	3
Richland Well #12	12	18	8	5	4
Richland Well #13	26	19	7	5	3
Richland Well #14	13	15	9	7	4
Richland Well #15	8	16	12	10	7
Richland Well #18	12	16	7	7	4
3000 Area Well "A"	12	23	6	7	<2
3000 Area Well "B"	14	34	7	<2	<2
Benton City Store	12	30	15	10	5
Benton City Water Company	12	38	28	19	14
Cobb's Corner	12	29	7	2	<2
Pistol Range	11	9	8	5	3

* 1 dis/min/liter = 4.5×10^{-10} uc/cc

A map showing the location of the Richland wells in which the positive activity density from the alpha emitter of uranium exceeded 2 μg U/liter may be referred to in Figure 11.

Individual samples from some of the wells which are not included in Table I showed trace activity density of alpha emitters in individual samples. Subsequent resampling did not confirm the presence of this activity and on a quarterly basis the average activity density did not exceed 6 dis/min/liter in any case. A complete tabulation of the activity density in measurements for those locations which showed trace amounts of alpha activity at any time during the three month period may be referred to in Tables II and III. Table II summarizes the results obtained from the analysis of 12 liter samples and Table III summarizes the results obtained from the analysis of 500 ml. samples.

[redacted]

[redacted]

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TABLE II

SUMMARY OF ALPHA EMITTERS MEASURED IN DRINKING WATER

12 liter samples

Activity Density - units - dis/min/liter

JULY-AUGUST-SEPTEMBER-1950

Location	Number Samples	Maximum	Average
Foster's Ranch	4	6	2
Headgate	5	11	4
Hanford Well #1	4	3	<2
3000 Area Well "A"	5	4	<2
3000 Area Well "B"	5	4	<2
3000 Area Well "C"	5	4	<2
3000 Area Well "D"	5	9	3
3000 Area Well "E"	5	4	3
3000 Area Pond Inlet	2	4	3
Richland Well #2	6	9	4
Richland Well #4	5	9	5
Richland Well #5	3	4	3
Richland Well #12	4	6	2
Richland Well #13	6	11	4
Richland Well #14	3	11	6
Richland Well #15	4	15	11
Richland Well #18	6	10	5
Tract House J-685	5	7	3
Benton City Store	3	17	7
Benton City Water Company	3	16	7
Cobb's Corner	3	6	4
Columbia Field Well "A"	2	13	8
Columbia Field Well "B"	2	3	3
Columbia Field Well "C"	2	5	4
1100 Area Well #8	4	6	4
P-11 Well	6	4	2
Kennewick Highlands	4	6	2
Kennewick Standard Station	7	5	2
Riverland	2	6	4
Midway	2	3	2
Wills Ranch	2	4	4
Pistol Range	5	5	4
300 Area Sanitary	4	10	3
White Bluffs	5	5	3
251 Building Sanitary	2	4	3

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TABLE III

SUMMARY OF ALPHA AND BETA EMITTERS MEASURED IN WATER SUPPLIES

500 ml. samples

JULY-AUGUST-SEPTEMBER-1950

Location	Number Samples	Alpha Emitters Activity Density dis/min/liter		Beta Emitters Activity Density x 10^8 µc/cc	
		Maximum	Average	Maximum	Average
Foster's Ranch	8	4	2	<1	<1
Headgate Well	9	7	2	<1	<1
Hanford Well #1	11	8	3	<1	<1
Hanford Well #4	10	8	2	<1	<1
Hanford Well #7 Sanitary	34	9	3	5	<1
Hanford Well #7 Raw	12	13	3	3	<1
3000 Area Well A	12	23	6	2	<1
3000 Area Well B	14	34	7	6	1
3000 Area Well C	12	7	3	3	<1
3000 Area Well D	14	8	4	14	1
3000 Area Well E	14	30	5	4	<1
3000 Durand #5	6	6	5	<1	<1
Richland Well #2	12	17	10	5	<1
Richland Well #4	50	16	6	2	<1
Richland Well #5	12	13	4	<1	<1
Richland Well #12	12	18	8	<1	<1
Richland Well #13	26	19	7	4	<1
Richland Well #14	13	15	9	2	<1
Richland Well #15	8	16	12	1	<1
Richland Well #18	12	16	7	<1	<1
Tract House J-685	11	10	4	<1	<1
Benton City Store	12	30	15	1	<1
Benton City Water Company	12	38	28	1	<1
Cobb's Corner	12	29	7	<1	<1
Enterprise Well	10	5	2	1	<1
Kennewick Highlands	10	15	4	15	7
Kennewick Standard Station	13	5	<2	11	2
Kennewick Well #1	6	7	3	2	<1
Kennewick Well #2	6	3	<2	1	<1
Riverland	12	13	4	2	<1
Midway	12	5	2	4	<1
Lower Knob	12	9	2	6	<1
Wills Ranch	12	7	2	1	<1
Columbia Field Well A	12	15	4	1	<1
Columbia Field Well B	12	5	2	2	<1
Columbia Field Well C	12	5	<2	1	<1
P-11 Well	12	6	4	6	<1
1100 Area #8	11	12	4	<1	<1
Pasco H&R Depot	10	7	<2	8	3
Segerson's Ranch	12	6	2	1	<1
Pistol Range	11	9	8	1	<1
300 Area Sanitary	23	7	3	3	<1
White Bluffs Ice House	11	10	4	9	2
Pedox Administration Building	11	4	<2	2	<1
Smitty's Garage	8	5	2	15	6

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TABLE III (con't.)
SUMMARY OF ALPHA AND BETA EMITTERS MEASURED IN WATER SUPPLIES
500 ml. samples
JULY AUGUST SEPTEMBER 1950

Location	Number Samples	Alpha Activity Activity Density dis/min/liter		Beta Activity Activity Density x 10^8 µc/cc	
		Maximum	Average	Maximum	Average
251 Bldg. Sanitary Water	13	20	5	9	1
100-B Sanitary Water	10	8	2	<1	<1
100-D Sanitary Water	12	6	<2	3	1
100-F Sanitary Water	11	9	2	10	5
100-H Sanitary Water	13	5	<2	4	2
200 East Sanitary Water	42	13	3	7	<1
200 West Sanitary Water	42	6	<2	4	<1

Activity density of uranium was measured in samples as listed in Tables II and III at a frequency of at least one analysis per month. The activity density of uranium averaged less than 2 μg U/liter at nearly every location; several individual samples which showed measureable alpha activity by the ether extraction process also showed trace amounts of uranium on the order of 2 to 4 μg U/liter in the same sample.

Two wells were established as control locations to determine the range of activity and also evaluate the efficiency of sampling techniques and the ability to duplicate the analysis. At Hanford Well #7, 34 samples showed the average activity density from alpha emitters to be 3 dis/min/liter with a maximum of 9 dis/min/liter. Uranium measurements averaged less than 2 μg U/liter which included a maximum of 3 μg U/liter. The analysis of 50 samples obtained from Richland Well #14 showed the average activity density of alpha emitters to be 6 dis/min/liter and the average activity density from uranium as 3 μg U/liter. The maximum measurements were 16 dis/min/liter and 6 μg U/liter, respectively.

Radiochemical analysis to determine the activity density of beta emitters in drinking water showed that the average activity density did not exceed 5.0×10^{-8} μc/cc at any location except those which were taking water directly from the Columbia River. Drinking water supplies in which the average activity density from beta emitters exceeded 5×10^{-8} μc/cc included the 100-F and 100-H Area sanitary water, the Kennewick Highlands supply, and the pumping station located at Smitty's Garage along highway US 410 between the Richland Y and Kennewick. The latter location is used to pump water into the Kennewick Highlands. The average activity density from beta emitters at the pumping station was 6.0×10^{-8} μc/cc as compared with an average of 7.0×10^{-8} μc/cc at a sampling location in the Kennewick Highlands. The maximum activity density from beta emitters in drinking water was 1.5×10^{-7} μc/cc; this value was observed in samples obtained in the pumping station and in the Kennewick Highlands. Several locations which use Columbia River Water for drinking purposes showed measurable activity density of beta emitters on the order of 5.0×10^{-8} μc/cc to 1.2×10^{-7} μc/cc. These locations included Kennewick, Pasco H & R Dept, White Bluffs, and several of the Hanford Works Operating Areas. The presence of beta emitters in these drinking water supplies was expected and the order of magnitude was not indicative of any trend when compared with previous results. In general, most of the positive results were somewhat lower than usual; however, this fact tends to prevail during periods in which the flow rate of the Columbia River is above average. The sampling program at the Pasco Filter Plant which was inaugurated during the previous quarter was continued on a weekly basis throughout the current period. Samples of treated water which were obtained at the Pasco Filter Plant as the water is leaving for subsequent use in the city showed the average activity density of beta emitters to be 4×10^{-8} µc/cc including a maximum result of 9.0×10^{-8} µc/cc. Samples of the filtering media were obtained from the surface of the filter beds; the activity density from beta emitters in this material averaged 7.0×10^{-6} µc/gram including a maximum measurement of 1.4×10^{-5} µc/gram. The activity density from beta emitters in the mixture at the time the filter beds were backwashed averaged 8.0×10^{-8} µc/cc; the maximum activity detected in this material was 1.9×10^{-7} µc/cc. The order of magnitude of the activity found in the various media at the filter plant was 2 to 3 times greater than that detected in the preliminary measurements performed during the previous quarter; this increase in activity was apparently caused by the fact that the previous measurements were performed during a period when the Columbia River was at peak flow. The results summarized for the current period were evenly weighted and would tend to be higher toward the latter part of the period during the month of September when the flow rate of the Columbia River tended to level off.

The natural activity in drinking water supplies in the region adjacent to the plant was evaluated in samples which were obtained from Moxie City, Yakima, Zillah, Granger, Sunnyside, and Ellensburg. The average activity density of alpha emitters from uranium and/or plutonium was less than 6 dis/min/liter in all samples except those obtained from Sunnyside and Ellensburg where the activity density was 6 and 14 dis/min/liter, respectively. Radon measurements in these water samples indicated a value of 629 dis/min/liter at Sunnyside and 21 dis/min/liter at Ellensburg. The maximum activity density of radon measured in samples from the above locations was 760 dis/min/liter in the drinking water at Granger, Washington.

One hundred and sixty-nine samples were obtained from test wells on and adjacent to the Hanford Works. One hundred and forty-one samples were 500 ml. samples and twenty-eight were 12 liter samples. As in the past, the only test wells which consistently indicated alpha emitters above the detectable limit of the analysis were the four 300 Area wells and the BY well. The presence of alpha emitters in the 300 Area wells was in agreement with past data and again was associated with the nearby open waste disposal areas. The maximum average activity density from alpha emitters in test wells was measured in samples obtained from well #2 at 300 Area which averaged 353 dis/min/liter throughout the period. The maximum activity density measured at this location was 663 dis/min/liter. Uranium measurements in samples obtained from this location averaged 209 µg U/liter including a maximum of 586 µg U/liter. The average activity density from alpha emitters in the remaining wells in the 300 Area ranged from 185 to 220 µg U/liter; the average activity density from uranium in these wells varied from 94 to 160 µg U/liter.

Several of the remaining test wells on the project showed measurable activity density from alpha emitters in individual samples; however, the overall average during the quarter was on the order of 2 dis/min/liter. Measurement for uranium by the fluorophotometer method showed that the activity density was less than 2 µg U/liter in these supplies. Table IV summarizes the results obtained from the measurement of the activity density of alpha emitters in all test wells which showed positive activity in any individual samples.

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TABLE IV
ALPHA EMITTERS IN TEST WELLS
JULY AUGUST SEPTEMBER
1 9 5 0
500 ml. samples

Location	No. Samples	ACTIVITY DENSITY: Ether Extraction dis/min/liter Maximum	Ether Extraction dis/min/liter Average	Fluorophotometer µg U/liter Maximum	Fluorophotometer µg U/liter Average
300 Area Well #1	11	349	191	174	94
300 Area Well #2	21	633	353	586	209
300 Area Well #3	20	304	185	169	102
300 Area Well #4	12	437	221	769	160
B-Y Well	12	21	10	3	2
Spring #13	10	10	3	<2	<2
Ranch #13	2	4	2	<2	<2
Snively Ranch	2	4	<2	<2	<2
Rattlesnake Spring	2	3	<2	<2	<2
200 North #5	10	8	2	<2	<2
McGee Well	12	10	2	2	<2
Ford Well	12	4	2	<2	<2
Meeker Well	12	5	<2	<2	<2

Random samples were obtained from various irrigation ditches and construction area drinking water supplies throughout the quarter. The activity density from alpha and beta emitters in these supplies was below the detectable limits of 6 dis/min/liter and 1.0×10^{-8} µc/cc, respectively.

SECTION VII

(Please Refer to Figure 11.)

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AVERAGE ACTIVITY DENSITY FROM ALPHA EMITTERS

RICHLAND WELLS

JULY AUGUST SEPTEMBER

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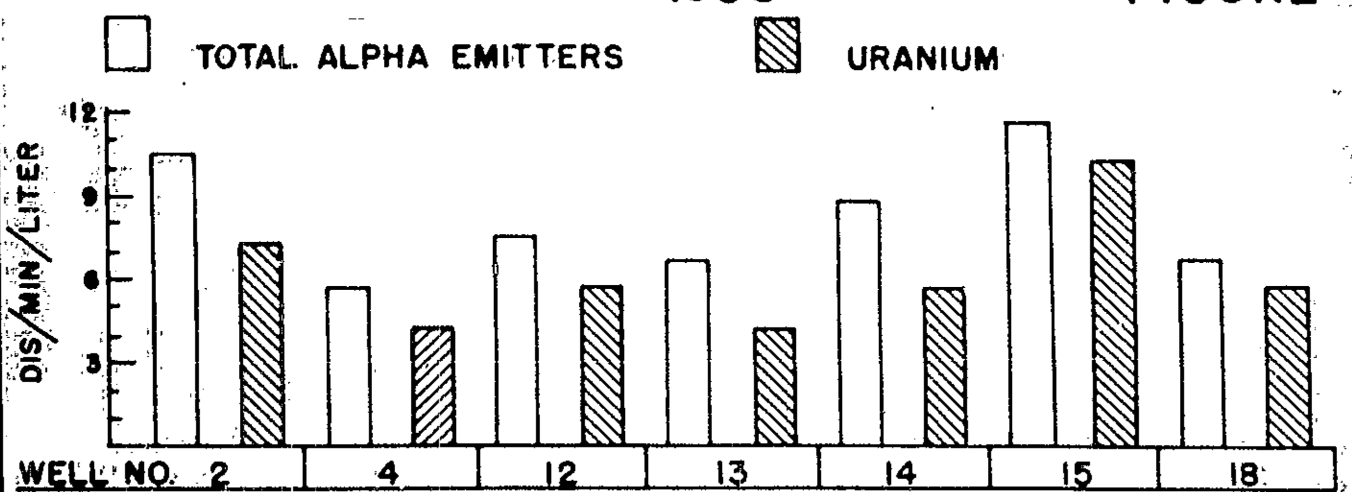
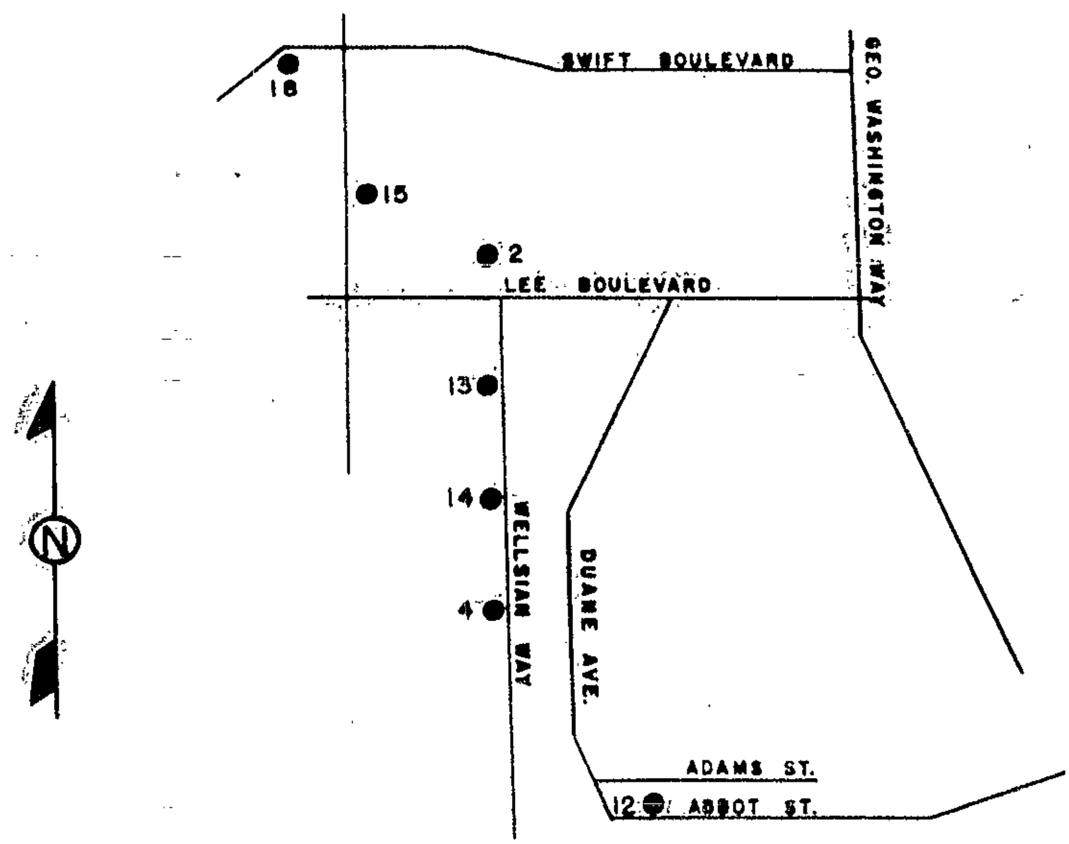
FIGURE-11



LOCATION OF WELLS



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(2) HW-15743 - Analysis of Vegetation for I-131 by M. B. Leboeuf, Jan. 27, 1950.

(3) HW-14243 - Radioactive Contamination in the Environs of the Hanford Works for the Period January, February, March, 1949. H. J. Paas, W. Singlevich

(4) HW-19454 - Radioactive Contamination in the Environs of the Hanford Works for the Period April, May, June, 1950. H. J. Paas, W. Singlevich.

(5) HW-17434 - Radioactive Contamination in the Environs of the Hanford Works for the period April, May, and June, 1949. W. Singlevich, H. J. Paas.

(6) HW-19046 - H. I. Environs Report for the Month of September, 1950. W. Singlevich.

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