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HW 18446

DEVELOPMENT DIVISION
HEALTH INSTRUMENT DIVISIONS

RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS

for the period

JANUARY, [redacted]CH, 1950

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD JANUARY, FEBRUARY, MARCH, 1950

HANFORD TECHNICAL RECORD

by

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

July 28, 1950

HANFORD WORKS
RICHLAND, WASHINGTON

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD JANUARY-FEBRUARY-MARCH, 1950

ABSTRACT

The results of monitoring for radioactive contamination in the environs of Hanford Works as affected by operations of the Hanford Works are reviewed. These data were originally compiled and reported in the H. I. Environs Monthly Reports on a monthly basis. However, by compiling and studying three months accumulation of data, possible trends can be evaluated which would not have been detectable by a study of one month's data. A summary of the highlights of the results and trends observed are in this document and an abstract of these results appears below:

SECTION I: METEOROLOGICAL DATA - HANFORD WORKS AREA:

The overall average meteorological conditions during this quarter did not differ significantly from that of the previous quarter with minor difference observed on a month to month comparison. The wind direction prevailed with a westerly component 65 per cent of the time with the predominant specific wind direction from the northwest. The wind directions agreed reasonably with the pattern of deposited I-131 on vegetation. The calculated dilution ratios during this quarter were slightly lower than during the previous quarter. Detailed graphs and tables are included in the evaluation of meteorological conditions during hours of dissolution of irradiated uranium.

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION:

Decreases in the quantity of I-131 deposited on vegetation during this quarter were observed as compared with the previous quarter; the principal cause of the decrease was due to the decay of the large quantities of 8 day iodine deposited during the "green run" of December 2 and 3, 1949. Excepting the green run period, no significant changes in production schedules were made to account for the observed differences. The maximum activity from I-131 measured on any vegetation sample was 1.3 uc/kg collected near the badge house of the 200 West Area, the normal location of maximum ground deposition. The average I-131 activity on vegetation in the 200 East and West Areas was 58 and 26 muc/kg, respectively. In Richland, I-131 activity which includes the residual activity from the green run averaged 5 muc/kg with an individual maximum result of 49 muc/kg. Off area surveys which included Soap Lake, Ritzville, and Washtucna indicated average activity from I-131 to be less than 3 muc/kg. Tables and graphs are included summarizing the results of the surveys in detail.

SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE:

Monitoring for atmospheric radioactive contamination by means of integrons and detachable ionization chambers did not differ significantly from the results of the previous quarter. Values near the separations area were slightly below the order of magnitude of 1 mrep/24 hours with background levels of 0.3 to 0.5 mrep/24 hours measured at outlying locations such as Pasco, Kennewick, Benton City and Richland; the levels within ten miles of the separations area were slightly lower this quarter than during the previous three months. Decreases in average filterable beta emitters were noted during the quarter; the maximum filterable beta activity measured inside the 200 West Area was 4×10^{-10} uc/liter. Small decreases in the average concentration of 8 day iodine were also observed in this quarter as compared with the last quarter. The maximum activity from I-131 measured in a scrubber solution was 2.0×10^{-9} uc/liter sampled at the 200 West Area badge house. No signifi-

[redacted]

cant differences were observed in comparing the active particles estimated to be present in the atmosphere during this quarter with that of the previous quarter. The number of particles estimated to be present in the atmosphere of the 200 West Area was 5.0×10^{-3} particles per cubic meter of air samplod. Graphs and tables are included which present detailed summarios of the results of the air monitoring program.

SECTION IV - RADIOACTIVE CONTAMINATION IN HANFORD WASTES:

Radioactive contamination measured in the 200 and 300 Area wastes systems remained essentially within the levels observed during the last quarter. Small increases were observed in the 107 effluent of the 100-B, D, and F Areas. The maximum beta activity measured in this effluent during this quarter was 1.5, 2.1, and 3 uc/liter in the basins of the 100 B, D, and H Areas, respectively. Alpha activity from plutonium, uranium, and polonium was <6 dis/min/liter in this effluent water. Table and graphs are included enumerating the detailed results of the radioactive waste surveys.

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

The average flow rate of the Columbia River during this quarter was 544,000 gallons per second, slightly greater than the flow measured during the previous quarter. In spite of the increased flow rate of the river, activity in the river increased during this quarter as influenced by start up of 100-H Area and increase in power level of the 100-F Area. Background beta activity in the Columbia River averaged from 3 to 5 uuc/liter. The maximum average activity in the river was 2822 uuc/liter as measured near Hanford. Alpha activity in the river from plutonium and uranium was <6 dis/min/liter. The results of a cross-section survey of the activity in the river are described in detail; the general conclusion indicated that mixing of the activity with the river water was not uniform but was channelled with the higher levels of activity measured in the channel nearest the plant side of the river (south side.) A cross-section surface depth study of the river at Hanford indicated definite channels but also show that in any given channel the activity was uniformly distributed from top to bottom of the river.

SECTION VI - RADIOACTIVE CONTAMINATION IN RAIN AND SNOW:

Detailed analytical results for monitoring for radioactivity in rain and snow at twenty-seven representative locations are included. Average beta activity in rain as measured inside the separations area was 2.2 to 2.4 muc/liter. The individual maximum result was 24.3 muc/liter in a sample 7000 feet southeast of the 200 East Area stack; the maximum in the 200 East Area was 12.5 muc/liter. One sample from Benton City was as high as 12.5 muc/liter, with values 1.0 muc/liter at Pasco, Kennewick and Richland. The maximum activity measured in any snow sample was 970 uuc/liter collected within the 200 West Area.

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

No significant deviations of differences in trends from past data were observed in a review of the current survey results. Alpha activity from apparent naturally occurring uranium of 2 to 10 ug/liter was measured in Richland wells with values as high as 45 ug/liter in a Benton City well. Complete and detailed summations of all monitoring results for radioactive contamination are included.

[redacted]

SECTION I

METEOROLOGICAL DATA - HANFORD WORKS-AREA

The meteorological conditions observed during the period January, February, and March, 1950 were reviewed with respect to the affect they may have on the distribution and deposition of the radioactive gases discharged into the atmosphere at the Hanford Works. The original meteorological measurements summarized in this report were made by the Meteorology Group of the Health Instrument Division.

The bulk of the meteorological data was obtained from the Meteorology Tower Station located near the 200 West Area. The measurements were made at elevations ranging from ground level to 400 feet. Supplementary data was obtained from stations in the 100 Areas and Richland. The data from the 100 Area stations was obtained at an elevation of approximately 50 feet; the data from the Richland Station was obtained from the tower at the Airport approximately 50 feet above ground level.

A review of the wind direction data showed that the current period did not differ significantly from previous observations. Based on a day to day observation, for the entire quarter, the wind prevailed with a westerly component 65 per cent of the time; during the hours of metal dissolution the westerly component prevailed 63 per cent of the time. The predominant direction was from the northwest; this direction prevailed 22 per cent of the total time and 29 per cent of the time that dissolving was in progress. The wind direction data showed a negligible amount of wind from the north, northeast, and east. These directions prevailed less than 8 per cent of the time during the quarter. The variable and calm conditions existed less than 2 per cent of the total time as observed at the Meteorology Station. Figure 1 is a summary of the three month's average wind direction data as recorded on an eight point compass made at the 200' level of the Meteorology Tower. The 200' level most closely represents the height of the separation area stacks from which radioactive gases are discharged. Figure 2 shows a breakdown of the wind data observed using a 16 point compass and summarizes the prevailing wind directions for all hours during the period January, February, and March. A comparison of Figure 1 with Figure 2 shows reasonable agreement between the two compilations. The estimated pattern of deposited I-131 on vegetation also follows the general pattern of the prevailing winds, (Figure 6 , Section II); the maximum I-131 activity was deposited on vegetation in a region downwind from the respective separation areas.

A study of the month to month variation of the prevailing wind directions showed that the wind directions were not as consistent as had been observed during past quarters; Figure 3 summarizes this variation. A glance at Figure 3 indicates that the northwest direction which prevailed during the quarter was not the prevailing direction during the month of January. During January, the southwest direction prevailed 27 per cent of the time; normally, only 15 per cent of the wind comes from this direction. Trace activity from I-131 measured on vegetation collected in the region of the Wahluke Slope was generally attributed to the southwest wind which is usually accompanied by higher velocities. A study of the higher velocities recorded at the Meteorology Tower during this quarter showed that in all cases where the wind velocity exceeded forty miles per hour, the direction was either from the south, southwest, or west southwest. A more detailed summary of the meteorological conditions which accompany wind velocities exceeding forty miles per hour at the 200' level appears in the table below:

TABLE I
SUMMARY OF CONDITIONS ACCOMPANYING VELOCITIES OVER 40 MPH
JANUARY-FEBRUARY-MARCH
1 9 5 0

DATE	DURATION	PEAK VELOCITY	PEAK GUST	WIND DIRECTION	DILUTION
January 10	0500-2200	34	56	S -SW	>20
January 21	1900-1000	27	44	S - SW	>20
January 21	1200-2400	41	51	S - SW	Aloft
February 8	0000-1400	37	55	SSE-WSW	>20
March 3	0900-0600	40	54	SW	>20
March 16	1200-2400	30	40	SSW	15
March 17	0700-0300	34	45	WSW	~18
March 19	0700-2200	29	40	WSW	~18
March 22	0800-2300	27	40	W - SW	>20

[redacted]

Along with the predominance of the southerly component during periods of high velocity winds, it was significant to note that the dilution rates were also greater during this period. It is also worth while to note that the gust exceeded the normal velocity by a factor roughly one-third higher than the peak velocities. The paek velocities, as recorded in Table I, were conditions which existed for a period of one hour or longer.

The variation in the prevailing wind direction found at the other stations located around the project may be reviewed by referring to Figure 4; the stations included in this summary are the Meteorology Tower near the 200 West Area, 100-B, D, and F Areas, and Richland. Among the significant observations made when comparing the wind direction data at the various locations with each other were the following: (1) the only station where the northwest wind direction prevailed was at the 200 West Meteorology Tower; (2) the calm condition existed for aa greater percentage of time during this quarter at 100-D, 100-F, and Richland, as compared with only one per cent of the time at the Meteorology Tower; (3) the west direction prevailed at Richland where the wind blew 35 per cent of the time from that direction during the quarter. The variations discussed above were probably the cause of the wide spread of deposited radioactive contamination found during certain periods of the quarter and could probably account for the occasional random particles detected at some monitored locations. These variations also account for the monthly variations of the estimated distribution patterns of deposited I-131 on the vegetation.[1]

A review of the atmospheric factors as determined during the hours of metal dissolution in the separation areas showed that lower than usual dilution ratios prevailed during the period January through March, 1950. The more desirable dilution ratio of greater than 1000:1 prevailed seventy-three per cent of the time that dissolving was in progress during this period as compared with 88 per cent during the previous quarter. The undesirable dilution ratio of less than 500:1 occurred 9 per cent of the time during the quarter as compared with 5 per cent during the previous quarter. The low dilution tended to prevail during the month of January when the less that 500:1 ratio was 14 per cent of the total dissolving hours. Similarly, aloft conditions were experienced 33 per cent of the time during January as compared with 53 per cent and 49 per cent during February and March, respectively. A graphic summation of the atmospheric dilution factors calculated for the quarter is presented in Figure 5.

A review of the ratio between the wind velocity at the higher elevations as compared with the velocity at the 7' level showed that it was relatively a constant. The differences in velocity at the different elevations has been associated with studies of atmospheric gas diffusion and studies of the particle lifting and rolling problem and it is with this interest that the following data is presented. Table II includes the average velocity tabulated for four elevations on the Meteorology Tower and the calculated ratio of the velocity at each elevation with the velocity at 7 feet. The average was computed from the hourly recordings made during the quarter.

TABLE II
RATIO OF WIND VELOCITY AT DIFFERENT ELEVATIONS
JANUARY-FEBRUARY-MARCH
1 9 5 0

	January		February		March		
Height	Average Velocity	Ratio to 7 feet	Average Velocity	Ratio to 7 feet	Average Velocity	Ratio to 7 feet	Average Ratio to 7 feet
7'	4.2	- -	3.0	- -	4.6	- -	- -
50'	6.4	1.5	5.1	1.7	7.3	1.6	1.6
200'	9.4	2.2	7.4	2.5	10.8	2.3	2.3
400'	10.9	2.6	8.0	2.7	12.7	2.8	2.7

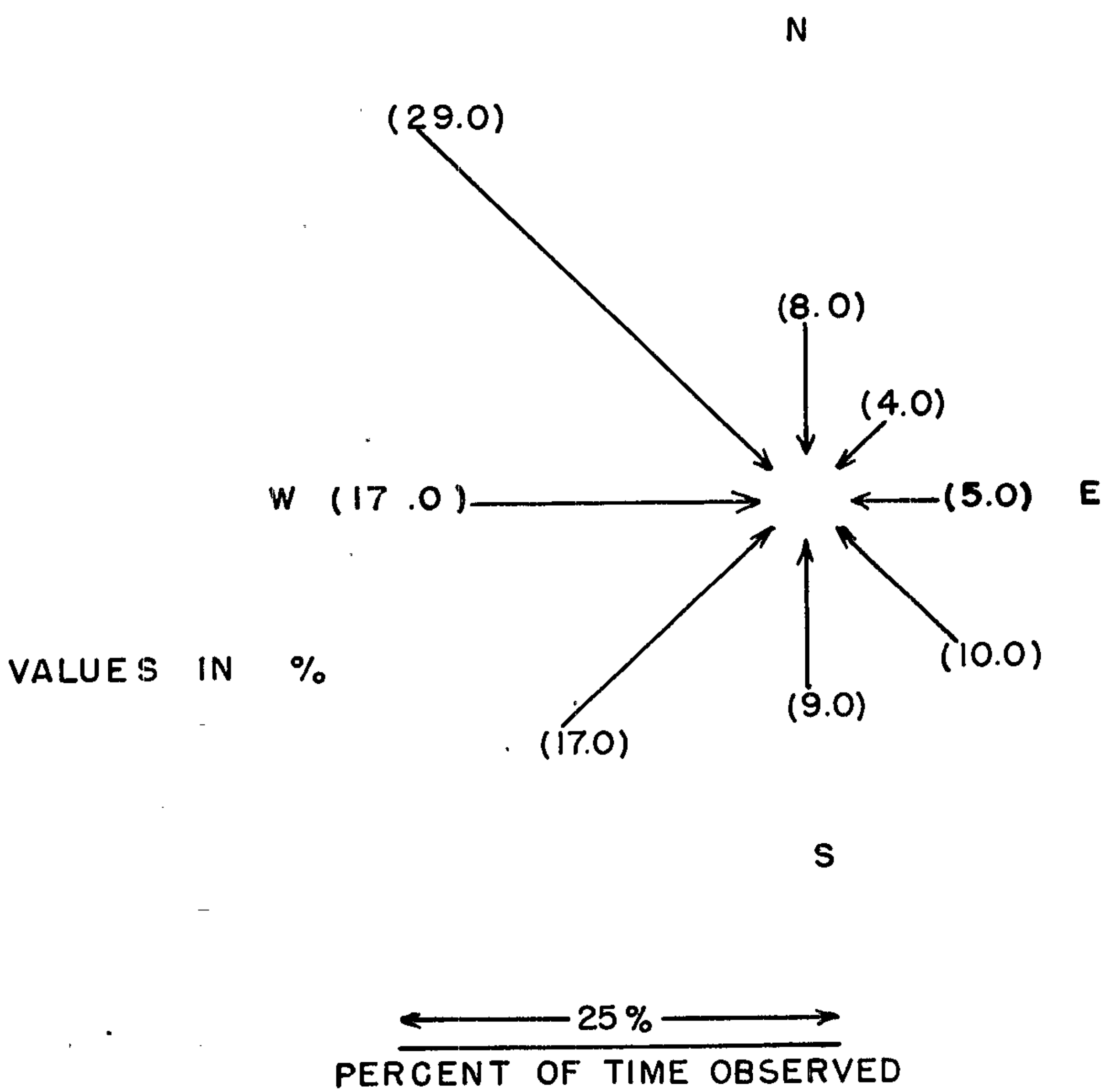
SECTION I

(Please refer to Figures 1, 2, 3, 4, and 5.)

[redacted]

SUMMARY WIND DIRECTIONS 200-W
DISSOLVING HOURS ONLY
JANURARY — FEBRUARY — MARCH
1950

FIGURE - I



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SUMMARY WIND CONDITIONS 200-W
ALL HOURS
JANURARY — FEBRUARY — MARCH
1950

FIGURE-2

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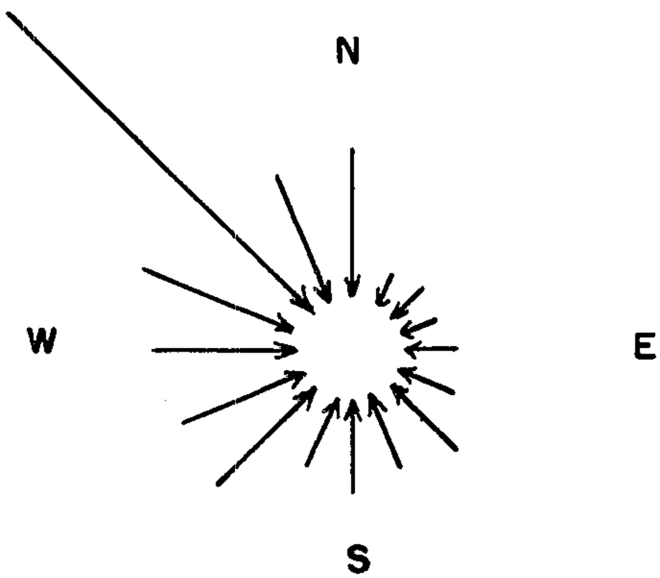
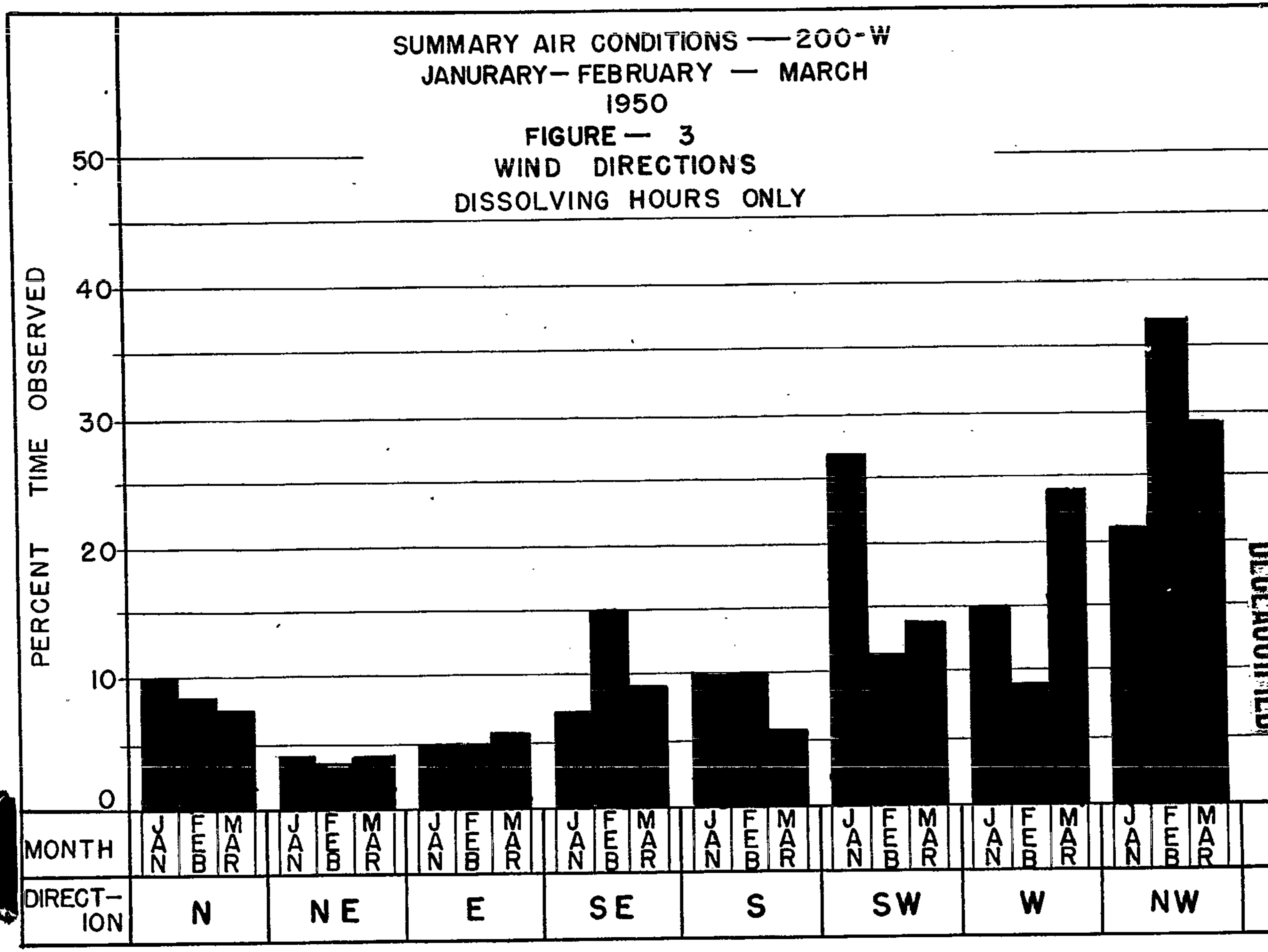


PERCENT OF TIME OBSERVED

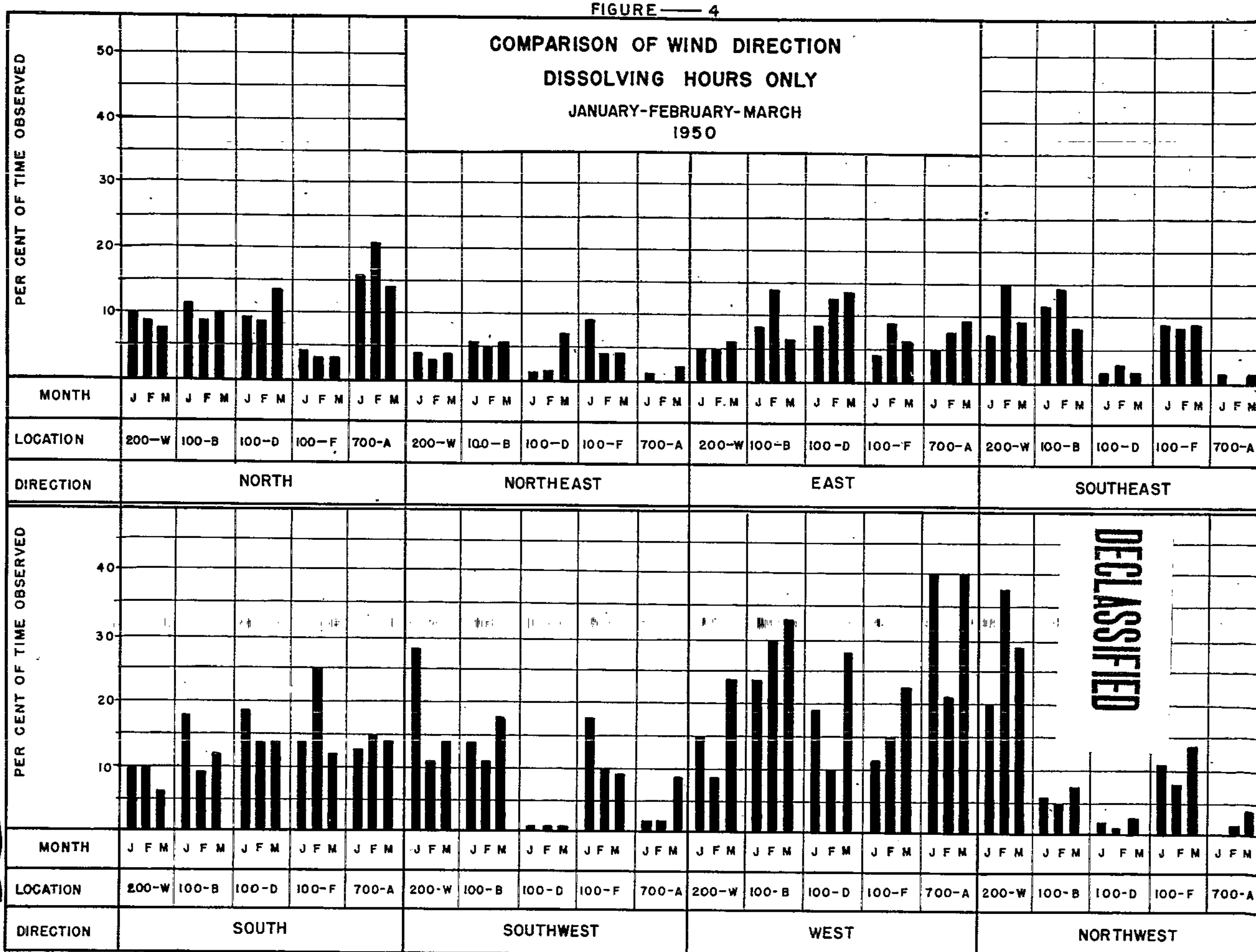
SSW-4	N-8
SW-8	NNE-2
WSW-7	NE-3
W-8	ENE-2
WNW-9	E-3
NW-22	ESE-3
NNW-7	SE-5
CALM-1	SSE-4
VARIABLE-1	S-4

[redacted]



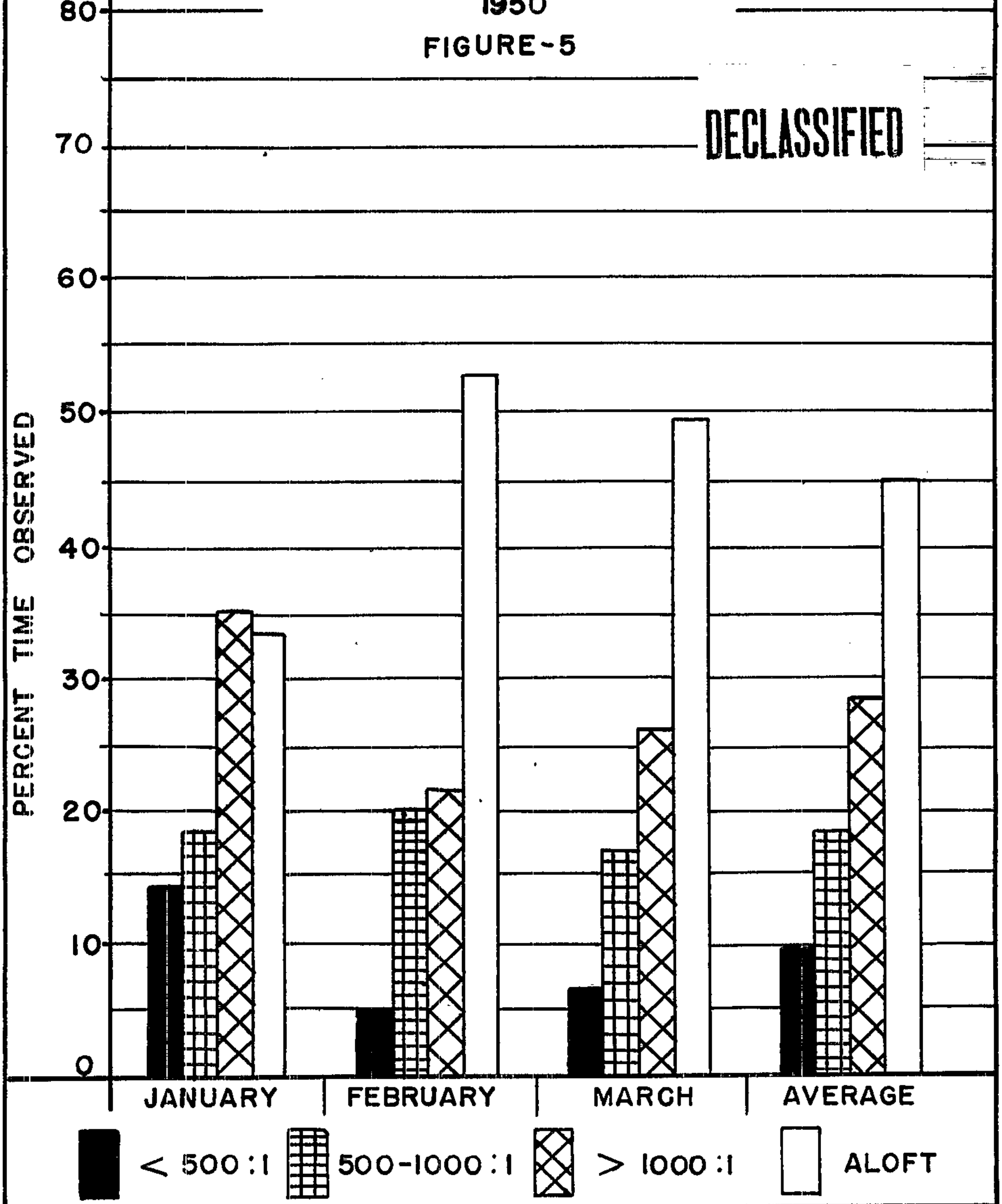
SUMMARY AIR CONDITIONS —— 200-W
JANURARY — FEBRUARY — MARCH
1950
FIGURE — 3
WIND DIRECTIONS
DISSOLVING HOURS ONLY

FIGURE — 4


COMPARISON OF WIND DIRECTION
DISSOLVING HOURS ONLY
JANUARY-FEBRUARY-MARCH
1950
PER CENT OF TIME OBSERVED
50
40
30
20
10
MONTH
J F M
LOCATION
200-W
100-B
100-D
100-F
700-A
DIRECTION
NORTH
NORTHEAST
EAST
SOUTHEAST
SOUTH
SOUTHWEST
WEST
NORTHWEST

WIND DILUTION ANALYSIS
622 BLDG. — 200 W AREA
DISSOLVING HOURS ONLY
JANUARY — FEBRUARY — MARCH
1950

FIGURE-5



SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION:

The radioactive effluent of the two stacks in the separations area is the principal source of radioactive contamination found on vegetation as affected by the operations of the Hanford Works. The principal contaminant found in greatest abundance on vegetation is 8 day iodine (I-131); to a much lesser extent, beta emitters from longer half-lived fission production isotopes are also found.

During the quarter it was estimated that 1036 curies of I-131 were evolved in the dissolver units. Five percent of this, or 52 curies of I-131 were actually discharged into the atmosphere.(2) The cooling times for each batch of irradiated metal ranged from 80 to 102 days.

In monitoring for radiocative contamination on vegetation, about 1400 vegetation samples were collected during this period. The samples were analyzed for beta activity from 8 day iodine (I-131) and for the total beta activity from the non-volatile longer half-lived fission product elements. The methods of analysis for I-131 and the non-volatile emitters may be referred to in previous reports. (3 & 4) Table I shows the maximum and average activity from I-131 and the non-volatile beta emitters measured on vegetation samples collected during this quarterly period from representative locations.

[redacted]

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TABLE I

RADIOACTIVE CONTAMINATION ON VEGETATION
JANUARY-FEBRUARY-MARCH
1950

LOCATION	I-131 -- muc/kg MAXIMUM	I-131 -- muc/kg AVERAGE	Non-Volatile Beta--muc/kg MAXIMUM	Non-Volatile Beta--muc/kg AVERAGE
North of 200 Areas	70	7	165	11
Near the 200 Areas	318	29	109	20
Route 3	1186	220	279	61
200 West Gate	1274	542	397	175
Meteorology Tower	329	106	77	33
South of 200 Areas	230	12	83	12
Richland	49	5	40	<10
Pasco	8	<3	17	<10
Kennewick	41	3	23	<10
Benton City	176	13	56	11
Richland "Y"	6	<3	11	<10
Hanford	84	10	34	<10
200 East Area	232	58	93	27
200 West Area	146	26	92	32
Goose Egg Hill	168	26	79	20
Wahluke Slope	23	<3	20	<10
Pasco to Ringold	9	<3	15	<10
OFF AREA SAMPLES				
Pasco to Eltopia	<3	<3	10	<10
Odessa-Ritzville-Soap Lake	24	<3	--	--
Pasco - Washtunca Ritzville	3	<3	12	<10
Yakima-Ellensberg-Sunnyside	12	<3	12	<10

A sharp decrease in the activity density of I-131 on vegetation throughout January and part of February was noted during this quarter. This decrease was attributed to the decay of the I-131 deposited on vegetation during the green run of December 2, 1949.(5) The trend of the I-131 activity indicated a gradual decrease up to the latter part of February when the activity density dropped to the normal expected range and remained at equilibrium throughout March.

Figure 6 is an iso-activity chart estimating the distribution of the deposited I-131 on vegetation throughout the quarter. The average values shown are, of course, weighted by the "one shot" dose of I-131 as discharged during the green

[redacted]

run period. The maximum values were noted immediately after the green run and the activity density of the I-131 decreased primarily by 8 day decay. Figure 9 shows three representative decay curves of samples taken immediately after the green run period from locations on the site. A referrence line indicating the 8 day half-life decay rate of I-131 is drawn on the chart where the observed counting rates are indicated. The decay of these samples are representative of the over all decrease for the total deposited I-131 on vegetation throughout the quarter. Decay studies of these samples show that the emitter has a half life of 8 days which fits the decay of I-131 very nicely. Since it was stated that the I-131 activity density on vegetation approached equilibrium during March, 1950, the iso-activity map of the estimated distribution of I-131 on vegetation at this time is shown on Figure 7. The iso-activity maps, Figures 6 and 7, are presented as transparencies over a base map which shows the locations at which vegetation samples were obtained during the quarter. The base map may be referred to as Figure 8.

A comparison of the I-131 activity density of vegetation samples collected during March, 1950, with those of October and November in 1949, (the period just previous to the green run) indicated that in those areas within a distance of about 5 miles of the seporation areas, the I-131 activity density on vegetation during March was greater by a factor of 5 to 10 than during the October to November period. For outlying areas, such as Richland, Pasco, and Kennewick, a similar comparison showed that the activity density involved was less than 3 muc/kg indicating no significant differences between the activity measured during the two periods under comparison.

Vegetation samples collected just outside the 200 West gatehouse showed the maximum activity; one sample indicating an activity from I-131 approaching 1.3 uc/kg. Vegetation from the 200 East and 200 West areas indicated average activity from I-131 of 58 and 26 muc/kg, respectively; maximum results observed in these areas were 232 and 146 muc/kg, respectively. Samples collected in

Richland averaged about 5 muc/kg with one sample as high as 49 muc/kg. These high averages and maximum values reported were due to the large quantity of I-131 deposited during the green run.

Two special off-area vegetation surveys were made during January and February as follow-ups on surveys made late in December which indicated that tracer activity from I-131 resulting from the green run was present on the vegetation; the areas covered included Soap Lake, Ritzville, and Washtucna. The vegetation collected on these more current trips revealed, upon analyses, very little I-131 above the sensitivity level of 3 muc/kg.

The maximum activity from the non-volatile fission products was measured on vegetation collected just outside the 200 West Area gatehouse. This is consistent with previous measurements and with the location of the maximum deposition point of I-131. One sample collected at this location showed about 400 muc/kg from non-volatile emitters. Activity on vegetation from the 200 East and 200 West Areas averaged 27 and 32 muc/kg, respectively. Maximum results from these areas were 93 and 92 muc/kg, respectively. Vegetation samples collected in Richland averaged less than 10 muc/kg, the current arbitrary reporting limit which accounts for the beta activity from naturally occurring K-40 present in the potassium salts of vegetation.

Figure 10 is an iso activity map which portrays the estimated distribution of non-volatile beta activity on the vegetation in the environs of the Hanford Works. This estimation included that activity attributed to natural occurring K-40.

SECTION II

(Please refer to Figures 6, 7, 8, 9, and 10.)

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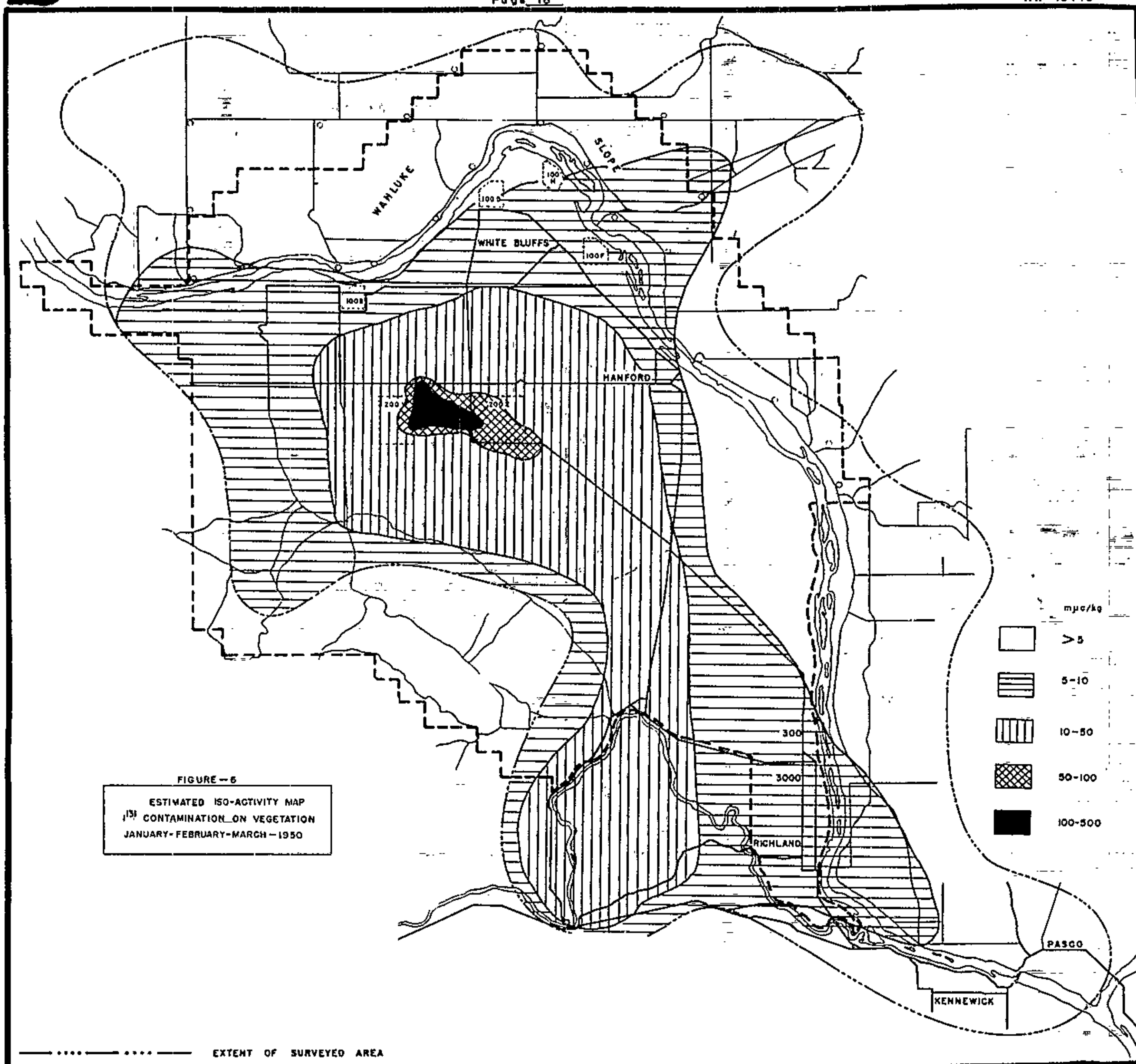

FIGURE - 6

ESTIMATED ISO-ACTIVITY MAP
I131 CONTAMINATION ON VEGETATION
JANUARY-FEBRUARY-MARCH-1950

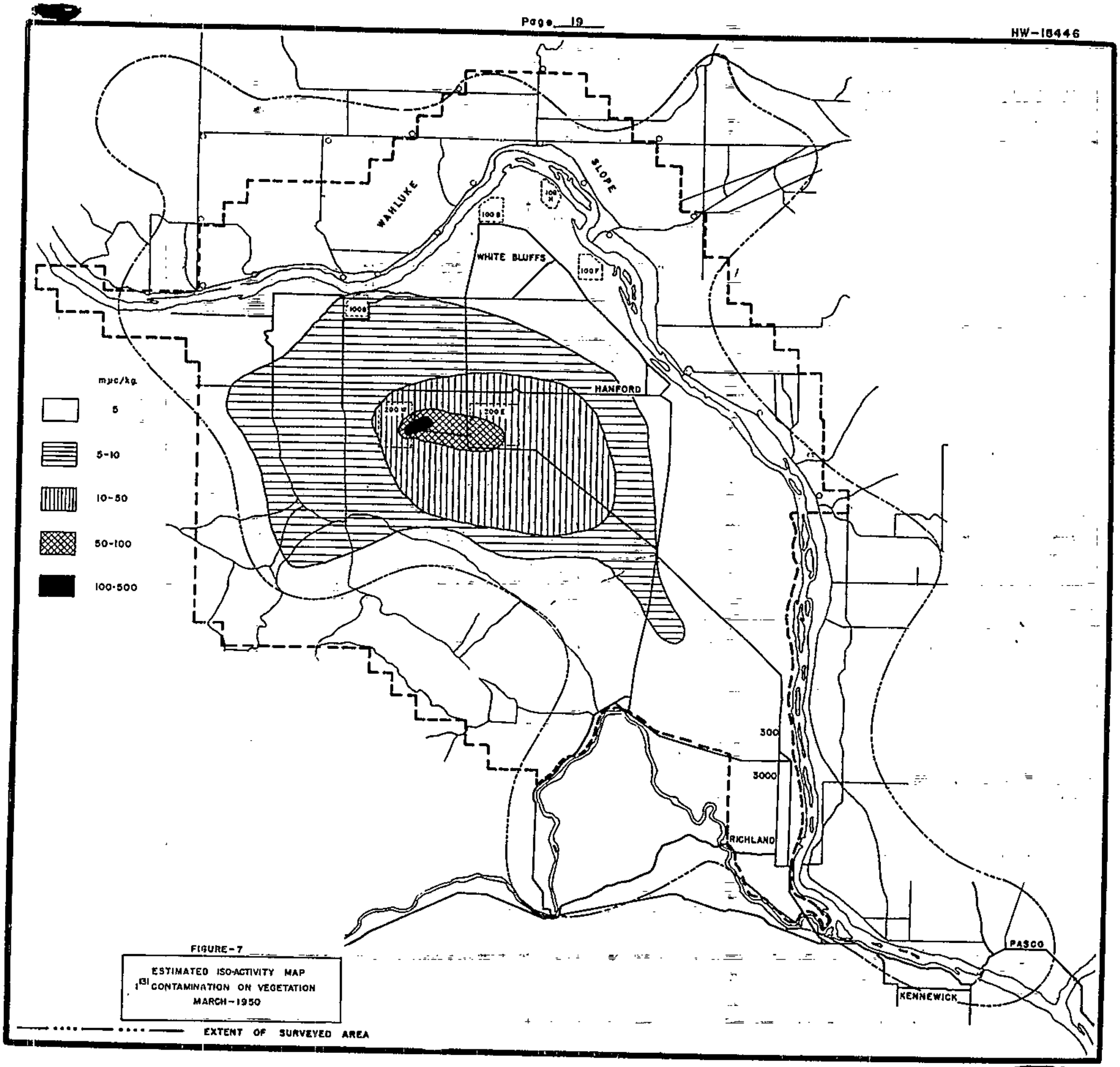

FIGURE-7

ESTIMATED ISO-ACTIVITY MAP
I[131] CONTAMINATION ON VEGETATION
MARCH-1950

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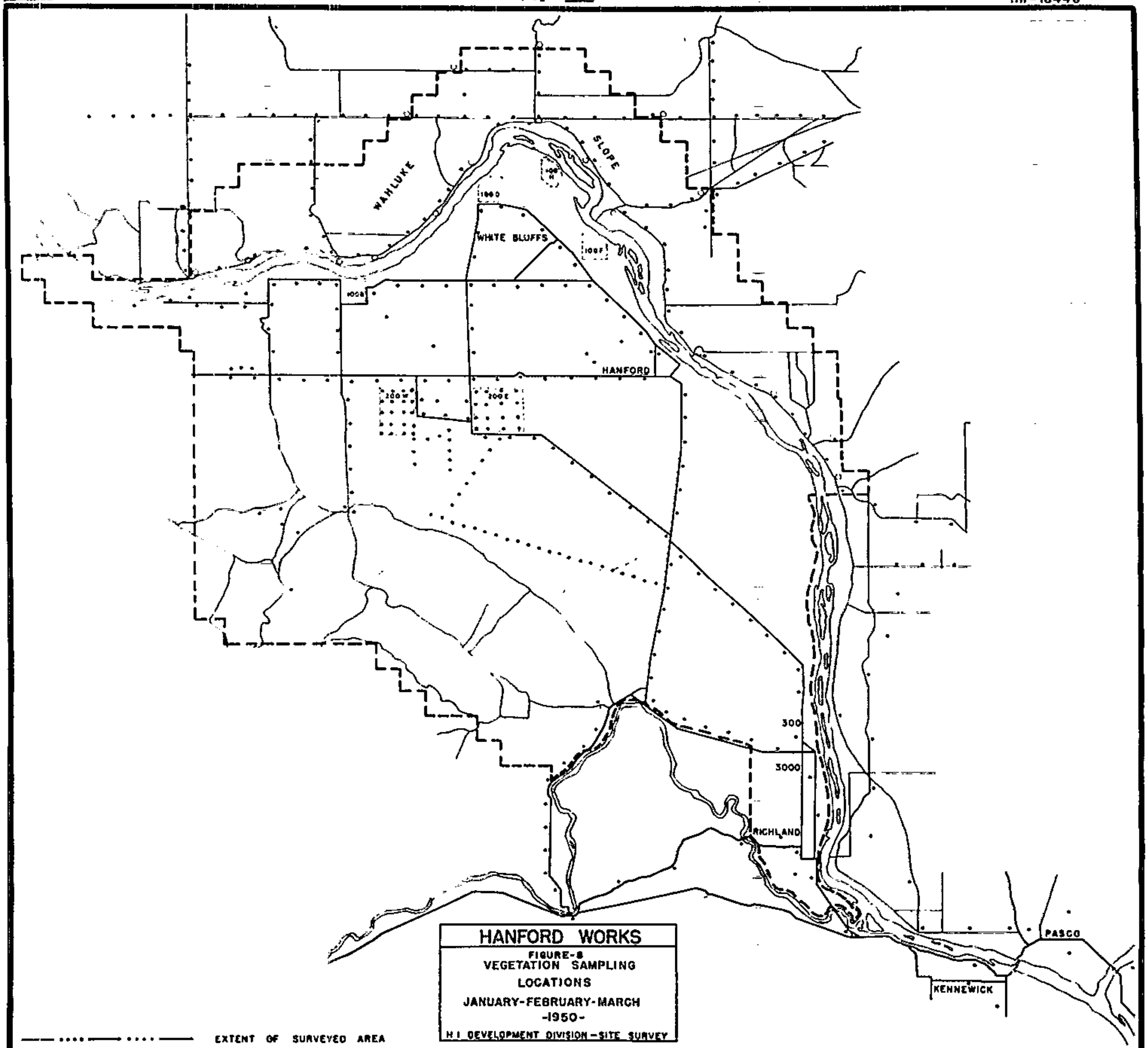
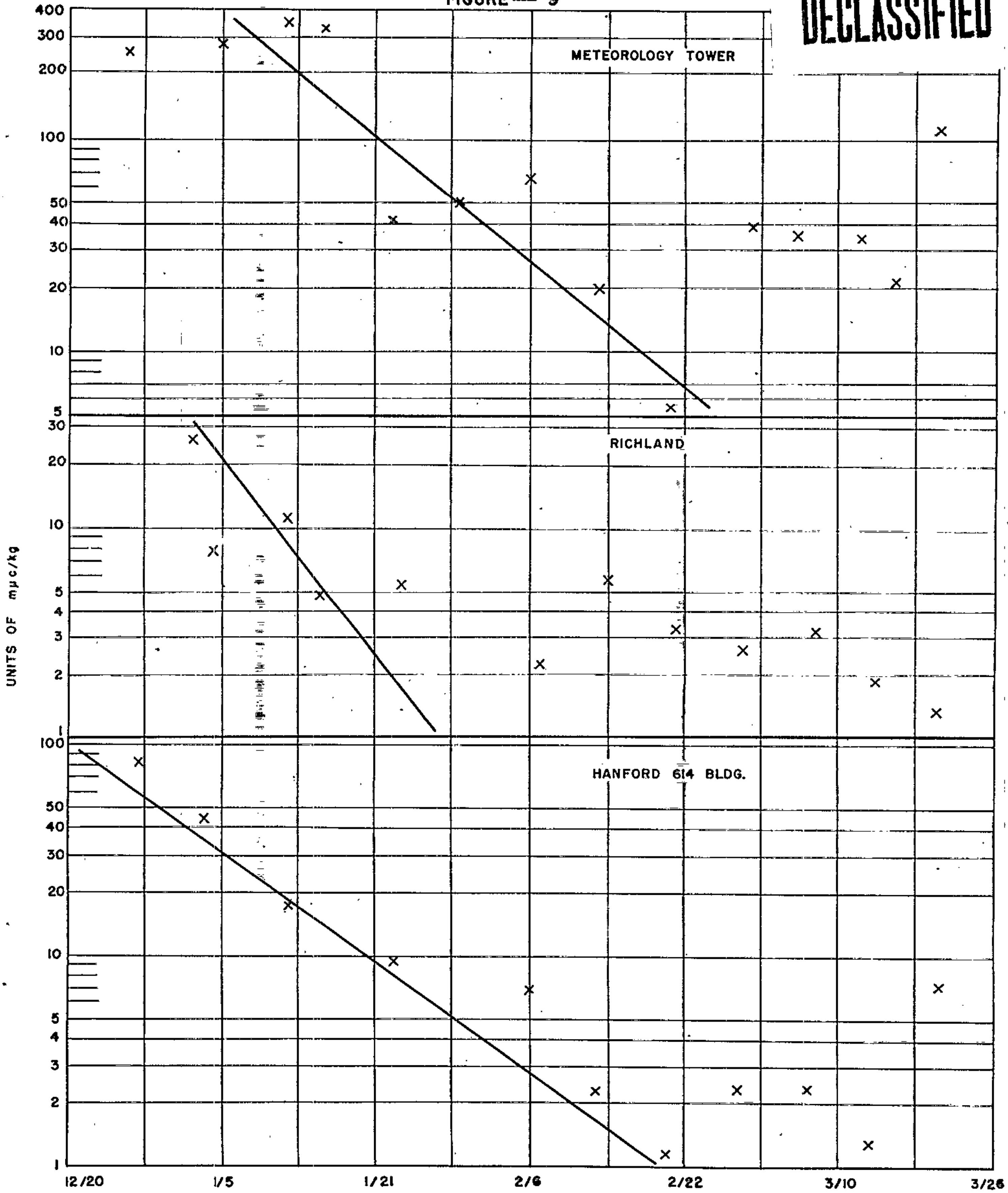


HANFORD WORKS
FIGURE-8
VEGETATION SAMPLING LOCATIONS
JANUARY-FEBRUARY-MARCH
-1950-
H I DEVELOPMENT DIVISION - SITE SURVEY

DECAY OF I^{131} ON VEGETATION
JANUARY-FEBRUARY-MARCH
1950
FIGURE — 9



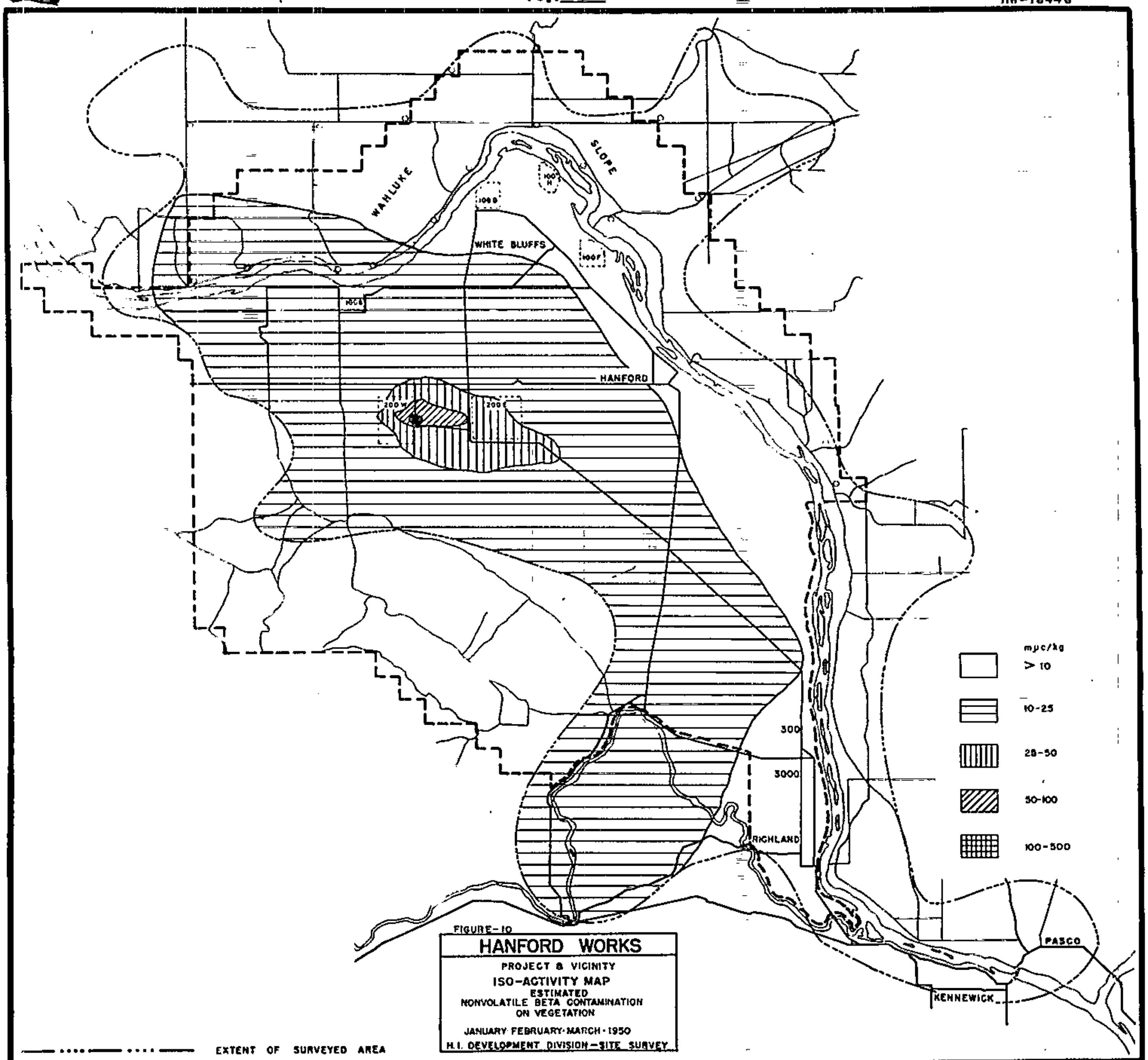


FIGURE-10

HANFORD WORKS

PROJECT & VICINITY

ISO-ACTIVITY MAP

ESTIMATED NONVOLATILE BETA CONTAMINATION ON VEGETATION

JANUARY-FEBRUARY-MARCH-1950

H.I. DEVELOPMENT DIVISION—SITE SURVEY

SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Radioactive contamination in the atmosphere is measured using fixed and detachable ionization chambers, air filters and scrubber solutions, and special filter units used to monitor for the presence of active particles in the atmosphere. The location of the monitoring equipment and the method of monitoring employed at the various locations is a function of the source and type of activity measured and the trend of the current data as evaluated by comparing with previous measurements. Most of the monitoring equipment is concentrated in the operating areas and in nearby residential communities such as Richland, Pasco, and Benton City; several units are operated at locations remote to the Hanford Works in order to evaluate the background radioactivity in the atmosphere.

Dosage rates measured during the quarter using fixed Victoreen Integrons located along the perimeter fence of the operating areas and in residential communities adjacent to the Hanford Site did not differ significantly from the dosage rates observed during the previous quarter. Dosage rates did not exceed 1.0 mrep per 24 hours at any location. With few exceptions, the prevailing dosage rates were consistent from month to month, and were comparable with the background levels as determined by small detachable ionization chambers. This background varies from 0.3 to 0.5 mrep/24 hours. A summary of the dosage rates as measured by Victoreen Integrons for this period appears in Table I.

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TABLE I

AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS

JANUARY-FEBRUARY-MARCH
1 9 5 0

units - mrep per 24 hours

LOCATION	Number of units	AVERAGE DOSAGE as mrep/24 hours			
		January	February	March	Quarter
100-B Area	3	0.5	0.4	0.5	0.5
100-D Area	3	0.2	0.2	0.4	0.3
100-F Area	3	0.3	0.6	0.2	0.4
100-H Area	3	0.6	0.5	0.3	0.5
200 West Area	2	< 0.1	< 0.1	0.2	0.1
200 East Area	3	0.4	0.1	0.2	0.2
Riverland	1	0.9	1.0	0.5	0.8
300 Area	1	0.4	0.3	0.9	0.5
700 Area	1	0.3	0.6	0.6	0.5
Pasco	1	0.3	0.6	0.5	0.5
Benton City	1	<0.1	0.2	0.7	0.3
3000 Area (N)	1	0.7	0.7	0.9	0.8
3000 Area (S)	1	0.4	0.3	0.5	0.4
Hanford	1	<0.1	0.5	0.4	0.3

The higher dosage rate noted at 300 Area during December and at Riverland during November was weighted by including some doubtful high values which the instrument recorded. The data showed some indication of leakage as recorded by the drift of the instrument; omission of these doubtful high values from the averages would show dosage rates comparable with the other stations.

Dosage rates were also measured by means of detachable ionization chambers (Hanford Type "M", "S", and "C".) The "C" type chambers are used in the operating areas and the "M" and "S" types are used at field stations located between the operating areas. These chambers are supported on wooden stands approximately five feet off the ground. Two chambers are placed at each location, essentially giving two readings to serve as a duplicate check on any measured value. The frequency of reading the detachable chambers is based on the trend of previous dosage rates and on the capacity of the chamber at the given location; the normal frequency of reading is three times per week.

A review of the dosage rates as measured by detachable chambers during the quarter indicated a decrease in the region within ten miles of the 200 Areas. The average dosage rate decreased from 1.2 mrep/24 hours during the previous quarter to an average of 0.74 mrep/24 hours at four locations within a radius of five miles of the 200 East Area; a similar decrease from an average of 1.00 mrep/24 hours to 0.65 mrep/24 hours was noted at the four stations within a ten mile radius of the 200 East Area. The dosage rate measured in the environs of the 100 Areas and 300 Area remained essentially the same as in the past. Dosage rates measured in Richland and Benton City averaged 0.40 mrep/24 hours. The decrease noted at the locations near the 200 Areas was due to the higher levels observed during the month of November of the previous quarter. During the current quarter, the average dosage rate showed very little fluctuation between months and were in fair agreement with the averages noted during the month of October and December, 1949. The average dosage rates measured at the monitoring locations by detachable chambers during this period are summarized in Table II.

[redacted]

TABLE II
RADIATION LEVEL OBSERVED WITH DETACHABLE IONIZATION CHAMBERS
JANUARY-FEBRUARY-MARCH-1950
(mrep per 24 hours)

"C" CHAMBER READINGS

LOCATION	JANUARY	FEBRUARY	MARCH	QUARTERLY AVERAGE
Within 100-B	0.3	0.3	0.3	0.3
Within 100-D	0.4	0 4	0.4	0.4
Within 100-F	0.4	0.4	0.4	0.4
Within 200-W	0.4	0.4	0.3	0.4
Within 200-E	0.6	0.5	0.5	0.5
Within 300 Area	*	0.5	0.4	0.5

"M" AND "S" CHAMBER READINGS

LOCATION	JANUARY	FEBRUARY	MARCH	QUARTERLY AVERAGE	GROUP AVERAGE
100-Area and Environs					
Route 1, Mile 8	0.66	0.41	0.46	0.51	
Route 2N, Mile 10	0.14	0.31	0.37	0.27	
Route 2N, Mile 5	0.43	0.47	0.38	0.43	
At White Bluffs	0.77	0.46	0.51	0.58	0.52
Route 11A, Mile 1	0.91	1.31	0.91	0.58	
At Hanford 614	0.76	0.35	0.35	1.04	
Intersection Rt. 1 & Rt. 4N	0.31	0.43	0.44	0.39	
At Hanford 101	0.82	0.51	0.48	0.60	
At 100-H Area	0.44	0.51	0.39	0.45	
P-11 Area **			0.38	0.38	
100-D-R Waterworks **			0.56	0.56	
Within 5 Miles 200 East Area					
Route 4S, Mile 6	0.75	0.40	1.08	0.74	
Batch Plant	- -	0.59	0.41	0.50	
Route 11A, Mile 6	0.59	0.72	0.82	0.71	
Route 3, Mile 1	0.77	0.76	0.76	0.76	0.74
Meteorology 200'	*	0.64	1.36	1.00	
Within 10 Miles 200-East Area					
Route 4S, Mile 10	0.81	0.58	0.70	0.70	
Route 10, Mile 1	0.53	0.70	0.60	0.61	0.65
Route 10, Mile 3	0.51	0.48	0.61	0.53	
Route 2S, Mile 4	*	0.79	0.75	0.77	
Near 300 Area					
Route 4S, Mile 16	1.61	0.73	0.84	1.06	
Route 4S, Mile 22	1.18	1.18	1.23	1.20	
3000 Area North	0.25	0.34	0.26	0.28	0.75
3000 Area South	0.54	0.42	0.35	0.44	
Outlying Zone					
Richland	0.33	0.42	0.41	0.39	
Benton City	0.41	0.46	0.33	0.40	0.40

* Readings were voided due to faulty equipment.
** These stations were placed in operation during this quarter.

[redacted]

Several new chamber locations were established during this period. Dosage rates measured at the P-11 Area, the 100-DR Water Works, and the Batch Plant are included for the first time in the tabulation in Table II.

The average filterable beta activity in air was determined by measuring the activity deposited on a CWS #6 filter paper while passing approximately 2 cubic feet of air per minute through the filter. The exposed surface on the filter was 2.3 square inches; the filters were exposed for one week periods such that the total air flow through a given filter approached 20,000 cubic feet.

A comparison of the filterable beta activity in air during this quarter with similar measurements during the previous quarter showed that a decrease has occurred at most locations close to the operating areas. This decrease in the average was due to the higher results obtained during December, 1949, when a batch of green uranium was dissolved in the 200 West Area.[5] This decrease as compared with the December average, was by a factor of 3 at the 200 East SE station and in the extreme case, a factor of over 30 in the 200 West Area. Smaller decreases were observed at those locations which were removed 5 or 10 miles from the separation areas. For the outlying locations, the decrease noted at Richland was the extreme case; the average filterable activity measured at Richland during this quarter was 9.5×10^{-11} uc/liter as compared with a December average of 1.8×10^{-10} uc/liter. Normal filterable beta activity measurements in the vicinity of Richland are in the order of 10^{-11}.

The highest average filterable beta activity in the air during the period January, February, March, 1950 was found in the 200 East Area where the station located at Twr. #16 showed a quarterly average of 2.6×10^{-9} uc/liter. This activity concentration was confirmed by measurements made at the 200 East Southeast station which is located less than one-half mile from Tower #16; the station in the southeast corner of the 200 East Area averaged 1.4×10^{-9} uc/liter during the quarter. The highest average activity detected in the West Area was of the order of 4×10^{-10} uc/liter; the difference in activity measured in the two separations

[redacted]

areas was attributed to the different amount of iodine (I-131) involved in the dissolvers as approximately 20 percent more iodine was involved in the 200 East Area during this period. An estimation of the I-131 involved during the quarter may be referred to in Section II of this report.

One new station was established during this quarter; this station was placed in the 100-D Area near the 105- DR Water Works construction program. Filterable beta activity averaged 2.2 x 10^{-10} uc/liter at this location and showed very little fluctuation between the months during which the measurements were made.

Table III summarizes the monthly averages for filterable beta activity measurements; Figure 11 is a graphic presentation of the respective quarterly averages for several representative locations.

TABLE III
AVERAGE FILTERABLE BETA ACTIVITY IN AIR
JANUARY-FEBRUARY-MARCH
1 9 5 0

units - uc/liter

LOCATION	JANUARY AVERAGE	FEBRUARY AVERAGE	MARCH AVERAGE	QUARTERLY
200 East, SE	1.8 x 10^{-9}	1.2 x 10^{-9}	1.4 x 10^{-9}	1.4 x 10^{-9}
200 West, Twr #4	1.6 x 10^{-10}	3.9 x 10^{-10}	4.5 x 10^{-10}	3.8 x 10^{-10}
Gable Mountain	3.9 x 10^{-10}	8.6 x 10^{-10}	3.4 x 10^{-10}	5.2 x 10^{-10}
Richland	1.0 x 10^{-10}	8.8 x 10^{-11}	1.0 x 10^{-10}	9.5 x 10^{-11}
Pasco	6.0 x 10^{-11}	1.0 x 10^{-11}	1.4 x 10^{-10}	9.0 x 10^{-11}
300 Area	1.1 x 10^{-10}	2.0 x 10^{-10}	1.8 x 10^{-10}	1.7 x 10^{-10}
200 East Twr #16	3.3 x 10^{-9}	1.4 x 10^{-9}	3.1 x 10^{-9}	2.6 x 10^{-9}
Benton City	2.2 x 10^{-10}	1.6 x 10^{-10}	2.2 x 10^{-10}	2.0 x 10^{-10}
Hanford	1.8 x 10^{-10}	8.8 x 10^{-11}	2.8 x 10^{-10}	1.9 x 10^{-10}
White Bluffs	8.0 x 10^{-11}	2.4 x 10^{-10}	2.1 x 10^{-10}	1.9 x 10^{-10}
3000 Area North	8.0 x 10^{-11}	1.2 x 10^{-10}	1.4 x 10^{-10}	1.2 x 10^{-10}
200 West Twr #15	3.0 x 10^{-11}	3.3 x 10^{-10}	4.9 x 10^{-10}	3.9 x 10^{-10}
200 West Gate	5.1 x 10^{-10}	4.8 x 10^{-10}	6.9 x 10^{-10}	5.7 x 10^{-10}
100-D Area	2.0 x 10^{-10}	3.1 x 10^{-10}	1.6 x 10^{-10}	2.2 x 10^{-10}
100-H Area	*	1.2 x 10^{-10}	8.0 x 10^{-11}	1.0 x 10^{-10}

* Monitoring equipment installed during February, 1950.

[redacted]

Measurements of the concentration of 8 day iodine (I-131) were accomplished by employing caustic scrubbers in series with the air filters and motoaires. The scrubber solution consists of approximately 2 liters of solution containing 4 grams of sodium hydroxide and 10.6 grams of sodium carbonate. Sodium iodide is added to this solution as the carrier. A review of the I-131 detected in the air at the various locations during the quarter showed a decrease from the average activity measured during October, November, and December of 1949. Again, this decrease was a result of the decrease in the amount of iodine involved in the dissolvers during this period. The highest activity in the I-131 scrubbers was detected at the 200 West Area Gate location where the average for this quarter was 2.0×10^{-9} uc/liter. The higher I-131 measured at this location is in very good agreement with the amount of I-131 measured on the vegetation; the maximum I-131 on vegetation was detected at this same location during each of the previous quarterly periods. In the 200 East Area, the I-131 activity was of the order of 10^{-10} uc/liter except for the month of March when the over-all average was 1.1×10^{-9} uc/liter. This increase in March may be associated with the increased amount of iodine involved in the 200 East Area dissolver during that month. Scrubbing units were established at Gable Mountain and 200 East Tower #16 during this quarter. The results obtained from these stations along with the remaining stations placed randomly throughout the project showed average I-131 activity on the order of 10^{-10} and x 10^{-11} uc/liter at all locations with a predominance of results around the latter figure in the residential areas of Benton City and Richland. Table IV summarizes the monthly averages obtained at the various locations used in the scrubber monitoring program. A graphic comparison of the quarterly averages may be referred to in Figure 11.

TABLE IV
AVERAGE I-131 DETECTED IN SCRUBBERS
JANUARY-FEBRUARY-MARCH
1950

units-uc/liter

LOCATION	January AVERAGE	February AVERAGE	March AVERAGE	Quarterly AVERAGE
200 West Area Gate	2.4×10^{-9}	2.0×10^{-9}	1.8×10^{-9}	2.0×10^{-9}
Benton City	1.0×10^{-10}	3.3×10^{-11}	2.0×10^{-11}	4.9×10^{-11}
200 East-SE	6.2×10^{-10}	2.2×10^{-10}	— *	*
300 Area	9.0×10^{-11}	1.3×10^{-10}	5.8×10^{-11}	8.8×10^{-11}
Richland	9.3×10^{-11}	2.0×10^{-11}	2.6×10^{-11}	5.1×10^{-11}
100-H Area	8.7×10^{-10}	5.5×10^{-10}	1.8×10^{-11}	3.9×10^{-10}
200 East Twr #16	9.4×10^{-10}	2.6×10^{-10}	1.2×10^{-9}	8.8×10^{-10}
Gable Mountain	2.3×10^{-10}	2.0×10^{-10}	1.5×10^{-10}	1.8×10^{-10}
3000 Area	3.4×10^{-10}	3.0×10^{-11}	3.6×10^{-11}	1.0×10^{-10}

* Unit not operating during this period.

The small filter papers that were exposed at the locations listed in Table III and Table IV was radioautographed by exposing filter paper to K type x-ray film for 168 hours. The number of radioactive particles deposited on these filters was estimated by counting the number of individual darkened areas on the developed film.

The number of particles detected on these filters showed very little trend occurring throughout the quarter. During the quarter, a total of fifty-one particles were found on the filter obtained from the 200 West gatehouse location and 30 particles were found on the 200 East Tower #16 location; during the previous quarter the total particles found at locations in those Areas ranged from 0 to 5 particles per filter per week. The average concentration of particles in the air in the 200 Areas as measured on the small filters was about 5.0×10^{-3} particles/cubic meter of air. Of the ten locations removed from the separations areas, only four locations showed any particle deposition. The number of particles detected at these locations ranged between 3 and 6 particles for the entire quarter. A summary including all locations at which particles were detected on small filters is presented in Table V; this summary includes the monthly and quarterly average as well as the total volume of air sampled.

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TABLE V
SUMMARY OF PARTICLE DEPOSITION ON SMALL FILTERS
JANUARY-FEBRUARY-MARCH
1950
units of 10^{-3} particles/meter^3

LOCATION	Volume of Air Sampled (m^3)	JANUARY AVERAGE	FEBRUARY AVERAGE	MARCH AVERAGE	QUARTERLY AVERAGE
White Bluffs	6,844	*	0.9	1.4	0.9
Hanford 614	7,002	*	0.9	0.3	0.4
100-D Area	6,529	0.8	1.2	0.4	0.8
Benton City	5,090	*	0.1	1.4	0.6
200 East Twr #16	5,588	6.9	5.0	5.5	5.4
200 WEC	5,575	4.5	3.7	17.8	9.1
200 W Tower #4	5,782	*	1.4	4.4	2.4
200 ESE	6,783	2.9	2.8	4.8	3.7
200 West Twr #15	6,854	0.6	1.1	5.3	3.1

* Indicates no particles detected during period indicated.

Supplementing the study of the number of particles deposited on the small air filters, special filters were installed at numerous locations on and adjacent to the Hanford Works specifically designed for particle estimation. These units employed CWS #6 type filter paper; the exposed area to filtering was approximately 26 square inches. Air was pulled through the filter directly from moto-aires which were rated at 2 or 10 cubic feet per minute. The air was sampled through the filter for a period of one week, at the end of which time the filter was removed and exposed to K-type x-ray film for a period of 168 hours. Normally, the filters removed from locations on the site were exposed the same week that they were removed from the locations; those filters that were obtained from remote locations were exposed within two weeks from the date of their removal. The number of particles were estimated by visually counting the darkened spots on the developed film. Table VI is a summary of particle deposition rates at locations in the immediate environs of the 200 Areas.

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TABLE VI
SUMMARY OF PARTICLE DEPOSITION
JANUARY-FEBRUARY-MARCH
1 9 5 0

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

LOCATION	TOTAL AIR SAMPLED m^3	JANUARY AVERAGE	FEBRUARY AVERAGE	MARCH AVERAGE	QUARTER AVERAGE
200 EAST & VICINITY					
2704 (Outside)	37090	0.4	0.5	1.1	0.7
H. I. Garden	32684	2.6	1.0	1.3	1.7
BY-SE	37203	1.1	0.5	2.4	1.4
BY-NE	8704	1.3	1.1	4.5	2.5
"B" Gate	7806	0.4	0.4	2.0	1.2
222-B (Outside)	35749	1.4	1.5	0.9	1.3
2701 (Outside)	37103	0.8	0.5	1.2	0.9
2704 (Inside)	37144	0.8	0.3	1.2	0.8
221-B Outside Gallery	9174	2.8	5.0	1.7	3.0
222-B Hall	8829	5.6	8.5	4.3	6.0
222-B Laboratory	8673	361.2	465.2	185.1	323.3
2701 (Inside)	8470	1.8	3.2	2.2	2.5
200 WEST & VICINITY					
2701 (Outside)	27172	1.2	1.7	4.5	2.7
2722 (Outside)	24101	1.4	1.3	8.0	4.1
"T" Gate	34622	11.7	2.3	6.1	6.4
231 (Outside)	35142	0.2	4.7	2.7	2.7
So. Guard Tower (Out)	37143	0.4	3.4	1.4	0.9
"U" Gate	32680	<0.1	1.0	2.3	1.3
West Guard Twr (Out)	35950	0.1	1.1	0.8	0.7
222-T (Outside)	6683	26.9	7.4	15.6	15.9
2701 (Inside)	9091	2.5	4.1	12.5	6.7
272 (Inside)	8471	2.2	0.4	4.4	2.5
222-T (Hall)	8472	11.9	7.9	8.2	9.0
222-T Laboratory	1975	---	---	218.2	218.2
METEOROLOGY TOWER					
3'	40,004	---	0.4	3.0	1.4
50'	40,004	---	0.2	2.1	0.9
100'	32,472	---	0.2	3.1	1.3
150'	28,041	---	0.3	7.4	3.1
200'	25,740	---	0.8	3.9	2.0
250'	25,740	---	0.3	4.6	2.0
300'	20,247	---	0.6	4.7	1.5
350'	22,611	---	0.6	6.3	2.8
400'	15,991	---	1.0	3.7	2.0

[redacted]

A review of the data shows that very little fluctuation in the deposition rates were observed from month to month; however, the averages noted for the quarter were considerably higher than those observed previously at the monitoring locations in the laboratory building. The current quarterly average deposition rates of 0.3 particles/cubic meter is approximately 6 times greater than the average noted during October, November and December, 1949, at the 222-B laboratory. Similarly the current average of 0.2 particles/cubic meter at the 222-T laboratory is approximately 5 times greater than that observed during the previous quarter. With the exception of these inside locations, the particle deposition data showed that very few particles were detected outside of the 200 Area exclusion zones. The average number of particles did not exceed 7.0×10^{-3} particles/cubic meter at any location.

Filters were operated at 50 foot intervals from the ground level to 400 feet on the meteorology tower between the 200 West and 200 East Areas. As in the previous quarter, the maximum deposition was found at the 150 foot level which is the elevation that compares favorably with the height of the seperation areas stacks. The quarterly average at this elevation was 3.1×10^{-3} particles/cubic meter. The significance of this maximum deposition is questionable as the concentration found at the 350 foot elevation was 2.8×10^{-3} particles/cubic meter. The data do indicate that the deposition rate at elevations greater than 150 feet above ground were from 2 to 3 times higher than those found near the surface. Table VI includes a summary of the data obtained at the meteorology tower; the absence of data for the month of January was due to the ice and sleet which prevailed at this time and made climbing the tower extremely hazardous.

In addition to those units located in the environs of the 200 Areas, several monitoring installations were operated around the Hanford Works perimeter and in the nearby residential communities. The average number of particles detected at these locations did not exceed 5.0×10^{-4} particles/cubic meter during the quarter at any given location. The data show that very few particles were leaving the

200 Area environs and that the deposition of these particles was random. The month to month data show no trend and the over-all data are in good agreement with that obtained during the previous quarter.

The number of particles detected at locations throughout the states of Washington, Oregon, Idaho, and in Montana showed no trend or significant departure from previous results; the total number of particles collected at these locations was negligible. A summary of the particle deposition rates for the locations on the project perimeter and those off area locations discussed above is presented in Table VII:

TABLE VII
SUMMARY OF PARTICLE DEPOSITION
ON AREA AND OFF AREA LOCATIONS
JANUARY-FEBRUARY-MARCH
1950

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

LOCATION	TOTAL AIR SAMPLED	JANUARY AVERAGE	FEBRUARY AVERAGE	MARCH AVERAGE	QUARTERLY AVERAGE
Hanford Area					
100-B	34,876	<0.1	<0.1	0.1	0.2
100-D	34,905	0.1	0.1	0.2	0.1
White Bluffs	35,539	0.1	0.4	0.2	0.2
100-F	29,835	0.7	0.2	0.5	0.5
Off Area					
Benton City	36,692	<0.1	0.1	0.3	0.1
Pasco	36,709	0.3	0.2	0.1	0.2
Richland	34,570	0.1	0.5	0.3	0.3
Distant Locations					
Boise, Idaho	9,866	<0.1	<0.1	<0.1	<0.1
Klamath Falls, Ore.	13,117	<0.1	<0.1	<0.1	<0.1
Stampede Pass, Wash.	10,926	<0.1	<0.1	<0.1	<0.1
Great Falls, Mont.	11,708	<0.1	<0.1	<0.1	<0.1
Walla Walls, Wash.	13,017	0.2	<0.1	<0.1	0.07
Meacham, Oregon	12,875	<0.1	<0.1	<0.1	<0.1
Lewiston, Idaho	13,921	<0.1	<0.1	<0.1	<0.1
Spokane, Wash.	8,908	----	0.3	<0.1	0.1

SECTION III

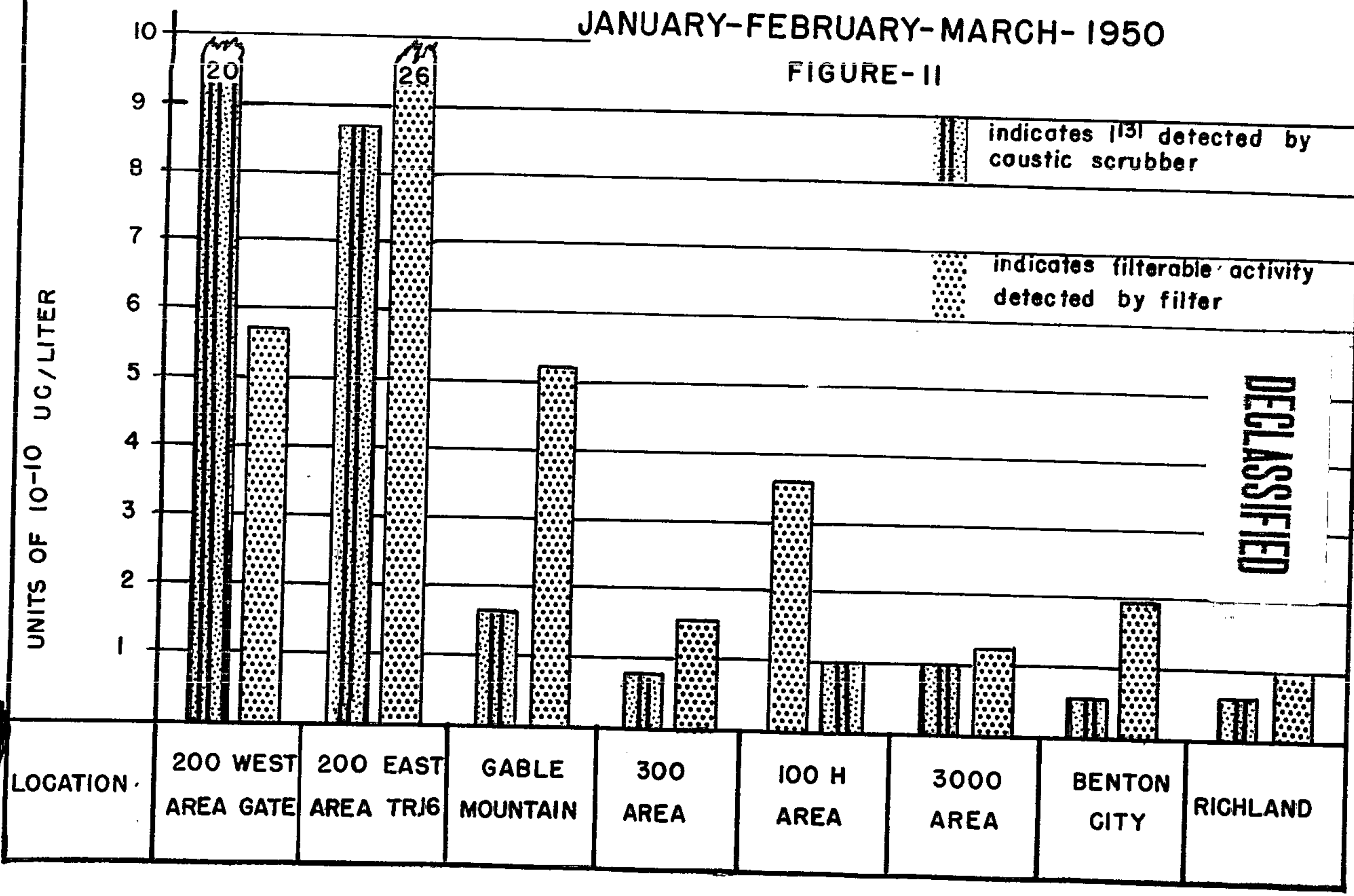
(Please refer to Figure 11.)

[redacted]

AVERAGE BETA ACTIVITY DETECTED IN ATMOSPHERE

JANUARY-FEBRUARY-MARCH-1950

FIGURE-11



SECTION IV
RADIOACTIVE CONTAMINATION IN HANFORD WASTES

100 AREAS:

About two hundred 500 ml. samples of radioactive effluent water were collected from the 107 basins in the four 100 Areas during the period January, February, March, 1950. The average beta activity measured in these samples was 546, 638, 576, and 524 muc/liter at the 100-B, 100-D, 100-F, and 100-H Areas, respectively. These average results include only those samples which were analyzed within twelve hours of collection time and were representative of the activity in the basins during pile operating conditions.

The above averages represent a significant rise in activity levels at all locations. The most significant increase in activity in any of the pile area retention basins within the quarter was noted at 100-H Area; the power level increased from 275 MW to 330 MW during this period.

The increases noted in 100-B, 100-D, and 100-F Areas are shown in the table below:

TABLE I
RADIOACTIVE CONTAMINATION IN 107 BASINS
AVERAGE BETA ACTIVITY - muc/liter

	1949			1950			
	October	November	December	January	February	March	Quarter Average
100-B Area	438	453	454	519	539	567	546
100-D Area	378	368	380	393	605	777	638
100-F Area	388	501	394	660	589	509	576

These overall average increases were attended by some individual high values obtained during January, February, and March, 1950. During January, results of 1.5, 2.1, and about 3 uc/liter were measured on samples obtained from 100-B, 100-F, and 100-H Areas, respectively. The highest result, obtained from the 100-D effluent during the quarter, was about 1.7 uc/liter; this sample was collected in March.

[redacted]

A study of the 107 basin flow patterns and retention times is in progress at the present time. A more thorough determination of the relative amounts and decay of the radioactive isotopes found in the pile effluent waters is also being made and should aid in the explanation of the erratic results such as measured during this quarter.

Total alpha activity in samples of each of the 107 basins averaged less than 8 dis/min/liter. Fluorophotometer analyses of the majority of these samples indicated that no significant amounts of uranium were present. Spot analyses for plutonium and polonium also indicated no alpha activity from these sources.

200 AREAS:

Table II summarizes the results of radio-chemical analyses of about 275 samples taken from the 200 Area waste systems:

TABLE II
RADIOACTIVE CONTAMINATION IN 200 AREA WASTES
JANUARY-FEBRUARY-MARCH
1950

LOCATION	TYPE SAMPLE	ALPHA dis/min/kg		BETA EMITTERS units muc/kg	
		MAXIMUM	AVERAGE	MAXIMUM	AVERAGE
T Swamp	water	674	63	0.8	<0.1
T Swamp	mud	5.5×10^5	1.1×10^5	310	60
U Swamp	water	96	20	<0.1	<0.1
Laundry Ditch	water	1900	290	0.8	0.1
Laundry Ditch	mud	4.3×10^4	1.9×10^4	1300	220
231 Ditch	water	230	60	<0.1	<0.1
200 E "B" Ditch	water	15	<6	2.1	0.5
200 E "B" Ditch	mud	9×10^3	4×10^3	710	320
200 E "B" Swamp	water	<6	<6	0.4	0.3
200 E "B" Swamp	mud	3×10^3	2×10^3	320	200
234-35 Ditch	water	33	11	<0.1	<0.1
234-35 Ditch	mud	8.2×10^4	1.4×10^4	30	17
Laundry Lint	solid	4.2×10^6	8.8×10^5	530	160
Retention Ponds					
200 East	water	24	<6	2.4	0.3
200 West	water	11	<6	0.1	<0.1

[redacted]

The general activity levels tabulated above do not vary more than expected from those of the previous quarterly reporting period.

Eleven samples of laundry rinse water from the 200 West Laundry building averaged 0.7 muc/liter beta activity with a maximum result of 2.0 muc/liter. Alpha activity averaged about 1000 dis/min/liter including a maximum result of 5900 dis/min/liter. Fluorophotometer analyses of these samples indicated the alpha activity to be due to uranium, with results ranging as high as 4700 ug U/liter. As would be expected, uranium was also confirmed as the alpha emitter measured in laundry ditch and laundry lint samples.

Fluorophotometer analyses of samples obtained from the "T" Swamp, "U" Swamp, and 231 Ditch indicated no uranium to be present at those locations. One sample of waste water obtained from the 231 Ditch measured about 300 dis/min/liter alpha activity due to plutonium.

The frequency of direct sampling of the 200 East Area "B" Swamp was increased during this quarter; the higher activity noted during the later part of 1949 in this region prompted this increase. Alpha and beta activity measurements during this period were considerably lower than noted previously; the alpha activity in the mud currently averaged 4000 dis/min/liter as compared with an average of 7000 dis/min/liter during the previous quarter.

Portable instrument surveys (VGM) indicated maximum radiation levels of about 500 c/m above background in the vicinity of the 200 West "T" Ditch and Swamp and near the laundry ditch. Maximum levels of nearly 4000 c/m above background were detected above the mud along the 200 East "B" Ditch during surveys completed this quarter.

Land surveys in the separations areas indicated that radiation levels varied from background to about 150 c/m above background, with the exception of the areas downwind and close to the stacks where readings as high as 500 c/m above background were not unusual.

[redacted]

200 North Area waste ditch surveys showed usual radiation levels in the "P" and "R" ditches, ranging as high as 24,000 c/m. The "N" ditch, which was dry during February, showed abnormally high levels when surveyed in March. Instrument readings over mud ranged from 20,000 c/m to over 100,000 c/m above background. This condition was referred to the H. I. Operation Division for further monitoring to determine the extent of personnel hazard existing at this location.

300 AREA:

Table III is a summary of the radioactive contamination detected in waste samples collected from the 300 Area waste ponds during January - February - March, 1950.

TABLE III
RADIOACTIVE CONTAMINATION IN 300 AREA WASTE
JANUARY FEBRUARY MARCH
1 9 5 0

LOCATION	ALPHA ACTIVITY dis/min/liter Maximum	Average	BETA ACTIVITY muc/liter Maximum	Average
Old Pond Inlet (liquid)	12000	2200	4.5	1.1
New Pond Inlet	9200	1500	16.1*	0.2
	dis/min/kg Maximum	Average	uc/kg Maximum	Average
Old Pond Inlet (mud)	1.3×10^7	3.6×10^6	5800	830

* This is the highest beta result recorded since the start of sampling at this location. However, samples from the Old Pond Inlet have previously yielded as high or higher results than the one above.

The results of fluorophotometer analyses of the above samples showed uranium activity of 7.3×10^4 ug/liter and 6.5×10^7 ug/kg on water and mud samples, respectively; this analysis indicates that the alpha activity was primarily from uranium.

Fifty-nine liquid waste samples were collected directly from the 300 Area waste line which empties into the old and new ponds. The average beta activity

[redacted]

detected on these samples was about 0.4 muc/liter with a maximum result of 5.0 muc/liter. Alpha activity averaged about 1000 dis/min/liter, not including a maximum result of 18000 dis/min/liter. Fluorophotometer analyses results of these samples averaged about 700 ug U/liter, not including a high result of 41000 ug U/liter, which was the maximum amount of uranium measured to date. Analyses of nineteen of these samples indicated traces of plutonium, the average being less than 6 dis/min/liter and the maximum, 15 dis/min/liter.

SECTION IV

SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA AND YAKIMA RIVERS

The radioactive contamination in the Columbia River was measured by analyzing 500 ml. samples and 12 liter samples. The 500 ml. samples were analyzed for the total beta and alpha emitters; the 12 liter samples were analyzed specifically for the long life activity (greater than 14.8 hour sodium) and for uranium.

With the exception of a short period during the cold weather when the river was iced along the shore, samples were obtained weekly from sixteen representative shore locations. These weekly samples were supplemented periodically with surface cross section and depth cross-section surveys; the frequency of the activity dispersion studies was dependent on the changing flow of the Columbia River. The activity measurements discussed in this report were made by evaporating the water sample and mounting the residue on a flat one inch diameter stainless steel plate and counting the activity from the sample. Thin mica-window counters in which the window thickness varied between 3 and 5 mg/cm^2 were used for the beta determination. These counting rates were corrected for counter geometry, decay, backscatter, and self-absorption effects. The results discussed and tabluated in this report include only those samples which were radio assayed less than twelve hours after the sample was taken from the river to minimize the exorbitant correction factors applied for the decay of the 14.8 hour sodium (Na^{24}.) The alpha activity was determined by transfering the residue from the steel plate to a beaker and performing an ether extraction on the residue using aluminum nitrate as the salting out agent. The alpha activity on these samples was measured on a standard alpha counter. The raw data were corrected for 52 percent geometry and for the efficiency of the extraction analysis which was determined by analyzing control samples to which known quantities of plutonium or uranium were added. Those samples in which alpha activity was indicated were further analyzed by the TTA process for plutonium.

The source of the radioactive contamination present in the Columbia River is

[redacted]

the radioactive effluent of the four pile areas; this water is discharged into the river after a short holdup period in the 107 retention basins.

The average flow rate of the Columbia River, as measured by the Power Division in Richland during the period January, February, and March, 1950, was approximately 544,000 gallons per second. This average flow rate represents a small increase over the previous quarter average of approximately 455,000 gallons per second. This increase was weighted toward the end of the current period when the flow rate approached 765,000 gallons per second as compared with a flow of about 500,000 gallons per second during January and February. With the exception of the last ten days in March when the flow rate increased from 585,000 gallons per second on March 24 to 765,000 gallons per second on March 31, the current flow data do not show any significant trend during the period under discussion. Figure 12 summarizes the trend of the measured flow rate of the Columbia River during the quarter; the data for the previous three months are included for a better evaluation of the trend during the current period.

A summary of the results of radiochemical analysis of the alpha and beta emitters in the Columbia River samples is presented in Table I:

[redacted]

TABLE I
RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER
JANUARY FEBRUARY MARCH
1 9 5 0

LOCATION	Number Samples	ALPHA EMITTERS dis/min/liter Maximum	Average	BETA EMITTERS uuc/liter ** Maximum	Average
Wills Ranch	11	7*	<6	<50	<10
Above 100-B Area	5	<6	<6	<50	<10
181-B Area	13	10*	<6	1440	190
181-D Area	14	7*	<6	3328	774
181-H Area	13	9*	<6	1794	941
181-F Area	16	8*	<6	2652	1520
Fosters Ranch (Below 100-F)	7	9*	<6	953	613
Hanford South Bank	9	<6	<6	5416	2822
Hanford Middle	11	<6	<6	2675	1425
Hanford North Bank	9	<6	<6	3908	1449
300 Area	9	8*	<6	1606	1100
Richland	15	22*	<6	1640	1221
Pasco Bridge (Kennewick Side)	9	<6	<6	781	558
Pasco Bridge (Pasco Side)	11	7*	<6	893	644

* Results were not confirmed by resample and subsequent analyses.
** The reporting level for individual samples is currently established at 50 uuc/liter; for an average including 4 or more samples reporting level of 10 uuc/liter is used.

The average beta activity measured in samples from the Columbia River showed an increase at all locations except the middle of the river near Hanford. This increase tends to become significant, as the increased flow rate discussed above would normally tend to dilute the activity and reflect a decrease in average activity during this period. The small increase noted was attributed to the start up of operations of the 100-H Area which did not operate at full power level during the previous quarter. Another contributing factor to the increase noted in the beta activity in the Columbia River was the change in power level at the 100-F Area which operated at 275 MW during January and increased to 305 MW during February and March. The power level at the 100-H Area was 320, 330, and 330 MW during January, February and March, respectively. On one occasion during March, the power level at 100-H Area approached 345 MW. A comparison of the average beta activity measured in the Columbia River during this period with similar data from

[redacted]

previous years would show an increase that can be attributed to the additional operation of 100-H along with increased power level in the other areas.

The background beta activity in the Columbia River can be appraised from the samples taken at Wills Ranch and above 100-B Area; the average activity in the samples from these locations was between 3 and 5 μμc/liter with no individual sample exceeding 10 μμc/liter. Each of these locations are above the 100- Areas of the Hanford Works where radioactive effluent is absent.

The first trace of beta activity was detected at the 181-B sampling location where the average activity during the quarter was 190 μμc/liter. This average was not representative of the effluent from the 100-B Area 107 Basin as the sampling location was slightly above the effluent discharge line; this sampline location indicates the extent of the mixing of activity upstream from the discharge line.

The effect on the activity in the river by the addition of the 107-B waste was better appraised at the 100-D sampling location where the average activity was 774 μμc/liter. The beta activity measured on the plant side of the river continues to increase as the sampling locations progress downstream. The contributing 107 wastes from 100-D, 100-H, and 100-F increased the average activity in the river to 2,822 μμc/liter at Hanford. This location represents the maximum activity measured in the Columbia River. Cross-section samples obtained weekly from locations at Hanford near the south bank, the middle of the river, and near the north bank indicated that the bulk of the activity was carried along the plant side or south bank of the river. The beta activity averaged 1425 and 1450 μμc/liter in the middle and on the north bank of the Columbia at Hanford. As these averages were nearly identical, it appeared that during this quarter the activity in the middle and near the north banks were approximately the same but were lower by a factor of two than the average activity measured on the plant side. The maximum individual activity measured in any sample collected from the Columbia River was 5.4 μμc/liter taken from the south bank of the river at Hanford. The principal emitter in these river samples was 14.8 hour sodium (Na-24.)

[redacted]

The average activity in the Columbia River at Richland was 1,221 μμc/liter during the quarter; this average was computed from samples obtained from one locations in the river. Weekly samples were obtained at the 300 Area where the water that is accessible to sampling is extremely dormant compared with the water flow noted at the other sampling locations. The average activity of 1100 μμc/liter noted at this 300 Area location was somewhat lower than that at Richland.

The greatest decrease observed between any two sampling locations was noted between Richland and the Pasco Kennewick Bridge. The average activity decreased from 1200 μμc/liter at Richland to about 600 μμc/liter at the Pasco Kennewick Bridge; this decrease was largely attributed to the flow of the Yakima River which enters the Columbia immediately below Richland. As in the past, the average activity of the Pasco Side at the Pasco Kennewick bridge location was slightly higher than that noted on the Kennewick side; the average of the Pasco side during this quarter was 644 μμc/liter and on the Kennewick side was 558 μμc/liter.(6)

Ether extraction analyses of river samples for uranium and for plutonium indicated the activity from the source to be less than 6 dis/min/liter. The results of the alpha activity measurements in Columbia River water are included in Table I; occasional individual samples indicated alpha activity slightly greater than 6 dis/min/liter but were not confirmed by the subsequent samples taken from these locations.

Background measurements for the alpha and beta activity of the Yakima River were made. Samples were obtained from the mouth and at the Horn each week during the quarter. The alpha and beta activity detected in these samples were below the detection limit and were comparable with those measured in the Columbia River water above the 100-B Area.

Several 3 gallon samples were obtained at Bonneville Dam and analyzed for the beta and alpha activity. The alpha activity in these samples averaged about 2 dis/min/liter; this value is comparable with the alpha activity considered as back-

[redacted]

ground in the Columbia River. The beta activity in samples obtained at Bonneville was less than 10 μμc/liter.

Supplementing the river samples taken from the established representative locations, samples were taken to estimate the surface dispersion pattern of the beta activity in the Columbia River in the vicinity of the Hanford Works. One hundred and forty one river samples were obtained from forty-seven surface cross-section locations between 100-B Area and the Pasco Kennewick Bridge. Three samples were obtained at each cross-section location; these samples were obtained from the middle of the river and from near each bank of the river. The river samples were analyzed the same day they were collected such that large correction factors for the decay of the principal emitter (14.8 half-life Na-24) were minimized.

This survey was representative of the maximum concentration of beta activity in the Columbia River during this quarter. Each of the 100 Areas was operating during this survey; the flow rate of the river was 555,000 gallons per second. A summary of the operating conditions in the pile areas immediately previous to and during this survey is presented in Table II.

TABLE II
OPERATING CONDITIONS AT TIME OF COLUMBIA RIVER SURFACE BETA ACTIVITY
JANUARY-FEBRUARY-MARCH
1950

DESCRIPTION	100-B AREA	100-D AREA	100-F AREA	100-H AREA
Power level at 0800 3/2/1950	275	305	305	330
Last shutdown	15 February	24 February	13 February	28 February
Startup	16 February	25 February	15 February	1 March
Full power attained	16 February	25 February	15 February	2 March
Flow in 107 Basin	32,000 g.p.m.	23,400 g.p.m.	30,800 g.p.m.	38-39,000 g.p.m.
Hold up-time in Basin	2 hours	2 hours	2 hours	4 hours
1904 Dilution flow	4000 g.p.m.	3000 g.p.m.	4000 g.p.m.	4000-5500 g.p.m.
Columbia River flow 3-2-1950	555,000 g.p.s.	555,000 g.p.s.	555,000 g.p.s.	555,000 g.p.s.

The surface dispersion pattern of the beta activity in the Columbia River as determined by this survey was comparable with a similar survey made during March, 1949.[4] The survey indicated that there was no point in the Columbia River

[redacted]

between 100-B area and Pasco where the radioactive contamination was completely mixed with the river water although the degree of mixing approached uniformity just above Richland and further down stream. As in the past, the higher levels of radioactive contamination were measured in samples taken from the plant side of the river in the vicinity of the 100 Areas and Hanford. Immediately below 100-B Area the beta activity was confined to a rather narrow channel which gradually widened to about 400 feet in the vicinity of 100-D Area and 100-H Area. Immediately below 100-F Area and approximately 2 miles above the Hanford Ferry, the beta activity in the river tended to channel directly toward the plant side of the river. It is at this location that the maximum activity was measured in any part of the river. This zone of maximum activity was confined within an area approximately five miles long and five hundred feet wide; the maximum activity of any sample in this area was about 3 $m\mu c$/liter. From Hanford to points further downstream, the mixing of activity was somewhat better than that above Hanford but the higher activities were still measured in samples taken from the plant side of the river. The degree of mixing improved as one ppogressed further downstream such that in the vicinity of Richland the mixing of activity in the river was about as uniform as any other point surveyed in the river. The general activity pattern found at Richland was slightly distorted below the point where the Yakima River entered the Columbia River; the water from the Yakima River tended to divert the activity in the river to the opposite side of the river. This dilution appeared to exist as far downstream as the Pasco Kennewick Bridge. The difference in activity noted in the results of weekly samples at Pasco and Kennewick as shown in Table I were attributed to this effect of the Yakima River on the distribution of activity in the river.

An estimated dispersion pattern of the beta activity as found in the Columbia River during this survey is shown in Figure 13. Figure 14 is a graphic presentation of the individual sample results obtained in the middle and on each side of the Columbia River during this survey.

[redacted]

A cross-section depth dispersion study of the beta activity in the Columbia River at Hanford was completed on March 15. Samples were obtained from the surface at the same time the depth samples were withdrawn. A review of the data obtained from this survey showed no difference in activity when comparing the activity of a given surface sample with samples taken below the surface samples at varied depths. The samples from the intermediate zone between the top and bottom of the river were in agreement with the surface measurements. The major differences in activity were noted across the river; the activity increasing from an average of around 1.0 mμc/liter on the north side of the river to an average of about 5.0 mμc/liter on the south side (plant side). This ratio of increase was reflected at all depths and it appeared that at this point in the river the beta activity was channeled horizontally but uniformly dispersed vertically. Figure 15 portrays the estimated dispersion of the beta activity in this survey including a contour of the river as determined by soundings.

Several special studies of the dispersion pattern of the beta activity immediately below the 100-B Area effluent line in the Columbia River were completed. The irregular dispersion pattern found during previous surveys was confirmed; a very strong current existed in this region. The current tended to channel the activity towards the plant side of the river; only tracer or no activity was detected in samples taken at points in the river outside the small channel.

One hundred and sixty-four mud samples were taken from nine shore locations along the Columbia River. The samples obtained at these locations were taken on shore and five feet out into the river from the shore line. As the river flow remained relatively constant throughout this entire period, no significant trends or changes were noted in comparing the current activity level with those of last quarter. A summary of the beta activity measured in these samples taken from representative locations appears in Table III.

[redacted]

TABLE III
COLUMBIA RIVER MUD SAMPLES
JANUARY - FEBRUARY - MARCH
1 9 5 0

DECLASSIFIED

Location	Number Samples	Beta Activity - mμc/kg Onshore Samples Maximum	Onshore Samples Average	Five Feet From Shore Maximum	Five Feet From Shore Average
Near Wills Ranch	12	20	11	21	11
Allard Pump Station	8	48	15	47	16
At 100-H Area	9	17	12	19	13
Below 100-F Area	9	17	11	22	22
Richland Dock	9	14	11	17	13
At 300 Area	6	32	28	31	13
Pasco Bridge (Pasco Side)	12	21	10	20	13
Pasco Bridge(Kennewick Side)	9	20	12	13	8
Hanford Ferry	8	19	13	30	14

The mud samples were also analyzed for alpha activity from plutonium and/or uranium by the ether extraction method; analyses for uranium were made using the fluorophotometer method. The average activity from the alpha emitters was less than 6 dis/min/gram in all cases; the postive alpha activity noted at the 300 Area location during the previous quarter was not confirmed during this period.

Seven mud samples were taken from the bottom of the river at Bonneville Dam and analyzed for the beta emitters. The total beta activity in these samples was about 6 mμc/kg. Decay study indicated that this activity was from longer half-lived emitters normally detected in the river and included such isotopes as Fe-59, Ca-45, Cr-51, and P-32.

Radiochemical analysis of four samples of algae collected at Bonneville Dam indicated that the activity level were 11, 8, 23, and 78 mμc/kg, respectively, for each sample.

The raw river water which is pumped from the Columbia River at each of the 100 Areas and transported to the operating areas for sanitary purposes via the export line, was sampled at the 183 and 283 building in the 100 and 200 Areas respectively. One hundred and fifty-five samples were analyzed for alpha activity from plutonium and/or uranium and for the beta emitters. The bulk of the sampling was concentrated in the 283 buildings in the 200 Areas where a slight increase in the beta activity was observed over the previous quarter. The analyses for the alpha emitters indicated less than 6 dis/min/liter in all samples; the beta activity measured is tabulated in Table IV:

TABLE IV
BETA ACTIVITY IN RAW WATER RIVER EXPORT LINE
JANUARY FEBRUARY MARCH
1 9 5 0

Location	Number Samples	μμc/liter Maximum	μμc/liter Average
183 Building 100-B Area	12	146	18
183 Building 100-D Area	13	2731	328
183 Building 100-F Area	14	599	286
183 Building 100-H Area	12	644	193
283 Building 200-E Area	51	176	39
283 Building 200-W Area	53	223	57

The beta activity in the raw water was somewhat lower at all areas during this period with the exception of 100-D where the average increased from 165 μμc/liter to 328 μμc/liter during the present quarter. This overall average was weighted by one high result in which the beta activity was 2,731 μμc/liter. This result was not confirmed by subsequent resamples and was approximately two times greater than the highest beta activity noted in the raw water during the past year. Beta activity averaged around 50 μμc/liter in the 200 Areas with occasional samples showing nearly 200 μμc/liter, however, results above 100 μμc/liter were few. Decay studies have indicated that 90 - 95 per cent of the activity in the raw water was from 14.8 hour sodium (Na-24). A review of the averages listed in Table IV showed that the magnitude of activity measured at any of the locations was closely associated with the period of transport in the export lines; those locations which were the most remote to the source of pumping such as 100-B and the 200 Areas showed the least activity in the raw water. Additional decay of the sodium occurs during the retention period in the basin in each of the operating areas; the period of retention is dependent on the consumption in the individual areas.

Twenty-three samples were obtained directly from the retention pond in the 200 Areas. The beta activity measured in these samples averaged less than 50 μμc/liter in each area; occasional individual sample results around

[redacted]

100 μμc/liter were common in this water. These same samples were analyzed for the alpha activity; alpha activity was less than 6 dis/min/liter in the 200 East Area retention pond but some trace of alpha activity was noted in the 200 West Area retention pond. On two occasions during the quarter, one in January and one in February alpha activity of 54 and 45 dis/min/liter was measured in water from the 200 West Area pond. Laboratory contamination was associated with the first result in January as subsequent resamples did not show detectable amounts of alpha activity in this water. The February sample was also discounted for similar reasons; again, the subsequent sample showed negligible activity. Figure 16 is a graph showing the average beta activity measured in the raw water from the respective operating areas; this graph may be compared with Figure 21 in Section VII which shows the beta activity measured in this same water at the time it was used for sanitary purposes.

SECTION V

(Please refer to Figures 12, 13, 14, 15, and 16.)

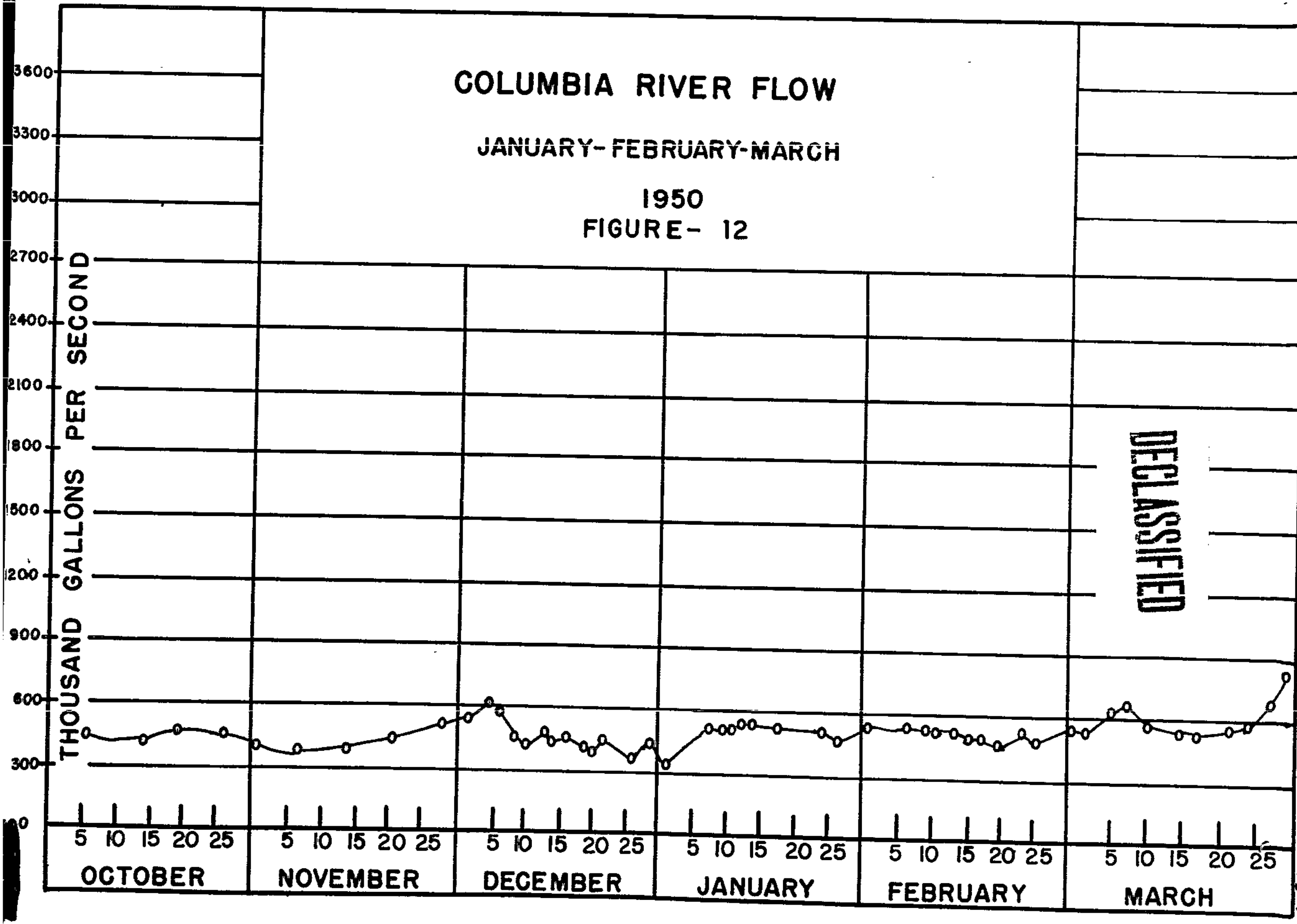
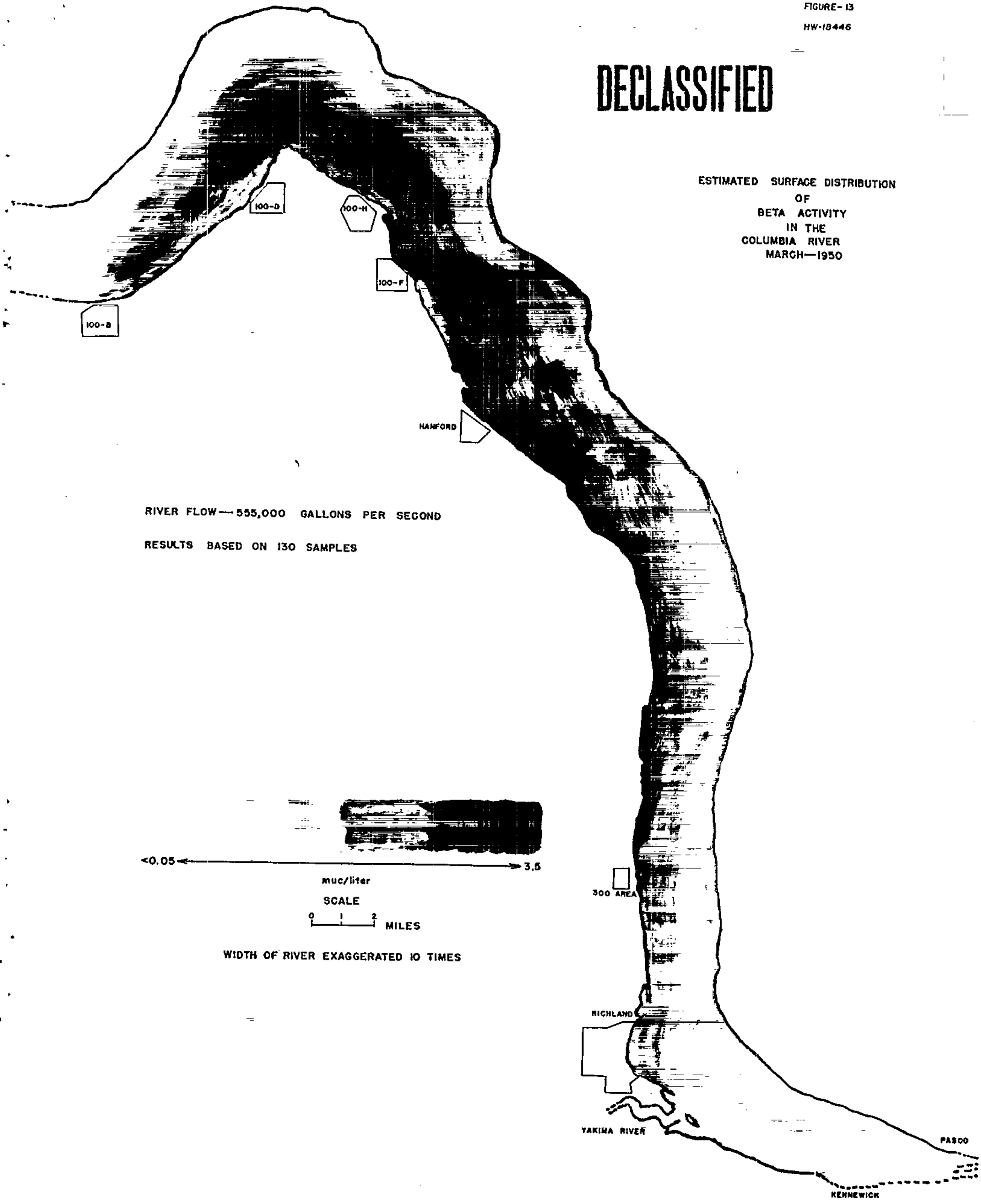

COLUMBIA RIVER FLOW
JANUARY-FEBRUARY-MARCH
1950
FIGURE- 12
THOUSAND GALLONS PER SECOND
3600
3300
3000
2700
2400
2100
1800
1500
1200
900
600
300
5 10 15 20 25
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH

FIGURE- 13
HW-18446

DECLASSIFIED

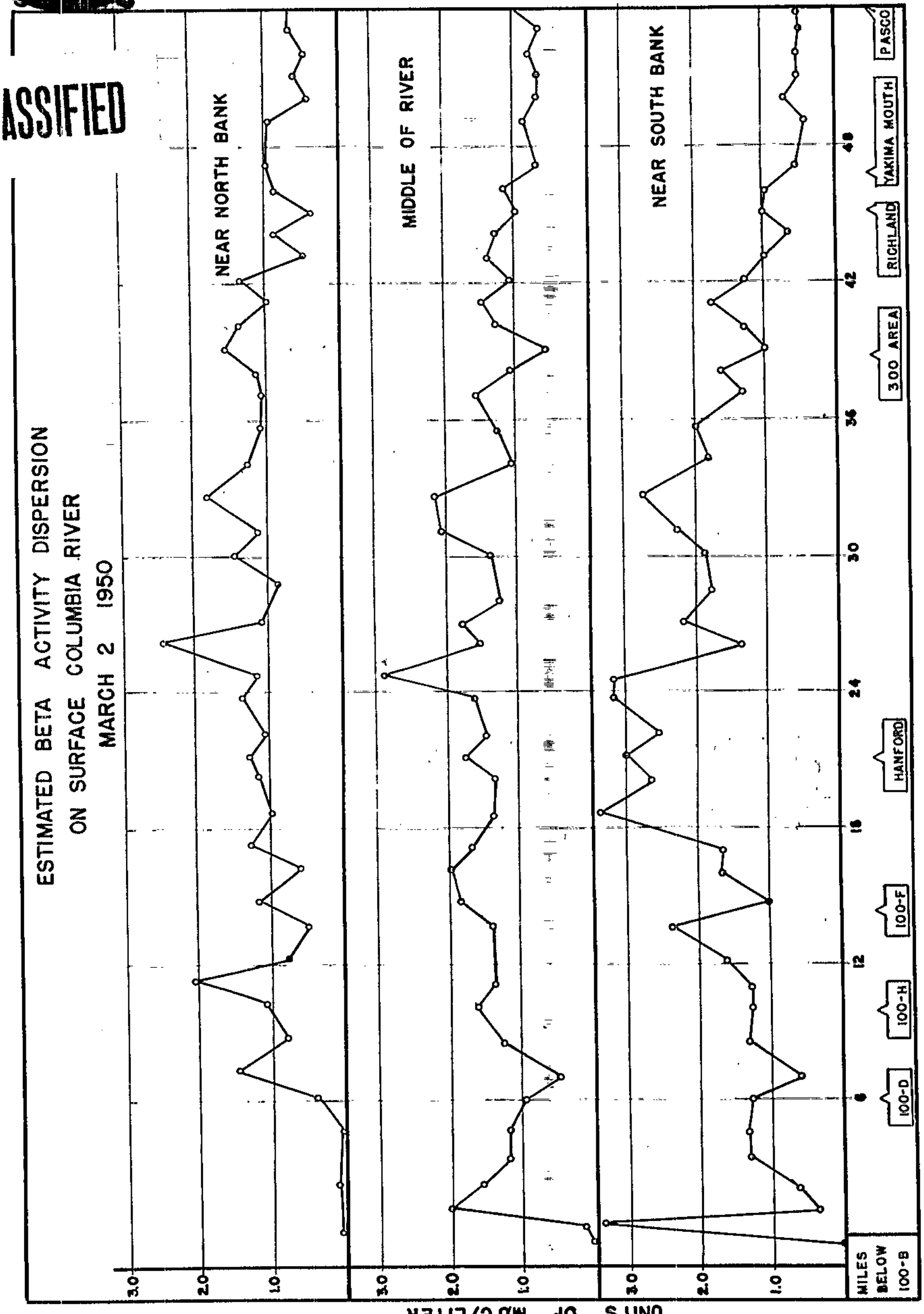
ESTIMATED SURFACE DISTRIBUTION
OF
BETA ACTIVITY
IN THE
COLUMBIA RIVER
MARCH—1950



RIVER FLOW — 555,000 GALLONS PER SECOND

RESULTS BASED ON 130 SAMPLES

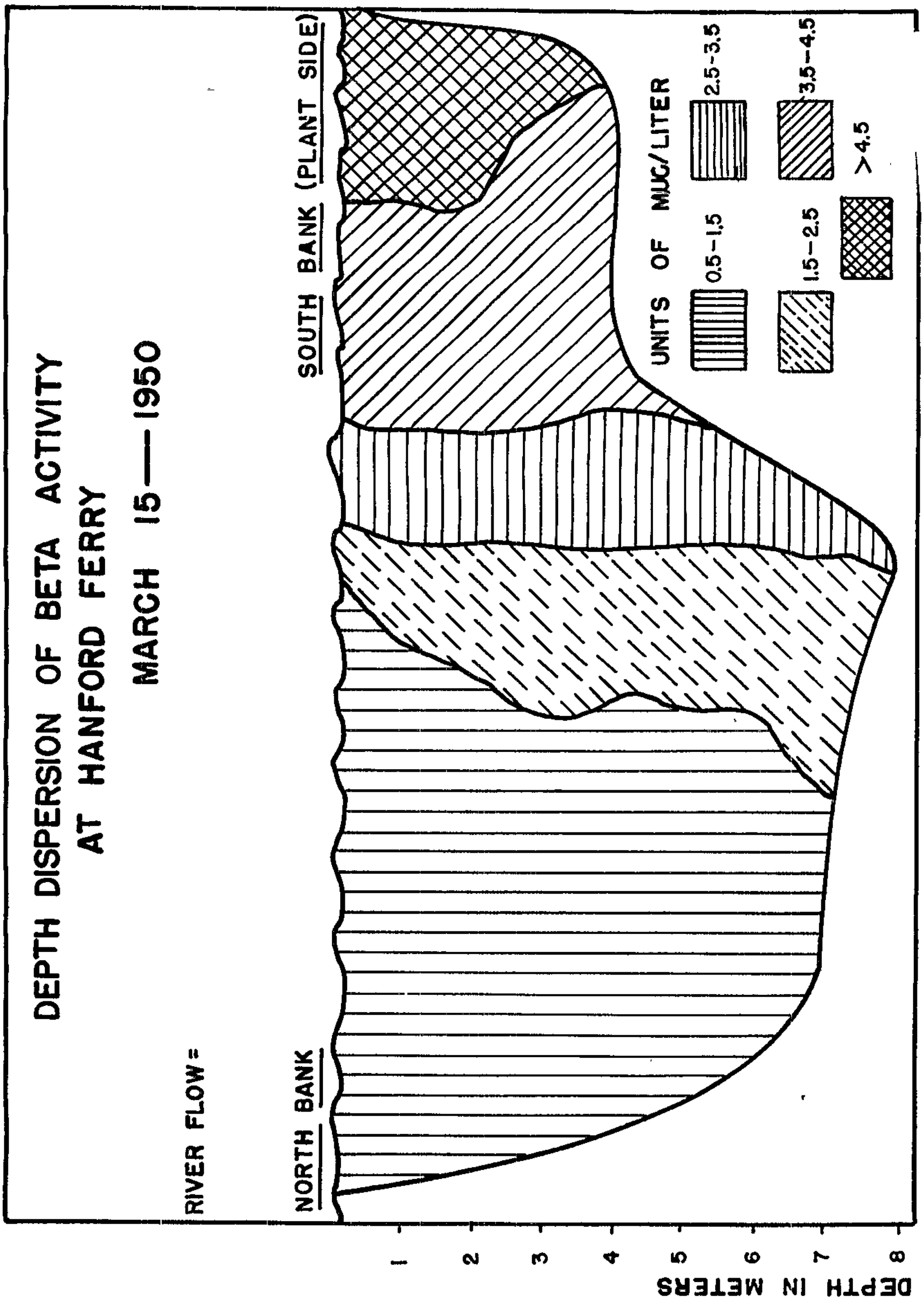
WIDTH OF RIVER EXAGGERATED 10 TIMES


ESTIMATED BETA ACTIVITY DISPERSION
ON SURFACE COLUMBIA RIVER
MARCH 2 1950
NEAR NORTH BANK
MIDDLE OF RIVER
NEAR SOUTH BANK
UNITS OF MU C/LITER
3.0
2.0
1.0
MILES BELOW 100-B
6
12
18
24
30
36
42
48
100-D
100-H
100-F
HANFORD
300 AREA
RICHLAND
YAKIMA MOUTH
PASCO

[redacted]

FIGURE-15

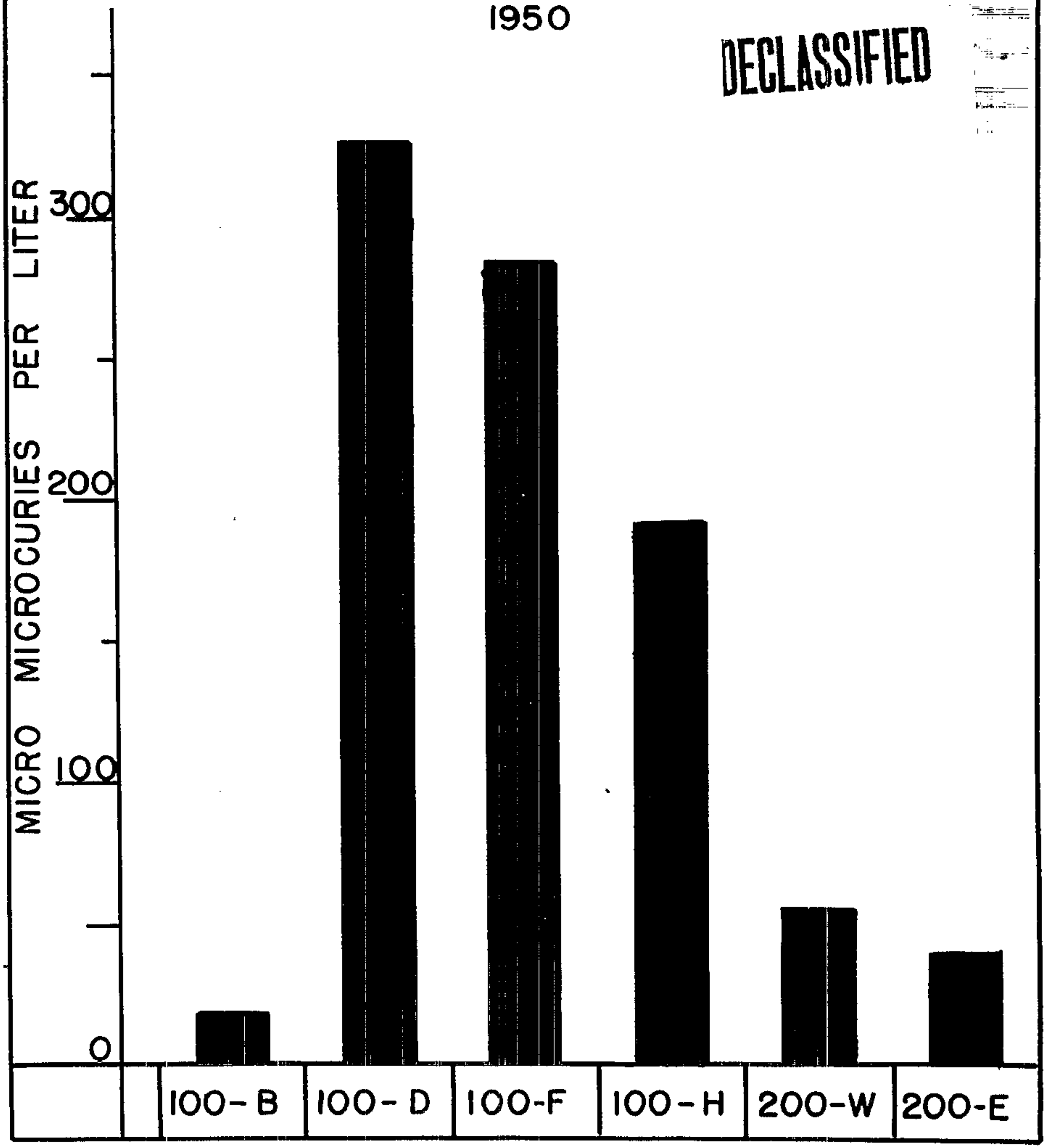
HW-18446



[redacted]

FIGURE-16

AVERAGE BETA ACTIVITY MEASURED IN RAW WATER HANFORD WORKS OPERATING AREAS JANUARY-FEBRUARY-MARCH 1950



DECLASSIFIED

SECTION VI

RADIOACTIVE CONTAMINATION IN RAIN AND SNOW

Three hundred and three samples were collected from twenty-seven locations on and adjacent to the Hanford site. The rain samples were collected in 500 ml vessels which were placed at twenty eight representative locations. The number of samples collected from locations varied from eight to forty-one depending on the amount of precipitation.

A summary of the rainfall data for the period January, February, and March as obtained from the Meteorology Group is presented in Table I; rainfall measurements for two previous years is also included for comparison. The figures represented the total precipitation and include measured rainfall as well as the measured melted snow.

TABLE I

PRECIPITATION MEASURED AT HANFORD WORKS
JANUARY - FEBRUARY - MARCH
units-inches

YEAR	JANUARY	FEBRUARY	MARCH	QUARTERLY TOTAL
1948	1.36	1.69	0.07	2.12
1949	0.13	0.68	1.12	1.93
1950	1.80	1.06	0.87	3.73

The above tabulation indicates that the current period was extremely wet when compared with past years. The meteorology history shows that the thirty-five year mean rainfall for the three month period was 1.81 inches. The precipitation noted during January was influenced by one snowfall which totaled 23.4 inches of snow. This was the greatest amount of snow recorded for one period since the startup of the Hanford Works.

A comparison of the beta activity measured in the rain collected during this quarter with similar measurements made during late 1949, shows that the averages and the maxima have decreased. This decrease was expected as the higher activities measured during December 1949 were abnormally high as

[redacted]

influenced by the activity expelled during the December, 1949 green run.

The average beta activity measured in rainfall collected in the 200 East and 200 West Area was nearly identical; the averages were 2.2 and 2.4 mμc/liter in each area, respectively. The maximum beta activity detected in any rain sample was 24.3 mμc/liter collected about 7000 feet southeast of the 200 East Area stack. This sample showed almost twice as much beta activity as the maximum sample collected in the 200 West Area; the maximum beta activity in 200 West Area rain was 12.5 mμc/liter.

Ninety-nine samples were obtained from locations between the separation areas and the project perimeter. The maximum activity detected in any sample from this region was 6.8 mμc/liter, collected at Route 4S, Mile 6. This location is approximately 2 miles directly downwind from the 200 East Area stack. In general, the average beta activity measured in samples collected from seven locations in the intermediate zone was less than 1.0 mμc/liter.

The beta activity measured in rain samples collected in the 100 Areas environs (includes Hanford 101 Area and White Bluffs Area) averaged 0.2 mμc/liter. The maximum beta activity was 1.3 mμc/liter collected in a sample from White Bluffs.

Sixty-two samples were obtained at locations outside the perimeter barricades. The highest average beta activity in rain was found at Benton City where ten samples averaged 1.4 mμc/kg. This average was influenced by one sample which was collected over a week period, during which the wind prevailed from contributing directions (N) less than ten of the hours that dissolving was in progress. This sample contained 12.5 mμc/liter; this magnitude of activity was comparable with similar measurements made within the 200 East Area.

A summary of the results of the beta activity measurement in rain sample is presented in Table II which includes all locations at which rain samples were collected during the quarter.

[redacted]

TABLE II
RADIOACTIVE CONTAMINATION MEASURED IN RAIN SAMPLES
JANUARY - FEBRUARY - MARCH
1 9 5 0

LOCATION	NO. SAMPLES	BETA EMITTERS units - $\mu\mu c$/liter MAXIMUM	AVERAGE
Meteorology Building	41	2.55	0.60
200 West Area 250' E of Stack	12	12.54	2.11
200 West Area 2000' E of Stack	11	3.49	0.98
200 West Area 3500' SE of Stack	10	9.67	3.60
200 West Area 750' SE of Stack	10	5.54	2.03
200 East Area 1000' E of Stack	10	7.55	1.53
200 East Area 7000' E of Stack	9	24.32	3.39
200 East Area 4900' E of Stack	11	8.77	2.89
200 East Area 8000' SE of Stack	11	7.92	1.85
Route 4S, Mile 6	9	6.80	1.49
300 Area	11	9.35	0.12
Richland	10	0.70	0.27
Pasco	11	0.77	0.16
Benton City	10	12.46	1.35
100-B Area	10	0.19	0.09
100-D Area	10	0.26	0.09
100-F Area	9	1.18	0.20
Hanford	10	0.17	0.05
Riverland	11	0.21	0.14
200 North Area	11	1.16	0.40
Benson Ranch	1	0.04	0.04
Gable Mountain Summit	8	1.18	0.46
Hanford 101 Building	9	0.92	0.28
White Bluffs	10	1.30	0.20
North Richland (South)	8	1.78	0.63
North Richland (North)	11	0.39	0.09
100-H Area	11	0.34	0.07
Batch Plant	8	6.23	1.45

Figure 17 is a graphic portrayal of the results obtained from the rain sampling program this quarter. This graph shows the magnitude of the activity measured at the various zones on and off the Hanford Works.

Sixty-one snow samples were obtained within the 200 Areas on January 19. These samples were collected between 0900 and 1200; snow started falling on midnight January 18 and dissolving was in progress at the 200 West Area between 0105 and 0605 on January 19. The maximum I-131 deposition was observed in the 200 West Area where the average beta activity from I-131 was about 200 $\mu\mu c$/liter of melted snow. The maximum activity measured in the 200 West Area was 970 $\mu\mu c$/liter. The maximum I-131 measured inside 200 East Area was only

23 $\mu\mu c$/liter. An estimation of the distribution of the I-131 on the snow in the separations areas is presented in Figure 18.

SECTION VI

(Please refer to Figures 17 and 18.)

[redacted]

BETA ACTIVITY IN RAIN
HANFORD WORKS & VICINITY
JANURARY — FEBRUARY — MARCH
1950

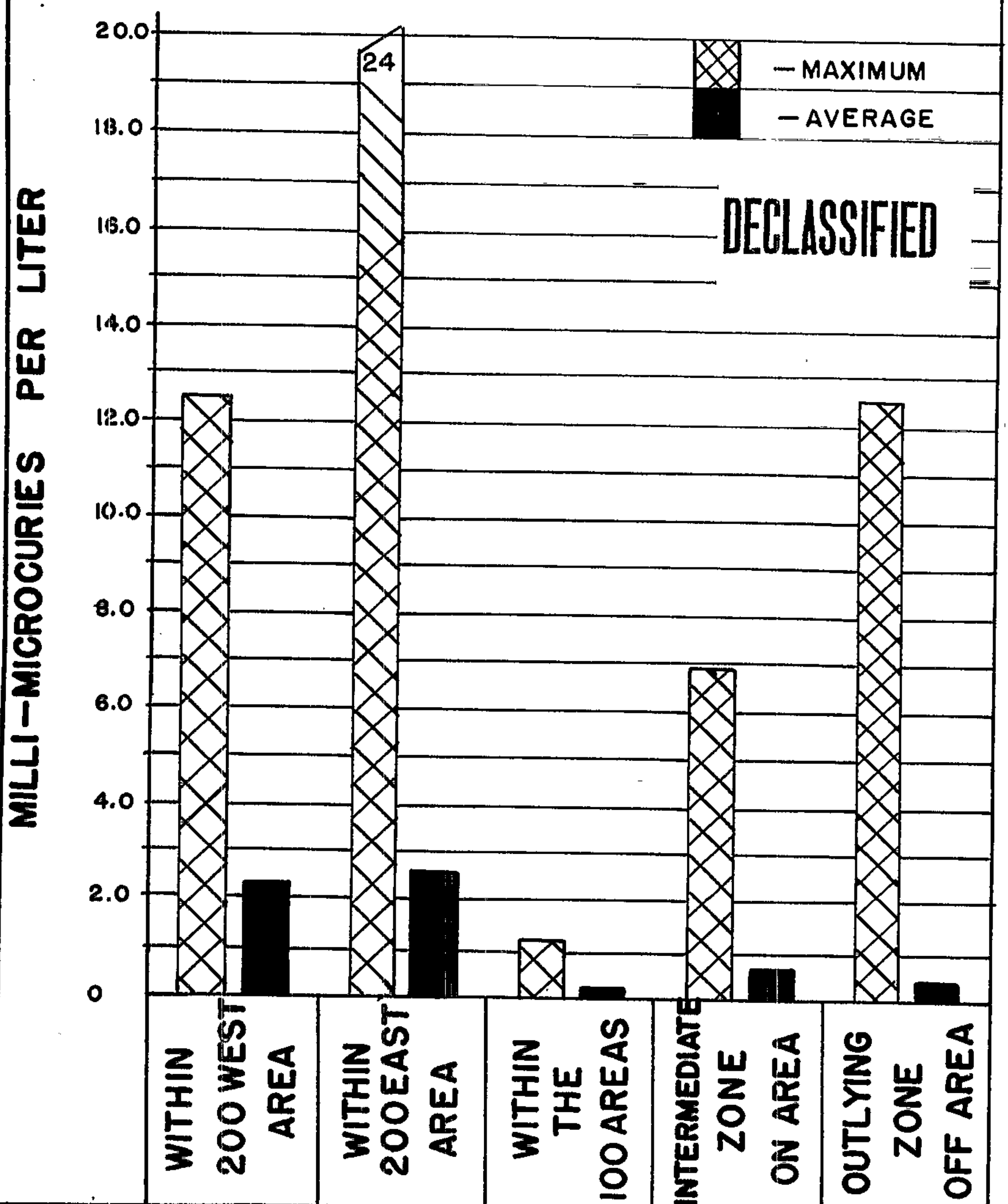


FIGURE - 17

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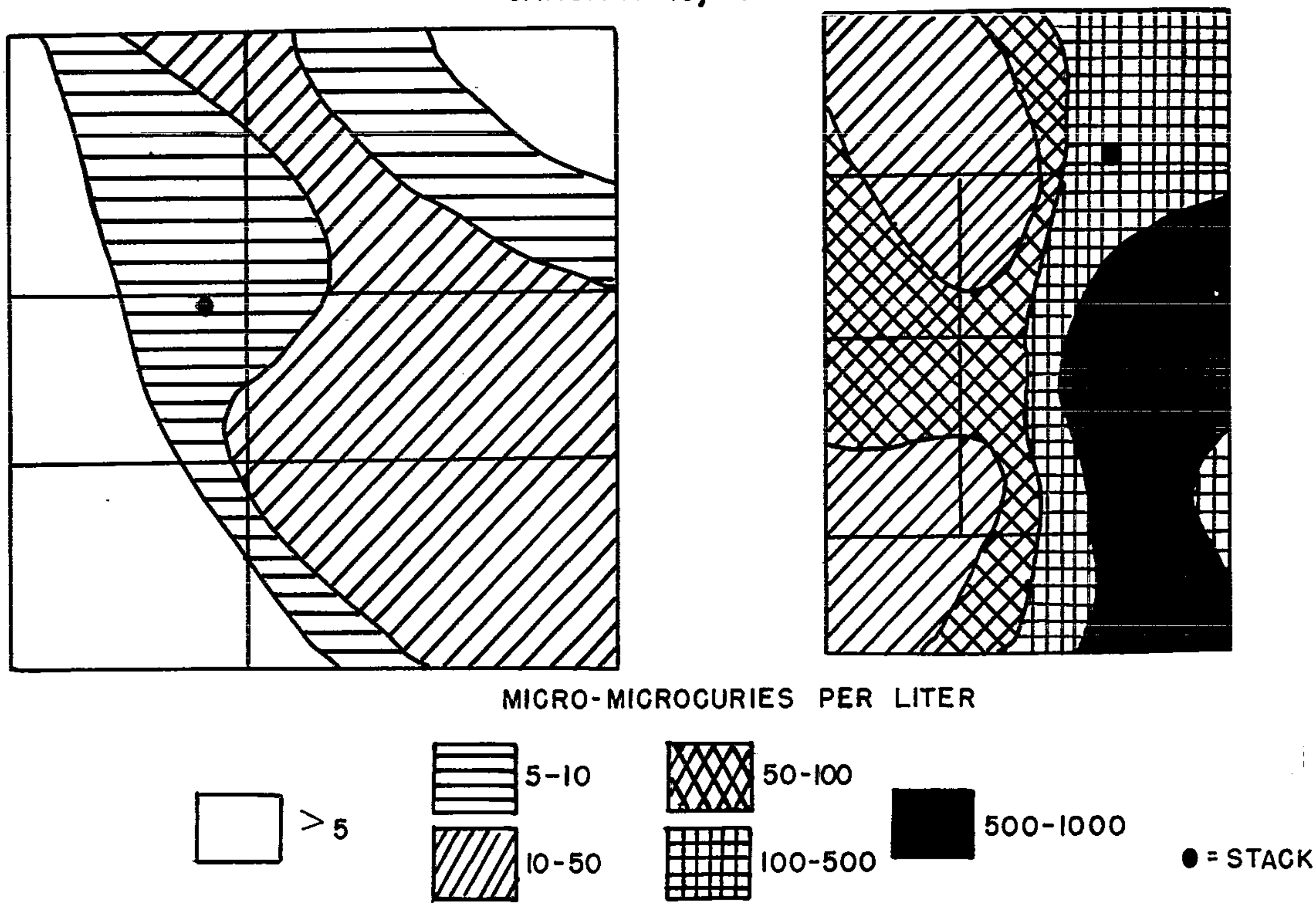
FIGURE-18
ISO-ACTIVITY MAP
BETA ACTIVITY IN SNOW
JANUARY 19, 1950



SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER AND TEST WELLS

The principal source of radioactive contamination in drinking water is the effluent water of the pile areas which are discharged into the Columbia River and subsequently used for drinking purposes after purification in the 100 and 200 Areas and at Kennewick and Pasco and points along the river downstream. Activity from naturally occurring isotopes such as uranium, K-40, and radon is also accounted for in drinking water analyses. The test wells sampled are primarily tested in an attempt to determine seepage of activity from the various disposal areas into the underground water system.

Six hundred and twenty-eight drinking water samples were analyzed during the period January to March, 1950. One hundred and twenty-seven of these samples were 12 liter samples and the remainder were 500 ml. samples. The 500 ml. samples were analyzed for total beta and alpha emitters; the twelve liter samples were analyzed only for the alpha emitters. Most drinking water samples were analyzed specifically for uranium by the fluorophotometer method. Samples of questionable activity or significantly positive were analyzed for plutonium by the TTA extraction process or by the lanthanum flouride precipitation method.

The frequency of sampling drinking water sources varied from monthly to daily depending upon the sampling location, the probability of contamination, and the trend of the past activity measurement. In general, however, the over-all sampling frequency increased during this quarter. Some of the wells were temporarily discontinued during this quarter because of the frozen conditions found at some of the sampling ports during the cold weather period.

The activity measurements discussed in this report were made by mounting the residue of the evaporated water sample on a flat one-inch diameter stainless steel plate and counting the activity from the sample. Thin mica window counters in which the window thickness varied from 3 to 5 mg/cm^2 were used for the beta emitters analyses. The raw counting data were corrected for counter geometry,

[redacted]

and decay when known, backscatter effect, and chemical yield.

The alpha activity from plutonium and uranium in the sample was determined by transfering the residue from the steel plate to a beaker and performing an ether extraction on the residue using aluminum nitrate as the "salting out agent." The activity on the one-inch diameter steel plate was measured using a standard alpha counter and correcting for 52 percent geometry. The raw counting data were corrected for the over-all efficiency of the extraction which was determined by analyzing control samples to which known quantities of plutonium or uranium were added.

The results of the radiochemical analysis of the drinking water samples showed trace quantities of alpha activity in the well system of Richland and Benton City. The amount of alpha activity found in these systems was consistent with similar observations made in the past. The alpha emitter in these samples was confirmed to be uranium as shown by fluorophotometer analyses. This uranium presumably occurs naturally in these water sources samples. The maximum alpha activity detected during the quarter was found at Benton City where the samples obtained from the Water Company well showed a quarterly average of 19 µg U/liter. Samples from the Benton City Store supply showed an average of 16 µg U/liter. The maximum individual result was obtained from the Benton City Water Company well in a sample which showed 45 µg U/liter. The alpha activity from uranium which was detected in the Richland Wells did not approach the magnitude of that found at Benton City. Six of the Richland wells, one of the North Richland Wells, and a well adjacent to the 1100 Area showed average alpha activity between 5 and 20 dis/min/liter. The average uranium measured in all of the Richland wells varied between 5 and 10 µg U/liter. The results of the alpha activity measurements of samples obtained from the Richland wells and Benton City wells are portrayed in Figures 19 and 20.

Table I is a summary of sampling locations where the alpha activity measured in drinking water samples indicated average activity above the detectable limits.

[redacted]

TABLE I
ALPHA ACTIVITY IN DRINKING WATER
JANUARY-FEBRUARY-MARCH
1950

LOCATION	Alpha Activity - dis/min/liter: 500 cc Samples Maximum	500 cc Samples Average	12 Liter Samples Maximum	12 Liter Samples Average	Uranium-μg U/Liter Maximum	Uranium-μg U/Liter Average
3000 Durand #5	9	9	--	--	--	--
Richland Well #13	11	6	7	5	8	5
Richland Well #2	17	9	9	5	10	7
Richland Well #4	23	11	9	7	8	5
Richland Well #14	18	9	9	9	15	6
Richland Well #15	24	9	11	10	11	9
Richland Well #18	17	11	7	4	9	7
Benton City Store	28	19	20	15	21	16
Benton City Water Co.	39	22	24	14	45	19
1100 Area Well #8	13	5	10	6	4	3

* Weekly samples were obtained from each of the above locations except Richland #13, which is sampled three times each week.

Trace amounts of alpha activity were occassionally detected in individual samples obtained from locations other than those listed in Table I, but in no case did the subsequent samples confirm these activity measurements. A complete tabulation of the results of the alpha and beta activity measurements in drinking water samples (both 500 ml. and 12 liter samples) obtained from all the known sampling locations is presented in Tables II and III.

All the wells listed in Table II and III were spot checked for uranium activity by analyzing the samples on the fluorophotometer; trace amounts of uranium varying between 2 and 4 μg U/liter were detected in these wells when trace quantities of alpha activity were measured using the ether extraction method.

Beta emitters in drinking water as determined by analyzing 500 ml. samples showed that this activity was confined to those locations which were either located near the Columbia River or used the Columbia River as their source of supply. With the exception of these drinking water sources, the overall average beta activity in all other drinking water supplies was less than 10 μμc/liter. Wells and sanitary supplies which showed an average beta activity greater than 10

[redacted]

TAPLE II

SUMMARY OF ALPHA ACTIVITY MEASURED IN DRINKING WATER

12 Liter Samples

units of dis/min/liter

JANUARY FEBRUARY-MARCH

1950

LOCATION	NUMBER SAMPLES	MAXIMUM	AVERAGE
1100 Area Well #8	2	10	6
P-11 Well	3	6	3
Fosters Ranch	3	2	2
Columbia Camp	4	5	2
Headgate Well	5	3	< 2
Hanford Well #1	4	4	2
Hanford Well #7	5	3	2
Richland Well #13	3	7	5
Richland Well #2	6	9	5
Richland Well #4	2	9	7
Richland Well #5	2	4	3
Richland Well #12	4	41	2
Richland Well #15	3	11	10
Richland Well #18	5	7	4
Track House J-685	4	2	< 2
Benton City Store	5	20	15
Benton City Water Co.	4	24	14
Cobb's Corner	5	3	2
Kennewich Highlands	4	3	2
Kennewich Std. Sta.	3	6	3

(Cont'd.)

TABLE II
SUMMARY OF ALPHA ACTIVITY MEASURED IN DRINKING WATER
12 Liter Samples
units of dis/min/liter
JANUARY-FEBRUARY-MARCH
1950

LOCATION	NUMBER SAMPLES	MAXIMUM	AVERAGE
Enterprise Well	5	3	< 2
Riverland	5	2	< 2
Midway Well	6	3	< 2
Lower Knob	6	2	< 2
Wills Ranch	4	5	3
Pasco H & R Depot	3	4	2
Segerson's Ranch	6	4	1
Pistol Range	4	5	3
300 Area Sanitary	3	7	5
White Bluffs Ice House	4	5	2

μμc/liter were Kennewick Highlands, Kennewick Standard Station, Pasco H & R Depot, White Bluffs Ice House, and Hanford Well #4. The maximum average beta activity observed during the quarter was at the Kennewick Highlands where an average of 84 μμc/liter was measured; the maximum individual result from this location was 348 μμc/liter. An average beta activity of 71 and 66 μμc/liter at Pasco H & R Depot and Kennewick Standard Station during the quarter, respectively, was measured. These locations where positive beta activity was observed during this quarter generally indicate tracer activity as influenced by the concentration of activity in the river. The higher results observed during October, November, and December of 1949, were closely associated with the low flow of the Columbia River; slightly lower values are expected as the river is now starting to rise with subsequent added dilution of the activity in the river water. The trend of the Columbia River flow during this period may be referred to in Figure 12 of Section V.

[redacted]

TABLE III

SUMMARY OF ALPHA AND BETA-GAMMA ACTIVITY MEASURED IN WATER SUPPLIES
500 ml. Samples
JANUARY-FEBRUARY-MARCH
1950

LOCATION	Number Samples	Alpha Activity dis/min/liter Maximum	Alpha Activity dis/min/liter Average	Beta Activity µµc/liter Maximum	Beta Activity µµc/liter Average
P-11 Well	10	6	3	110	12
1100 Area Well #8	8	13	5	<10	<10
Fosters Ranch Well	8	7	3	18	<10
Columbia Camp	12	4	2	14	<10
Headgate Well	11	9	5	32	<10
Hanford Well #1	7	6	4	39	<10
Hanford Well #4	8	8	4	148	23
Hanford Well #7 San.	37	15	3	24	<10
3000 Durand #5	1	9	9	<10	<10
Richland Well #13	29	11	6	12	<10
Richland Well #2	12	17	9	11	<10
Richland Well #4	14	23	11	13	<10
Richland Well #5	11	11	5	<10	<10
Richland Well #12	11	12	5	17	<10
Richland Well #14	10	18	9	<10	<10
Richland Well #15	7	24	9	10	<10
Richland Well #18	12	17	11	16	<10
Tract House J-685	12	9	3	15	<10
Benton City Store	11	28	19	21	<10
Benton City Water Co.	12	39	22	27	<10
Cobb's Corner	13	8	4	29	<10

(Cont'd)

TABLE III

SUMMARY OF ALPHA AND BETA-GAMMA ACTIVITY MEASURED IN WATER SUPPLIES

500 ml. Samples

JANUARY-FEBRUARY-MARCH

1950

LOCATION	Number Samples	Alpha Activity dis/min/liter		Beta Activity μμc/liter	
		Maximum	Average	Maximum	Average
Enterprise Well	13	5	<2	14	<10
Kennewich Highlands	14	7	3	348	84
Kennewich Std. Station	14	10	3	162	66
Riverland	13	4	2	11	<10
Midway Well	13	7	3	12	<10
Lower Knob	13	21	3	50	<10
Wills Ranch	12	32	5	46	<10
Pasco H.& R. Depot	12	9	3	149	71
Segerson's Ranch	13	6	2	14	<10
Pistol Range	11	7	4	<10	<10
300 Area Sanitary	23	19	4	<10	50
White Bluffs Ice House	11	14	4	197	50
Sanitary Water 100-B	12	7	2	24	<10
Sanitary Water 100-D	13	6	3	18	<10
Sanitary Water 100-F	12	24	4	121	57
Sanitary Water 100-H	15	5	2	133	29
Sanitary Water 200-E	60	15	3	279	20
Sanitary Water 200-W	58	13	3	80	15

Table III includes the results of the beta activity measurements in all wells which were sampled during the quarter.

Positive beta activity was detected in the sanitary water supplies of the operating areas at Hanford Works. This activity appears to be directly related with beta activity measurements in the Columbia River as the maximum average result for the quarterly period was obtained in samples taken at the downstream areas near 100-F and 100-H Areas. The sanitary water in the operating areas is obtained from the raw water in the river export lines and the activity detected is related to the raw water activity which in turn is taken directly from the river. Beta activity averaging 57, 29, 20, and 15 μμc/liter was detected in the 100-F, 100-H, 200-E, and 200-W Area Sanitary supplies, respectively. The 100-B and 100-D sanitary supplies did not show a detectable average beta activity during this period, however, individual results approached a magnitude of activity comparable with the average activity in the other operating areas. The lower activity noted in the 200 East and 200 West sanitary water is apparently due to the retention period and added transport period of the water between the 100 Areas and the 200 Areas. The average transport period is currently estimated at between 10 and 11 hours, however, the specific retention period in the 200 Areas is dependent upon the volume demand in each specified area. Figure 21 portrays the average and maximum beta activity measured at the various sanitary water supplies during the quarterly period.

The sanitary water samples were measured for alpha activity. All results indicated less than 6 dis/min/liter with the exception of the 300 Areas supply which showed an average of 3.6 μg U/liter with an individual maximum of 7.7 μg U/liter. This alpha activity is attributed to the occasional pumping of water from the 300 Area Well system which admits small quantities of uranium known to be present in these wells into the 300 Area sanitary system. A summary of the alpha activity measured in the 300 Area Well system is included in the test well section of this report.

[redacted]

One hundred samples were obtained from the test wells on and adjacent to the site. Eighty of these samples were 500 ml. and twenty were 12 liter samples. The only wells which showed alpha activity were those located in the 300 Area where each of the four wells showed alpha activity exceeding 6 dis/min/liter. Thirty-six samples were obtained from the 300 Area wells with twenty samples being taken directly from well #2 which was the only well used for supplementing the 300 Area sanitary supply. Normally, the 300 Area sanitary supply is obtained from the wells at North Richland. At times when the 200 Area sanitary water supply is below the minimum safe requirements for fire protection the supply is supplemented by pumping water from the 300 Area well system. The trace amounts of alpha activity detected in the 300 Area sanitary system were attributed to those periods when the sanitary water was augmented by water from the 300 Area Wells. Investigation into the pumping data showed that over a million gallons of water were admitted from the 300 Area well during the quarter. The monthly breakdown showed that during the month of January, February, and March, the volume of water admitted was 378,500, 227,500, and 737,150 gallons, respectively.

Twenty samples from well #2 showed the average alpha activity to be 89 dis/min/liter. Each of these samples showed uranium activity; the average during the quarter was 49 µg U/liter which included a maximum of 83 µg U/liter. As observed in the past, considerable day to day variation in the activity measurement were noted, and it is again apparent that confirming results are difficult to obtain. A summary of the results obtained from the measurements of the alpha activity in the 300 Area well system is presented in Table IV.

A graphic portrayal of the day to day variation in the alpha activity measured in 300 Area Well #2 is presented in Figure 22. This portrayal includes the volume of water pumped from this well into the sanitary system, along with the date on which this water was admitted.

[redacted]

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TABLE IV
ALPHA ACTIVITY IN 300 AREA WELLS
JANUARY-FEBRUARY-MARCH
1 9 5 0

LOCATION	Alpha Activity-dis/min/liter 500 cc Samples		Alpha Activity-dis/min/liter 12 Liter Samples		Uranium Activity µg U/liter	
	Maximum	Average	Maximum	Average	Maximum	Average
Well #1	428	229	76	62	210	159
Well #2	211	89	-	-	83	49
Well #3	16	8	5	5	6	3
Well #4	1016	512	-	-	-	-

Samples were obtained from many of the wells which supply irrigation water to the fruit industry located northwest of the Hanford Works. The beta activity in these samples was less than 10 µµc/liter and the alpha activity was less than 5 dis/min/liter in all samples. Twenty-five samples were obtained from these wells.

SECTION VII

(Please refer to Figures 19, 20, 21, and 22)

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

HJP:JP

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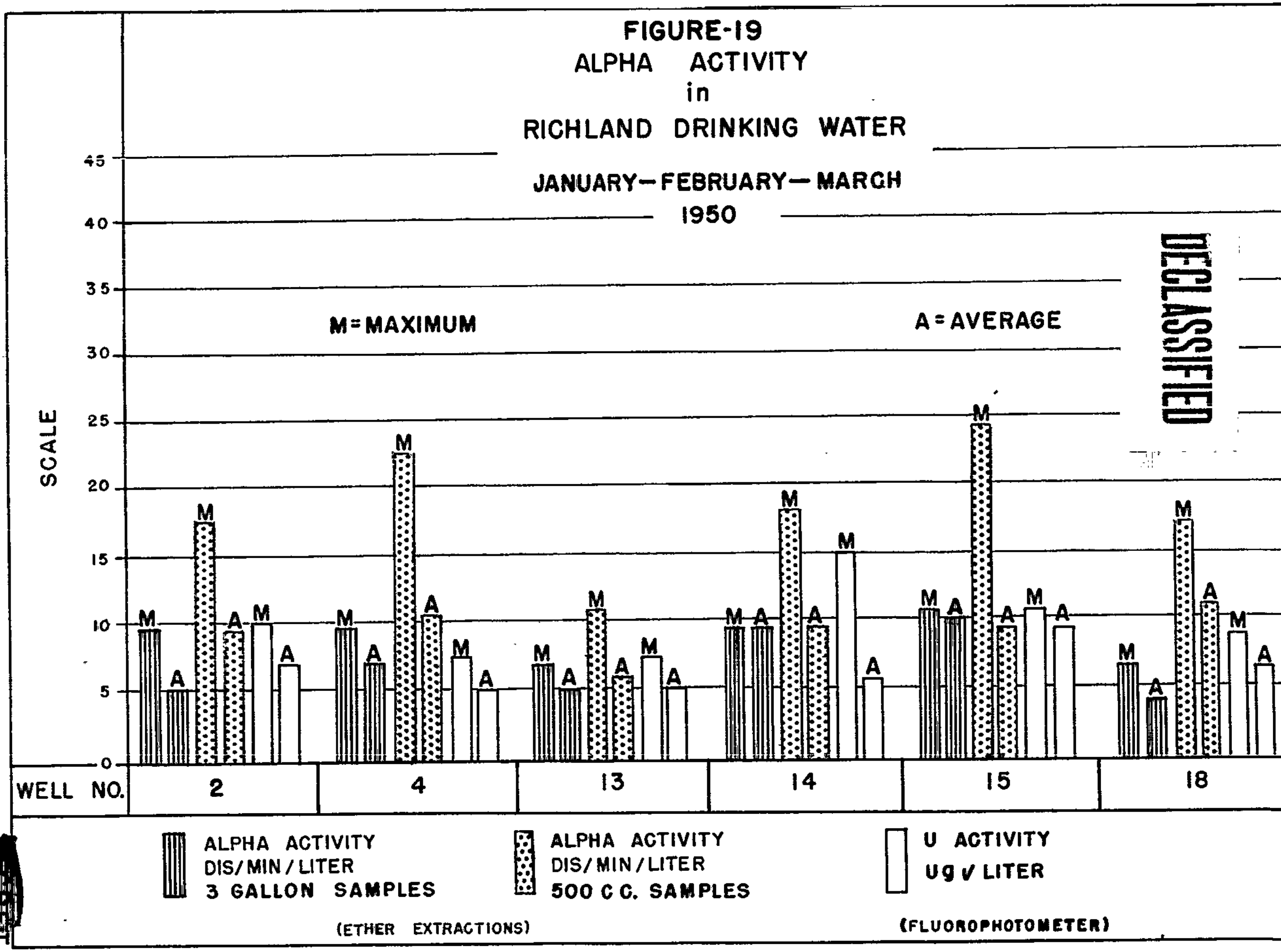
FIGURE-19
ALPHA ACTIVITY
in
RICHLAND DRINKING WATER
JANUARY—FEBRUARY—MARCH
1950
DECLASSIFIED
M = MAXIMUM
A = AVERAGE
SCALE
45
40
35
30
25
20
15
10
5
0
M
A
WELL NO.
2
4
13
14
15
18
ALPHA ACTIVITY
DIS/MIN/LITER
3 GALLON SAMPLES
(ETHER EXTRACTIONS)
ALPHA ACTIVITY
DIS/MIN/LITER
500 C C. SAMPLES
U ACTIVITY
Ug √ LITER
(FLUOROPHOTOMETER)

SECRET

FIGURE- 20

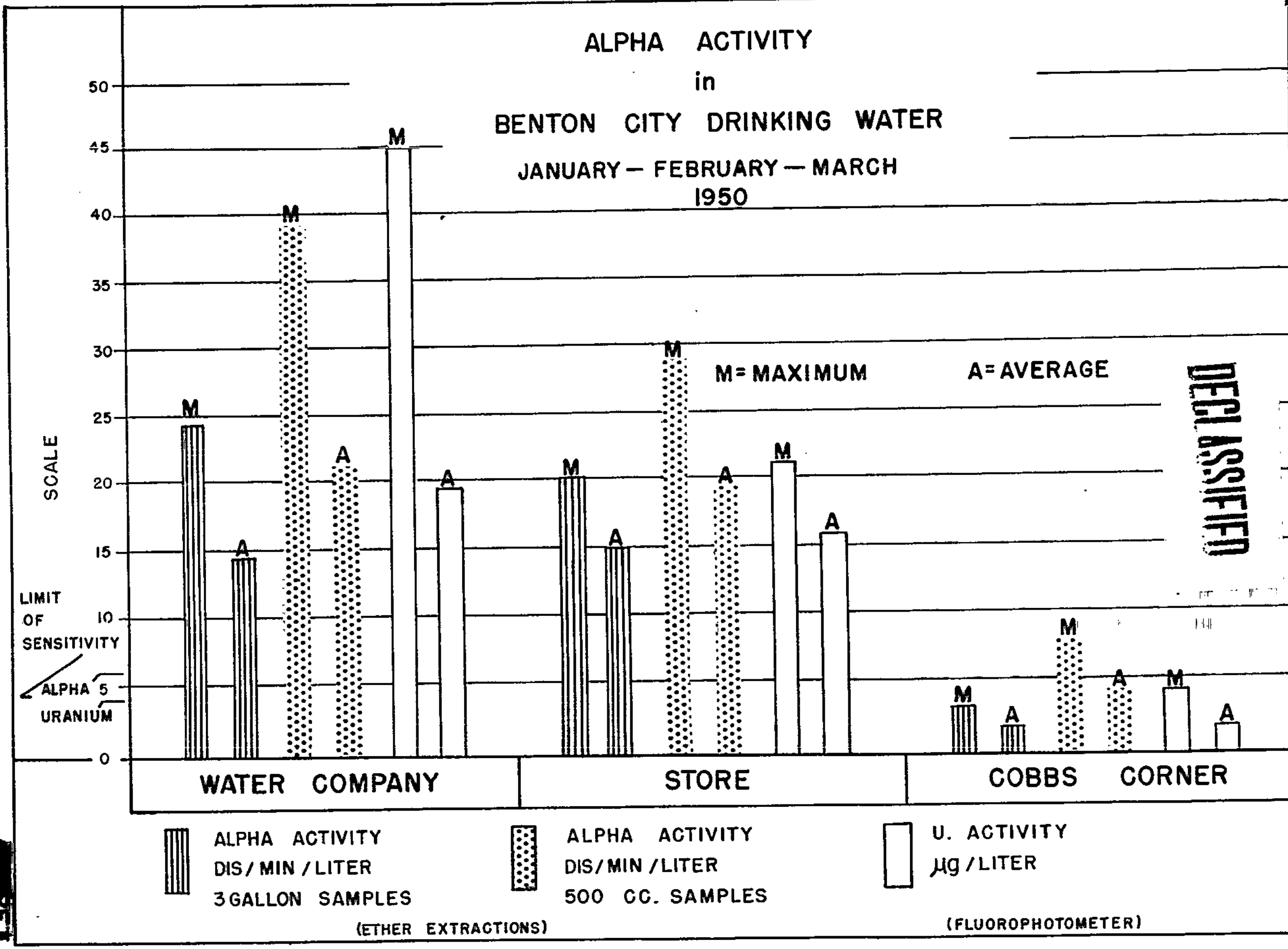

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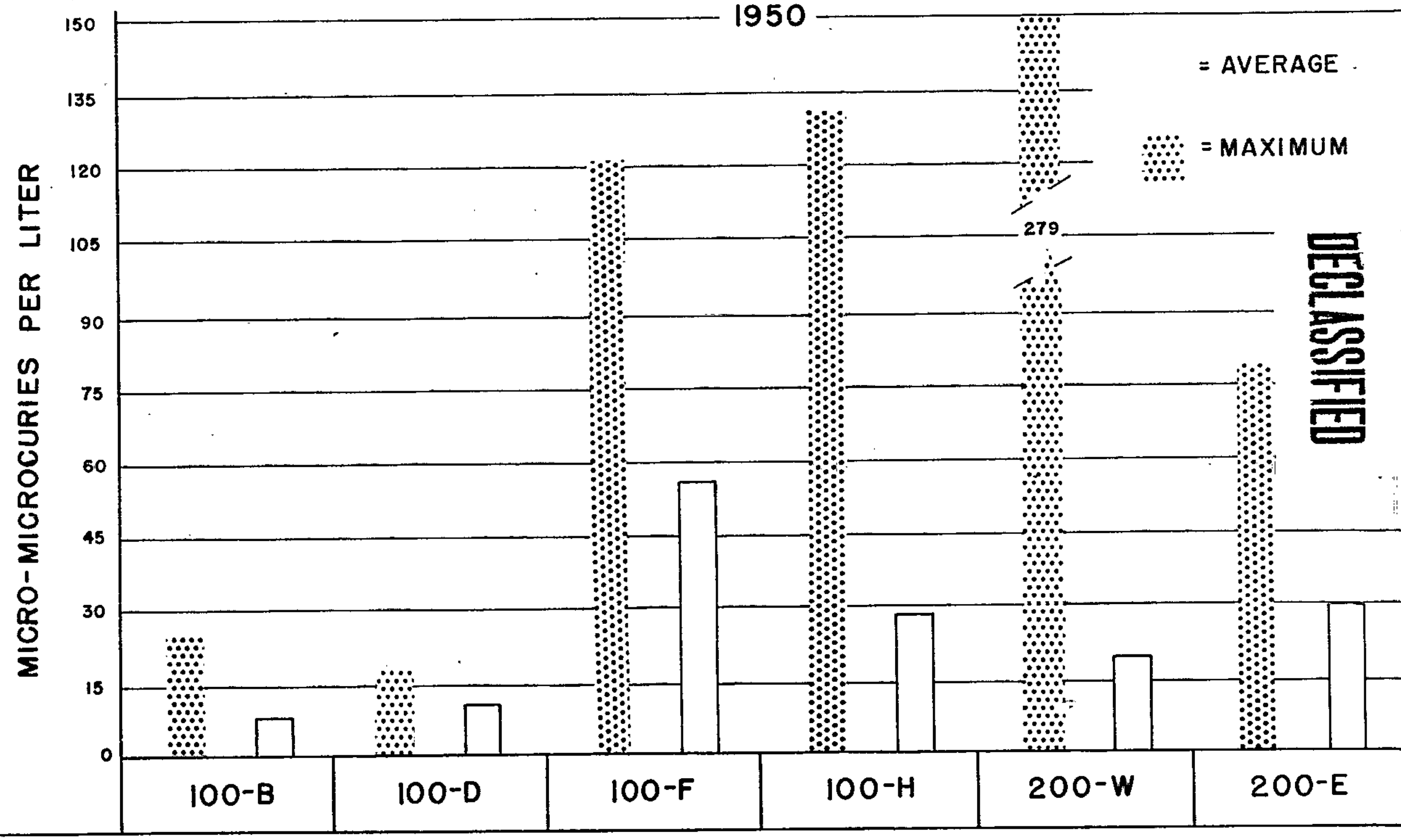
FIGURE-21

BETA ACTIVITY MEASURED IN SANITARY WATER

HANFORD WORKS OPERATING AREAS

JANUARY — FEBRUARY — MARCH

1950



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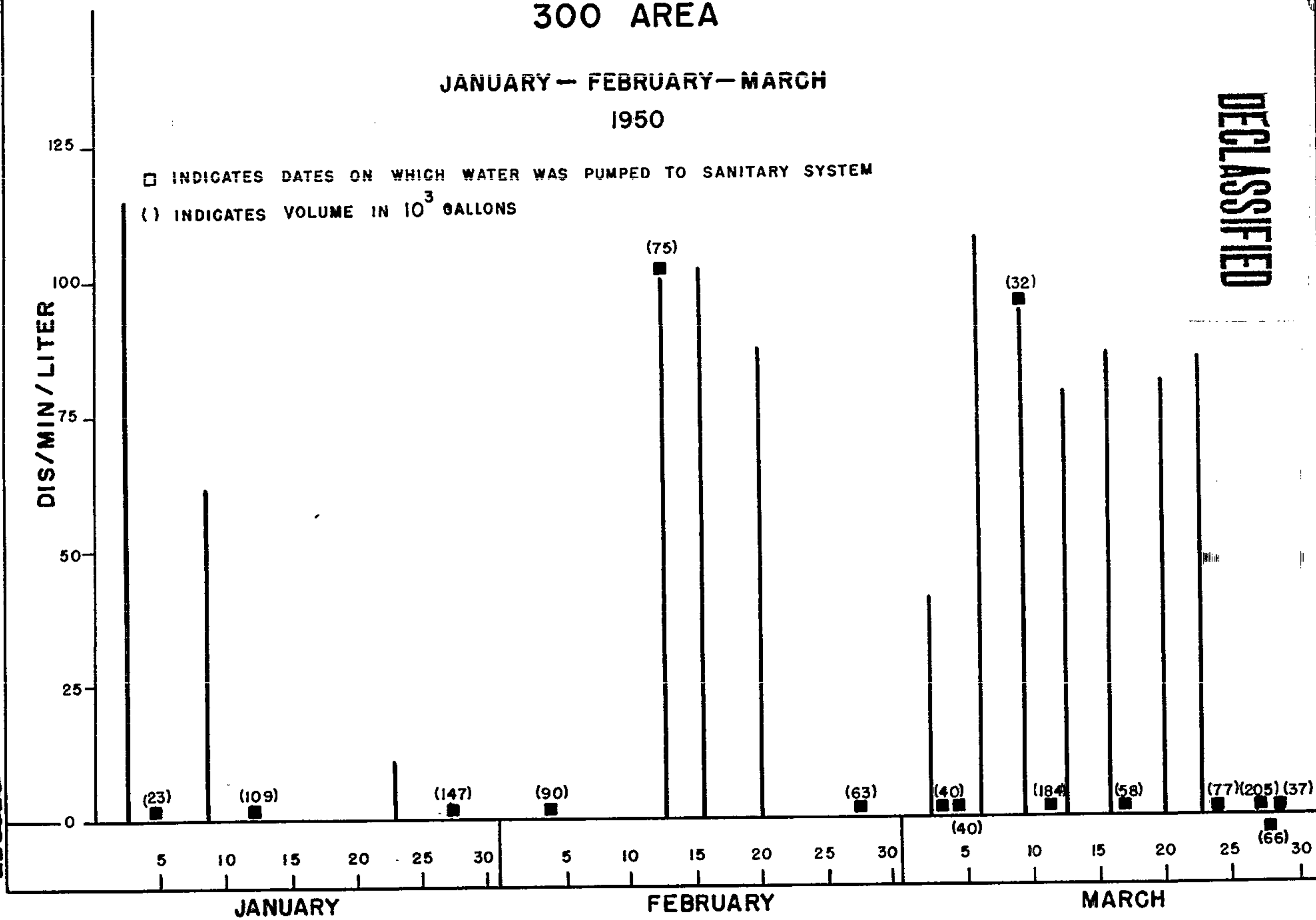
DECLASSIFIED

FIGURE-22
ALPHA ACTIVITY MEASURED IN WELL NO. 2
300 AREA

JANUARY — FEBRUARY — MARCH
1950

□ INDICATES DATES ON WHICH WATER WAS PUMPED TO SANITARY SYSTEM
( ) INDICATES VOLUME IN 10^3 GALLONS



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(4). HW-14243 Radioactive contamination in the environs of the Hanford Works for the period January, February, and March, 1949, by W. Singlevich and H. J. Paas. Issued December 23, 1949.

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