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DEVELOPMENT DIVISION

HEALTH INSTRUMENT DIVISIONS

RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS

FOR THE PERIOD
APRIL, MAY, JUNE, 1949

NUCLEONICS DEPARTMENT
HANFORD WORKS
RICHLAND, WASHINGTON

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Technology - Hanford

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD APRIL, MAY, JUNE, 1949

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By Authority of CG-PR-1

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by

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Development Division
Health Instrument Division

April 3, 1950

HANFORD WORKS
RICHLAND, WASHINGTON

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD APRIL, MAY, JUNE, 1949

INTRODUCTION:

This report summarizes the measurements made for radioactive contamination in the environs of the Hanford Works for the quarter April through June 1949. This belated document is issued for the records to fill in the gap for the quarterly reports not issued in 1949 because of personnel shortage at that time. Although the data summarized in this report were already reported in the H.I. Environs Reports for the months involved, it is still of value to study the data by combining the three months of data which give a better opportunity to evaluate the trends and patterns of the levels of radioactive contamination emanating from the various sources at the Hanford Works.

ABSTRACT:

SECTION I - METEOROLOGICAL DATA:

Dissolving of irradiated uranium decreased by about thirty-five per cent during this period as compared with the previous three month figure. The wind direction prevailed from the west 38 per cent of the time with about 36 per cent of the wind coming from the northwest; winds from the east were negligible. These observations were made at the 622 building near the 200 West Area. Contrary to previous observations, the wind directions at the 100 Areas corresponded closely to those observed at the Meteorology Tower at the separations area. Metal was dissolved when the dilution ratio was greater than 2000:1 47 per cent of the time and about 7 per cent of the time when the dilution ratio was less than 500:1.

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION:

The chief source of deposited activity on vegetation is the radioactive effluent from the separations area stacks resulting from the dissolution of irradiated uranium. The cooling time of the irradiated metal varied from 84 to 102 days in this quarter. The amount of metal dissolved in this period was less than that dissolved in the previous three months; this decrease was reflected by a corresponding decrease in the activity level on vegetation. The average I-131 activity level on vegetation in the 200 West and East Areas this quarter was 7 and 93 muc/kg as compared with 44 and 93 muc/kg, respectively in the last quarter. The average I-131 activity on vegetation in Kennewick, Pasco, and Richland was <3 muc/kg. Activity from the longer half-lived isotopes (non-volatiles, fission product) in the outlying area of the Hanford Works ranged from 6 to 10 muc/kg; this activity is well in the range of expected activity from K-40 known to occur naturally in the potassium salts of the vegetation. Isoactivity maps estimating the distribution of radioactivity on vegetation in the environs of the Hanford Works are attached.

SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE:

Air radiation levels determined by Victoreen Integrons prevailed in the range 0.1 to 0.3 mrep/24 hours which is comparable with the normal drift of the instruments. Dosage rates obtained from detachable ionization chambers during this period did not deviate from the dosage rates determined during the previous three months. Filterable beta activity within the separation areas was of the order of 10^{-10} uc/liter and about 10^{-11} uc/liter in Richland and nearby communities. I-131 in the atmosphere, as determined by passing the air through a caustic scrubber, indicated

about 10^{-10} µc/liter in the separations area and about 10^{-11} µc/liter in Richland. Monitoring for active particles in air this quarter showed no significant departure from the number measured in the previous quarter. The average number of particles detected in filters taken from eight stations located in the states of Washington, Idaho, Oregon, and Montana fluctuated about the background level of 0.07 to 0.31 x 10^{-3} particles/cubic meter air sampled.

SECTION IV - RADIOACTIVE CONTAMINATION IN RAIN:

Beta emitters measured in rain collected within the 200 East Area averaged 7 muc/liter with one individual sample as high as 50 muc/liter; the average inside the 200 West Area was 15 muc/liter with a maximum value of 60 muc/liter. The maximum activity detected in any rain sample was 185 muc/liter collected at Route 4S, Mile 6, about 2 miles east of the 200 East Area stack. Activity in rain samples taken from Richland and adjacent communities was less than the reporting level of 50 µµc/liter.

SECTION V - RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER:

Slight decreases in the levels of activity in river water were observed during this quarter as compared with the previous quarter; this decrease was a direct function of the accompanying decrease in the river flow. The average activity in the river above the 100-B Area (control location) was < 50 µµc/liter with a maximum value of 2163 µµc/liter measured in a sample from the south bank of the river near Hanford; the average activity at this location was 663 µµc/liter. The average activity in the river near Pasco was 123 µµc/liter. A study of the distribution of the activity in the Columbia during low river flow indicated that the bulk of the activity hovered nearest the Hanford plant shore as far down the river as 300 Area; further downstream somewhat better mixing was found. The entry of the Yakima River into the Columbia tended to move more of the activity to the opposite shore from that found further upstream. A graph showing this estimated distribution of activity in the river is attached. A similar study of the distribution of activity in the river during high flow indicated better mixing than noted during the low flow with the bulk of the activity concentrated near the center of the water and toward the Hanford plant side of the river. The effect of the Yakima River in the activity in the Columbia as observed during low flow was not noted during high river flow. Beta activity in the river at high river flow was lower by a factor of 5 to 10 at the upstream locations and lower by a factor of 2 to 3 near Pasco and Kennewick. A direct correlation was found in comparing the river activity with river flow. Decay studies of activity in the river again confirmed that more than 90 per cent of the total activity was contributed by 14.8 hour sodium (Na-24). Analyses of the long half-lived emitters in the 107 effluent water indicated a total of 0.008, 0.003, and 0.003 µc/liter in three pile areas; of this total, about 20 per cent was contributed by P-32, 20 per cent by Ca-45, and the remainder by such isotopes as Fe-59, Cr-51, and S-35. Beta emitters measured in mud samples taken from the banks of the Columbia River ranged from 5 to 44 muc/kg, well within the range of activity noted in mud samples of previous surveys. Activity in 100 and 200 Area water was at a minimum with the activity varying from 50 to 70 µµc/liter. On an average, no alpha activity exceeding 6 dis/min/liter was measured in any of the river water samples taken from any sampling location.

SECTION VI - RADIOACTIVE CONTAMINATION IN HANFORD WASTES:

The beta emitters measured in the 107-B, 107-D, and 107-F effluent water averaged 341, 336, and 307 muc/liter, respectively during the quarter. Activity from S-35 in the pile area 107 basins ranged from about 2 to 3 muc/liter. Measurements for radioactivity in the separations area waste system are reviewed; no outstanding

changes were observed when the current results were compared with those of a month ago. Samples taken from the 300 Area ponds indicated a maximum value of 3.7×10^4 dis/min/liter in the mud. This activity is principally from uranium.

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

Alpha activity from natural occurring uranium ranged from 2-10 ug/liter in Richland wells and averaged about 15-20 ug/liter in some wells in Benton City. These values confirm the findings of previous surveys. Data, in the form of tables and charts, for complete summaries of the water analyses are included. Tracer beta activity from 14.8 hour sodium (Na-24) averaged 42, 33, and 20 μμc/liter in samples taken from the Kennewick Highlands, a Kennewick Standard Station, and the Pasco H & R Depot, respectively. Positive activity from beta emitters was measured in two sanitary water sources within the perimeter fence of Hanford Works; the average activity in the 100-F and 100-H supplies was 13 and 32 μμc/liter, respectively. This activity was also from Na-24.

[redacted]

SECTION I

METEOROLOGICAL DATA

DEL

The meteorological conditions observed during the hours of metal dissolution for the period April, May, June, 1949, are summarized on Figures 1 through 4. The data summarized were compiled by the Site Survey Group of the Development Division from the original observations made by the Meteorological Group of the Health Instrument Divisions.(1) The data summarized in this report represent a total of 812 hours during which radioactive gases were discharged into the atmosphere. The dissolving hours during this period represent a decrease of thirty five per cent when compared with the previous quarterly total of 1,248 dissolving hours.

During this period, the prevailing wind direction at the Meteorology Tower, near the 200 West Area was from the west thirty-eight per cent of the time and from the northwest thirty-six per cent of the time. The prevalence of the northwest quadrant was in good agreement with similar observations made during previous quarters. As usually observed in the past, the amount of wind from the easterly components was negligible. Figure 1 is a eight point compass wind rose which summarizes the wind directions as recorded at the 200' level of the Meteorology Tower near the 200 West Area. The observations from the 200' level were used as this elevation closely represents the height of the separation area stacks.

A break down of the wind direction data on a month to month basis is presented in Figure 2. Very little fluctuation in wind direction was observed throughout the quarter and the consistency with which the west direction prevailed was a departure from observations in the past. During the first three months of 1949, it appeared that the prevalence of the west direction was increasing; however, current observations show that this higher percentage of wind from the west persisted throughout the quarter and the west direction has become the predominant component. In general, the fluctuation noted for any direction on a month to month basis during this period was much less than observed during the past year or two.

(1) Monthly summaries which represent the meteorological data for 24 hour periods are available in restricted reports issued by D.E.Jeanne, of the Health Instrument Divisions, Meteorology Group.

[redacted]

Figure 3 summarizes the average wind direction observed at the 100 Areas, the prevailing directions at 100-B, 100-D, and 100-F, are compared with the corresponding measurements made at the Meteorology Tower near the 200 West Area. A review of Figure 3 again showed the prevailing wind direction to be extremely consistent in each month; very little difference was noted when comparing a given direction at any two locations. The westerly direction prevailed at all the 100 Areas and similar to observations made at the 200 West Area (Figure 2) this direction prevailed consistently throughout the entire period. The 100 Area stations showed minimum winds coming from the northeast component and in general the total wind from the east and southeast was negligible. This consistency of wind direction at all areas observed is unusual in that a review of past observations showed a wide variation in wind directions when comparing the 100 Areas with the 200 Areas.

The iso-activity pattern of the radioactive contamination on vegetation at the Hanford Works directly reflects the predominance of the west wind throughout the quarter (Figure 1). A comparison of the current wind data with that recorded and observed during the first three months of the year showed that the wind direction varied considerably on a month to month basis at that time, and similar comparisons of the iso-activity pattern showed that the radioactive contamination on vegetation was much more widespread during that period.(2)

The atmospheric dilution ratios which existed during the quarter are graphically portrayed on Figure 4. The more desirable aloft condition (dilution ratios greater than 2000:1) existed about 47 per cent of the time. This figure represents a slight decrease when compared with January, February, and March when the greater dilutions existed over 50 per cent of the time that dissolving of uranium was in progress. The more undesirable dilution ratio of less than 500:1 also decreased slightly; the current quarterly average was 7 per cent as compared with 11 per cent during the previous quarter. The two decreases discussed above were accompanied by an increase in the amount of time that the intermediate dilution ratios prevailed, dilutions between

(2) HW-14243 Radioactive Contamination in the Environs of Hanford Works, January, February, March, 1949. To file by W. Singlevich and H.J. Paas.

1000:1 and 2000:1 showed an increase of nearly 40 per cent during this period.

The meteorological conditions discussed in this section may be referred to when reading Sections II and III of this report which summarizes the related deposition of activity on vegetation and airborne radioactivity measurements for the quarter.

SECTION I.

(See Figures 1,2,3, and 4)

SUMMARY WIND DIRECTIONS — 200-W
DISSOLVING HOURS ONLY
APRIL — MAY — JUNE
1949

FIGURE 1

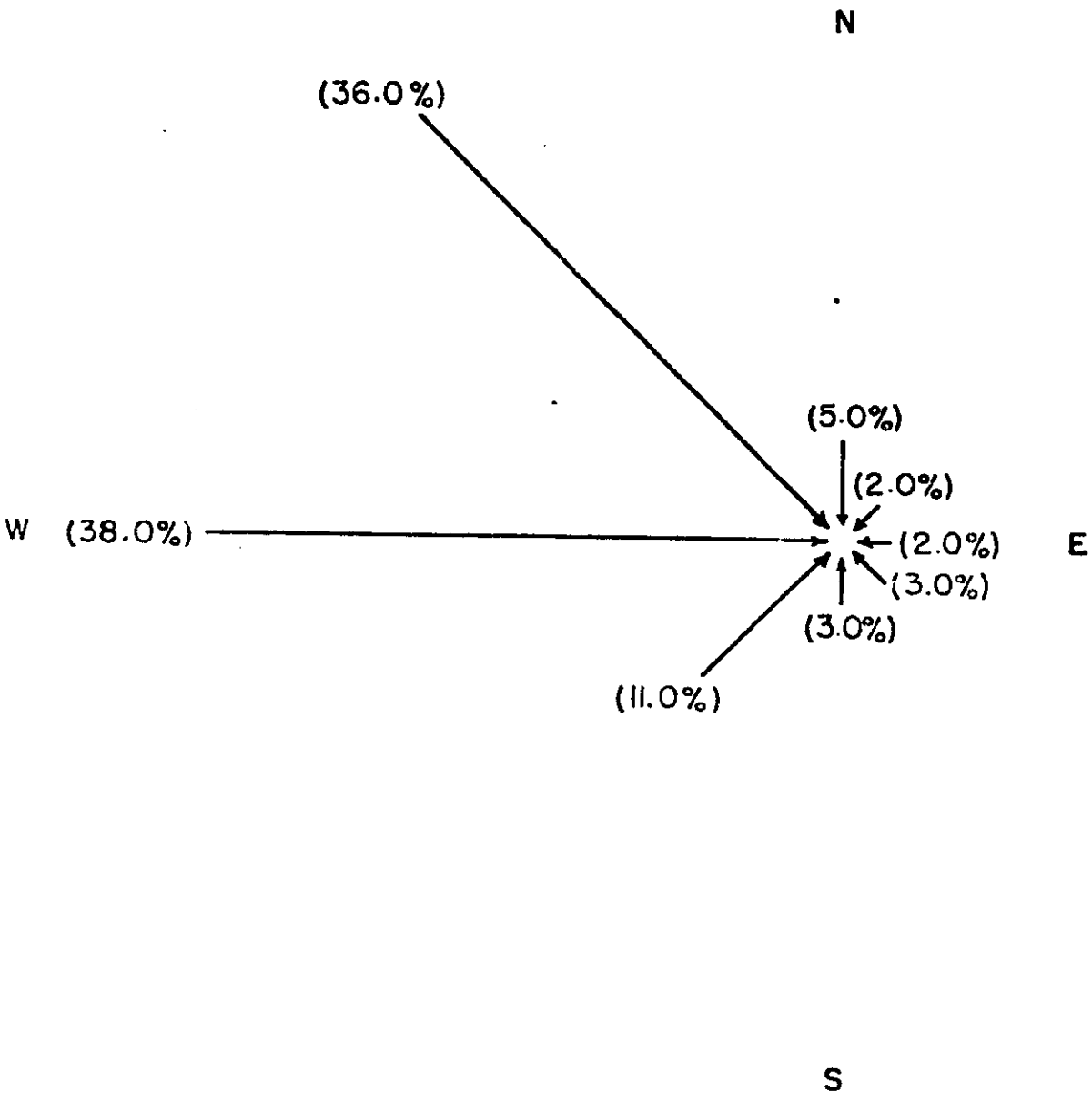


FIGURE 2

SUMMARY AIR CONDITIONS — 200-W
APRIL — MAY — JUNE
1949

WIND DIRECTIONS
DISSOLVING HOURS ONLY

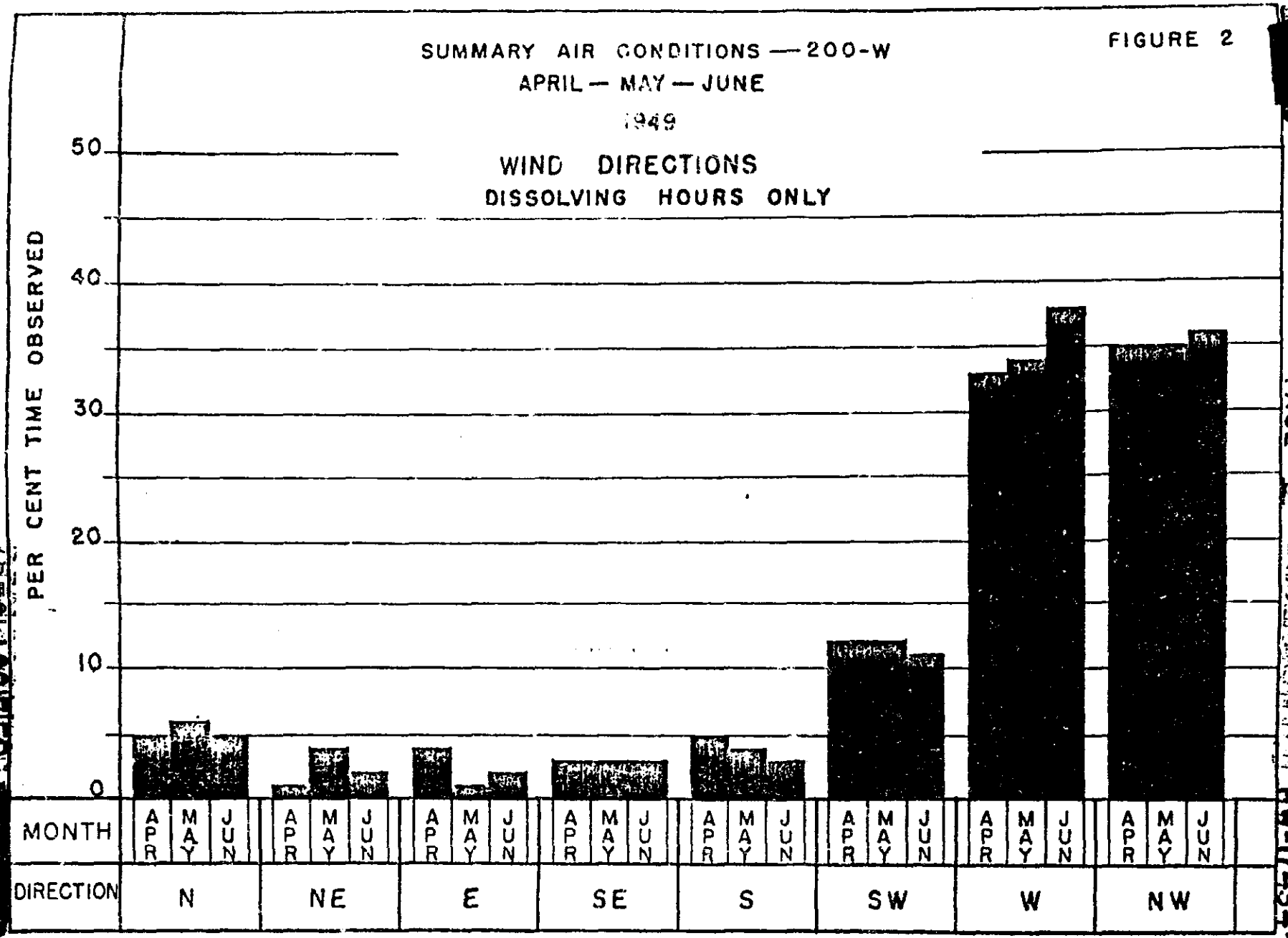
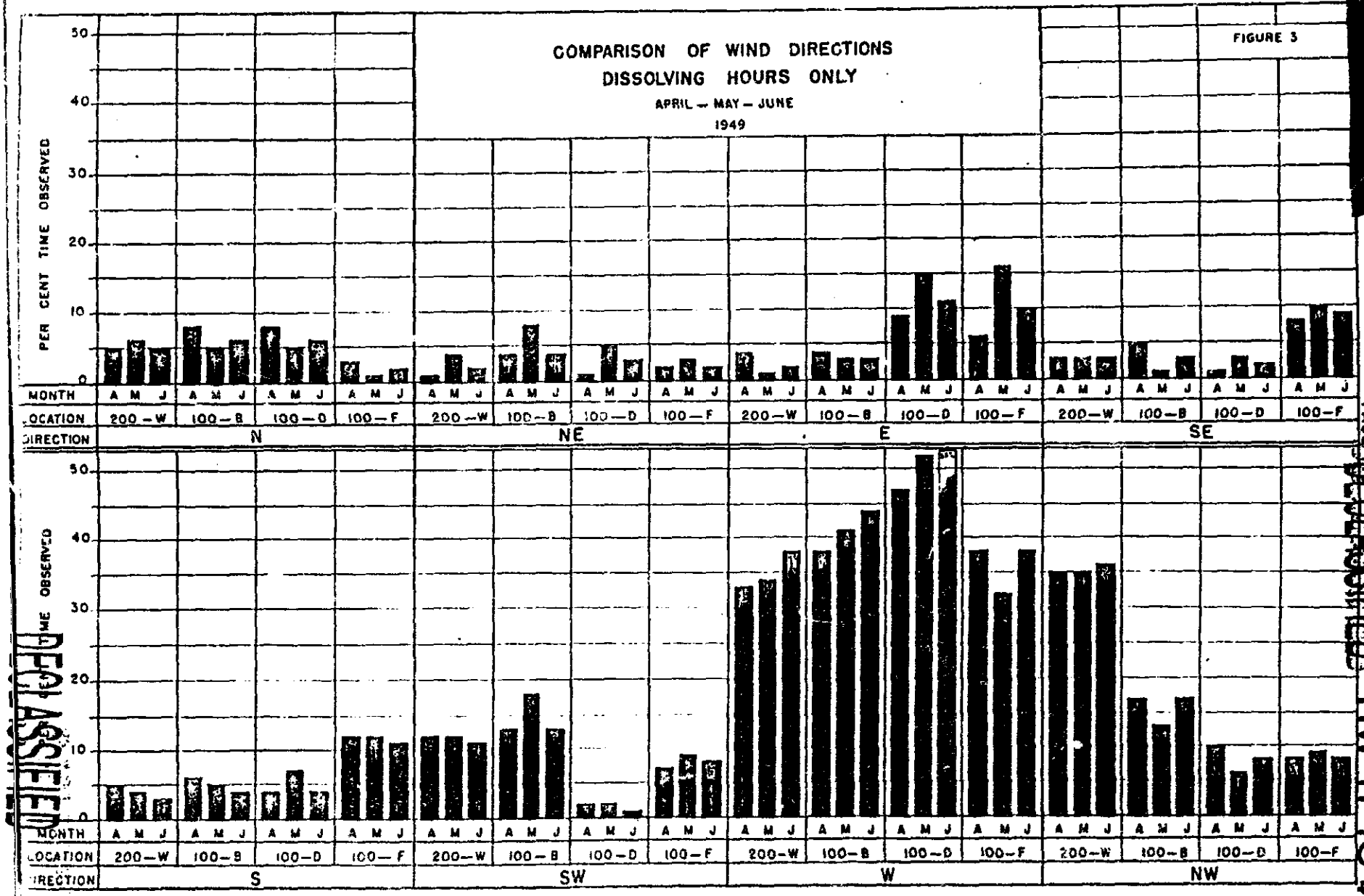


FIGURE 3

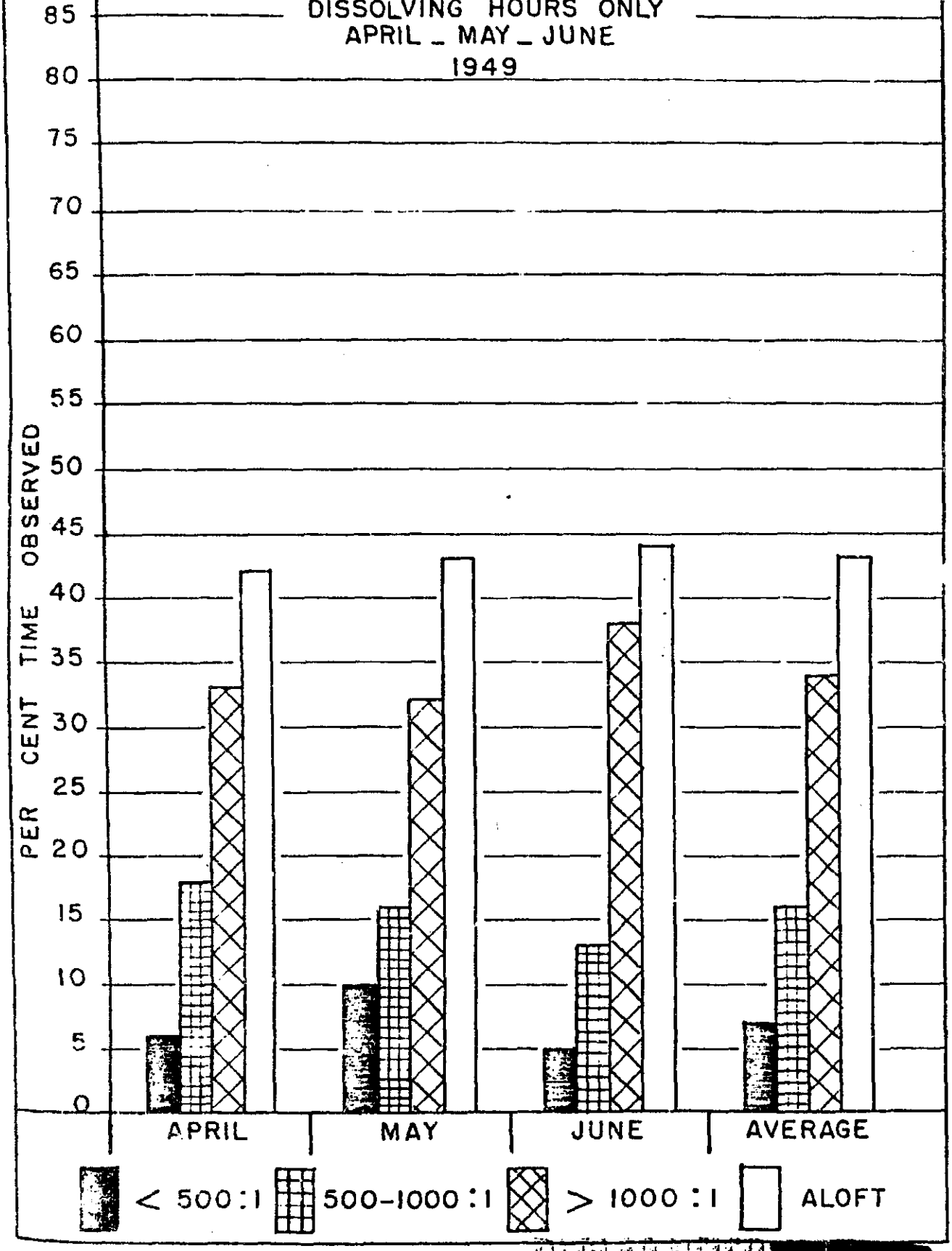
COMPARISON OF WIND DIRECTIONS
DISSOLVING HOURS ONLY
APRIL – MAY – JUNE
1949



WIND DILUTION ANALYSIS

622 BLDG. — 200W AREA
DISSOLVING HOURS ONLY
APRIL - MAY - JUNE
1949

FIGURE 4



SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

The amounts of eight day radio-iodine (I-131) | calculated to have been involved in the dissolver unit during the dissolution of irradiated uranium during April, May, June, 1949, are summarized These calculations are based on the weight and cooling time of each batch of irradiated uranium which was dissolved, but does not represent the actual amounts of radioactive gases which were liberated into the atmosphere. The efficiency of the water scrubbing system which is in the off gas line, was not accounted for in this calculation as well as any iodine held in the dissolver unit itself; the latter effect accounts for about 50 per cent of the iodine alone.

Figure 5 graphically portrays the above data on a day to day basis.

Cooling times for the irradiated uranium varied from 84 to 102 days with an average of approximately 90 days. The average cooling period during the months of April, May, and June, for the uranium dissolved in the 200 East Area was 90.4, 90.2, and 92.8 days, respectively, as compared with an average cooling period of 89.7, 90.1, and 88.6 days for the same months in the 200 West Area.

Eighteen hundred vegetation samples collected during this period were analyzed for the beta activity from eight day iodine (I-131) and for the beta emitters from the non-volatile longer half-lived fission product elements. The analytical methods used for the measurement of the non-volatile activity (1) and the radioiodine activity (2) are discussed in other reports.

(1) HW-12131, H.I. Environs Report for the Month of December, 1948. To file from T. Singlevich, January 3, 1949.

(2) HW-15743, Analysis of Vegetation for I-131. To file by M.B. LeBoeuf, January 27, 1950.

The decrease in amount of I-131 involved in the dissolution of the irradiated uranium during this three month period was strikingly reflected by a general decrease in I-131 activity detected on vegetation samples obtained both within and outside of the project perimeter. These decreases were most noticeable at the 200 West Area and 200 West Area gate sampling locations, where the decreases were from 44 muc/kg to 7 muc/kg and from 383 muc/kg to 93 muc/kg, respectively.

An isoactivity map (Figure 6) shows the estimated general distribution of I-131 activity on vegetation in the environs of Hanford Works. Figure 6 also includes a wind rose which summarizes wind conditions during dissolving hours only.

As would be expected from the decreased dissolving in the 200 West Area (TableI) the most significant changes in I-131 activity were observed at the locations near the 200 West Area stack. The vegetation collected from locations lying in the general prevailing wind direction and near the 200 East Area also showed a sharp decrease in activity, but not to the extent of that noted at those locations near the 200 West Area. General locations showing the least relative change were 200 East Area, Route 4S, Miles 1 to 7; and Route 2S Miles, 2 to 6. In these locations about the perimeter of the project, decreases in vegetation activity seemed to reflect the decrease in the calculated I-131 involved during metal dissolution in the separation areas.

For the apparent decreases in I-131 activity on vegetation noted during this quarter, it was difficult to establish statistical significant differences by comparing average values by means of the "T" Test in most cases. The mathematics of the "T" Test is such that variance (squared standard deviation values) of each group of data is averaged and the resulting value used in the application of the test. Statistical "T" Test methods are applicable only if it has first been established that standard deviation (σ) values of each group of data to be compared have arisen from the same population. To determine whether such differences exist, a statistical "F" test is applied. "F" values are defined by the ratio of variances or

$$F = \frac{\sigma_1^2}{\sigma_2^2}$$; where σ_1^2 is the larger of the two standard deviations.

Table II lists the results of "F" tests arising from the comparison of the I-131 activity found on vegetation samples collected at given locations between the first and second quarters of 1949. Where applicable, "T" tests are also applied, and their results and the conclusions are tabulated.

During the current three month reporting period, no significant differences were found in I-131 activity deposited on vegetation at the Richland, Pasco, and Kennewick sampling locations, where the average I-131 activity calculated from 168 vegetation samples was 0.6 mμc/kg. The average from this populated region was compared with the average I-131 activity found on vegetation samples collected from the following outlying locations: Benton City and vicinity, Columbia Camp and vicinity, Hanford and vicinity, Midway-Riverland vicinity, Benton Cap, Pasco to Ringold, Wahluke Slope and Yakima Barricade to Ellensburg. The only location which differed significantly from the Richland-Pasco-Kennewick region was the Pasco to Ringold route which averaged 1.4 mμc/kg.

A noticeable decrease also occurred in non-volatile beta activity detected on vegetation samples collected during this quarter. The maximum decrease occurred at the most highly contaminated sampling location, the 200 West Area Gate, where the non-volatile beta activity fell from 240 mμc/kg to 74 mμc/kg. This was the same location at which maximum decreases were noted for the I-131 activity. Figure 7 is an iso-activity map which portrays the average non-volatile activity deposition pattern, as measured during the quarter. An estimate of the areas in which the decreased activity was noticed during this period, may be made by comparing this map with a similar portrayal for the previous quarter.(3)

For outlying locations, significant decreases in the average non-volatile activity were noted on samples collected on the 300 Area to Hanford route, Wahluke Slope, Yakima Barricade to Ellensburg, Goose Egg Hill, and Rattlesnake M.P. Posts. The activity on the vegetation in the populated areas of Richland, Pasco, and Kennewick did

(3) HW-14243, Radioactive Contamination in the Environs of the Hanford Works, January, February, March, 1949, to file by W. Singlevich and H.J. Paas, 12-23-1949.

TABLE II

STATISTICAL COMPARISON OF I-131 ACTIVITY MEASURED ON VEGETATION

1 9 4 9

Values in milli-microcuries per kilogram

Location	January No. Samples	February Average	March	April No. Samples	May Average	June	"F" Value	"F" Value Conclusions	"T" Value	"T" Value Conclusions
Richland	62	2.49		65	0.62		2.89	Significant difference		Not applicable.
Pasco	52	1.76		52	0.60		1.56	Difference not significant	4.64	Highly significant decrease this quarter.
Kennewick	50	1.87		51	0.59		2.57	Significant difference		Not applicable.
Benton City & Cobb's Corner	39	2.84		38	0.35		2.13	Questionable significance	9.58	Highly significant decrease this quarter.
Wahluke Slope	112	1.87-		304	0.82		1.12	Not significant	7.00	Highly significant decrease this quarter.
Columbia Camp to Benton City	91	3.16		91	0.91		5.28	Significant difference		Not applicable.
Midway-Riverland-Wells & Segersons	38	2.80		41	0.56		3.35	Significant difference		Not applicable.
Cable Mountain & Putte	52	5.00		50	2.03		1.27	Not significant	4.26	Highly significant decrease this quarter.
Hanford	25	2.89		25	0.91		6.53	Significant difference.		Not applicable.
Yakima Barricade to Ellensburg	27	0.92		54	0.56		1.18	Not significant	1.00	No significant difference.

not differ significantly from last quarter. Figures 8 and 9 graphically portray the average beta activity detected at several listed locations. Each of the locations are sampled routinely and the portrayals present the results of the I-131 and non-volatile activities separately.

Comparison of non-volatile beta results between outlying locations for this quarter revealed that the average activity ranged from 6 muc/kg to 10 muc/kg. The lowest activity was found on the Yakima Barricade to Ellensburg trip route. The average results of two off area surveys in the Yakima-Ellensburg region are presented on Figure 10. Again, these results are extremely low, and are presented for comparison with a similar portrayal in the previous quarters report.

SECTION II

(See Figures 5,6,7,8,9, and 10)

FIGURE-5

CALCULATED I^{131} IN URANIUM DISSOLVED IN SEPARATION AREAS APRIL—MAY—JUNE 1949

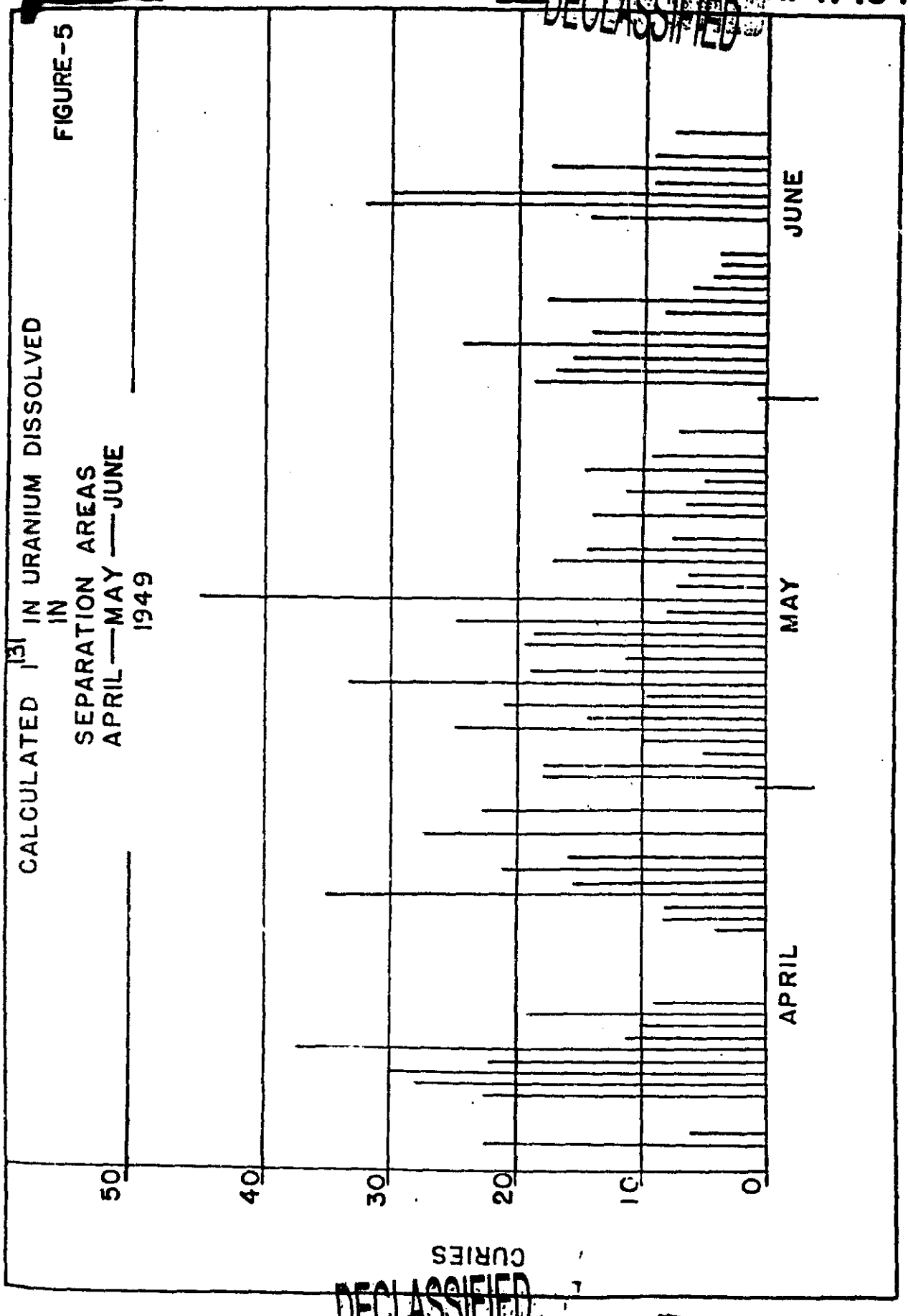


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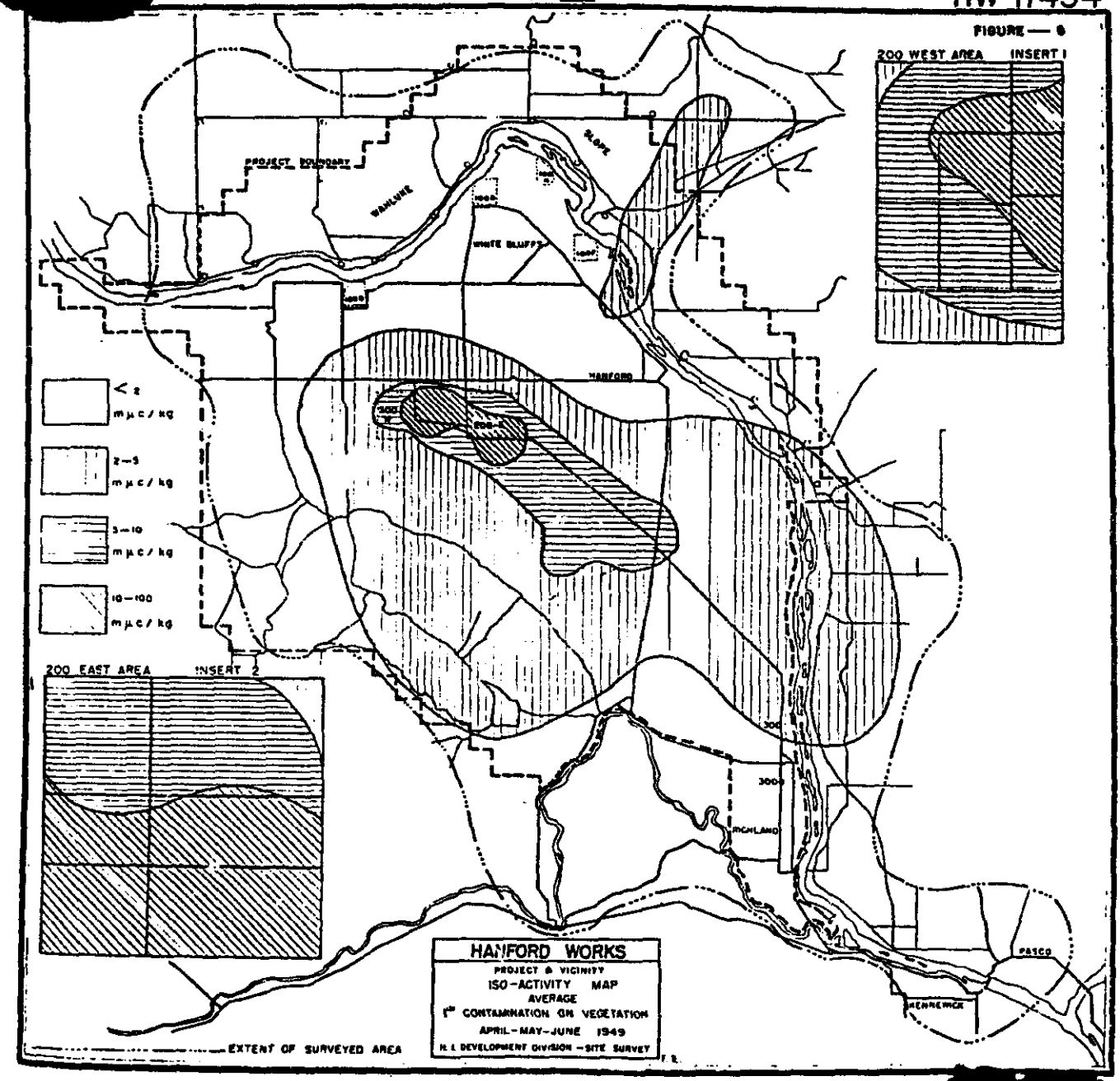
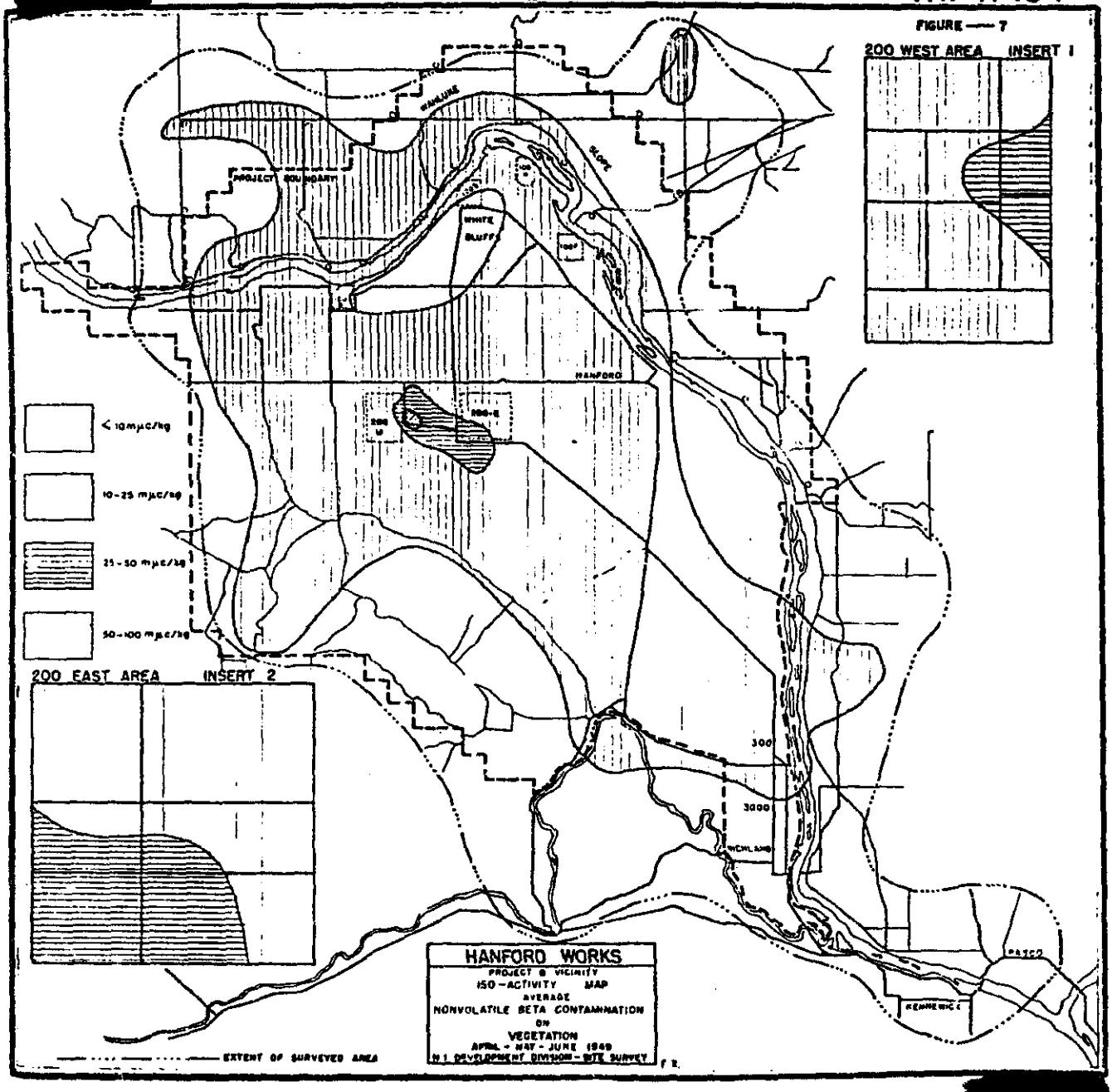
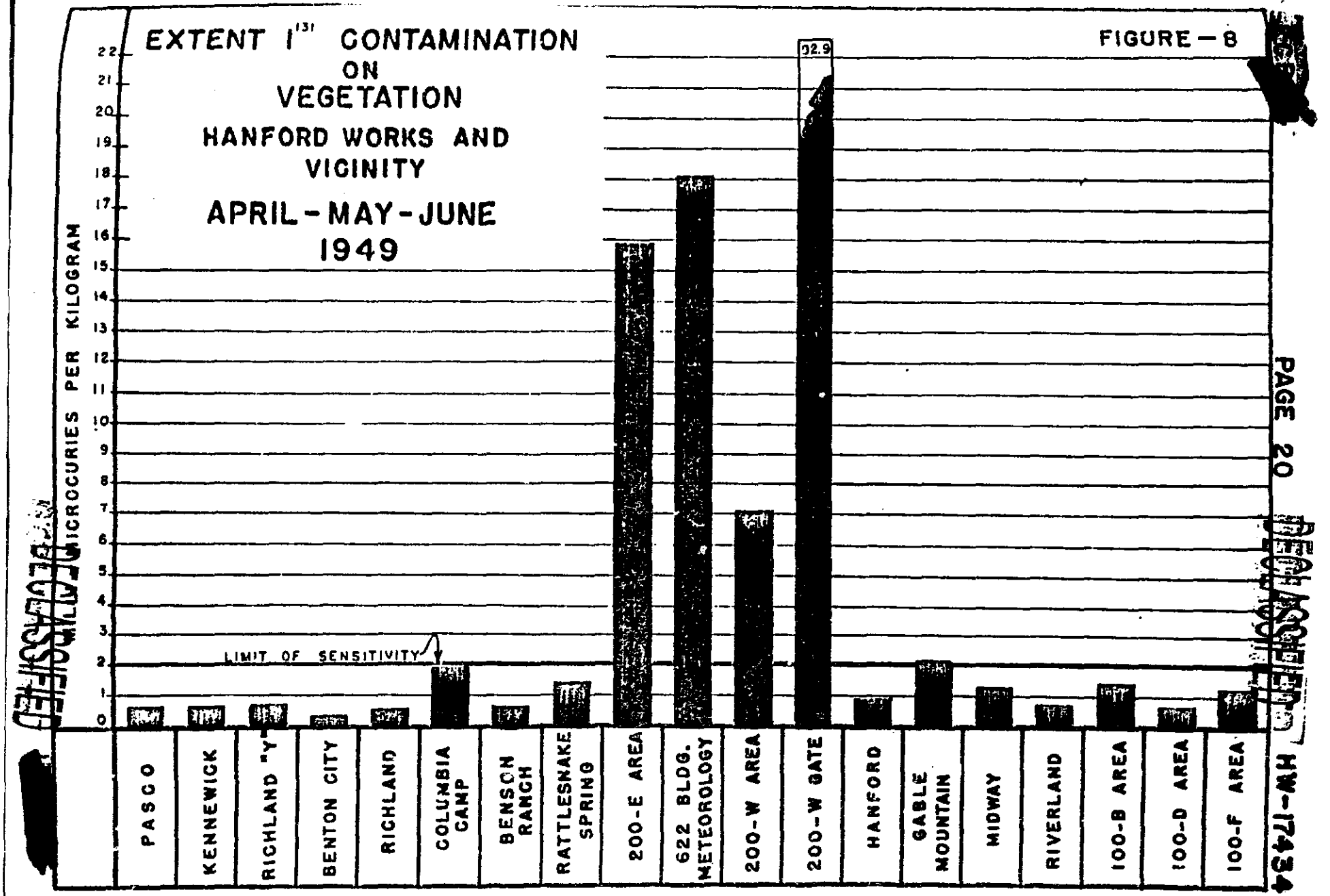
FIGURE — 6

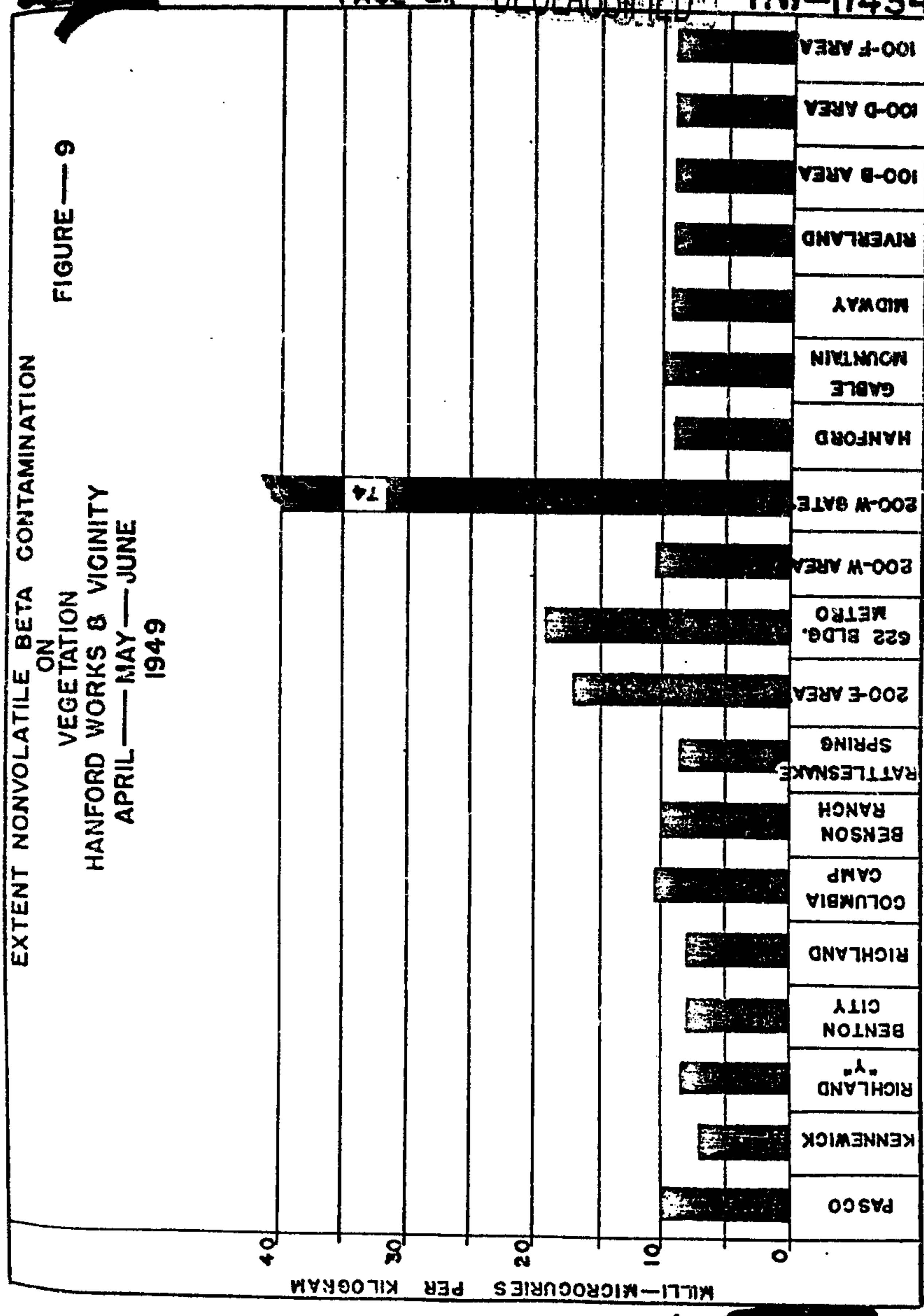


HW-17434

FIGURE — 7





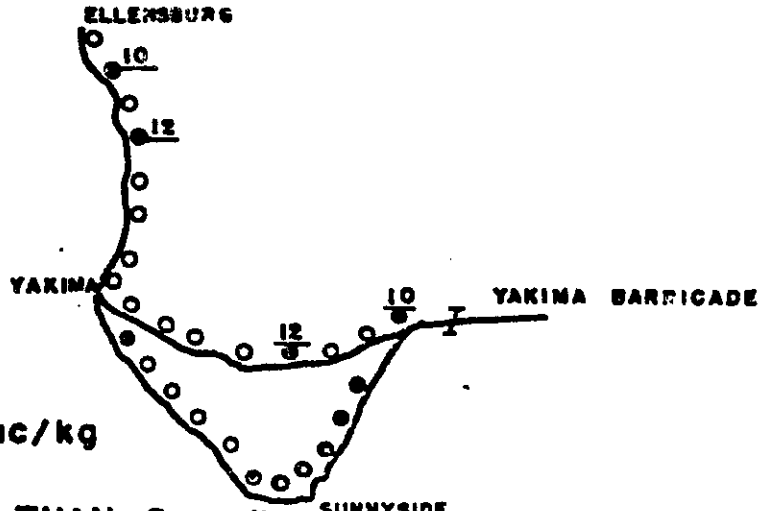

EXTENT NONVOLATILE BETA CONTAMINATION
ON
VEGETATION
HANFORD WORKS & VICINITY
APRIL——MAY——JUNE
1949
FIGURE——9
100-F AREA
100-D AREA
100-B AREA
RIVERLAND
MIDWAY
GABLE MOUNTAIN
HANFORD
200-W GATE
74
200-W AREA
622 BLDG. METRO
200-E AREA
RATTLESNAKE SPRING
BENSON RANCH
COLUMBIA CAMP
RICHLAND
BENTON CITY
RICHLAND "Y"
KENNEWICK
PASCO
0
10
20
30
40
MILLI-MICROCURIES PER KILOGRAM

BETA CONTAMINATION ON VEGETATION

OFF AREA

APRIL—MAY—JUNE 1949

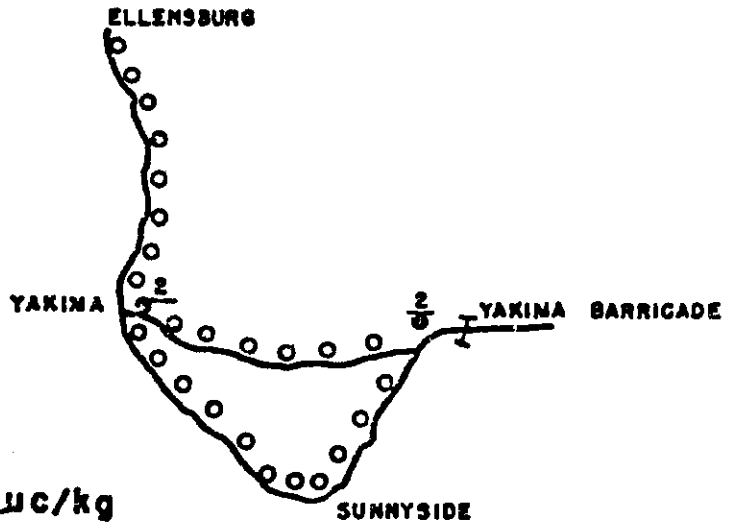
NONVOLATILE BETA CONTAMINATION



● VALUE IN muc/kg

o VALUE LESS THAN 2 muc/kg

I^{131} CONTAMINATION



● VALUE IN muc/kg

o VALUE LESS THAN 2 muc/kg

SCALE: 1" = ≃ 18 MILES

SECTION III
RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Measurements for radioactive contamination in the atmosphere in the environs of the Hanford Works were made employing several methods. The methods of monitoring used and the locations at which the atmospheric monitoring equipment was maintained were dependent upon the source and type of activity measurements, and the probability of detecting radioactivity at any given location based on the operating characteristics of the Hanford Works. The results and trends observed and recorded from each phase of this program are discussed in this section of the report.

The air radiation levels were recorded by fixed Victoreen Integrons which are located at the permanent 614 building monitoring stations. Several of these units were located inside each operating area and single units were in operation in the vicinity of the populated residential areas adjacent to the Hanford Works. The average dosage rate obtained by these devices was less than 1.0 mrep per 24 hours at all locations throughout the period April, May, June, 1949. The far majority of the individual readings were about 0.1 to 0.3 mrep/per 24 hours; this range of reading was assumed to be within the normal deviation and drift from the zero setting. Individual readings were obtained from each location for each eight hour period through the quarter; these readings are summarized in Table I which presents the monthly averages and the quarterly average. The number of units operating at each of the listed locations is included.

TABLE I

AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS
APRIL - MAY - JUNE
1949

units mrep/24 hours

LOCATION	Number of units	AVERAGE DOSAGE mrep/24 hours		
		APRIL	MAY	JUNE
100-B Area	3	0.8	0.5	0.2
100-D Area	3	0.2	0.2	0.3
100-F Area	3	0.4	0.4	0.3
200 West Area	2	0.1	0.6	0.2
200 East Area	3	0.1	0.1	0.1
Riverland	1	0.5	0.1	0.1
300 Area	1	0.1	1.1	1.2
700 Area	1	0.1	0.3	0.1
Pasco	1	0.1	0.3	0.8
Benton City	1	1.1	0.3	0.1
3000 Area North	1	0.1	0.1	0.7
3000 Area South	1	- -	0.1	0.1
Hanford	1	- -	0.9	- -
Kennewick	1	0.1	0.2	- -

A review of Table I shows the prevalence of the lower dosages and, in general, shows negligible trend and difference between months. The occasional average greater than 0.6 mrep/24 hours usually represents a value which has been weighted by higher readings obtained at times when it was believed that the instruments were not functioning properly. Film studies, portable instrument surveys, etc. indicated normal background levels at these stations. Elimination of the doubtful high values would bring the dosage rate at all locations within the normally expected range of less than 0.6 mrep/24 hours.

The radiation levels in air were also measured by means of detachable ionization chambers. These ionization chambers (Hanford Type "H", "S", and "C") were supported on wooden stands about five feet off the ground and located at random locations on and adjacent to the Hanford Works. Readings were obtained at frequencies comparable with the dosage rate at the location; normally each chamber was read about three times per week.

Table II is a summary of the radiation levels measured at the various locations. A review of this tabulation showed that the dosage rates as measured by "C" chambers within the areas indicated negligible fluctuation throughout the quarter. The dosage

rates measured by "G" Chambers were in good agreement with similar observations made during the past several months. The dosage rates measured by the "M" and "S" type ionization chambers showed the average dosage rates for the quarter were within the range of background fluctuation, between 0.3 mrep/24 hours and 0.5 mrep/24 hours, except for those locations within a ten miles radius of the stack. In the vicinity of the separation areas, several locations showed average measurements to be around 1.0 mrep/24 hours, with maximum dosages existing in the vicinity of the Meteorology Tower and nearby Route 3. During previous quarters, average readings around 1.0 mrep/24 hours prevailed at locations downwind from the areas. Apparently, the continual west wind during the quarter caused a slight decrease in the average radiation level to the southeast along Route 10, and also caused a slight increase at Route 2S, Mile 4, which is almost directly east of the stacks.

TABLE II

(on following page)

 HW-17434 DEL

TABLE II
RADIATION LEVEL OBSERVED WITH DETACHABLE IONIZATION CHAMBERS
(mrep per 24 hours)**

"C" CHAMBER READINGS

LOCATION	APRIL	MAY	JUNE	QUARTERLY AVERAGE
100-B Area	.3	.3	.2	.3
100-D Area	.3	.3	.3	.3
100-F Area	.4	.3	.3	.3
200-W Area	.5	.3	.3	.4
200-E Area	.5	.5	.6	.5
300 Area	.5	.7	.5	.6

"A" AND "S" CHAMBER READINGS

LOCATION	APRIL	MAY	JUNE	QUARTERLY AVERAGE	GROUP AVERAGE
100 Area Environs					
Rt. 1, Mile 8	.47	.44	.37	.43	
Rt. 2N, Mile 10	.42	.41	.34	.39	
Rt. 2N, Mile 5	.34	.35	.31	.33	
White Bluffs	.53	.43	.36	.44	
Rt. 11A, Mile 1	.86	1.29	1.40	1.18	
Hanford 614 Building	.48	.71	.48	.56	
Intersection Rt. 1 & 4N	.38	.42	.43	.41	
Hanford 101 Area	.46	.41	.39	.42	
100-H Area	- -	.40	.38	.39	.51
Within 5 Miles of 200 East					
Rt., 4S, Mile 6	-*-	-*-	.71	.71	
Batch Plant	-*-	.82	.56	.69	
Rt. 11A, Mile 6	-*-	.83	.81	.82	
Rt. 3, Mile 1	1.20	.71	.89	.93	
Meteorology 200 West	0.89	1.17	.94	1.00	
234-235 Area	0.40	.40	.40	.40	.77
Within 10 Miles of 200 East					
Rt. 4S, Mile 10	0.94	.95	.71	.87	
Rt. 10, Mile 1	0.82	1.12	.48	.81	
Rt. 10, Mile 3	-*-	.71	.48	.60	
Rt. 23, Mile 4	1.63	1.98	1.06	1.56	.99
Near 300 Area					
Rt. 4S, Mile 16	1.27	0.54	.53	.78	
Rt. 4S, Mile 22	0.54	0.54	.48	.52	
3000 Area North	0.43	0.43	.46	.48	
3000 Area South	0.55	0.48	.48	.50	.57
Outlying					
Richland	0.48	0.60	.48	.52	
Benton City	1.06	0.48	.57	.70	.61

-*- Chambers at these locations were defective.

** The tabulated dosage rates include the background of the chambers used which vary from about 0.3 to 0.5 mrep per 24 hours.

Table III summarizes the results of the measurement for the filterable beta activity in air by using filtering devices. The magnitude of this activity was determined by measuring the activity deposited on a CWS #6 filter paper while passing about two cubic feet of air per minute through the filter for a period of one week. A small per centage (5 to 10 per cent) of the total I-131 in the atmosphere is collected on the filter papers in addition to the larger half-lived isotopes.

TABLE III
SUMMARY OF RESULTS OF AIR FILTER SAMPLING PROGRAM
FILTERABLE BETA ACTIVITY
APRIL-MAY-JUNE
1949

LOCATION	MAXIMUM WEEKLY AVERAGE μc/liter	QUARTER AVERAGE μc/liter
Pasco	1.9×10^{-10}	1.0×10^{-10}
100-D Area	1.0×10^{-10}	5.0×10^{-11}
105 DR	8.0×10^{-11}	4.0×10^{-11}
300 Area	3.8×10^{-10}	1.2×10^{-10}
200 East, Tower #16	2.0×10^{-9}	8.1×10^{-10}
Benton City	1.3×10^{-10}	3.0×10^{-11}
Hanford 614 Building	1.7×10^{-10}	7.0×10^{-11}
White Bluffs	7.0×10^{-11}	3.0×10^{-11}
3000 Area North	1.8×10^{-10}	8.0×10^{-11}
200 West Gatehouse	4.5×10^{-10}	1.5×10^{-10}
200 East, SE	1.1×10^{-9}	4.7×10^{-10}
Gable Mountain	2.1×10^{-9}	5.9×10^{-10}
Richland	1.8×10^{-10}	7.9×10^{-11}
200 West, Tower #4	1.2×10^{-9}	1.9×10^{-10}
200 West, Tower #15	1.4×10^{-10}	5.9×10^{-11}

Consistent with observations made during previous quarters, the higher average filterable beta activities were detected at locations within the separation areas and downwind from the stacks. The average filterable beta activity was in the order of 10^{-10} μc/liter of air at these locations as compared with an average in the order of 10^{-11} μc/liter in Richland and nearby communities. These averages were in good agreement with past data and were not indicative of any trend or departure from the expected airborne concentrations.

Table III also includes a tabulation of the maximum weekly average filterable beta activity measured at each location. Four of the locations showed a one week average of greater than 1.0×10^{-9} μc/liter. With the exception of Gable Mountain,

which is at an elevation of about 1,000 feet and is approximately five miles from the separation areas, the locations which showed a one week average greater than 1.0×10^{-9} µc/liter were confined to the separation areas, and were in the general region where greater concentrations of deposited I-131 were found. (Figure 6 & 7).

During the month of April, considerable effort was expended to specifically measure the average I-131 concentrations in air. In conjunction with the air filter monitors at four locations, caustic scrubbers were placed in series with the filters. These caustic scrubbers selectively extract the eight day iodine (I-131) from the air stream after it has passed through the filter. The caustic solution consisted of about 1 liter of 0.5 N NaOH and 0.1 N Na_2CO_3 with a small amount of NaI added to act as a carrier of the I-131. The results of the I-131 measurements made in this manner are presented in Table IV:

TABLE IV
I-131 ACTIVITY IN AIR
APRIL-MAY-JUNE
1949

LOCATION	MAXIMUM WEEKLY AVERAGE µc/liter	QUARTER AVERAGE µc/liter
200 West Gatehouse	2.6×10^{-9}	4.8×10^{-10}
Benton City	3.0×10^{-11}	1.4×10^{-11}
200 East-SE	1.6×10^{-9}	5.1×10^{-10}
300 Area	7.0×10^{-11}	3.0×10^{-11}
Richland	5.0×10^{-11}	1.8×10^{-11}

Consistent with the beta activity measurements on vegetation and with the measurements of filterable activity, the above tabulation showed that the higher I-131 concentrations were in the order of $\times 10^{-10}$ µc/liter, and were found within the confines of the 200 Areas. These locations which were outside the limits of the separation areas and within about a thirty-five mile radius, all showed I-131 activity in the order of $\times 10^{-11}$ µc/liter; (this figure was in identical agreement with the average filterable activity detected at these same locations during the quarter).

The one and one-half inch diameter filter papers which were used for measuring the filterable beta activity (Table III) were radioautographed by exposing the small filters to Type K X-Ray film for 168 hours. Visual examination of the developed film

showed a negligible number of dark spots which indicated that there was very little discharge of active particles from the stacks. In general, the total number of particles on these filters ranged between zero and three particles per filter.

In addition to the routine filming of the filters used in the air monitoring program, the responsibility of monitoring for active particles in the atmosphere was transfered to the Site Survey Group of the Health Instrument Divisions in June, 1949. Starting with this report, the particle deposition rates will be presented in terms of "number of particles per cubic meter," instead of the former units which evaluated the particle concentration in terms of "per cubic foot of air." Tables V and VI summarize the deposition rates, and for convenience and comparison with previous data include an evaluation of the number of particles for both volume expressions:

TABLE V

(On following page)

TABLE V
SUMMARY OF PARTICLE DEPOSITION
APRIL BY JUNE
1949

LOCATION	Cubic Feet of Air Sampled	Average Particle Concentration Particles/ft^3	Particles/meter^3
200 East & Vicinity			
2701 (Outside)	1,165,000	1.53	0.53
2704 (Outside)	1,368,000	2.16	0.76
222-S (Outside)	500,000	28.4	10.0
"A" Gate (Outside)	426,000	20.7	7.30
BY-SE (Outside)	424,000	13.0	4.59
BY-NE (Outside)	318,000	1.26	0.44
2701 (Inside)	453,000	1.54	0.54
2704 (Inside)	1,167,000	3.17	1.12
221 Operating Gallery	423,000	6.85	2.42
222-S Hall (Inside)	451,000	170.	60.0
222-S Laboratory	237,000	499.	176.0
200 West & Vicinity			
"T" Gate (Outside)	1,158,000	7.34	2.59
South Guard Tower (Outside)	1,057,000	0.85	0.30
"U" Gate (Outside)	1,240,000	0.64	0.23
West Guard Tower (Outside)	1,281,000	0.70	0.25
231 (Outside)	1,143,000	1.13	0.40
2722 (Outside)	1,203,000	1.41	0.50
222 "T" (Outside)	398,000	15.0	5.30
2701 (Outside)	1,233,000	2.19	0.77
2701 (Inside)	457,000	8.09	2.86
272 (Inside)	456,000	2.63	0.93
222 "T" (Inside)	141,000	63.8	22.5
224 "T" (Inside)	861,000	3.37	1.19
Meteorology Tower			
3'	1,393,000	3.16	1.12
50'	1,293,000	3.56	1.26
100'	1,393,000	3.30	1.16
150'	1,393,000	4.52	1.60
200'	1,293,000	7.12	2.51
250'	1,190,000	1.60	0.56
300'	1,290,000	2.95	1.04
350'	1,190,000	1.51	0.53
400'	1,293,000	2.70	0.95

A review of the data summarized in Table V shows that only a few particles were detected outside of the 271-T and 271-B exclusion areas; no location outside of this region showed an average deposition greater than 1.0×10^{-2} particles per cubic meter during the quarter. Inside the exclusion areas, the highest deposition was noted inside the laboratory buildings; in 200 West Area the average inside 222-T was 2.3×10^{-2} particles per cubic meter and in the 200 East Area the average deposition inside 222-B was 0.17 particles per cubic meter. A supplementary unit in the laboratory hallway (222-B) showed a confirming average deposition of 6.0×10^{-2} particles per cubic meter. This data was quite indicative of an indoor hazard, which was not confirmed in the nearby outer atmosphere and therefore was not directly associated with the stack discharge.

The continual monitoring of the number of active particles at 50' intervals at the Meteorology Tower showed the higher concentrations at the heights which were most closely related to the stack elevations; the average at the 150' and 250' levels was 1.6×10^{-3} and 2.5×10^{-3} particles per cubic meter, respectively. The actual number of particles detected at each elevation was negligible when compared with the number detected in the laboratory buildings.

A similar summary of the particle deposition rates at the locations which are removed from the separation areas is presented in Table VI:

TABLE VI

(On following page)

TABLE VI
SUMMARY OF PARTICLE DEPOSITION
ON AREA AND OFF AREA LOCATIONS
APRIL-MAY-JUNE
1949

LOCATION	Volume of Air Sampled	Average Particle Concentration Particles/ft^3 units of 10^{-5}	Particles/meter^3 units of 10^{-3}
Off Area			
Boise, Idaho	286,000	0.35	0.12
Klamath Falls, Oregon	434,000	0.23	0.08
Stampede Pass, Washington	502,000	- -	- -
Great Falls, Montana	503,000	0.40	0.14
Walla Walla, Washington	436,000	0.46	0.16
Wenatchee, Washington	385,000	0.78	0.27
Lewiston, Idaho	487,000	0.20	0.07
Spokane, Washington	343,000	0.87	0.31
Area			
100-B	987,000	0.90	0.28
100-D	1,321,000	0.51	0.16
White Bluffs	1,259,000	0.35	0.11
100-F	946,000	0.92	0.26
Benton City	1,307,000	0.11	0.03
Pasco	995,000	0.22	0.07
Richland	801,000	0.10	0.04

The particle deposition rates tabulated for the locations listed in Table VI shows that a negligible number of particles were detected at these locations during the quarter.

SECTION III

SECTION IV
RADIOACTIVE CONTAMINATION IN RAIN

An abnormally dry period during the months of April, May, and June, 1949, presented very little opportunity to make extensive measurements for beta emitters in the rainfall of this area. A total of forty-three samples were obtained from twenty-eight representative locations in the environs of the Hanford Works.

A resume' of the precipitation during this period, as compared to the precipitation measurements for past years is presented in the following table:(1)

INCHES OF RAINFALL MEASURED

	1949	1948	19 Year Average	Meteorology Tower Average
APRIL	0.02	0.95	0.31	0.34
MAY	0.16	1.71	0.31	0.34
JUNE	0.01	1.47	0.30	0.33

The above table shows that a total of only 0.19 inches of rain fell during the three month period as compared with 4.13 inches in the same period of the previous year. The year 1948 was abnormally wet as indicated by the figures in the 19 year average summation which indicate that around 0.9 inches can be expected during this quarter if normal conditions existed.

The rain samples collected varied in volume; the minimum volume was as low as several ml. while the maximum volume analyzed at any time would rarely exceed 500 ml..

The average beta emitters measured in the rain samples did not exceed 20 muc/liter in any sampling zone; however, individual locations adjacent to the separation areas showed activity in rain samples as great as 182 muc/liter. The maximum activity measured in rain samples inside the 200 East Area was 50 muc/liter whereas the maximum in the 200 West Area was 60 muc/liter. The average activity in all rain samples was 15 and 7 muc/liter in the 200 West and 200 East Areas, respectively. The highest activity detected in any rain sample was 165 muc/liter measured in a sample collected at Route 4S, Mile 6. This location is about two miles southeast of the 200 East Area.

(1) These measurements were made by the Meteorology Group of the Health Instrument Divisions and were furnished through the courtesy of Mr. D. Jenne.

stack, and is directly on the downwind axis of the prevailing wind in the 200 West Area. With the exception of this one sample, all samples taken in the region between the areas and the perimeter fence were within the normal expected range of activity.

Samples from within the 100 Areas showed no unusual activity; the average activity was 0.34 muc/liter as compared with the previous quarters average of 0.12 muc/liter. The maximum activity in rain samples collected near the 100 Areas was in the order of 1.0 muc/liter.

Rain samples from locations outside the perimeter fence showed the beta emitters to be less than that measured during the previous quarter. The average of all samples was at the reporting level of the analysis, (50 μμc/liter). The maximum activity measured in any off area rain sample was 0.2 muc/liter collected in the general vicinity of Benson's Ranch. This location is about five miles due south of the 200 West Area stack.

Two rain samples were collected inside the 234-235 general area; the beta emitters in these samples averaged 2 muc/liter with a maximum of 3.9 muc/liter.

Figure 11 is a graphic presentation of the average activity measured in rain samples taken from various zones discussed in this section of the report.

SECTION IV

(Please refer to Figure 11)

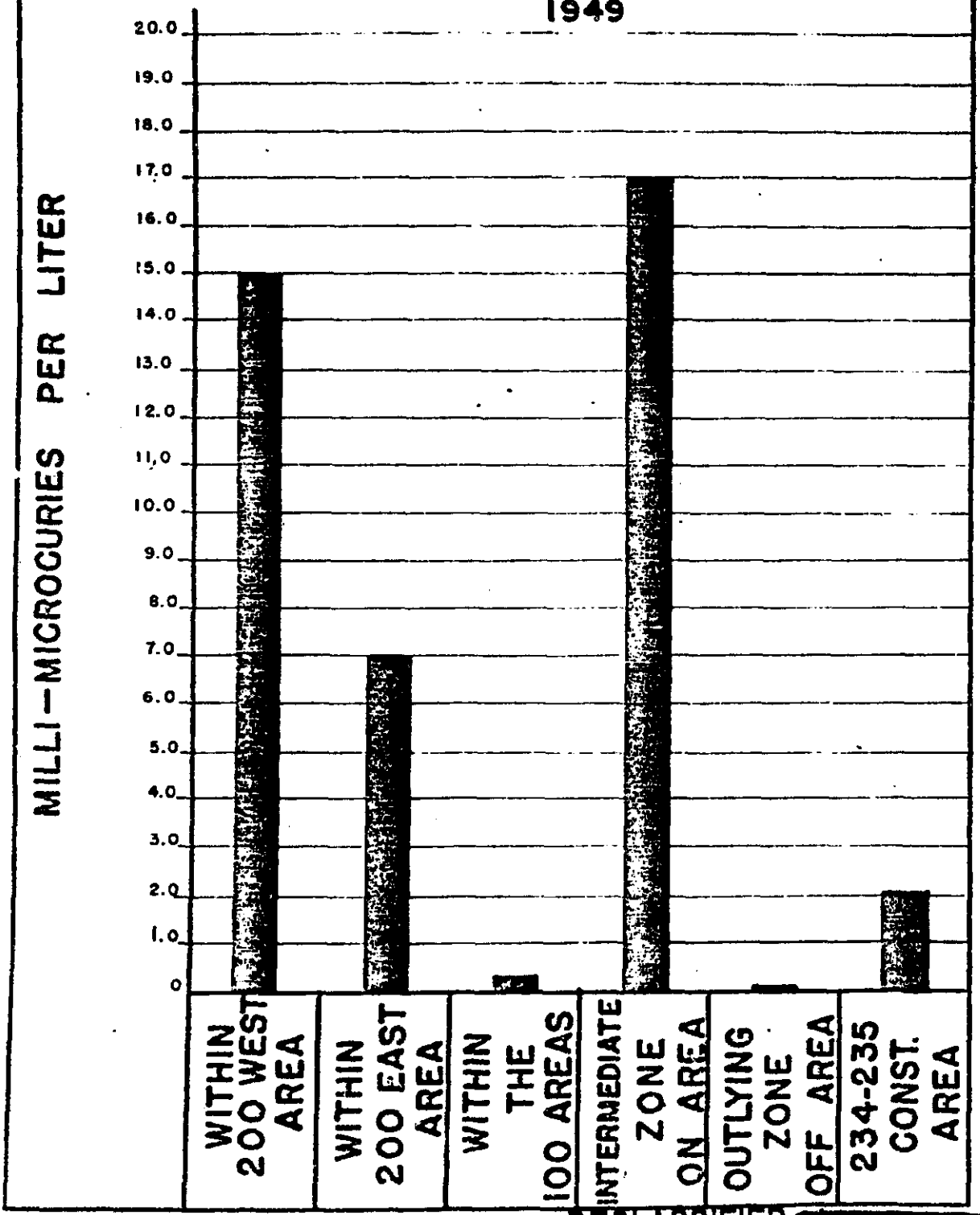
FIGURE—11

AVERAGE BETA ACTIVITY IN RAIN

HANFORD WORKS & VICINITY

APRIL—MAY—JUNE

1949



SECTION V
RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER

The average beta emitters measured in river samples taken from the Columbia River at representative locations downstream from the operating areas showed a significant decrease throughout the period April, May, June, 1949, as compared with the previous quarter. The decrease in average beta activity was expected during this period as the flow rate of the Columbia which dilutes the admitted beta activity increased by a factor of six to eight during this three months period over the previous three months. The average flow rate of the Columbia River as measured by the Power Division at Richland was about 2,200,000 gallons per second over the entire three months. The minimum flow rate was measured during the first part of April at 487,000 gallons per second; the maximum flow rate of 3,150,000 gallons per second was recorded during the latter part of May. The flow rates measured during this quarter represent a significant increase over similar measurements made during the period January-February-March, 1949 at which time the maximum flow recorded was 430,000 gallons per second. A summary of the trend of the measured flow rate is presented on Figure 12; the data for the previous three months are included for a better evaluation of the increasing trend discussed above.

Surface samples were obtained once a week from thirteen locations along the Columbia River. This sampling was supplemented by several dispersion studies which included measurements for the mixing of the beta emitters in the Columbia River between the 100-B Area and cities of Pasco and Kennewick. Several river samples were obtained from downstream locations in the vicinity of McNary Dam and Bonneville Dam to specifically evaluate the long half life activity in the Columbia River at these specific locations.

Table I summarizes the results of the radiochemical analyses for the alpha and beta emitters in the Columbia River for the period April, May, June, 1949:

TABLE I
(on following page)

TABLE I

RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER

APRIL-MAY-JUNE

1949

LOCATION	ALPHA dis/min/liter		BETA Emitters μμc/liter*	
	Maximum	Average	Maximum	Average
Wills Ranch	<6	<6	<50	<50
Above 100-B Area	<6	<6	<50	<50
181-B Area	<6	<6	<50	<50
181-D Area	<6	<6	788	178
181-F Area	<6	<6	1100	367
Foster's Ranch	<6	<6	354	134
Hanford South Bank	<6	<6	2168	663
Hanford Middle	<6	<6	2043	536
Hanford North Bank	8	<6	616	250
300 Area	6	<6	463	250
Richland	6	<6	493	122
Pasco Bridge (Kennewick Side)	6	<6	158	97
Pasco Bridge (Pasco Side)	6	<6	260	123

* The reporting level for the minimum activity detected in river samples is currently established at 50 μμc/liter (5×10^{-5} μc/liter).

A comparison of the averages summarized in Table I with similar averages for the previous three month period showed that significant decreases in the beta activity in the river were observed at all locations between 100-D Area and Richland. The decreases this quarter as compared with last quarter were lower by a factor of three to four at all locations which were on the south side of the river. Two locations on the north side of the river at Foster's Ranch and Hanford Ferry showed the minimum activity detected above Richland. The detection of a smaller amount of activity on the north side of the river is consistent with observations made in the past particularly noticeable during minimum flow rates. The maximum results listed in Table I are considerably higher than the averages, this fact was due to the changing flow rate during the quarter. All the maximum results listed were obtained early in April when the flow rate of the Columbia River was at a minimum. During the months of May and June the lower average beta activity prevailed throughout the entire river. Figure 13 is a graphic presentation of the average beta activity measured at the locations in Table I.

Several special surveys to determine the estimated distribution and dispersion of

beta activity in the Columbia River were completed during this quarter. During April seventy-five samples were taken in a cross section survey of the river between the 300 Area and the Pasco-Kennewick Bridge. This survey was a completion of a similar survey which was made between the 100-B Area and 300 Area during the latter part of March 1949. The flow rate of the river was 428,000 gallons per second at the time of this survey. The results of the radiochemical analysis of the surface samples indicated that a relatively uniform distribution of beta activity in the river existed between 300 Area and Richland. Beta activity measurements showed that the maximum difference between sample locations in this region was about 75 μμc/liter, individual higher results were obtained from locations on the west bank although the average on the west bank was not significantly higher than the east bank. In general, the beta activity averaged about 400 μμc/liter in the vicinity of 300 Area and decreased to about an average of 325 μμc/liter at Richland. The distance between these locations is about six miles and the speed of the river is estimated at between 3 and 5 miles per hour. The uniform dispersion was distorted at the point where the Yakima River enters the Columbia immediately below Richland. The added flow of 68,000 gallons per second from Yakima diluted the average beta activity to about an average of 225 μμc/liter on the west side of the river; the effect of this dilution was significant when compared with the prevailing average at and immediately above Richland. The Yakima River tended to push the bulk of the activity to the east side of the river, this condition apparently remained unbalanced between the point of the Yakimas entry and Pasco. Figure 14 is a portrayal of the estimated distribution of beta activity between 300 Area and Pasco as measured during this survey.

During May a special survey consisting of twenty-five cross section surface samples was taken between the 100-B and 100-D Areas in an attempt to determine if the increased flow rate of the Columbia would change the surface distribution of the beta activity in the river. The results of the survey indicated that the beta activity was essentially confined to the center of the river from the point where the 107-B effluent enters the river to a point about four miles downstream. The maximum

activity adjacent to the 100-B Area was 350 μμc/liter as compared with an average of about 100 μμc/liter at a point four miles downstream where the activity seemed to disperse more uniformly. An estimated distribution of the beta activity in this region may be referred to in a previous report.(1)

On June 15th and 16th a survey of the Columbia River between the 100-B Area and Pasco was completed. This survey was representative of the average flow rate for the Columbia River during this quarter; the recorded flow as measured by the Power Division at Richland was 2,400,000 gallons per second. This survey was confined to surface dispersion study and consisted of taking five samples across the river at each of twenty-five locations between 100-B Area and Pasco. Figure 15 indicates the approximate cross section locations at which samples were obtained. Figure 15 also summarizes the overall estimated distribution of the radioactive contamination on the surface in the Columbia River. A review of the results showed that the average beta activity was lower by a factor of 5 to 10 at the upstream locations in the vicinity of the project and lower by a factor of 2 to 3 around Pasco and Kennewick when compared with surveys made earlier this quarter and during the previous quarter. The results indicated a more uniform distribution of the beta activity at this time; this fact was attributed to the increased flow rate of the river at the time of the survey. The extent of the uniform dispersion for a period of low flow rate may be reviewed in a previous report.(2) This survey indicated that the magnitude of difference in activity on the two banks of the Columbia tended to minimize when the flow rate increases. The survey also showed that the entrance of the waters from the Yakima River did not materially affect the dispersion pattern between Richland and Pasco during the high flow. The absence of this difference which was previously noted (Figure 14) is probably due to the much greater flow of the Columbia as compared with the flow rate of the Yakima at this time.

(1) HW-13570 H.I. Environs Report for the Month of May, 1949. To file by W. Singlevich, June 3, 1949.

(2) HW-12948 H.I. Environs Report for the Month of March, 1949. To file by W. Singlevich, April, 1949.

The effect of the changing river flow on the average beta activity detected in the Columbia River at Hanford Ferry is graphically presented in Figure 16. This portrayal includes the observations made during the past six months and represents the two extreme flow rates for the period. Several of the beta activity measurements fall well below the estimated trend line; these lower results were attributed to pile shutdowns and were not included in estimating the average activity trend. Analyses of the data showed a significant linear relationship between the flow rate and the average beta activity, however the calculated equations would only apply when all piles were operating at power levels comparable with those at the time the samples included in Figure 16 were taken.

Analyses of the decay rates for the beta activity in river samples showed that between ninety and ninety-five per cent of the emitters were due to 14.8 hour sodium (Na-24). The remainder of the longer half-lived isotopes were probably contributed by such isotopes as P-32, Fe-59, Cr-51, and Ca-45 which were identified as an analyses of three samples of the 107 effluent samples from the three 100 Areas. The results of these analysis are summarized in Table II:

TABLE II
RADIOCHEMICAL ANALYSES OF 100 AREA EFFLUENT WASTES
JUNE 1949

	PER CENT COMPOSITION		
COMPONENT	107-B Wastes	107-D Wastes	107-F Wastes
P-32	11	24	22
Fe-59	9	5	5
Ca-45	21	18	20
S-35	6	5	5
Ti-51	- -	5	5
Cr-51	34*	23*	32*
RE	<5	<5	<5
Zr-65	1	5	5
Total Activity in Original Samples	0.008 uc/liter	0.003 uc/liter	0.003 uc/liter

*These results for the Cr-51 were somewhat questionable as the activity from this source was measured by a thin mica-window counter and no corrections were applied to the original counting for the soft X-Rays emitted in the K capture process of this non-beta omitting isotope. This analysis is under further investigation.

Weekly samples were obtained from the three locations in the Yakima River. Analysis of these samples showed activity to be comparable with that found in the Columbia River above the operating areas; all samples showed the beta activity to be less than 50 uuc/liter and the alpha activity to be less than 6 dis/min/liter.

Supplementing the direct sampling of the river, mud samples were obtained from various locations along the banks of the Columbia. Samples were taken on the shore at the waters edge and below the surface of river approximately five feet from the shore. Table III summarizes the results of the beta activity measurement in the mud samples.

TABLE III
COLUMBIA RIVER MUD SAMPLES
TOTAL BETA ACTIVITY muc/kg
APRIL-MAY-JUNE
1949

Location	Number Samples	Beta activity in milli-microcuries per kilogram: Onshore Samples Maximum	Onshore Samples Average	Five Feet From Shore Maximum	Five Feet From Shore Average
Near Wills Ranch	13	19	11	22	14
Allard Pump Station	13	21	13	44	16
At 100-H Area	13	18	11	16	10
Below 100-F Area *	13	33	15	18	13
Richland Dock	13	15	9	18	13
At 300 Area	13	25	13	18	13
Pasco Bridge (Pasco Side)	13	42	15	25	13
Pasco Bridge (Kennewick Side)	13	13	11	24	12
Hanford Ferry	13	16	11	21	14

* Two results were deleted from average because it was believed that they were contaminated in the laboratory.

The beta activity in mud ranged from around 5 to 45 muc/kg with a predominance of results around the lower figure. The range of fluctuation and the magnitude of the activity in the mud samples was not indicative of any change or trend occuring during this period.

Analysis for the alpha emitters in the mud samples indicated less than 6 dis/min/gram in all samples. Spot analyses for uranium showed all results to be negative, i.e. less than two ug U per gram of mud.

Raw river water in the Columbia River export line which is subsequently used for drinking purposes was sampled at the 183 Building in the 100 Areas and at the 283 Buildings in the 200 Areas. These samples were analyzed for alpha activity from plutonium and/or uranium and for the beta emitters. Analyses for the alpha emitters indicated less than 6 dis/min/liter in all samples; the beta activity measured is summarized in Table IV:

TABLE IV
(On following page)

TABLE IV

BETA ACTIVITY IN RAW WATER-EXPORT LINES

APRIL-MAY-JUNE

1949

LOCATION	Number Samples	μμc/liter Maximum	μμc/liter Average
183 Building 100-B Area	13	<50	<50
183 Building 100-D Area	13	180	<50
183 Building 100-F Area	14	230	70
183 Building 100-H Area*	38	290	70
283 Building 200-E Area	13	50	<50
283 Building 200-W Area	13	70	<50

*This location was not part of export line. The water was taken directly from the river to a chlorinator and the above sample represents the water before chlorination.

The lower average beta activity detected in the raw water was expected during a period in which the river flow increased. The maximum results tabulated above were obtained during the early part of the quarter at a time when the river flow was at a minimum. The difference in activity noted at the three 100 Area locations was attributed to the increase in the beta activity in the river samples at the downstream locations. The difference in activity noted when comparing the 100 Area data with the 200 Area data can be attributed to the decay of the Na-24; this decay period was dependent on the duration of the transport period of this water between areas. Currently, this transport time is estimated at from ten to eleven hours. Further decay of the sodium occurs during the retention period in the basins of the 200 Areas.

The raw water samples tabulated above were also analyzed for alpha activity by the ether extraction method. The alpha activity detected was less than 6 dis/min/liter in all samples.

SECTION V

(See Figures 12,13,14,15,and 16)

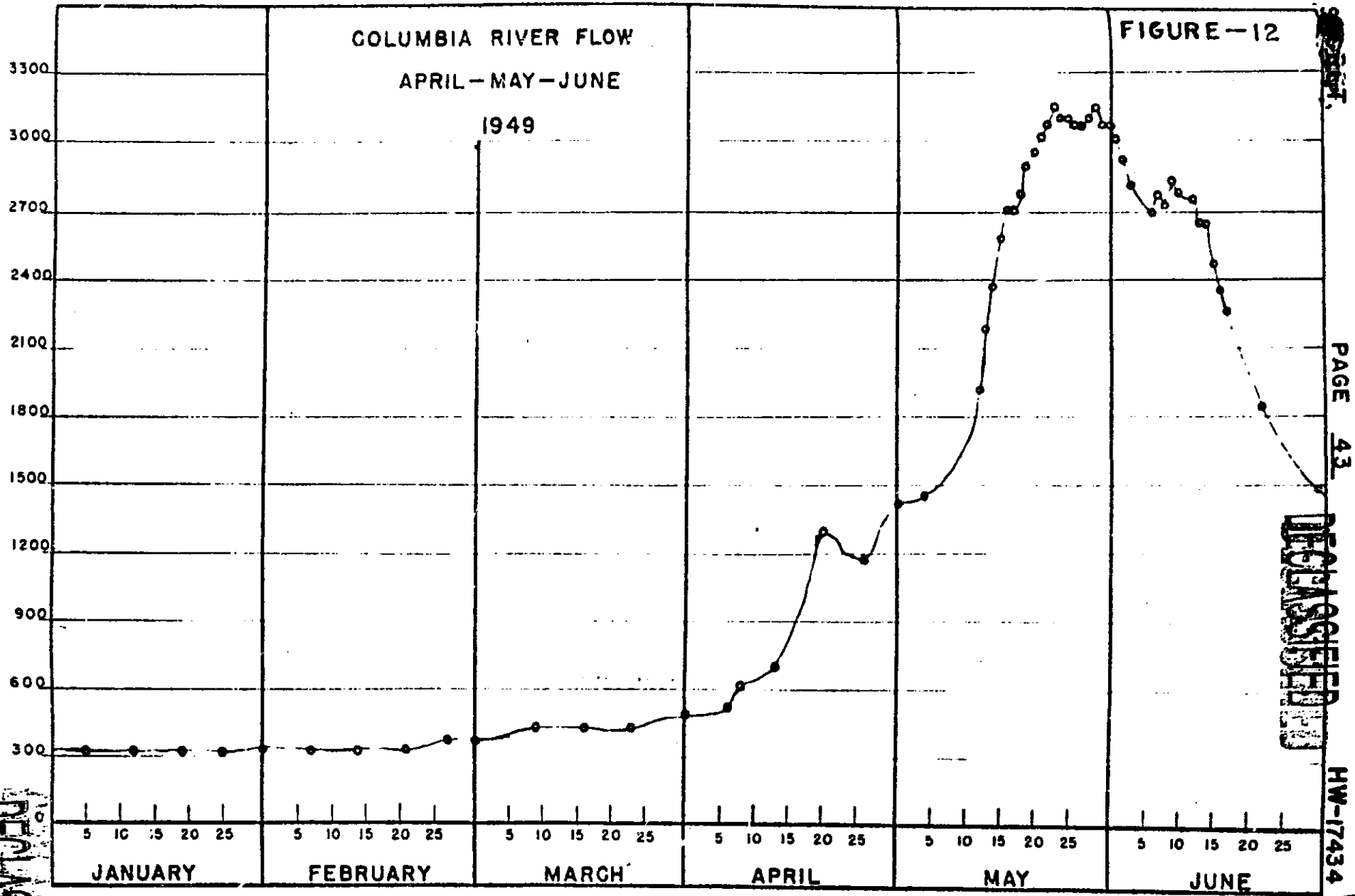
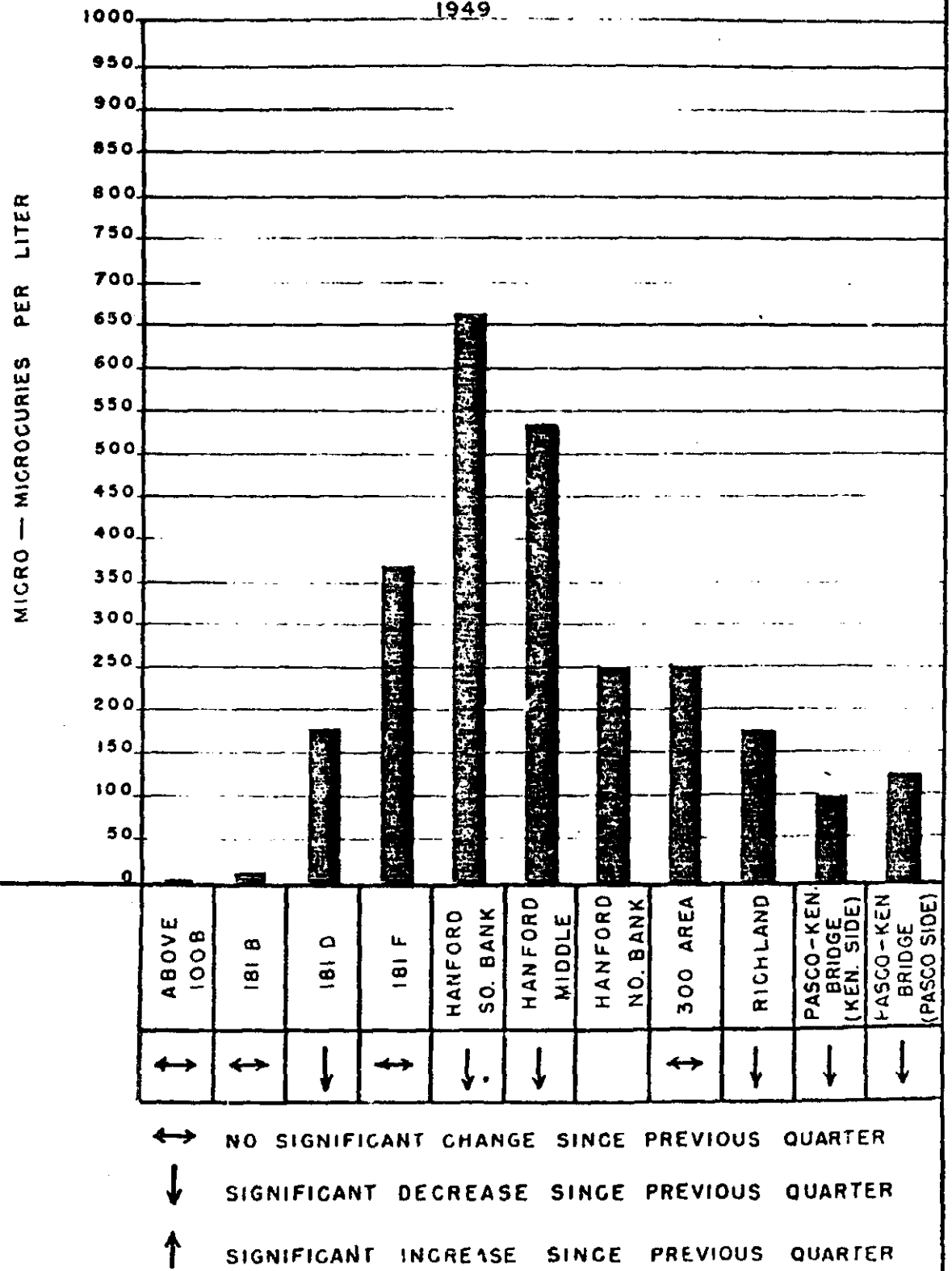


FIG.-13

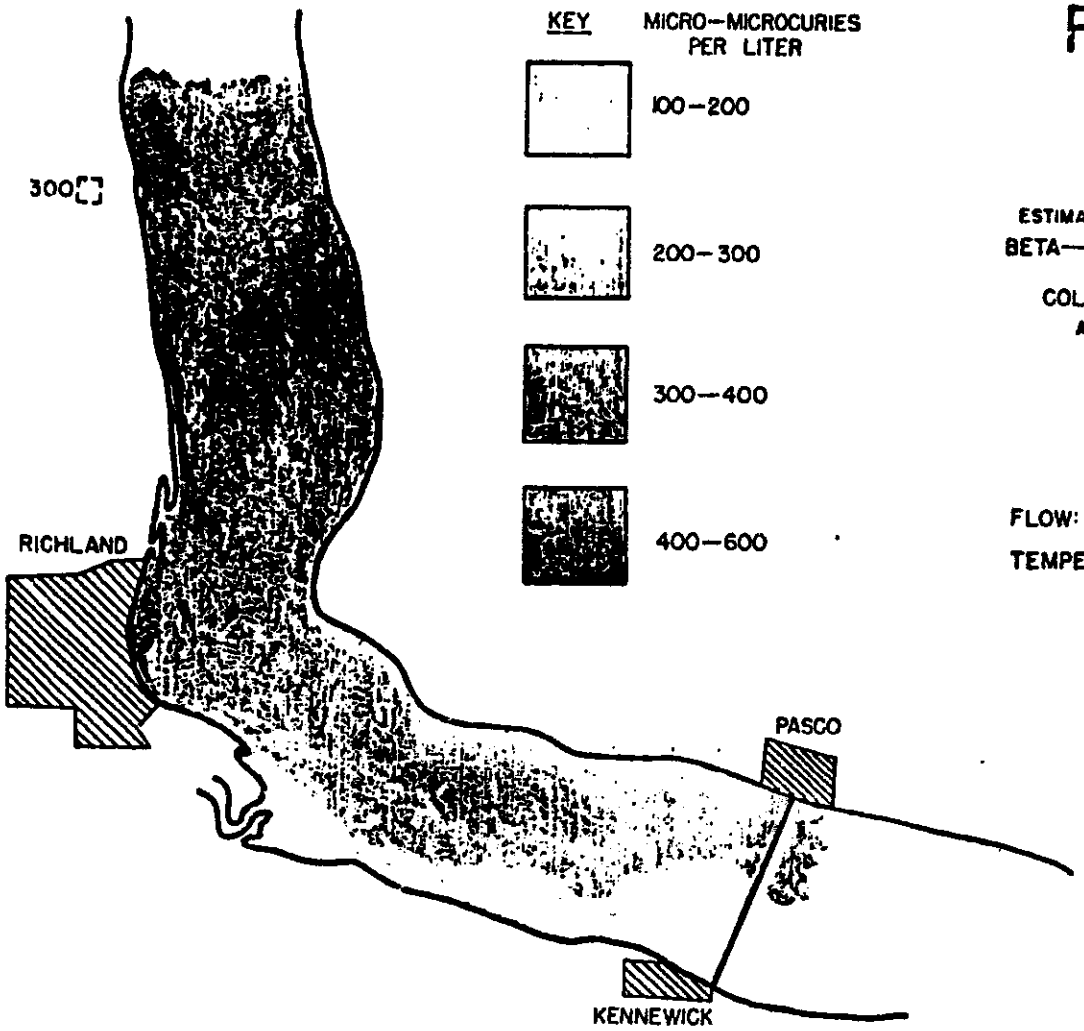
AVERAGE BETA CONTAMINATION
IN
COLUMBIA RIVER
APRIL — MAY — JUNE
1949



[redacted]

HW—17434 DEL

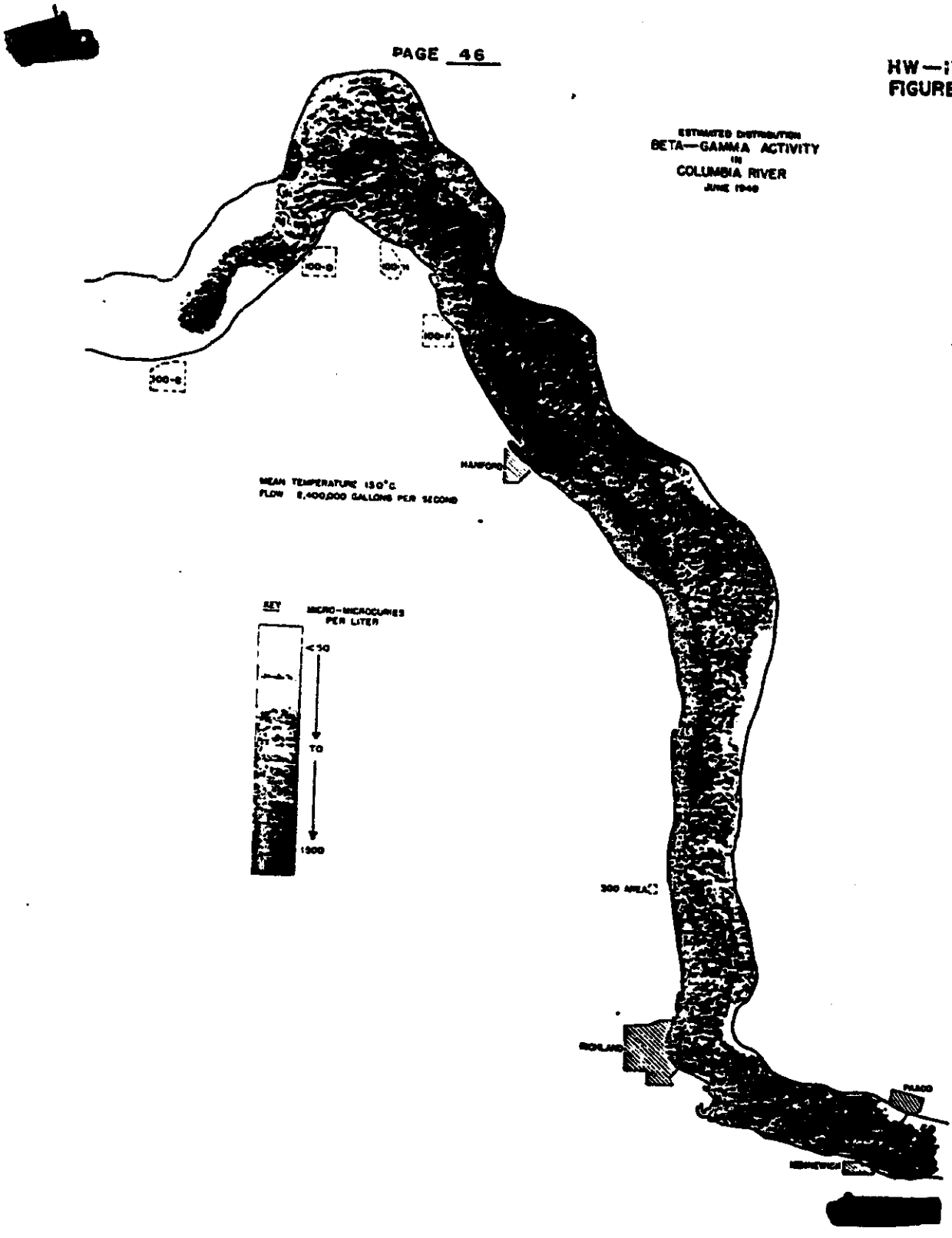
FIGURE-14



ESTIMATED DISTRIBUTION
BETA—GAMMA ACTIVITY
IN
COLUMBIA RIVER
APRIL 1949

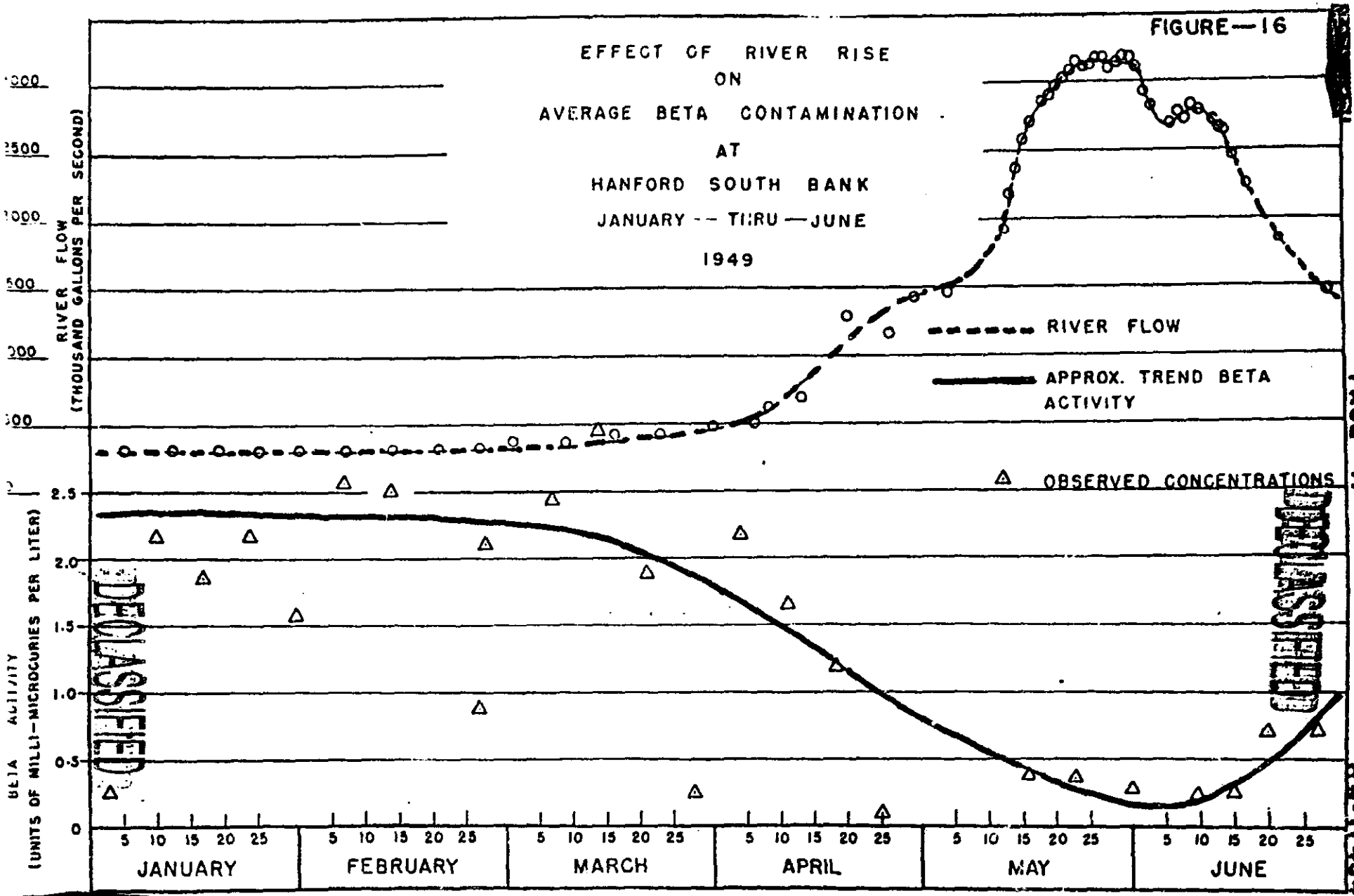
FLOW: 430,000 GALLONS PER SECOND
TEMPERATURE: 6.8° C.

[redacted]



FIGURE—16

EFFECT OF RIVER RISE
ON
AVERAGE BETA CONTAMINATION
AT
HANFORD SOUTH BANK
JANUARY -- THRU — JUNE
1949



SECTION VI
RADIOACTIVE CONTAMINATION IN HANFORD WASTES

100 AREAS:

About one hundred and sixty samples were obtained from 100 Area wastes during this quarter. Most of these samples were taken from the 107 retention basins. The results of the analyses of samples collected from the 107 basins are tabulated below. The tabulation includes only those results which are representative of normal operating conditions in the 100 Areas.

TABLE I
RADIOACTIVE CONTAMINATION IN THE 107 BASINS
APRIL-MAY-JUNE
1949

LOCATION	AVERAGE ALPHA ACTIVITY dis/min/liter	BETA ACTIVITY muc/liter	
		Maximum	Average
100-B Area	<30	890	341
100-D Area	<30	970	336
100-F Area	<30	670	307

Figure 17 is a portrayal which summarizes the power level of the piles, the activity detected in the 107 basins, and the estimated amounts of the beta emitters released from the 107 basins into the Columbia River. The shutdown periods of the pile areas are also shown.

The average beta activity listed in Table I above are not significantly different from the averages of the previous three month reporting period and no notable differences were found in comparing the activity of one area with other areas during this quarter. The trend of activity in the basins during the quarter, as may be noted from Figure 17, indicated that samples obtained during the month of April showed the highest beta activity with a subsequent decline throughout June. In general, the maximum results were somewhat higher than those usually found.

Analyses for total alpha activity from plutonium and uranium in the 107 basins indicated the average activity to be below the reporting level of 30 dis/min/liter. One sample from the 107-D and 107-F basin showed alpha activity of approximately 400 dis/min/liter. The day previous to the occurrence of this high sample from 107-D, a sample analyzed for polonium indicated 60 dis/min/liter. Subsequent resampling did

not confirm the aforementioned high results and hinted at contamination of the samples during laboratory processing.

One sample from each of the 107 basins was analyzed specifically for S-35. The results from the 107-B, 107-D, and 107-F basins were 3.0, 3.0, and 2.3 beta μc/liter, respectively, from S-35.

Eight dryer room condensate samples from the 100-B Area were analyzed for S-35 and for total beta. S-35 beta activity averaged 1.3×10^3 μc/liter with a maximum result of 2.2×10^3 μc/liter. Total beta activity results averaged 7×10^2 μc/liter with a maximum of 1.6×10^3 μc/liter.

Two samples of calol (water soluble oil) from 100-B Area gave identical results of 0.7 μc/liter. One sample collected from 100-D Area yielded a result of 2 μc/liter.

200 AREAS:

The following table summarizes the result of radiochemical analyses on samples collected from the 200 Area waste systems:

TABLE II
RADIOACTIVE CONTAMINATION IN 200 AREA WASTES
APRIL-MAY-JUNE

LOCATION	Number Samples	Type Sample	ALPHA - dis/min/kg** Maximum	Average	BETA - μc/kg Maximum	Average
T Swamp	39	Water	1200*	<30	1.7*	<0.1
T Swamp	25	Mud	6.3×10^5	2.0×10^5	140	58
U Swamp	28	Water	100	<30	1.8*	<0.1
Laundry Ditch	27	Water	270	43	0.3	<0.1
Laundry Ditch	9	Mud	9.1×10^4	4.0×10^4	89	41
231 Ditch	28	Water	85	<30	0.3	<0.1
200 E "D" Ditch	21	Water	410*	<30	0.8	0.2
200 E "B" Ditch	26	Mud	1.2×10^5	7.7×10^3	370	130
234-235 Ditch	12	Water	560	<30	0.1	<0.1
23 -235 Ditch	11	Mud	5.4×10^3	1.9×10^3	17	10
Laundry Lint	13	Solid	5.7×10^5	2.5×10^5	320	160
Retention Pond						
200 East Area	9	Water	<30	<30	0.2	0.1
200 West Area	4	Water	<30	<30	<0.1	<0.1

**It is assumed that one liter of liquid sample weighs one kilogram.
* These individual high result were not included in the averages, as there was evidence to indicate that the samples were probably contaminated during laboratory processing.

The average activity measured in 200 Area waste samples did not deviate significantly from the results of the previous quarter. As in the past, occasional samples indicated activity much higher than that normally found.

The high alpha activity detected in one waste solution sample from the 200 West Area "T" Swamp was not accounted for by fluorophotometer analysis for uranium. Traces of uranium have previously been found in this location. In June, three samples of mud collected from this swamp were analyzed for total alpha activity and also for uranium and plutonium content. No uranium was detected in the samples by the fluorophotometer process; however, TTA analysis for plutonium yielded an average of 1.6×10^5 dis/min/kg with a maximum result of 3.1×10^5 dis/min/kg.

The activity detected in the 200 West Area "U" Swamp samples was not unusual with the exception of the one high result for beta activity in one sample. It was noted that this high result was measured in a sample collected on April 7, the same day the high beta activity was measured in a sample collected from the "T" Swamp. Fluorophotometer analyses of samples at this location showed positive indications of uranium; one sample gave a reading as high as 60 ug U/liter during this period.

The beta and alpha activity measured in waste water samples collected from the Laundry Ditch was somewhat lower than that found during the previous quarter. Routine fluorophotometer analyses on these samples indicated the uranium content to be about 400 ug U/liter. This reading was unusual, but substantiated the findings of the special survey of the laundry wash water which was conducted during March. As a result of this study, routine sampling of the Laundry Ditch mud was initiated during April of this quarter. Laundry lint samples collected outside the 200 West Laundry Building gave results consistent with the previous three months reporting period.

Routine weekly sampling of the water and mud from the 200 East "B" Ditch was begun during April 1949. This ditch runs from the 200 East retention basin to a large swamp area outside the east perimeter fence of 200 East Area. Routine sampling was initiated after portable instrument (VGM) surveys showed contamination as high as 5000 counts per minute above instrument background along that portion of the ditch

within the 200 East Area perimeter fence.

Sampling of the 234-235 waste outlet was initiated during this quarter in order to obtain background measurements in advance of operation startup. This waste outlet is within a short distance of the 231 ditch outlet; both ditches join within a distance of fifty feet from the 234-235 outlet. Both ditches empty into the 200 West Area "U" Swamp. The one high alpha result listed for the 234-235 outlet is probably due to backup of 231 waste water. All other samples indicated levels of alpha and beta emitters below the detection limits of the analyses.

Portable instrument (VGM) surveys were made of the open waste zone areas in the separation areas. Normal readings of 200 to 300 counts per minute above background were detected in the 200 West "T" Swamp and ditch area and in the 200 West Laundry ditch area. Occasional maximum readings as high as 1000 counts per minute were measured above mud. These somewhat higher values are probably caused by the receding water leaving the mud containing the activity exposed. Instrument surveys of the 200 North Area ditches resulted in contamination levels ranging as high as 20,000 counts per minute above background. Readings of this magnitude are not unusual at this location.

300 AREA:

The following tabulation summarizes the activity found in the 300 Area waste ponds:

TABLE III
RADIOACTIVE CONTAMINATION IN THE 300 AREA WASTE PONDS
APRIL-MAY-JUNE
1949

LOCATION	Type Sample	Alpha dis/min/liter Maximum	Alpha dis/min/liter Average	Beta Activity muc/liter Maximum	Beta Activity muc/liter Average
Old Pond Inlet	Liquid	1.3×10^4	2.2×10^3	0.5	0.2
New Pond Inlet	Liquid	3.7×10^4	4.1×10^3	8.8*	0.2
		dis/min/kg		uc/kg	
Old Pond Inlet	Solid	1.5×10^7	5.1×10^6	7.8	1.2

* This individual high result was not included in the average, as subsequent resamples from this location did not confirm this high result.

The results tabulated above are representative of the activity found in the 300 Area ponds during previous reporting periods. Routine fluorophotometer analyses on all samples collected from these ponds indicated that alpha activity measured was

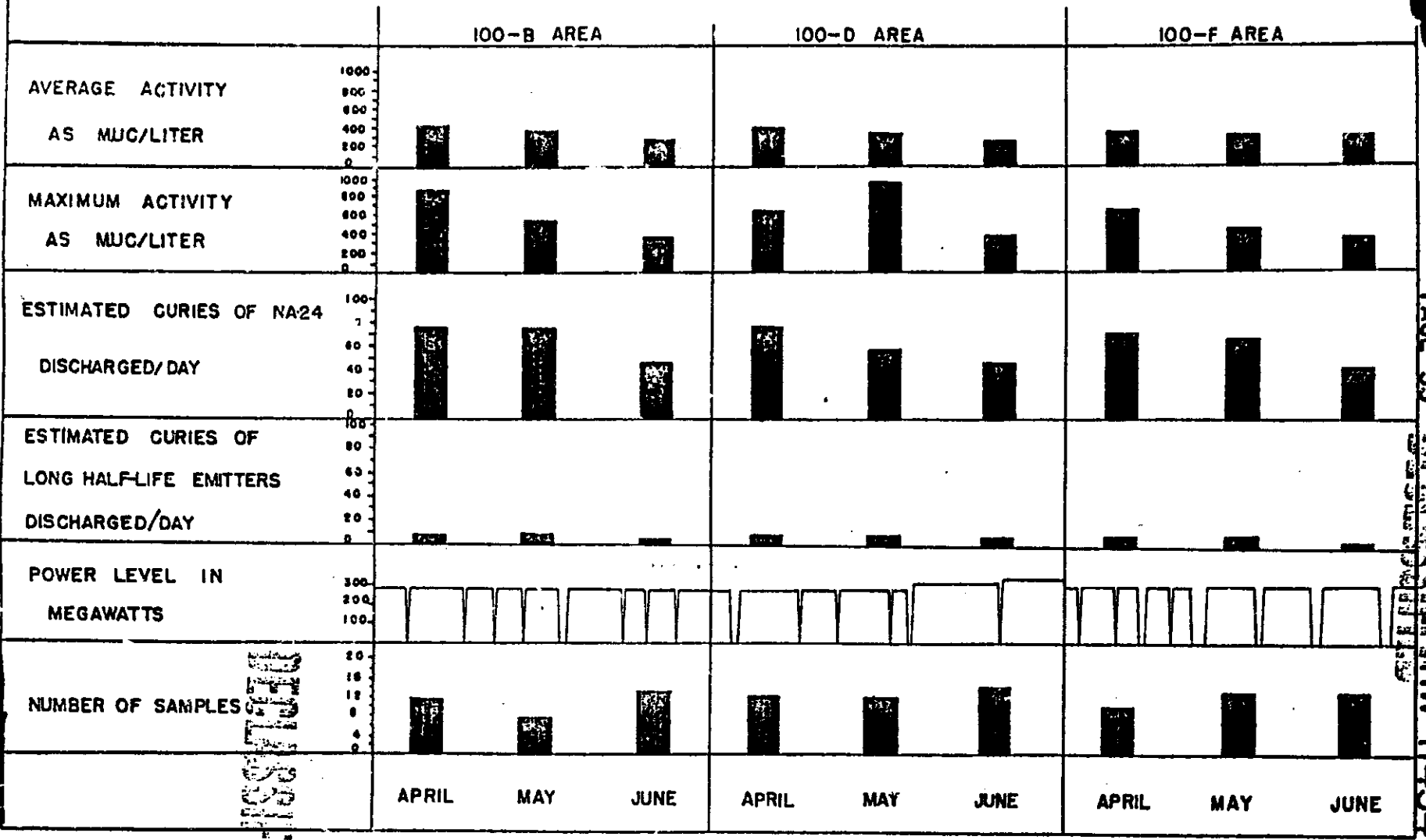
principally from uranium.

Sixty-six samples were taken directly from the 300 Area waste line which empties into the new retention pond. Beta and alpha activity averaged about 1.3 muc/liter and 320 dis/min/liter, respectively. Maximum results measured 22 muc/liter and 1.6×10^4 dis/min/liter. Analyses of most of these samples by fluorophotometer methods showed an average of about 160 ug U/liter, with one sample showing 1500 ug U/liter. One sample indicated about 130 dis/min/liter from plutonium.

SECTION VI
(See Figure 17)

BETA ACTIVITY MEASUREMENTS IN 107 WASTE EFFLUENT
APRIL——MAY——JUNE
1949

FIGURE—17



SECTION VII
RADIOACTIVE CONTAMINATION IN DRINKING WATER AND TEST WELLS

Nine hundred and sixty-eight drinking water samples were analyzed during the period April-May-June, 1949. Two hundred and forty-seven of these samples were 12 liter samples and the remainder were 500 ml. samples. All 500 ml. samples were analyzed for the alpha and beta emitters; the large volume samples were analyzed for the alpha emitters only. Representative drinking water samples were analyzed specifically for uranium by the fluorophotometer method. Samples which indicated alpha activity that could not be attributed to uranium were analyzed for plutonium by the TTA extraction process.

The sampling frequencies varied from daily to monthly; this frequency was dependent on the location of the well, the probability of finding contamination in the well, and the current trend of the activity detected in the sampled well or in wells located nearby.

Trace quantities of alpha activity were again detected in the well systems of Benton City and Richland. In general the alpha activity found in Benton City water was about twice that detected in the Richland Wells. The average alpha activity in all samples from Benton City was about 20 dis/min/liter; similar measurements of well water samples from Richland averaged a little below 10 dis/min/liter. Maximum alpha activity was detected in Richland Well #15 where a 500 ml. sample contained 47 dis/min/liter. The alpha activity in all samples was confirmed to be due to uranium which presumably occurs in its natural state at these locations. A tabulation of those locations which continually showed positive alpha activity throughout the period April-May-June, 1949 is presented in Table I:

TABLE I
(on following page)

TABLE I

ALPHA ACTIVITY IN DRINKING WATER

APRIL-MAY-JUNE

1949

units-dis/min/liter

LOCATION	Number Samples	500 ml. Samples Maximum	500 ml. Samples Average	Number Samples	12 liter Samples Maximum	12 liter Samples Average
Richland Well #4	13	16	8	7	17	8
Richland Well #5	10	12	6	7	10	5
Richland Well #12	7	12	5	5	10	5
Richland Well #14	13	18	9	7	13	6
Richland Well #13	52	20	7	6	8	4
Richland Well #15	12	47	14	7	9	5
Richland Well #16	13	19	5	6	9	4
Richland Well #18	9	14	9	6	10	7
Foster's Ranch	10	23	7		7	3
Benton City Store	13	29	14	7	29	17
Benton City Water Co.	13	35	25	7	33	16

In addition to those locations which continually showed positive alpha activity (Table I), trace amounts of alpha activity were occasionally detected in individual samples from other drinking water wells. Subsequent samples from these additional wells did not confirm the positive alpha activity originally detected and indicates probable laboratory contamination during processing. For record purposes, a summary of all locations at which an individual drinking water sample showed true alpha activity is presented in Table II:

TABLE II

SUMMARY OF ALPHA ACTIVITY MEASURED IN DRINKING WATER WELLS

APRIL-MAY-JUNE

1949

LOCATION	Number Samples	500 ml. Samples Maximum	500 ml. Samples Average	Number Samples	12 liter Samples Maximum	12 liter Samples Average
Columbia Camp	13	8	3	6	7	3
Headgate Well	12	5	2	6	3	1
Hanford #1	3	4	2	3	5	2
Hanford #4	3	4	3	2	4	4
3000 Area Well A	14	5	2	8	4	2
3000 Area Well B	9	17	2	6	2	1
3000 Area Well C	13	6	3	7	9	3
3000 Area Well D	10	4	2	5	4	1
3000 Area Well E	13	6	3	8	9	4
3000 Area Durand # 5	12	9	2	7	5	3
Richland Well #2	12	10	5	6	8	4
Richland Well #12	7	12	5	5	10	5
Richland Well #16	13	19	5	6	9	4
Tract House K-748	12	9	3	6	4	2
Tract House J-685	12	8	2	5	5	3
Chevron Station Cobb's Corner	13	9	4	7	10	4

LOCATION	Number Samples	500 ml. Samples Maximum	500 ml. Samples Average	12 Liter Samples	12 Liter Samples Maximum	12 Liter Samples Average
Texaco Station Kennewick	11	4	2	6	3	1
Kennewick Std. Station	14	11	4	7	4	2
Riverland	14	4	1	9	3	1
Midway	14	6	1	7	3	2
Lower Knob	14	11	1	7	2	<1
Wills Ranch	14	7	3	8	2	<1
Pasco H & R Depot	13	6	1	8	2	<1
Pistol Range	12	9	5	9	6	4
White Bluffs Ice House	11	4	<2	6	3	1
White Bluffs City Well	2	16	14	3	16	9
Segerson's Ranch	4	2	<1	2	3	1

Analysis of the 500 ml. samples for beta activity showed that several locations continually indicated trace amounts of this activity. These wells which showed beta activity to average greater than 10 μμc/liter were located adjacent to the Columbia River, or were taking their supply directly from the river water. As in the past, the drinking supplies of Kennewick and Pasco showed positive beta activity; the averages were 42, 33 and 20 μμc/liter at Kennewick Highlands, Kennewick Standard Station, and Pasco H & R Depot, respectively. Maximum beta activity detected at these same locations was 67, 80, and 100 uuc/liter, respectively.

Two wells located on the project showed periodic beta activity in the water; 500 ml. samples from 3000 Area Well B, and Richland Durand #2 indicated the maximum activity at these locations to be 65 and 117 μμc/liter, respectively.

In addition to the water that was obtained from the various wells, weekly samples were taken from the sanitary supplies in the operating areas at Hanford Works. This water has the Columbia River as its source and is transported via the raw water export line. Table IV in Section V may be used to compare the raw water beta activity with that found in the sanitary water in the respective areas. Table III summarizes the beta activity found in the sanitary water during this period.

TABLE III

SUMMARY OF BETA AND ALPHA ACTIVITY IN SANITARY WATER

APRIL-MAY-JUNE

1949

LOCATION	Number Samples	ALPHA dis/min/liter Maximum	ALPHA dis/min/liter Average	BETA uuc/liter Maximum	BETA uuc/liter Average
100-B Sanitary H_2O	13	5	< 2	10	<10
100-D Sanitary H_2O	13	4	< 2	12	<10
100-F Sanitary H_2O	12	5	< 2	38	13
100-H Sanitary H_2O *	38	12	4	261	32
200-E Sanitary H_2O	12	4	< 2	<10	<10
200-W Sanitary H_2O	12	21	3	17	<10

* The sanitary water at 100-H Area was not taken from the export line during this period. This water was pumped directly from the river, chlorinated, and then stored for consumption.

The beta activity detected in the sanitary water at 100-H varied according to the storage time which was dependent upon the volume used. Investigation of this time delay showed that this period could vary from around one hour to over twenty-four hours. The beta activity in this water was found to be nearly identical to that detected in the river; approximately 90 to 95 per cent of the activity was Na-24, and the remaining 5 to 10 per cent was due to longer half lived components.

One hundred and twenty-five samples were obtained from test wells during the period April, May, June, 1949. Ninety-six of these samples were 500 ml. and the remaining twenty-nine samples were 12 liters. Several of the test wells showed trace amounts of beta and alpha activity but in no case was the data indicative of any trend or increase when compared with the results obtained in the previous three month period. As expected, the 300 Area well system showed alpha activity which averaged between 4 dis/min/liter in Well #1, to 35 dis/min/liter in Well #3. The alpha activity detected in the 300 Area well system was confirmed by fluorophotometer analysis to be from uranium. It is of interest to note that occasional pumping of this water into the 300 Area sanitary supply did not cause the alpha activity average in the sanitary supply to exceed 2 dis/min/liter. Table IV summarizes the results of the alpha and beta analyses of the 500 ml. samples taken from test wells:

TABLE IV

ALPHA AND BETA ACTIVITY IN TEST WELL SAMPLES

APRIL-MAY-JUNE

1949

LOCATION	Number Samples	ALPHA dis/min/liter		BETA μμc/liter	
		Maximum	Average	Maximum	Average
300 Area Well #1	11	14	4	22	<10
300 Area Well #2	12	122	18	19	<10
300 Area Well #3	5	92	35	10	<10
300 Area Well #4	6	128	29	10	<10

SECTION VII

W. Singlevich and H. J. Paas
DEVELOPMENT DIVISION
HEALTH INSTRUMENT DIVISIONS