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AEC RESEARCH AND DEVELOPMENT REPORT

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HW-14243

DEVELOPMENT DIVISION

HEALTH INSTRUMENT DIVISION

RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS

FOR THE PERIOD

JANUARY, FEBRUARY, MARCH, 1949

GENERAL ELECTRIC

NUCLEONICS DEPARTMENT

HANFORD WORKS RICHLAND, WASH.

DECEMBER 23, 1949

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS

OF THE HANFORD WORKS

FOR THE PERIOD

JANUARY, FEBRUARY, MARCH, 1949.

[redacted]

By

W. Singlevich and H. J. Paas

December 23, 1949

DEVELOPMENT DIVISION

HEALTH INSTRUMENT DIVISIONS

GENERAL ELECTRIC COMPANY

HANFORD WORKS

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD JANUARY, FEBRUARY, MARCH, 1949

INTRODUCTION:

This report summarizes in somewhat more detail than the monthly H.I. Environs Reports the extent and magnitude of the radioactive contamination detected in the environs of the Hanford Works. Radioactive contamination resulting from the operation of the Hanford Works as well as that found occurring in natural quantities is included. This belated report is being issued merely for the records to serve as a complete summary of measurements already reported in the monthly H.I. Environs reports and covers the quarterly period January, February, and March, 1949.

SUMMARY:

SECTION I- METEOROLOGICAL DATA:

Wind directions in the northwest quadrant prevailed throughout this period as measured within the separations area. The wind directions at the 100 Areas differed significantly from those observed in the 200 Areas. The trend of the deposition of radioactive effluent from the separations area stacks on the vegetation followed the general pattern of the observed wind directions. Charts and graphs summarizing meteorological conditions during actual dissolving hours are attached.

SECTION II- AIRBORNE CONTAMINATION AND AIR RADIATION LEVELS:

Dosage rates measured by C type ionization chambers fluctuated around the normal instrument background of 0.3 to 0.5 mrep/24 hours during this period. N and S type ionization chambers indicated approximately 1.0 mrep/24 hours dose rate near and east of the separations area. In general, all ionization chambers indicated levels of radiation comparable with those levels measured during the previous three months. Filterable beta activity at a station in the 200 East Area was as high as 1.9 x [illegible] µc/liter of air sampled although the overall average activity detected in the [illegible] locations was of the same order of magnitude as that measured in the previous quarter. Detailed data are included in attached graphs and tables. Beta activity from I-131 in the atmosphere as detected by analyzing a scrubber solution through which the air was passed varied between 10^{-9} and 10^{-10} µc/liter inside the 200 [illegible] Areas.

SECTION III- ALPHA AND BETA CONTAMINATION IN THE COLUMBIA RIVER:

The average beta-gamma activity measured in the Columbia River water samples during this period varied from < 50 µµc/liter above the 100-B Area to a maximum of 19[illegible] µµc/liter near the south bank of the river near Hanford and dropping to about 1[illegible] µµc/liter near Pasco. The average river flow was about 350,000 gallons per second. These activity levels are higher than those measured in the previous quarter and are directly a function of the decreased river flow normally experienced at this time of the year. A cross-section survey of the Columbia indicated that the distribution of the radioactive contamination in the river was not uniform from the 100-[illegible] areas to some point just below Hanford; the distribution approached uniformity in the river between 300 Area and Pasco. There is evidence to indicate that the distribution of the activity in the river varied somewhat with the different flow rates of the Columbia normally experienced throughout any year. Decay and absorption studies indicated that 90-95 per cent of the activity in the river was from 14.8 hour sodium (Na^{24}) with 2-5 per cent of the activity contributed by such isotopes as Fe^{59}, [illegible], Sc^{46}, and Cr^{51}. Detailed tables and graphs summarizing all measurements are included.

SECTION IV- ALPHA AND BETA-GAMMA CONTAMINATION IN DRINKING WATER AND TEST WELLS

No outstanding changes or trends were noted in comparing the current levels of radioactive contamination in drinking water samples with those of the previous quarter. The usual 2-10 µg U/liter water presumably occurring as natural ura... was detected in Richland drinking water with slightly higher values for Benton ... water. Beta-gamma activity of 50-60 µµc/liter, principally from Mn^{24}, was mea... in drinking water from the Kennewick-Pasco area. This area uses the Columbia Ri... as its source of supply for drinking water. Beta-gamma activity in raw river wa... varied from <10 µµc/liter to 120 µµc/liter with positive activity detected in the 100-F Area sanitary water only; the average level was 23 µµc/liter. Alpha acti... from plutonium and for uranium in the water supplied by the Columbia River was ... than 6 dis/min/liter. Graphs and tables summarizing all data in detail are inc...

SECTION V - BETA CONTAMINATION IN RAIN:

Beta-gamma activity measured in rain samples collected inside the separation... area varied between 1-20 µµc/liter. The maximum activity in any rain sample was ... µµc/liter collected near the base of the 200 West Area stack. The average activ... in rain samples collected outside the perimeter fence of the Hanford Works was le... than 1 µµc/liter although the highest individual samples in this group was 1.4 µµc/... liter collected in Richland.

SECTION VI - BETA CONTAMINATION ON VEGETATION:

The deposition on vegetation of 8 day iodine and non-volatile fission product... elements emanating from the stacks in the separations area is reviewed. Tables and graphs summarizing detailed measurements are included. The maximum activity from I^{131} detected in any vegetation sample was 383 µµc/kg. This sample was taken abou... one mile from the 200 West Area stack in line with the prevailing northwest wind. This point of maximum ground concentration repeats itself rather consistently. S... µµc I^{131}/kg was detected in a zone about five miles from the stacks dropping to ... ground levels in the vicinity of 3000 Area, Richland, and Pasco. The average acti... ity on the Wahluke Slope was less than 2 µµc I^{131}/kg vegetation with some indiv... samples measuring 5-6 µµc/kg indicating a trace and spotty deposition of Hanford radioactive gas in that area. Some statistical analyses of minute quantities of ... posited radioactive contamination detected on vegetation collected from off area ... tions point to possible trends of slightly higher deposition of I^{131} in Pasco ... Kennewick or Dayton, Washington; in general, however, these average activity levels are below the sensitivity limit for any single individual analysis.

SECTION VII - ALPHA AND BETA CONTAMINATION IN HANFORD WASTES:

Average beta-gamma activity in the 107 basins of the 100-B, 100-D, and 100-F ... was 0.30, 0.31, and 0.37 µc/liter, respectively. The average alpha activity ... samples was less than 30 dis/min/liter. Data from other 100 Area wastes, ... 200 and 300 waste systems are also discussed in detail.

SECTION I

METEOROLOGICAL DATA

A summary of the meteorological data for the hours of metal dissolution is presented in Figures 1 through 4. The meteorological measurements were made at the Meteorology Tower (622 building - 200 West Area) by the Meteorology Group of the Health Instrument Divisions. The period January through March, 1949, is considered in this discussion of meteorological data.

The meteorological observations covered a total period of 1248 hours; this total time element represents the total number of hours in this period when the effluent was discharged into the atmosphere. A breakdown of this time period indicates that the observations were not biased for any one period as dissolving of irradiated uranium took place for about the same total hours in each month. For example, during January, metal was in process of dissolution for 454 hours, 384 hours in February, and 410 hours in March.

During this period, the prevailing wind direction was from the north-west thirty-nine percent of the time. The north-west quadrant accounted for more than fifty percent of the wind. This observation is relatively consistent with previous data. As usually observed in the past, the wind from the north-east quadrant was negligible. Figure 1 is a wind rose showing the percent of time that the wind was observed using an eight point compass; the data presented are the overall three month average condition.

A further breakdown of the wind direction data on a month to month basis is presented on Figure 2. It is interesting to note that some fluctuation is observed in a month to month comparison. The amount of wind observed from the prevailing northwest quadrant and from the northeast quadrant which is at a minimum, showed the least month to month variation whereas month to month variations within a factor of two occurred in comparing the remaining directions. The consist[illegible] this data is of extreme interest as the trend of deposition of the separation[illegible] area stack effluent on vegetation tends to follow the pattern of the wind dir[illegible] reasonably well.(1) (2) (3)

Figure 3 summarizes the average wind directions observed at the 100 Areas; the wind directions at 100-B, 100-D, and 100-F are compared with the correspond[illegible] wind direction measured at the Meteorology Tower, 200-West Area. Again, this [illegible] includes only that portion of the time when irradiated metal was in the process of dissolution. During the period, the prevalance of wind from the West directi[illegible] was considerably minimized when compared with the 200 West Area Meteorology Sta- tion observations. Previous quarterly summations have indicated that this dif- ference in wind directions at the different stations within the Hanford Project proper (4) is a common occurrence. At times, trace quantities of 200 Area stack effluent activity on vegetation is detected in the area east and north of the separation areas; this deposition of radioactive contamination apparently results from the cross-over wind conditions which exist between the 100 and 200 areas.

The month to month variation in the wind direction noted at the 200 West A[illegible] as portrayed in Figure 2 is not nearly as great as the variation noted in the 100 Area Stations. A quick study of Figure 3 summarizing the 100 Area wind directi[illegible] shows clearly the observed variations. The most outstanding difference was noted at 100-D Area, where during the month of March about thirty-eight percent of the wind came from the east, north-west, and north directions; the northeast direction accounted for twelve percent of the wind whereas during the months of January and February only one percent of the wind was observed from the northeast.

The atmospheric dilution ratios which existed during the quarter are graphi- cally portrayed on Figure 4. The aloft condition (dilution factor greater than

[redacted]

2000:1) existed over fifty percent of the dissolving hours; this figure is about the same as noted in previous quarters. The more undesirable dilution ratio of less than 500:1 existed only eleven percent of the time; this is somewhat greater than usually observed. The increase in the observed lower dilution ratio is a direct effect of the increased amount of metal dissolution during daylight hours when the dilution factor is at its lowest ebb in the 24 hour day cycle.

The atmospheric conditions discussed in this report represent only those hours when irradiated uranium was actually being dissolved. Meteorological summations are available for the complete twenty-four hour periods. The monthly summaries issued by the Meteorological Group of the Health Instrument Divisions can be consulted for this data. (5) (6) (7)

SECTION I

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

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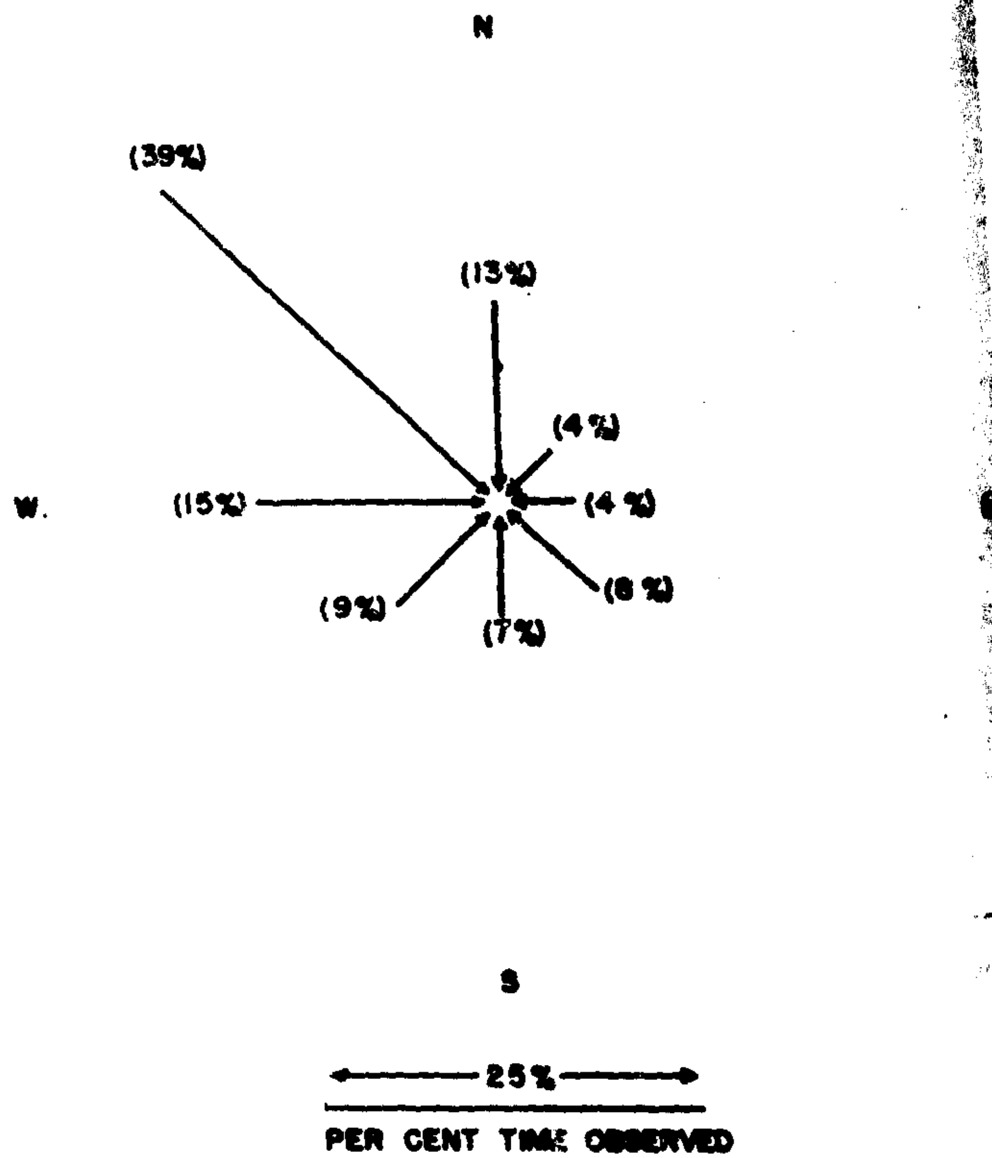
SUMMARY WIND DIRECTIONS — 200-W
DISSOLVING HOURS ONLY
JANUARY — FEBRUARY — MARCH
1949

FIGURE [illegible]



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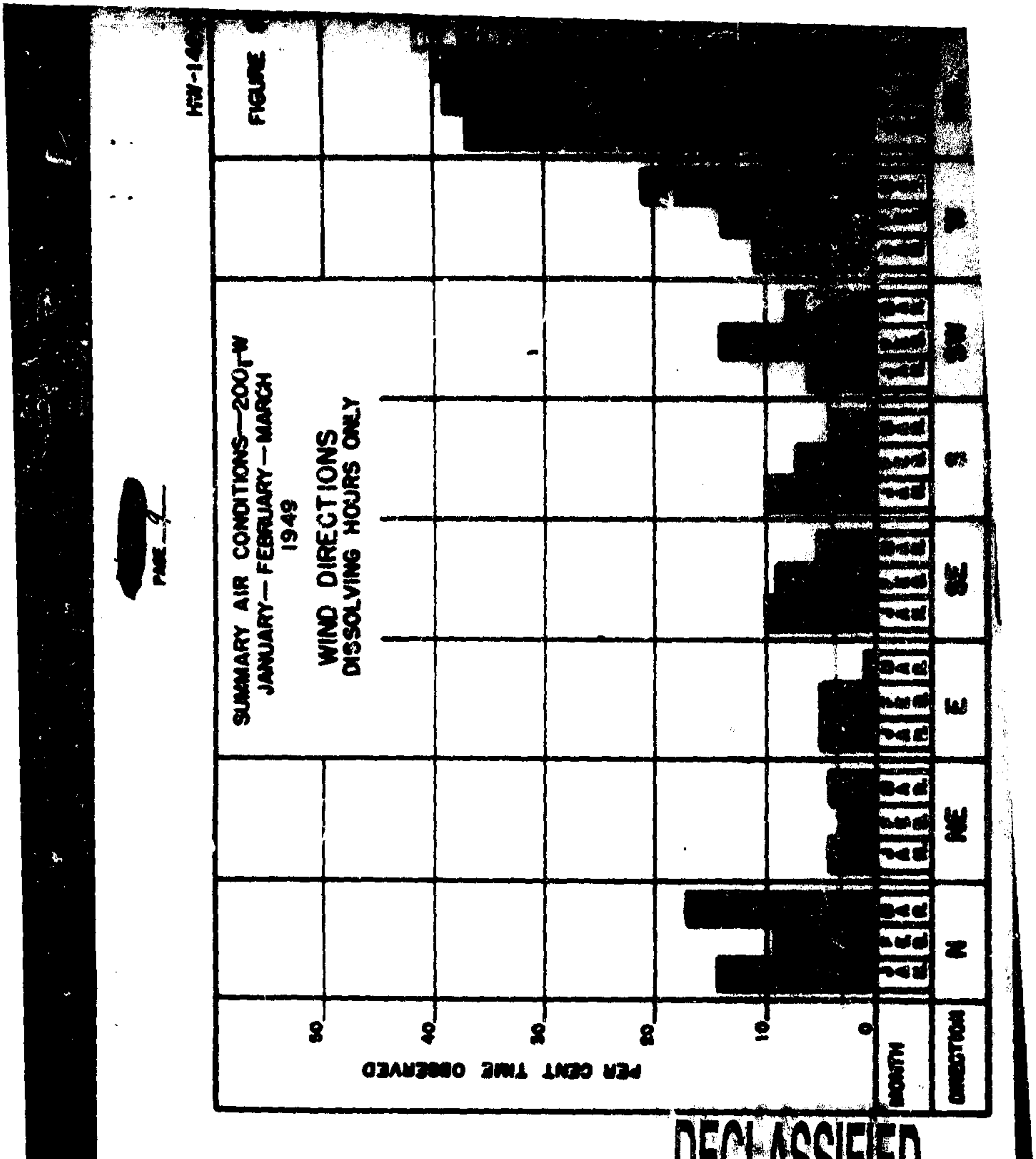

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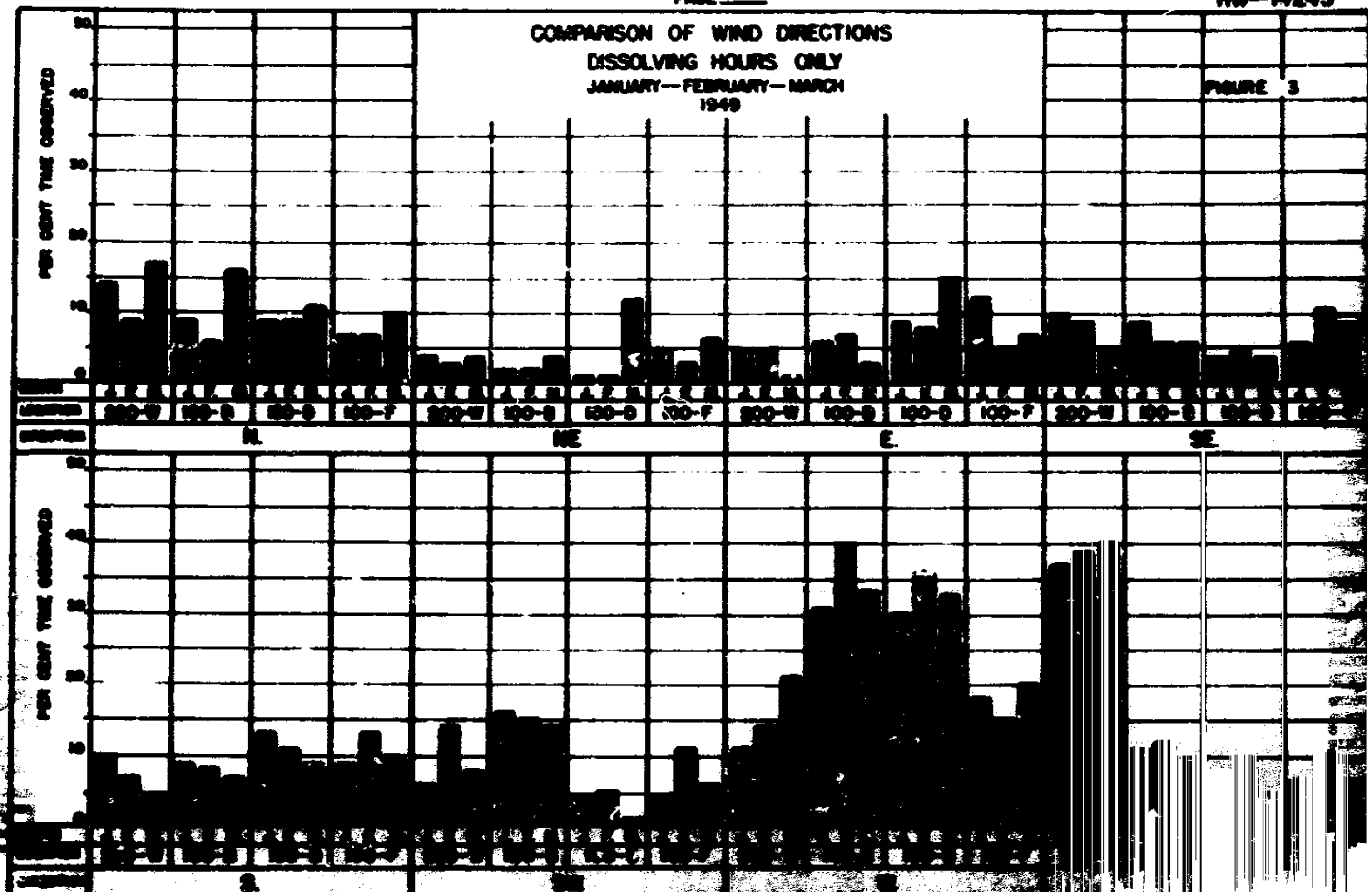

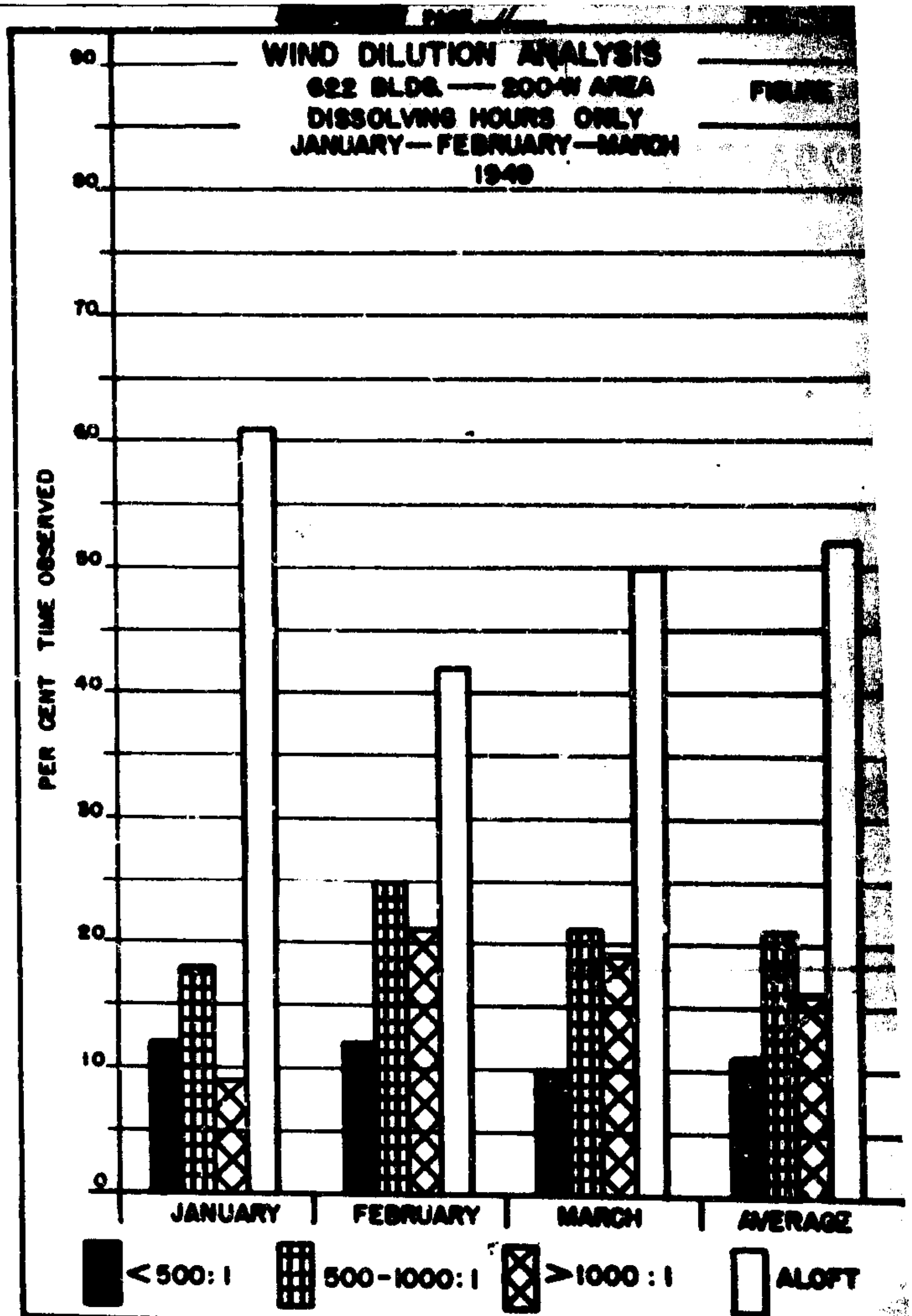
WIND DILUTION ANALYSIS
622 BLDG. — 200-W AREA
DISSOLVING HOURS ONLY
JANUARY—FEBRUARY—MARCH
1949
PER CENT TIME OBSERVED
90
80
70
60
50
40
30
20
10
0
JANUARY
FEBRUARY
MARCH
AVERAGE
<500:1
500-1000:1
>1000:1
ALOFT

[redacted]

SECTION II

AIRBORNE CONTAMINATION AND AIR RADIATION LEVELS

The radiation levels in the air were measured by use of detachable 'M', 'S', and 'C' type ionization chambers. The airborne contamination was measured using air filtering devices which collect the aerosol beta activity as well as the random stack discharge active particles. Several new locations have been added to the routine air monitoring program during this quarter. A location map showing the approximate location of each of the current airborne contamination and radiation level monitoring stations is included in this document as Figure 5. This map supercedes a similar identification map included in an earlier report, HW-9496.[8]

Table I is a summary of the radiation levels measured at the various locations. The average dosage rates within the areas, as measured by 'C' type chambers, indicated negligible variation when compared with measurements of previous periods. Similarily, the dosage rates throughout this quarter were relatively constant when compared with each other on a month-to-month basis. A review of the quarterly averages indicated that nearly all measured values were within the range of background fluctuation, between 0.3 mrep/24 hours and 0.5 mrep/24 hours. The dosage rates measured at the monitoring stations located at random throughout the project are also presented in Table I. These dosage rates were measured by use of the 'M' and 'S' type ionization chambers. The use of the smaller capacity 'S' type chambers predominated in those locations where construction personnel are employed. The chambers are read in pairs, at intervals ranging from one to five days, depending on the chamber capacity and the radiation level in the monitored location. A study of the current 'M' and 'S' chamber readings indicated no significant trends or changes in radiation levels within the quarter. As in

[redacted]

the past, dosage rates approaching 1.0 mrep/24 hours were measured at locations approximately southeast of the separations areas; this general location is directly downwind from the prevailing wind as indicated in Section I of this report.

Table II summarizes the results of the measurement for the "aerosol" beta activity in the air by use of air filtering devices. Two new stations have been established during this quarter; one in the 3000 Area which includes the airborne beta activity measurements in the residential area of North Richland, and the second, in the 200 West Area, Tower 15, which is adjacent to the currently proposed construction areas. The average beta activity detected in air by measuring the activity on the filter paper was less than 1.0 x 10^{-9} µc/liter at all locations except at the 200 East Area - Tower 16. This location is directly downwind from the 200 East Area stack as well as at the downwind quadrant of the 200 West Area stack. The average at this location (1.9 x 10^{-9} µc/liter) was not significantly different from the average noted for the previous quarter.

Only four of the sixteen locations indicated any significant change in the average filter activity level when compared with the average of the previous quarter. The locations where this decrease was noted are randomly located about the site at 300 Area, 3000 Area, 200 East-Southeast corner, and 200 West-Tower number 4. The spotting of these locations indicates that the decrease is not necessarily a general condition as the remaining twelve stations which are located in-between these locations indicated no trend whatever. There is no assignable cause or causes known to explain this minute decrease in airborne activity at the specific locations cited. Figure 5 is a graph of the average aerosol beta activity detected on the filter at each of the stations; an evaluation of the trends observed when the current data is compared with the previous quarter's measurements is also included in the self-explained legend on the graph.

In an effort to better evaluate the significance of the beta activity collected on the 1-1/2 inch diameter filter papers (C.W.S. No. 6) an experimental filtering device was set up in which air was sampled with the filter mounted horizontally with respect to the ground and the other mounted vertically. The same volume of air was sampled through each filter as mounted at the 200 West Area Gatehouse. Two cubic feet per minute were drawn through each filter for a period of a week after which the filterable beta activity was measured by use of thin window counters. The first few weeks of testing indicated possible differences, although later measurements indicated that these differences were merely fluctuations about a given average level. After nine weeks testing, the data was analyzed and it was found that no difference existed as to the amount of beta activity collected on the filter regardless of being mounted vertically or horizontally. The overall average beta activity detected on the filters mounted in a vertical position was 1.7×10^{-9} μc/liter air while for the horizontal mount the average was 2.1×10^{-9} μc/liter. The latter two filters were mounted out in the open air and were attached to the 614 building; the beta activity measured on the filter mounted in the vent cupola of the 614 building varied from 1.8×10^{-9} to 2.4×10^{-9} μc/liter during the same period the test filters were run. No significant difference was found in the activity level on any of the three sets of filters when the overall data was analyzed statistically.

As reported in the last H. I. quarterly report, it was found that the filter paper used (C.W.S. No. 6) in the air monitoring program did not collect the gas iodine (only 3.5 per cent). In order to monitor for the 8 day iodine, (I^{131}), caustic scrubbers have been installed behind the filter, in series with the Moto-aire pump. The scrubber solution consists of a solution of 50 per cent 0.1 normal sodium hydroxide and 50 per cent 0.1 normal sodium carbonate; sodium iodide is also added as the carrier. Preliminary tests using the scrubber solution indicates that the I^{131} is definitely passing through the filter and is being collected in the scrubber. The I^{131} activity in the scrubber calculated back to its concentration in the air indicates that about 10^{-9} to 10^{-10} μc I^{131} are present in a liter of air on an overall average basis in the 200 West Area. These iodine monitor units are to be installed in at least five of the permanent monitoring locations.

In addition to the measurements made on the filter papers, 168 hour exposures of the filters to sensitive K-type X-Ray film were made.

The usual dark spots noted on the developed film which is indicative of the presence of a stack discharge or otherwise "active particle" on a filter, as noted in months prior to December 1948, were absent during this period. The only assignable cause for this apparent significant decrease in the number of detected active particles is the installation of water scrubbers on the dissolver units in the 200 areas and the installation of sand filters. Exact figures for the specific efficiency of removing particulate matter of varying particle sizes by the installation of the filter and scrubber units is not known at the present time.

(SECTION II)

(See Tables 1 and 2, Figures 5, 6, & 6-A)

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TABLE I

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

"C" CHAMBER READINGS LOCATION	JANUARY	FEBRUARY	MARCH	
100-B Area	0.3	0.3	0.3	0.3
100-F Area	0.4	0.4	0.4	0.4
100-D Area	0.4	0.4	0.4	0.4
200-E Area	0.5	0.5	0.5	0.5
200-W Area	0.4	0.7	0.4	0.5
300 Area	---	0.5	0.5	0.5

"M" AND "S" CHAMBER READINGS LOCATION	JANUARY	FEBRUARY	MARCH	QUARTERLY AVERAGE	GROUP AVERAGE
100 Areas and Environs					
Route 1, Mile 8	0.5	0.6	0.5	0.5	
Route 2N, Mile 10	0.7	0.3	0.3	0.4	
Route 2N, Mile 5	0.4	0.5	0.4	0.5	0.55
Route 11A, Mile 1	0.7	0.8	0.7	0.7	
Route 1 & Route 4N	0.5	0.5	0.5	0.5	
Hanford Airport	0.8	0.5	0.8	0.7	
Within 5 Miles 200-East Area					
Route 4S, Mile 6	0.7	---	---	0.7	
Route 11A, Mile 6	1.0	0.8	---	0.9	
Route 3, Mile 1	1.0	1.1	0.8	1.0	[illegible]
Meteorology Tower 200'	0.8	0.7	---	0.8	
Within 10 Miles 200 East Area					
Route 4S, Mile 10	0.7	0.9	1.0	0.9	
Route 10, Mile 1	0.9	1.0	0.6	0.9	0.9
Route 10, Mile 3	0.9	---	0.9	0.9	
Route 2S, Mile 4	1.8	1.1	---	0.7	
Near 300 Area					
Route 4S, Mile 16	---	0.6	0.9	0.9	
Route 4S, Mile 22	1.0	0.9	0.6	0.8	0.8
Residential Zones					
Richland	0.5	0.5	0.4	0.5	
Benton City	0.5	0.5	0.4	0.5	0.5
Construction Zones					
3000 Area	0.5	0.5	0.5	0.5	
White Bluffs	0.6	0.5	0.8	0.6	
234-235 Area	0.9	0.7	0.5	0.7	
Batch Plant (200)	0.4	0.4	0.5	0.5	
101 Area	0.7	0.5	0.5	[illegible]	

*All of the above values include the background measurements of the instruments which vary from about 0.1 to 0.5 mrep per 24 hours.

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TABLE II

SUMMARY OF RESULTS OF AIR FILTER SAMPLING PROGRAM

FILTERABLE BETA ACTIVITY

January - February - March

1949

LOCATION	AVERAGE µc PER LITER
Pasco	8.5×10^{-11}
100-D Area	2.4×10^{-10}
300 Area	5.9×10^{-10}
200-East - Tower 16	1.2×10^{-9}
200-West - Gatehouse	5.6×10^{-10}
Benton City	1.1×10^{-10}
Hanford	2.6×10^{-10}
White Bluffs	8.9×10^{-11}
105-DR Construction Zone	1.7×10^{-10}
Gable Mountain	2.4×10^{-10}
Richland	1.[illegible] $\times 10^{-10}$
200-West, Tower 4	5.6×10^{-10}
200-East, Southeast	8.0×10^{-10}
Hanford 101 Building	1.9×10^{-10}
3000 N Area*	1.7×10^{-10}
200-West, Tower 15*	2.7×10^{-10}

*New locations added during this quarter.

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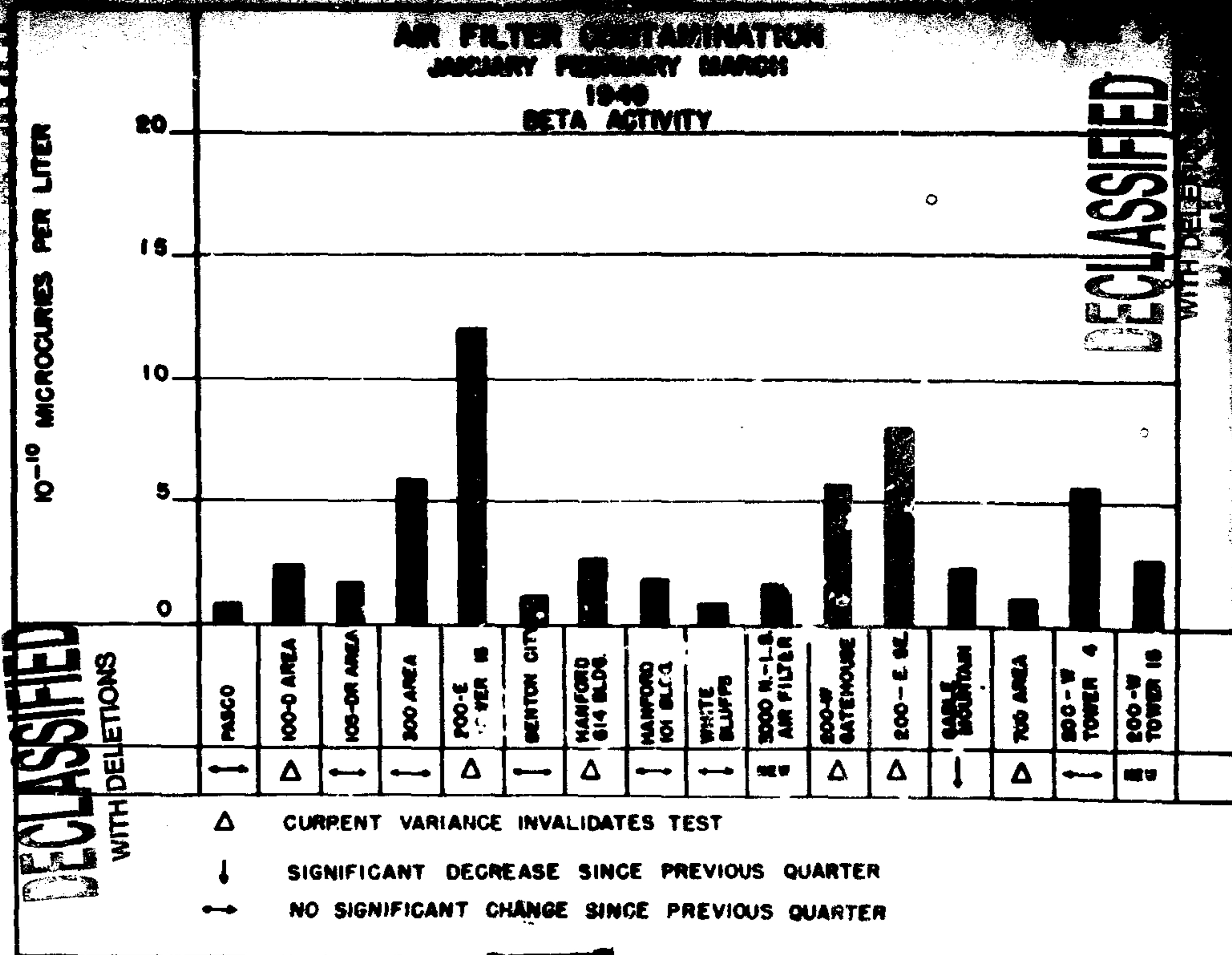
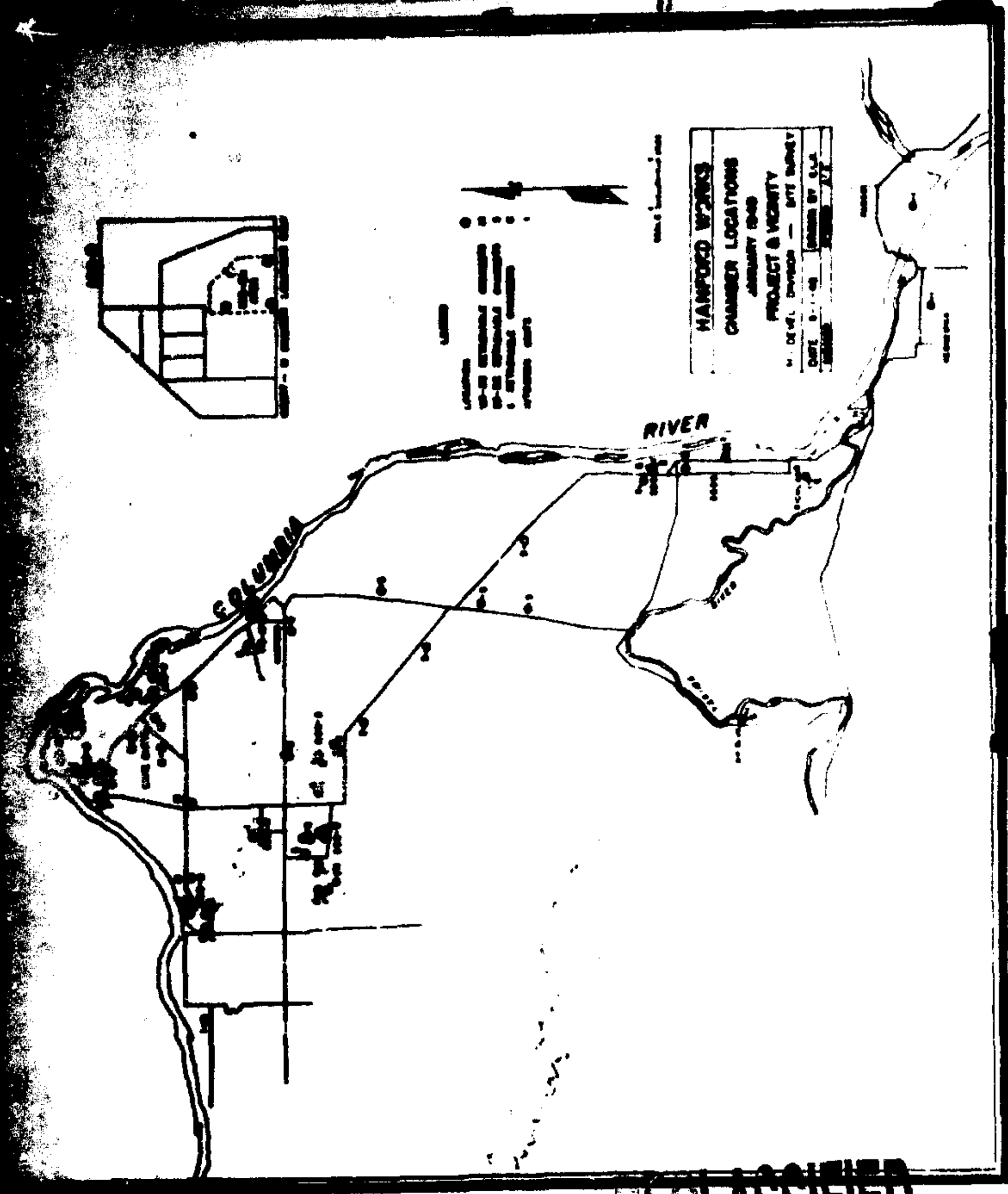
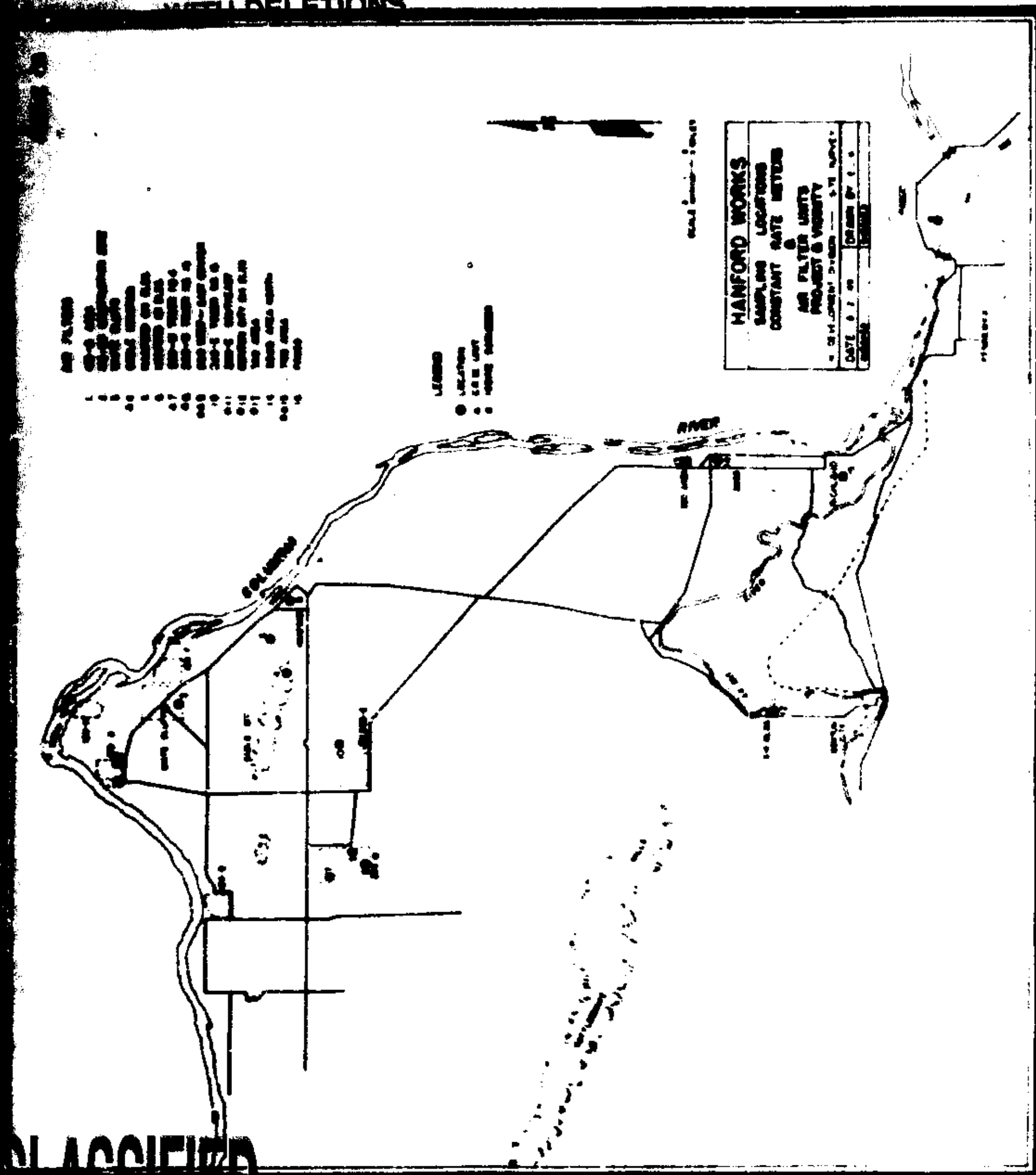

AIR FILTER CONTAMINATION
JANUARY FEBRUARY MARCH
BETA ACTIVITY
10^{-10} MICROCURIES PER LITER
0
5
10
15
20
PASCO
100-D AREA
105-DR AREA
300 AREA
200-E TOWER 18
BENTON CITY
HANFORD 614 BLDG.
HANFORD 101 BLDG.
WHITE BLUFFS
3000 N.-L.B. AIR FILTER
200-W GATEHOUSE
200-E 9L
GABLE MOUNTAIN
700 AREA
200-W TOWER 4
200-W TOWER 18
NEW
NEW
Δ CURRENT VARIANCE INVALIDATES TEST
SIGNIFICANT DECREASE SINCE PREVIOUS QUARTER
NO SIGNIFICANT CHANGE SINCE PREVIOUS QUARTER



HANFORD WORKS
CHAMBER LOCATIONS
PROJECT & VICINITY
COLUMBIA
RIVER



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SECTION III

ALPHA AND BETA CONTAMINATION IN THE COLUMBIA RIVER

The average flow rate of the Columbia River, as measured at Richland, by the [illegible] Power Division during the period, January, February, and March, 1949, was about 350,000 gallons per second. This flow rate was nearly identical to the measured [illegible] rate during the same season in 1947; it was about 100,000 gallons per second below the measured flow rate during the first quarter of 1948. Figure 7 summarizes the trend of the Columbia River flow rate, including the period from September 1948 through March 1949. The minimum flow rates prevailed during the month of January [illegible] showed a gradual increase toward the end of the quarter. The maximum river flow during this period was 430,000 gallons per second; this maximum was lower by a factor of about two when compared with the maximum flow during the previous period. Table [illegible] is a summary of the overall average activity detected in samples from representative locations:

TABLE III

AVERAGE BETA-GAMMA CONTAMINATION IN COLUMBIA AND YAKIMA RIVERS

January February March

1949

Location	Micro-microcuries per liter* μμc/liter
Above 100-B Area	< 50
100-B Area	< 50
100-D Area	580
100-F Area	608
Hanford North Bank	667
Hanford Middle	1150
Hanford South Bank	1943
300 Area	311
Richland	461
Pasco	194
Yakima River (mouth)	< 50
Yakima River (Horn)	< 50

* The normal reporting level for the beta-gamma emitters in a 500 ml. river sample is currently established at 50 μμc/liter (5×10^{-5} μc/[illegible])

[redacted]

Analysis of weekly river water samples t[aken] from twelve locations al[ong] banks of the Columbia showed a general increase in the average beta activi[ty de]tected in the river samples when the results were compared with those of the p[re]vious quarter. This increase is a direct effect of the low river flow encount[ered] at this time of the year and results in subsequent lower dilution effect of riv[er] water to 100 area radioactive liquid effluent.

The increased beta-gamma activity in river water was quite noticeable at [lo]cations in the river from 100-D Area to Richland. The greatest increase was ob[]served at the 100-D Area where the average beta activity in the river was about 580 µµc/liter as compared with the average of 315 µµc/liter during the previous quarter. The overall increase in the beta activity measured in the river sampl[es] during this quarter was consistent with a similar increase noted a year ago.(9) Figure 8 is a bar graph summarizing the average beta-gamma activity measured in river samples taken from representative locations. A tabulated summary of an analysis of the trends in the river contamination during this period is incl[uded] in the lower portion of Figure 8. The analysis also includes a comparison of the current quarterly average with the previous quarter.

It is of interest to note that again, at minimum river flow rate, the act[ivity] in samples from the south bank of the river was significantly higher than that [of] samples from the middle and north bank of the river. Samples from the middle [of] the river indicated the average beta activity to be about twice that amount de[]tected in samples taken from the north bank. As postulated in previous reports, the distribution of the radioactive contamination in the river apparently change[s] with the changing flow rates, more uniform mixing being experienced during the high river flow period. To portray the change in the activity in the river w[ith] the changing flow rate of the Columbia River, a summary of the past three y[ears] observations made during the first quarterly period is presented on Figure ... graph includes the average beta-gamma activity measured in the river samples ... the corresponding flow rates of the Columbia River. The tabulation indicates ... nearly identical ratio of difference between the locations tested during the ... quarterly period of 1947 and 1949. The measured flow rates during these two ... also appear to be somewhat similar. At low flow rates, samples from the south bank of the river at Hanford indicated the average beta activity to be about ... times greater than that on the north bank; the activity in samples from the ... bank was less than that found in samples from the middle of the river by a factor of two. This tabulation also indicates the effect of the shutdown of the 100-... Area in 1948; the measured activity was considerably lower at all sampling lo... in the river after the shutdown.

An attempt to determine, qualitatively, the distribution of the radioactive contamination in the Columbia River between Pasco and Richland resulted in two surveys of the river on January 5 and 6. A total of seventy-two samples were ... from the Columbia River in these surveys. During the surveys, the river flow ... 328,000 gallons per second; the operating conditions in the 100 Areas were ... The sampling method consisted of taking three 500 ml. samples; one from near ... shoreline and one from the middle of the river at intervals of about every mile along the river. At each location, a sample was also drawn from the surface, the middle, and just at the bottom of the river.

Measurements for the beta-gamma emitters in these samples indicated that ... average activity varied from 130 to 260 μμc/liter; the average activity in all samples was 180 μμc/liter. Analysis of the data, comparing the contamination levels at various depths with the given locations indicated no significant difference from the amount of beta activity found in samples taken from the surface ...

the middle, and bottom of the river. By comparing each individual activity with the overall average, it was found that no real significant difference between any of the individual results with the mean value of all the samples. From this, it was then concluded that the mixing of the activity in the river the area between Richland and Pasco was relatively uniform when the river was ing at the rate of about 328,000 gallons per second.

A similar survey was made of the Columbia River covering the area between 100-F Area and 300 Area in late February, 1949. Ninety 500 ml. samples were in a similar manner to that described in the Richland-Pasco river survey except that sampling spots were taken at intervals of about five miles. No conclusions were drawn on the surface and varied depth samples as later consideration dilution of the depth samples with other river water as the original sample was being drawn to the surface. Statistical analyses of the results of the radio-chemical assays of the river samples indicated significant differences between locations, the degree of difference between samples at a given location in the river increasing as the sampling approached the 100-F Area. From these data, it was concluded that the distribution of the radioactive contamination was not in this general area, the degree of non-uniform mixing increasing in magnitude one approached the operating areas in the 100 Area. Figure 10 is a map showing the estimated distribution of the activity in the river as extrapolated from the results of the analyses of the ninety samples taken. This estimated distribution is for the given river flow only; differences in this pattern are expected for different river flow rates.

Absorption in aluminum and decay studies were made on some of the more river samples noted in the river surveys previously discussed. The net results study of five samples indicated that about ninety-five per cent of was from 14.8 hour sodium (Na^{24}). (Some short half-lived Mn^{56} exists in the ... but generally this activity has decayed out before analyses are made on the ... samples.) About two to five per cent longer half-lived beta emitters (principally ... Fe^{59}, P^{32}, Ca^{45}, Cr^{51}, etc.) were measured in the river samples, the higher ... re detected in the samples taken from just below Hanford.

The river samples were also analyzed for total alpha activity from uranium ... plutonium by the ether-extraction method; the average alpha activity in all the ... samples was less than 6 dis/min/liter. Spot checks for uranium activity using the fluorophotometer method indicated that activity to be less than 4 µg/liter in the samples analyzed.

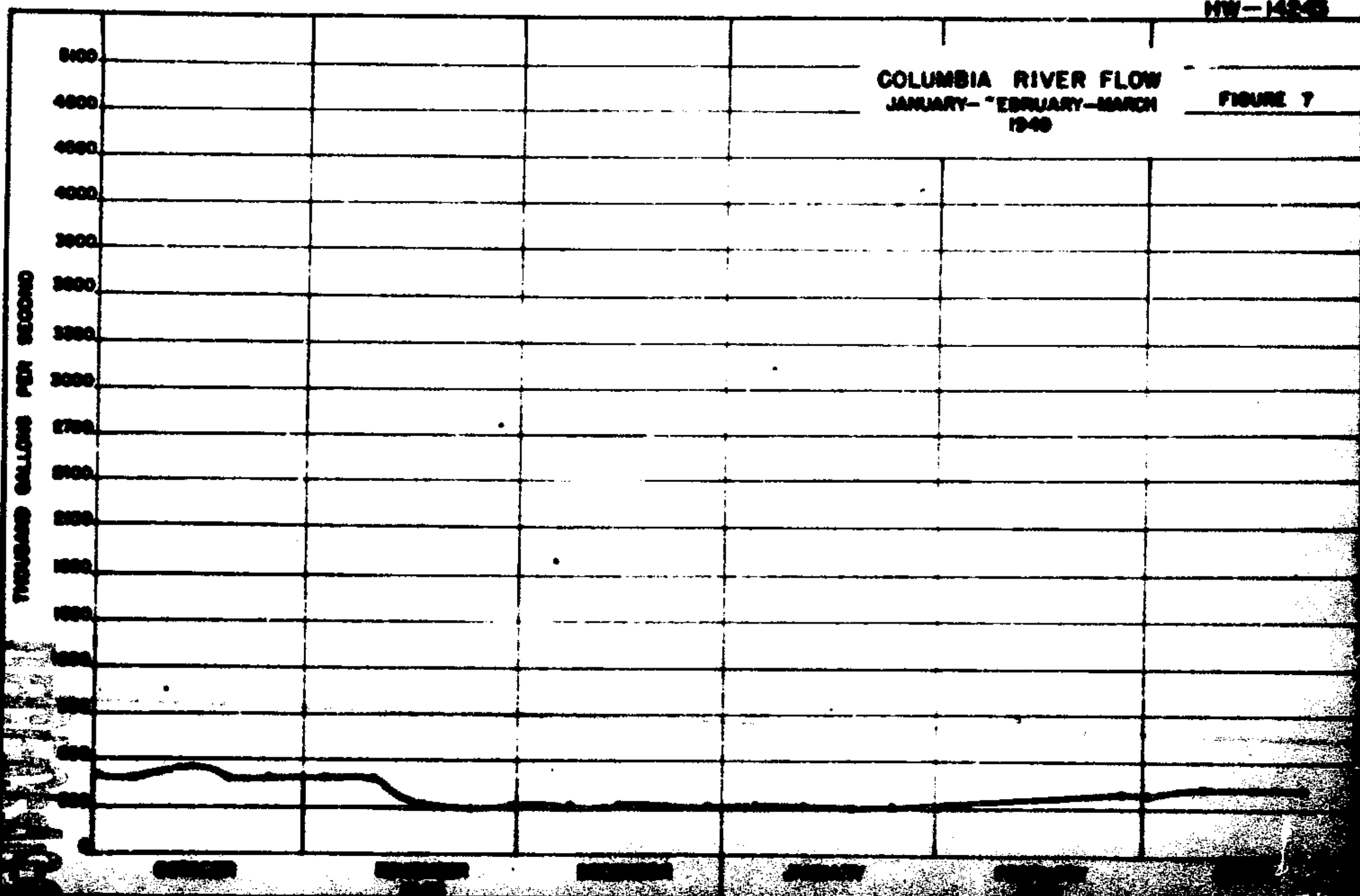
Figure 11 shows the locations on the Columbia River, where the routine 500 ml samples are taken at least once each week.

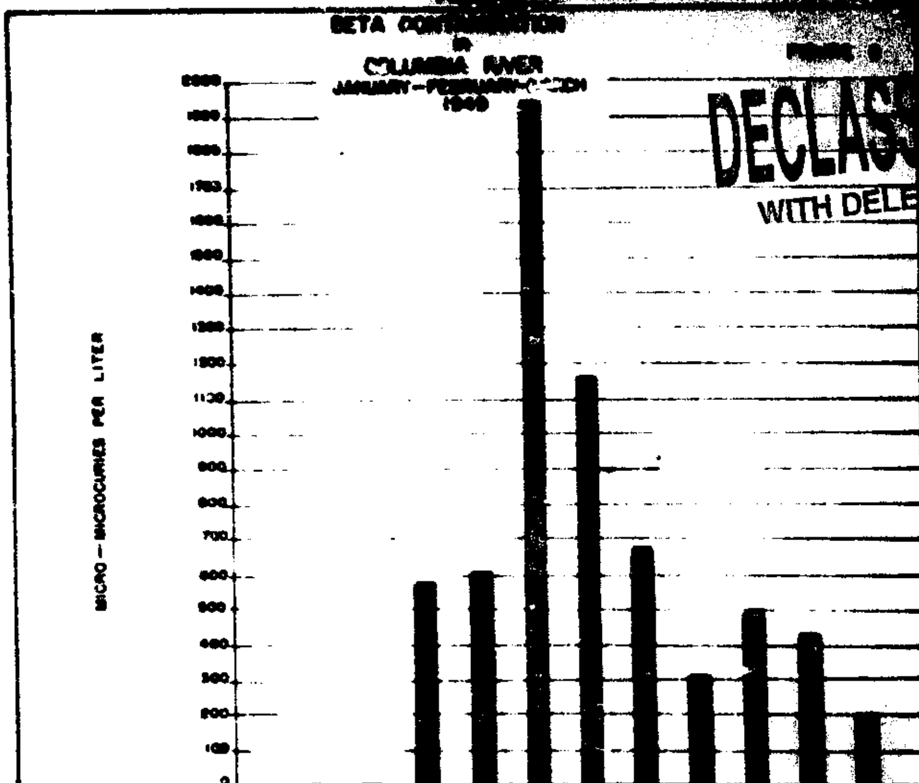
SECTION III

(See Table III, Figures 7,8,9,10,and 11)

[redacted]
PAGE 26

HW-142[illegible]





	ABOVE 100-B No. 1	ABOVE 100-B No. 2	181-B	181-D	181-F	[illegible]	[illegible]	[illegible]	300 AREA	[illegible]	[illegible]	[illegible]
ABOVE 100-B No 1	Δ		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
ABOVE 100-B No. 2		⟷	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
181-B	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
181-D	Δ	Δ	Δ	!		Δ	Δ	Δ	★★		★★	★★
181-F	Δ	Δ	Δ		⟷	★★			Δ	Δ	Δ	★
HANFORD SOUTH BANK	Δ	Δ	Δ	Δ	★★	!	★★	★★	Δ	Δ	Δ	Δ
HANFORD MIDDLE	Δ	Δ	Δ	Δ		★★	⟷	★	Δ	Δ	Δ	Δ
HANFORD NORTH BANK	Δ	Δ	Δ	Δ		★★	★	⟷	Δ	Δ	Δ	★
300 AREA	Δ	Δ	Δ	★★	Δ	Δ	Δ	Δ	⟷			
RICHLAND MIDDLE No 1	Δ	Δ	Δ		Δ	Δ	Δ	Δ		⟷	★★	★
RICHLAND MIDDLE No 2	Δ	Δ	Δ	★★	Δ	Δ	Δ	Δ		★★	!	
PASCO-KENN BRIDGE	Δ	Δ	Δ	★★	★	Δ	Δ	★		★		Δ

Δ CURRENT VARIANCE INVALIDATES TEST
★ CURRENT DIFFERENCE APPROACHES SIGNIFICANCE
★★ CURRENT DIFFERENCE HIGHLY SIGNIFICANT
⟷ NO SIGNIFICANT CHANGE SINCE PREVIOUS QUARTER
! QUESTIONABLE INCREASE SINCE PREVIOUS QUARTER
! SIGNIFICANT INCREASE SINCE LAST QUARTER
▭ NO SIGNIFICANT DIFFERENCE BETWEEN CURRENT AVERAGES

HW—14243

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PAGE 23

FIGURE 9

BETA ACTIVITY IN COLUMBIA RIVER
JANUARY — FEBRUARY — MARCH
1947 — 1948 — 1949

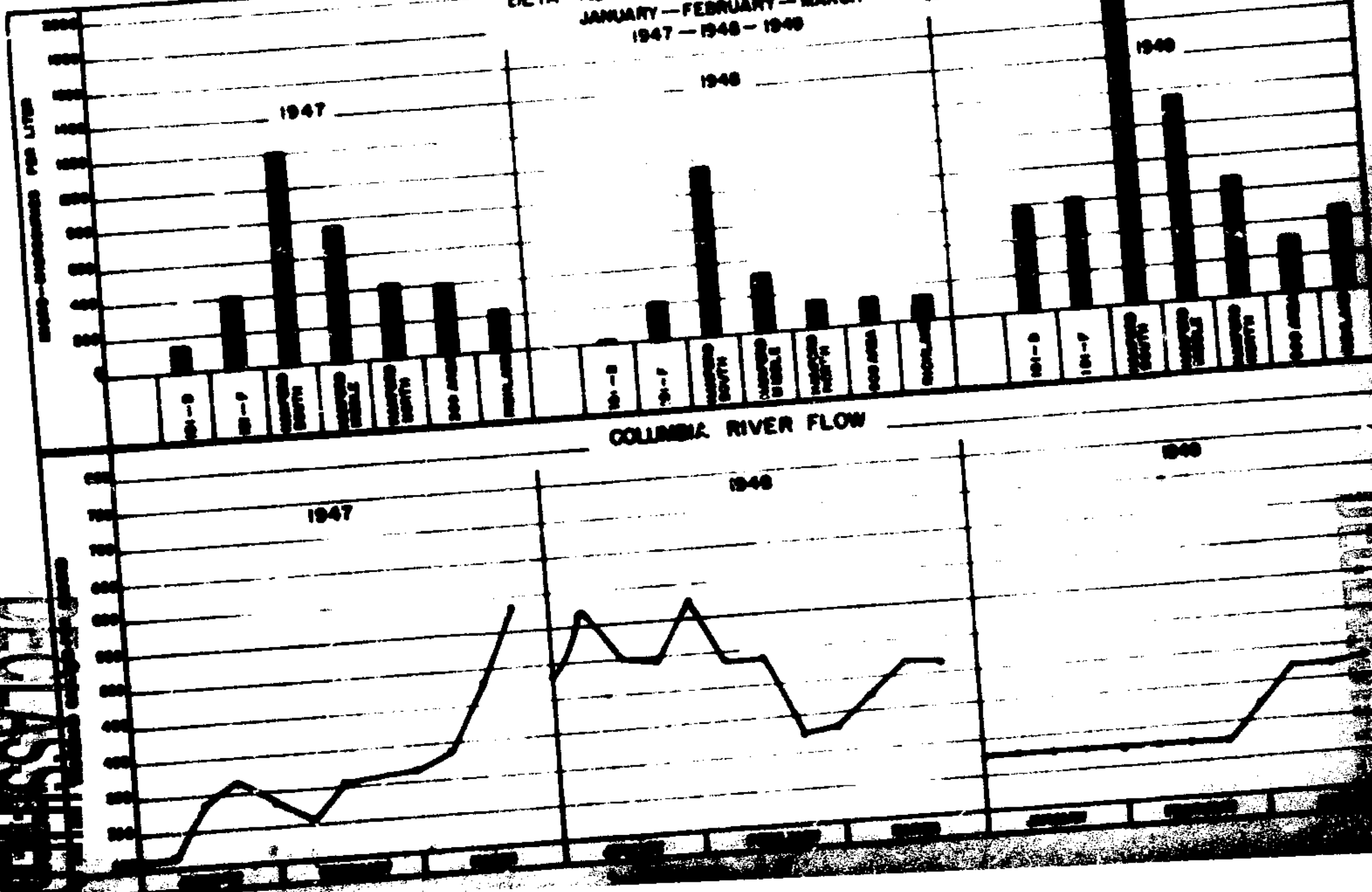

FIGURE 10

HW-14243

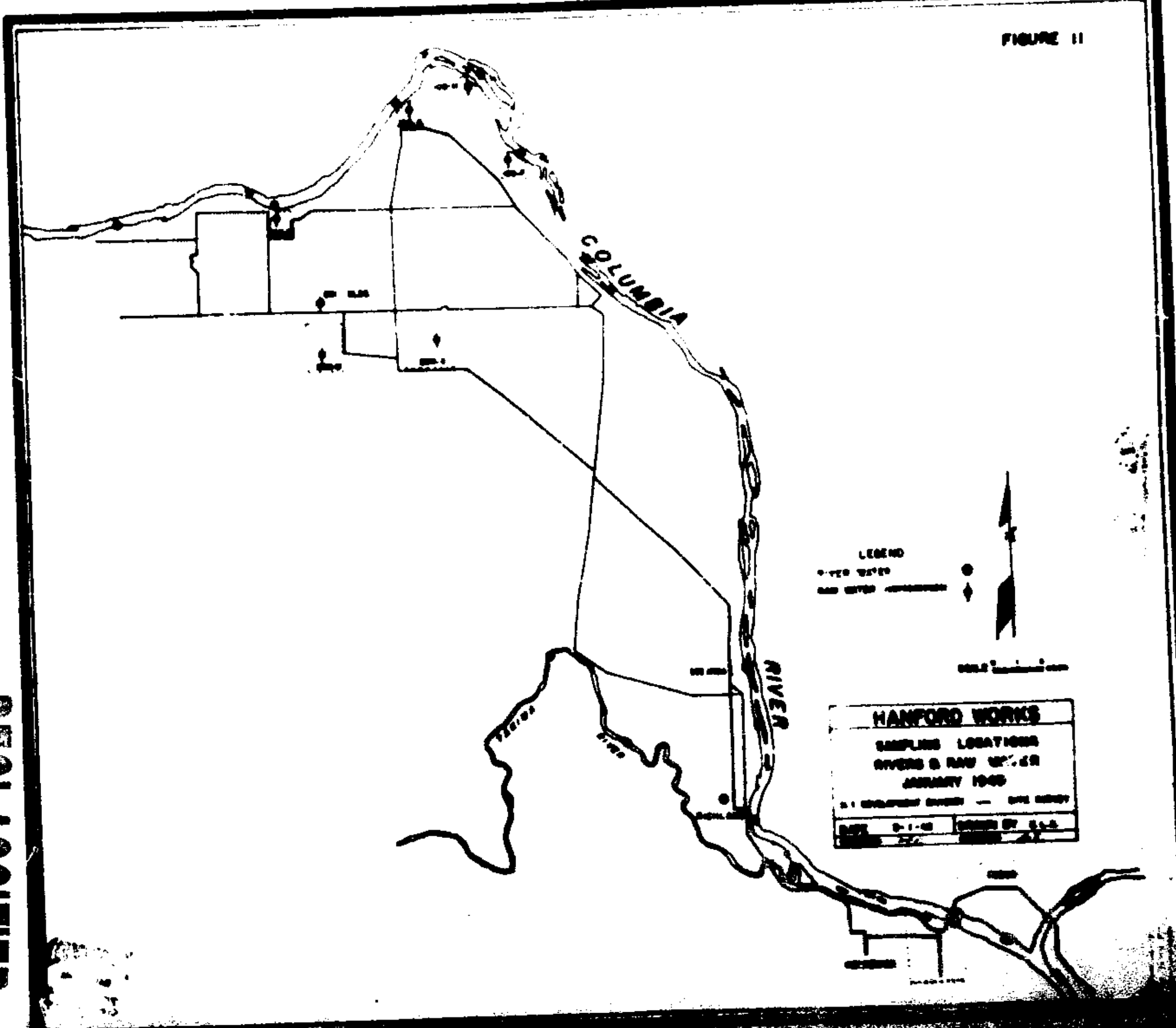

FIGURE 11

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[redacted]

SECTION IV

ALPHA AND BETA-GAMMA CONTAMINATION IN DRINKING WATER AND TEST WELLS

During this quarterly period, over eight hundred drinking water samples were taken on and off the Hanford Project for radioactive contamination analyses. Figure 14 illustrates the approximate location where the drinking water samples were taken. In general, most locations are sampled once each week, however, a few of the key stations were sampled daily. Most of the samples were 500 ml. samples; in some cases where increased sensitivity was desired (about 1 dis/min/liter) 12 liter samples were taken.

The beta-gamma emitters were measured in all the 500 ml. samples. This measurement was made by mounting the residue of the evaporated water sample on a flat 1-3/4 inch diameter stainless steel plate and counting the activity from the sample with thin mica-window counters (window thickness varies between 3 to 5 mg/cm^2). The counting rates were corrected for counter geometry and decay when known. The alpha activity from plutonium and uranium in a sample was then made by transferring the residue from the stainless steel plate to a beaker and performing a modified ether extraction using aluminum nitrate as the "salting out agent" on the residue; the activity in the residue was measured by use of a 52 per cent geometry, parallel plate standard alpha counter. The counting rates were corrected for geometry and overall extraction efficiency obtained by comparing the results with those obtained by analyzing control water samples to which known quantities of plutonium or uranium were added.

The results of the radiochemical analyses of the drinking water indicated levels of activity comparable with the results of the survey of the previous three months. In general, the beta-gamma activity in the drinking water of the Pasco-Kennewick Area averaged between 50-60 μμc/liter; some occasional samples indicated

[redacted]

values as high as 200 μμc/liter. These trace amounts of activity ... directly related to the activity in the Columbia River, which is the source ... for most of the drinking water in Pasco and Kennewick. Decay studies of some ... these water samples indicated that over ninety per cent of the activity ... from 14.8 hour sodium (Na^{24}). Minute trace quantities of beta-gamma emitters ... detected in samples from two Richland Wells and three 3000 Area Wells; this ... was of the order of about 10 μμc/liter. The identity of the specific emitter ... emitters is not known.

The results of all the analyses for radioactive contamination in drinking ... samples where detectable activity was noted are tabulated in Tables IV and V. ... IV summarizes the results of the analyses of the 500 ml. samples where the ... limit for the beta-gamma emitters is about 10 μμc/liter and for alpha activity ... plutonium and uranium, 6 dis/min/liter. The sensitivity limit for alpha ... the 12 liter water samples is about 1 dis/min/liter; the measurements for beta ... activity in the large volume water samples are essentially sensitive to about ... liter which is identical to the 500 ml. samples as direct counts are made on ... residue of an aliquot of the 12 liter sample. Each table includes the total ... of samples, taken from each location, the average activity detected in the ... and the maximum individual value both for the beta-gamma and alpha activity. ... general, it can be stated that the overall results did not differ significantly ... the results obtained in the surveys of the previous three months with only minor ... fluctuations occurring at some of the locations sampled.

The maximum alpha activity detected in any sample was 52 dis/min/liter taken ... the Benton City Water Company Well; the maximum average alpha activity detected ... samples from the given locations was 29 dis/min/liter; this was detected in the water samples taken from the Chevron Standard Station in Benton C... alpha activity in these wells was confirmed to be primarily from uranium, ... occurring in natural amounts in the wells; the specific analyses for uranium ... formed by the fluorophotometer method which should be sensitive to about 4 ... of solution. Figure 12 summarizes the radiochemical analytical results of ... City drinking water which is a representative area indicating the highest ... level of alpha activity in the drinking water supplies of this general area. ... results indicate that the alpha activity is principally from uranium with the ... level of activity in the three locations sampled within Benton City proper to be ... entially the same. Samples taken at Cobbs Corner, about 3 miles away from the ... three sampling locations, indicated a significantly lower level of activity. ... limit of sensitivity shown on the graph applies to a single 500 ml. sample; the ... of sensitivity fro the 3 gallon samples is about 1 dis/min/liter.

Figure 13 is a summary of the alpha activity detected in samples from repres... ative locations in Richland and is compiled in a similar manner as shown for the ... ton City water supply. The level of activity in the Richland water was decided... lower than that found in the Benton City Wells. The slight differences noted in ... activity measurements made on the 500 ml. and 3 gallon is believed to be prima... from errors in the laboratory procedures rather than environmental induced diff...

Samples were also taken from the drinking water in the 100 and 200 Areas; the ... source of supply for this drinking water is the Columbia River. The river water ... umped from either of the three 100 Areas for local use in those areas and piped ... the 100 Areas to the 200 Areas for consumption in the separations area. Samples ... taken at least once each week from a representative location in each

[redacted]

area. The results of the analyses of these samples are summarized in T

Table VI

AVERAGE ALPHA AND BETA ACTIVITY MEASURED IN SANITARY AND RAW WATER 1949 HANFORD WORKS

Location	RAW WATER		SANITARY WATER	
	Alpha Activity dis/min/liter	Beta Activity μμc/liter	Alpha Activity dis/min/liter	Beta Activity μμc/liter
100-B Area	< 6	< 10	< 6	< 10
100-D Area	< 6	83	< 6	< 10
100-F Area	< 6	120	< 6	23
200-East Area	< 6	23	< 6	< 10
200-West Area	< 6	30	< 6	< 10

The raw water is the river water as taken directly from the sampling po in the 183 buildings of the 100 Areas and from the 283 buildings in the 200 A. The sanitary water is taken directly from drinking water fountains. The resu are in the order of magnitude expected with minimum activity levels at the 10 Area (< 10 μμc/liter) and increasing in concentration as one approaches the 100-F Area where the average beta-gamma emitters detected was 120 μμc/liter. activity is primarily from 14.8 hour sodium (Na^{24}) as shown by decay studies. levels of activity in the 200 Areas are slightly lower (~ 20-30 μμc/liter) represent a decay period in piping the water from the 100 areas to the 200 Positive activity was detected in the drinking water at 100-F Area only, and Na^{24}, the value of 23 μμc/liter noted in the drinking is far below the permis concentration for that isotope in drinking water. Measurements for alpha act in all of these water samples using the ether-extraction method indicated le 6 dis/min/liter from plutonium and uranium.

SECTION IV

(See Figures 12,[redacted]ables IV,V, and VI)

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Table IV

SUMMARY OF ALPHA AND BETA GAMMA ACTIVITY MEASURED IN [illegible]

500 ml. samples

January - February - March

1949

Location	No. Samples	ALPHA ACTIVITY dis/min/liter MAXIMUM	ALPHA ACTIVITY dis/min/liter AVERAGE	[illegible]
Richland #2	12	24	10	28
Richland #4	10	23	11	<10
Richland #5	10	9	< 6	<10
Richland #12	12	17	6	<10
Richland #13	48	27	9	11
Richland #14	11	20	9	<10
Richland #15	10	27	16	14
Richland #18	2	11	8	<10
Tract House K-748	13	9	<6	11
Tract House J-685	13	19	<6	16
3000 Area Well A	9	8	<6	10
3000 Area Well B	2	6	<6	13
3000 Area Well C	9	13	<6	<10
3000 Area Well E	10	12	<6	<10
3000 Durand #5	12	9	<6	<10
Headgate	13	10	<6	10
Hanford	6	10	< 6	<10
Columbia Camp	13	9	< 6	<10
Benton City Store	3	30	23	<10
Benton City Chevron Station	7	44	29	<10
Benton City Water Company	12	52	26	10
Cobbs Corner	13	13	<6	< 10
Enterprise	2	12	<6	<10
Kennewick Texaco Station	3	<6	<6	70
Kennewick 614 Building	4	<6	<6	134
Kennewick Standard Station	11	7	<6	127
Riverland	12	11	<6	10
Midway	12	11	<6	[illegible]
Wills Ranch	7	10	<6	<10
Pasco	10	10	<6	192
Pistol Range	13	12	<6	18
White Bluffs	39	26	15	53

[redacted]

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[redacted]

Table V

SUMMARY OF ALPHA AND BETA-GAMMA ACTIVITY MEASURED IN DRINKING WATER [illegible]

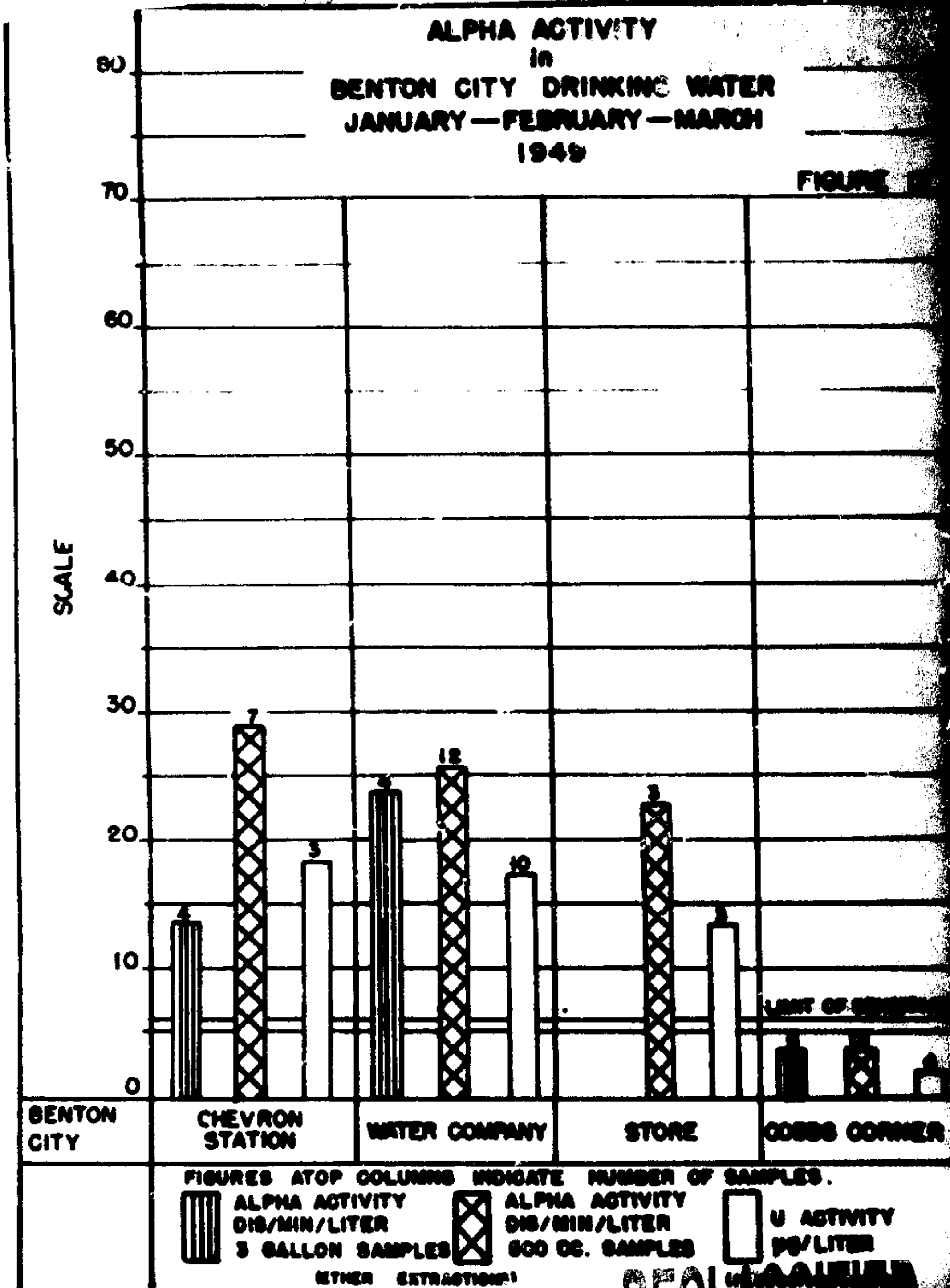
12 Liter Samples

January - February - March

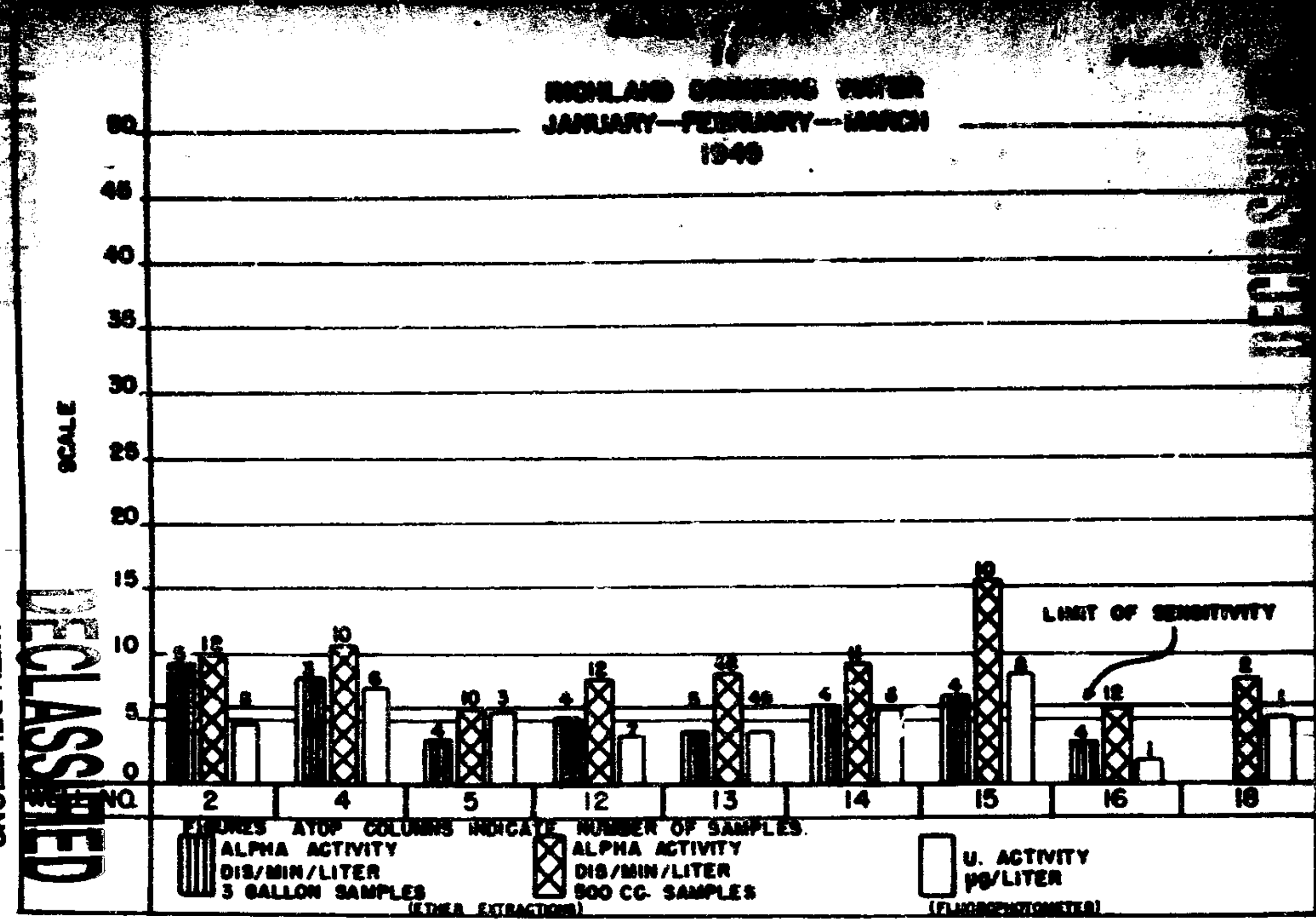
194[illegible]

Location	No. Samples	ALPHA ACTIVITY dis/min/liter		BETA-GAMMA ACTIVITY [illegible]	
		Maximum	Average	Maximum	Average
Richland #2	5	14	9	<10	<10
Richland #4	3	12	8	<10	[illegible]
Richland #5	4	5	4	<10	[illegible]
Richland #12	4	9	5	<10	[illegible]
Richland #14	4	[illegible]	6	<10	[illegible]
Richland #13	5	7	4	<10	[illegible]
Richland #15	4	10	7	<10	[illegible]
Richland #16	5	5	3	<10	[illegible]
Tract House K-748	5	4	3	<10	[illegible]
Tract House J-685	5	7	3	<10	[illegible]
3000 Area Well A	3	6	3	<10	[illegible]
3000 Area Well B	1	5	5	<10	[illegible]
3000 Area Well C	5	3	2	16	[illegible]
3000 Area Well E	4	3	3	<10	[illegible]
3000 Area Durand #5	5	5	3	<10	[illegible]
Headgate	5	3	1	<10	[illegible]
Riverland	4	5	2	<10	[illegible]
Pistol Range	5	7	4	<10	[illegible]
White Bluffs	4	17	15	<10	[illegible]
Benton City (Chevron Station)	4	20	14	<10	[illegible]
Benton City Water Company	4	34	24	<10	[illegible]
Cobbs Corner	6	6	4	<10	[illegible]
Kennewick (Texaco Station)	2	1	1	27	[illegible]
Kennewick (Standard Station)	5	2	1	<10	<10

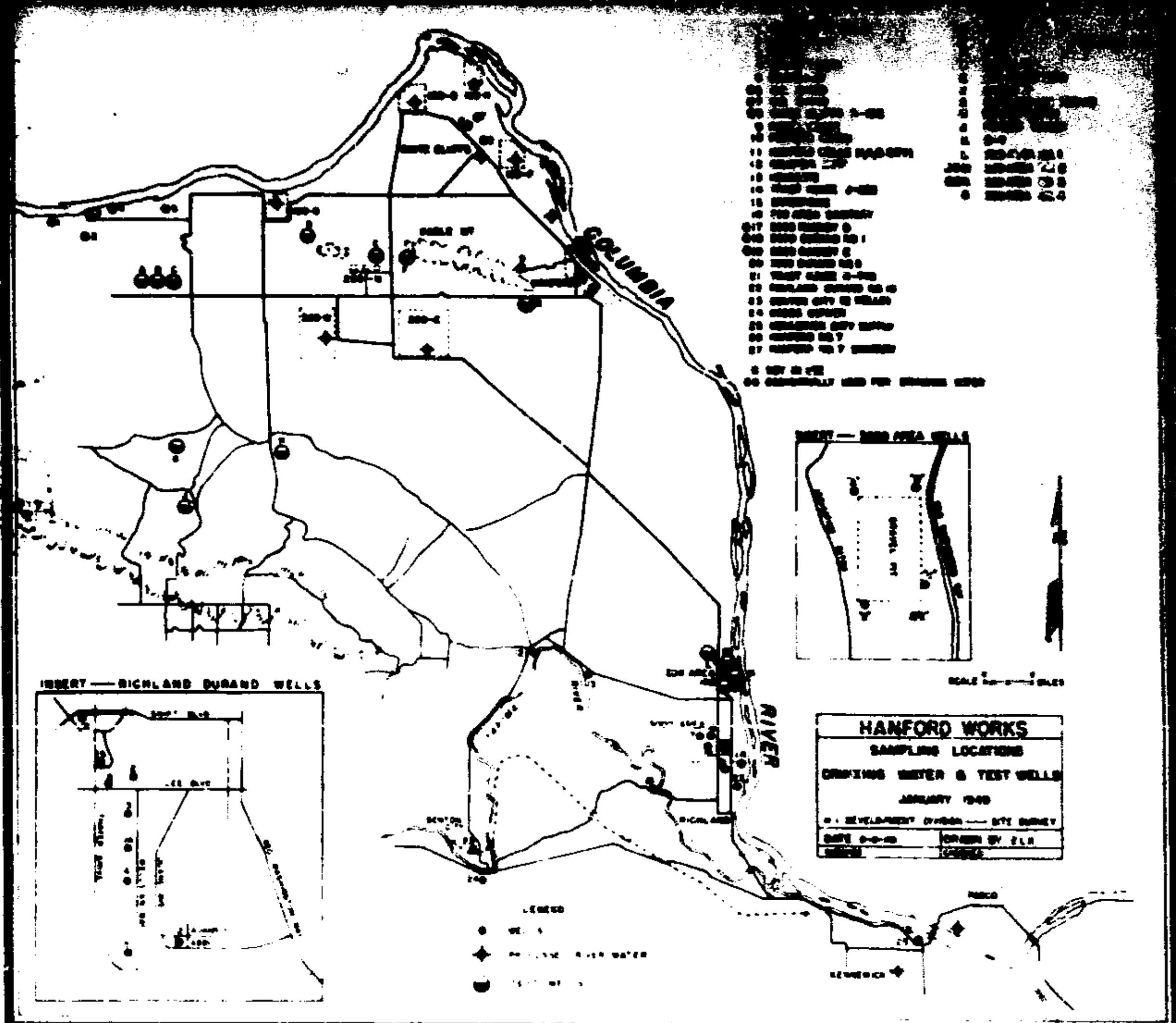
[redacted]


ALPHA ACTIVITY
in
BENTON CITY DRINKING WATER
JANUARY — FEBRUARY — MARCH
1949
SCALE
80
70
60
50
40
30
20
10
0
7
4
3
12
10
BENTON CITY
CHEVRON STATION
WATER COMPANY
STORE
COBBS CORNER
FIGURES ATOP COLUMNS INDICATE NUMBER OF SAMPLES.
ALPHA ACTIVITY DIS/MIN/LITER 3 GALLON SAMPLES
ALPHA ACTIVITY DIS/MIN/LITER 500 CC. SAMPLES
U ACTIVITY
ETHER EXTRACTION

[redacted]


RICHLAND DRINKING WATER
JANUARY—FEBRUARY—MARCH
1949
SCALE
50
45
40
35
30
25
20
15
10
5
0
NO.
2
4
5
12
13
14
15
16
18
LIMIT OF SENSITIVITY
FIGURES ATOP COLUMNS INDICATE NUMBER OF SAMPLES.
ALPHA ACTIVITY
DIS/MIN/LITER
3 GALLON SAMPLES
(ETHER EXTRACTIONS)
ALPHA ACTIVITY
DIS/MIN/LITER
500 CC. SAMPLES
U. ACTIVITY
µg/LITER
(FLUOROPHOTOMETER)

[redacted]


HANFORD WORKS
SAMPLING LOCATIONS
DRINKING WATER & TEST WELLS
JANUARY 1949
COLUMBIA
RIVER
INSERT — RICHLAND DURAND WELLS
LEGEND
RICHLAND
KENNEWICK
PASCO

[redacted]

SECTION V
BETA CONTAMINATION IN RAIN

One hundred and ninety-three rain samples were collected from twenty-eight [illegible]ations on and adjacent to the project during the period January to March, 19[illegible]. [illegible] total amount of precipitation throughout this period was 1.93 inches; during this period last year the rainfall was 2.12 inches. In previous years, the bulk of the rainfall in the first quarterly period occurred in January; the minimum quantity of rain falling during March. In the current quarterly period, however, most of the rain fell during March. The total rainfall for the entire period was relatively normal, however, and the usual number of rain samples were collected for analyses. The tabulation below summarizes the rainfall conditions observed during this quarterly period the past years:

RAINFALL - HANFORD WORKS				
Inches of Precipitation				
MONTH	35 YEAR AVERAGE	1947	1948	1949
January	0.85	0.32	1.36	0.13
February	0.63	0.27	0.69	0.68
March	0.33	0.42	0.07	1.12
TOTAL	1.81	1.01	2.12	1.93

An analysis of the results obtained for the beta activity measurements in rain samples indicated no significant trends or changes in the level of radioactive contamination detected in the rain samples. The range of beta activity [illegible] [illegible]les collected within the separation areas was between 1.0 µµc/liter and [illegible] µµc/liter; occasional samples were as high as 60 µµc/liter collected near [illegible] of the stacks. The average beta activity detected in rain samples at distances between two and twenty miles from the stacks indicated very little deviation from each other with one exception where a sample collected

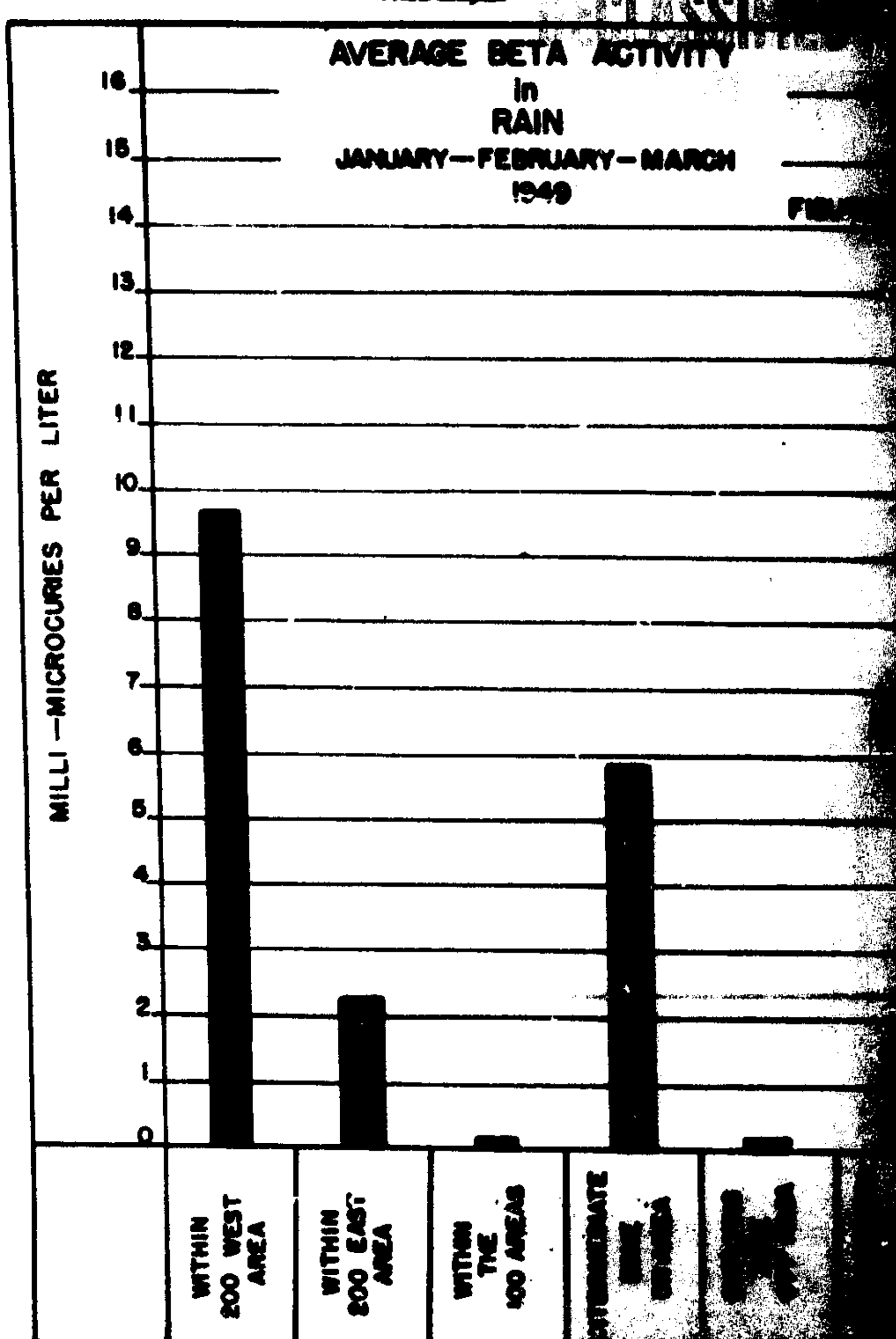
[redacted]

in the 3000 Area indicated 120 mμc/liter. This sample was radio-autographed and showed no evidence of particle deposition. The average beta activity detected in rain collected outside the project perimeter was less than 1.0 mμc/liter at all locations. The maximum activity found in this latter group was 1.4 mμc/liter detected in a sample collected in the village of Richland.

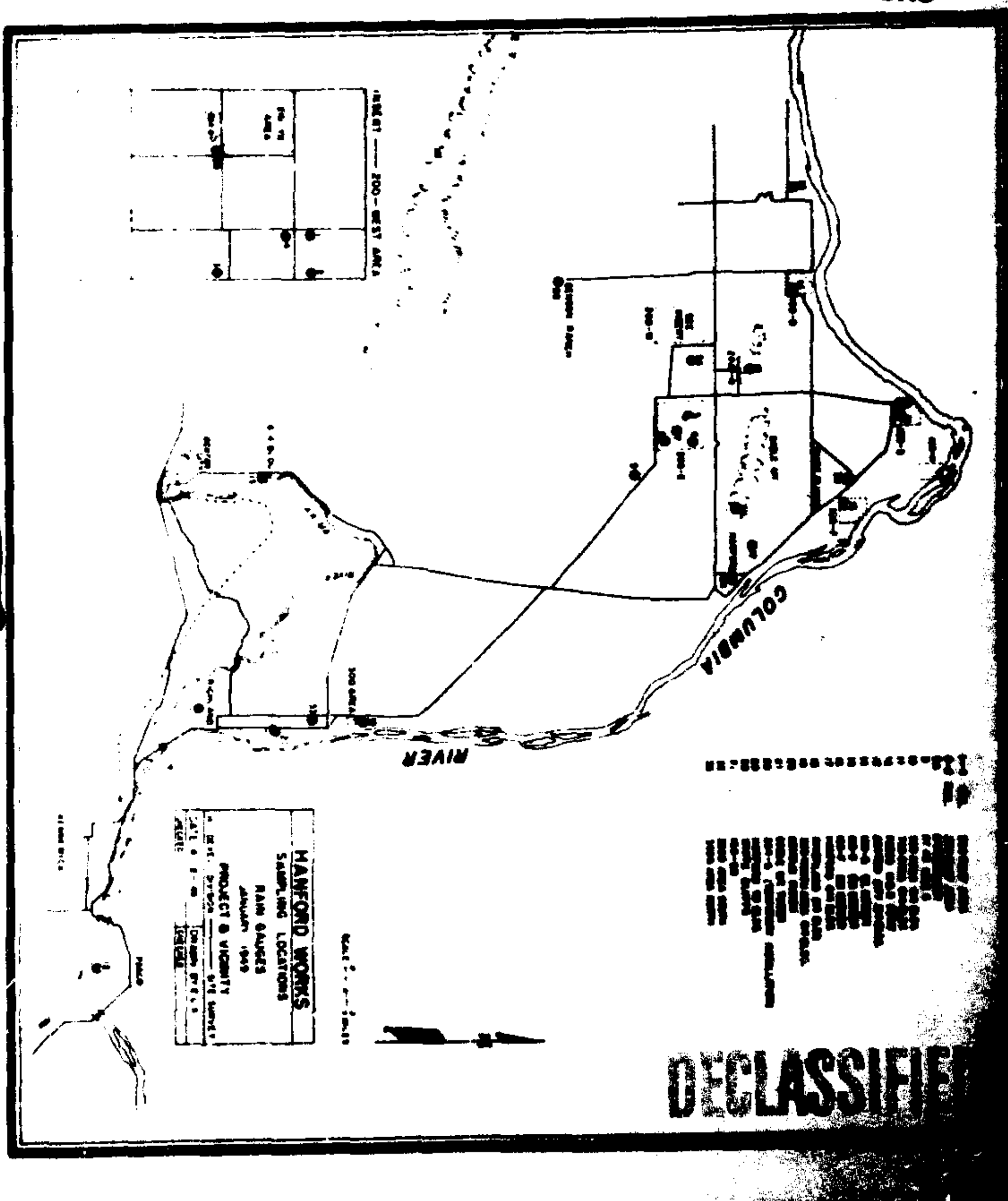
Figure 15 summarizes the average beta activity detected in the rain samples from the listed grouped locations. Figure 16 shows the rain gauge stations where the rain samples are normally collected after each rainfall in the area.

Section V

(See Figures 15 and 16)


AVERAGE BETA ACTIVITY
in
RAIN
JANUARY—FEBRUARY—MARCH
1949
MILLI—MICROCURIES PER LITER
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
WITHIN 200 WEST AREA
WITHIN 200 EAST AREA
WITHIN THE 100 AREAS

DECLASSIFIED
WITH DELETIONS



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SECTION VI

BETA-GAMMA CONTAMINATION OF VEGETATION

The quantity of eight day iodine calculated to be [illegible] the dissolver units based on the weight and cooling time of the irradiated [illegible] during the period January, February and March, 1949, is tabulated below

Month	200 East Area Curies I131	200 West Area Curies I131	[illegible]
January	312	225	[illegible]
February	67	341	[illegible]
March	178	476	[illegible]

The above values are only included to serve as a basis of comparison [illegible] amount of radioactive gases formed during this period with other periods [illegible] represent the amount of radioactive gas that was actually liberated into the [illegible]phere.

A graph showing the daily calculated quantities of I^{131} formed during [illegible] dissolution is presented on Figure 19. The cooling time for the uranium [illegible] during this period varied from about 85 days to 105 days. Estimates of the [illegible] filterable beta activity expelled from the stacks as determined by sampling [illegible]quot of stack gas and passing it through a filter paper and an iodine [illegible]ution indicate that about ½ to 1 curie of radioactive gas is expelled to the [illegible]phere daily. About fifteen hundred vegetation samples were collected in the [illegible] of the Hanford Works during this quarter. Each vegetation sample was analyzed [illegible] beta activity from eight day iodine (I^{131}), and for the beta activity from [illegible] half-lived "non-volatile" fission product elements.

The method of analysis for I^{131} in vegetation consisted of digesting a [illegible] sample of vegetation in a 0.2 N sodium hydroxide-sodium bisulphite solution [illegible]ing off the fibrous vegetation remaining after the digestion. The filtrate [illegible]ed with aluminum nitrate and centrifuged to remove any remaining organic [illegible]

[redacted]

The I^{131} was removed from the supernatant as a precipitate in the form ... iodide. The precipitate was mounted on a 1 inch diameter filter paper ... ivity was measured by means of a 3-5 mg/cm² mica-window counter. Control ... samples to which known quantities of I^{131} were added, were run simult... the regular vegetation samples; this data indicated that about 65-70 per ... can be expected for this type of analysis. All the raw data was corrected for ... ter geometry, overall extraction efficiency, and decay. The limit of sensitiv... for this analysis is about 2 µµc I^{131}/kg vegetation.

The method of analysis for the non-volatile activity (long-half-life) cons... of a nitric acid hydrogen peroxide (30% H_2O_2) digestion of a representative ... sample of vegetation. After digestion and concentration, the residue was quanti... tatively transfered to a one inch stainless steel plate and the activity measu... using thin mica-window counters. Control data indicated a yield between 9...% ... on this process for about 1.5 MEV beta emitter. The total beta activity ... this manner would include any beta activity from the natural occurring isotope ... tassium (K^{40}) present in the potassium salts of the vegetation. ... indicated that the average activity from K^{40} in the vegetation of this area is ... imately 10 µµc/kg; hence, this level of activity is currently considered as the ... round level of the activity in the vegetation.

A summary of the measured I^{131} activity in vegetation samples taken from ... sentative locations during this quarter is shown on Figure 17. ~~The maximum ave...~~ concentration of I^{131} deposited on the vegetation was 383 µµc/kg; this was dete... at a point downwind from the 200 West Area Stack and about one mile from the sta... This area is just outside the perimeter fence near the gatehouse of 200 West Area. The detection for the maximum ground concentration of I^{131} at this point is rela... y consistent as found in reviewing the data for the past two years. The maximum ... concentration on vegetation detected inside the 200 West and 200 East Areas ...

and 160 mμc/kg, respectively. Three month average activity from I^{131} outside [illegible] West Area was about 383 mμc/kg as compared with the average of 44 mμc/kg inside [illegible] area. The general deposited I^{131} activity on vegetation falls off abruptly with[illegible] zone approximately 1 mile northwest and approximately five miles southeast of the separations area stacks; the average activity on vegetation from I^{131} being in the range of 5 to 20 mμc/kg. The detectable I^{131} on vegetation at the Hanford Works [illegible] lows the pattern of the prevailing wind with reasonably good agreement. Figure [illegible] is an iso-activity map showing the estimated distribution of I^{131} on vegetation in the Hanford Works and environs; a wind rose summarizing the wind directions during dissolving hours is also shown on the graph.

Figure 17, is a bar graph listing the average I^{131} detected on vegetation at [illegible] key sampling locations.

Measurements for the longer half-lived fission products (non-volatile activi[illegible] expelled from the separation area stacks and deposited on vegetation were also [illegible] The non-volatile activity on the vegetation at the maximum ground concentration po[illegible] (just outside the 200 West Area gatehouse) was 240 mμc/kg. Measurements made insi[illegible] the separation areas indicated an average deposition of non-volatile activity of [illegible] and 51 mμc/kg in the 200 East and 200 West Areas, respectively. The maximum non-vo[illegible] atile activity detected on an individual vegetation sample was 600 mμc/kg found [illegible] side the 200 West Area near the gatehouse. About three miles from the separation areas a significant decrease in activity from the non-volatile emitters was noted; [illegible] activity at this point varying between 20 to 60 mμc/kg. Figure 18, is a bar graph summarizing the average non-volatile activity detected in vegetation at the key sa[illegible] pling points. Figure 23, is an iso-activity chart showing the estimated distribu[illegible] of the longer half-lived non-volatile fission products deposited on vegetation; [illegible] pattern follows the pattern obtained in I^{131} iso-activity chart; both of which [illegible] principally influenced by the wind directions in the area.

Approximately 180 vegetation samples were collected from the residential [illegible]unites of Richland, Pasco, Kennewick, and the Richland 'Y'. The average beta [illegible]ty from eight day iodine detected in the vegetation from this region was about 2 [illegible] and the average beta activity from non-volatile emitters being less than 10 $\mu\mu c$/[illegible]. The maximum I^{131} activity detected on any vegetation sample in this region was 10 $\mu\mu c$/kg, the maximum non-volatile activity detected in the same area was 32 $\mu\mu c$/kg; both samples were collected in the vicinity of Richland. The average beta activity detected on vegetation in the Pasco-Kennewick area was below the detection limit [illegible] $\mu\mu c$ I^{131}/kg and 10 $\mu\mu c$ non-volatile activity/kg.

A statistical comparison of the average activity on vegetation in the residential areas indicated no significant difference in the deposited activity on vegetation when any given section was compared with the other residential sections surveyed.

One complete survey for radioactive contamination on vegetation in the Wahluke Slope region was completed during this quarter. The average beta activity detected was less than 2 $\mu\mu c$ I^{131}/kg vegetation; occasional samples indicated 5 to 6 $\mu\mu c$[illegible] which tended to confirm the spotty deposition of I^{131} in small areas of the Wahluke Slope observed in past surveys. A statistical comparison of the detected activity [illegible] these spotty areas with the overall average deposition indicated that the small [illegible]areas were significantly higher than the overall average. The occasional deposition of activity noted on the vegetation in the Wahluke Slope is a function of the [illegible] mission of stack effluent and the cross over wind directions brought about by the different wind conditions observed at 200 West Area and the wind directions near 100 Areas (Figure 3, Section I). Beta activity from the non-volatile emitters [illegible] and about 12 $\mu\mu c$/kg on the vegetation; the individual maximum result was 30 [illegible]. A statistical comparison of the average non-volatile beta activity measured on [illegible]luke Slope with the activity measured [redacted] vegetation from Richland, indicated [illegible] activity on the Slope is higher. It should be noted, however, that ground measurements for beta activity from K^{40} in vegetation from Wahluke Richland areas have not yet been completely resolved and some variations ences in activity from this natural occurring isotope are possible.

Surveys of the MP posts in the vicinity of Rattlesnake Mountain the average I^{131} activity on vegetation was 6 mμc/kg and the non-volatile ivity was about 12 mμc/kg. The activity from the longer half-lived isotopes etation in the Rattlesnake region was found to be significantly higher than served on the vegetation in Richland.

In addition to the vegetation surveys made on the project proper, also taken at offsite locations. These surveys included the Finley, Hover, Dayton, and Ellensburg communities. The results of these surveys indicated ll average activity to be below the detectable quantities of 2 mμc I^{131}/kg mμc non-volatile activity/kg. Although, the levels of activity noted in veys were below the detectable quantities as established for an individ averaging the results of many samples, some significance can be assigned to grouped readings and by a study of these grouped data it was hoped that trends would be indicated. Studies of this nature show that the beta activity remote regions around Pasco were lower than the average activity measured in The results from the off area sampling were compared with the average activity Pasco; the results of this data comparison are tabulated below.

WS-File [redacted]

TABLE VII
COMPARISON OF BETA ACTIVITY MEASUREMENTS ON VEGETATION IN RESIDENTIAL AREAS

January February March 1949

Locations Compared	Average I^{131} Activity	Average Activity from Non-Volatiles*	Results of Statisti[cal] Comparison
Pasco City	1.7 muc/kg	8 muc/kg	No significant dif[ference]
Pasco to Eltopia	1.4 muc/kg	7 muc/kg	in activity depositi[on]
Pasco City	1.7 muc/kg	8 muc/kg	I^{131} in Pasco signific[ant]ly higher. No diff[erence] in non-volatile level
Kennewick-Finley-Hover	1.0 muc/kg	7 muc/kg	
Pasco City	1.7 muc/kg	8 muc/kg	No difference in act[ivity] deposition.
Pasco to Ringold	1.7 muc/kg	8 muc/kg	
Pasco City	1.7 muc/kg	8 muc/kg	Pasco significantly h[igh]er for both analysis.
Pasco to Dayton	0.2 muc/kg	5 muc/kg	
Pasco City	1.7 muc/kg	8 muc/kg	Yakima Ellensburg si[gni]ficantly higher than [...] in non-volatile act[ivity]
Yakima Barricade-Ellensburg	0.9 muc/kg	10 muc/kg	

* Includes natural activity from isotope of potassium (K^{40}) present in the pota[s]sium of vegetation.

The above results indicate that there are significant differences in the av[erage] activity from the non-volatile emitters when Pasco is compared with some of the o[ther] locations. The data also indicate that the activity from I^{131} on vegetation in Pa[sco] is greater than that noted in Kennewick and towards Dayton. Because of the low levels involved, these trends are not certain but it does tend to indicate that the[re] are minute quantities of radioactive stack gases deposited in Pasco as indicated by the trends shown in the above table. Here again, the measurements for activity from the non-volatile emitters must be qualified, in view of the fact that variations of the activity in the vegetation due to the varying quantities of natural occurring K^{40} is not thoroughly known at the present time. Figure 20, summarizes the detailed results of the off area vegetation survey covering the area enclosed by Ellensburg, Yakima, Sunnyside, and the Yakima Barricade. Statistical analyses indicated that those levels of activity noted in the off area surveys were not significantly different from that noted in the surveys around Richland.

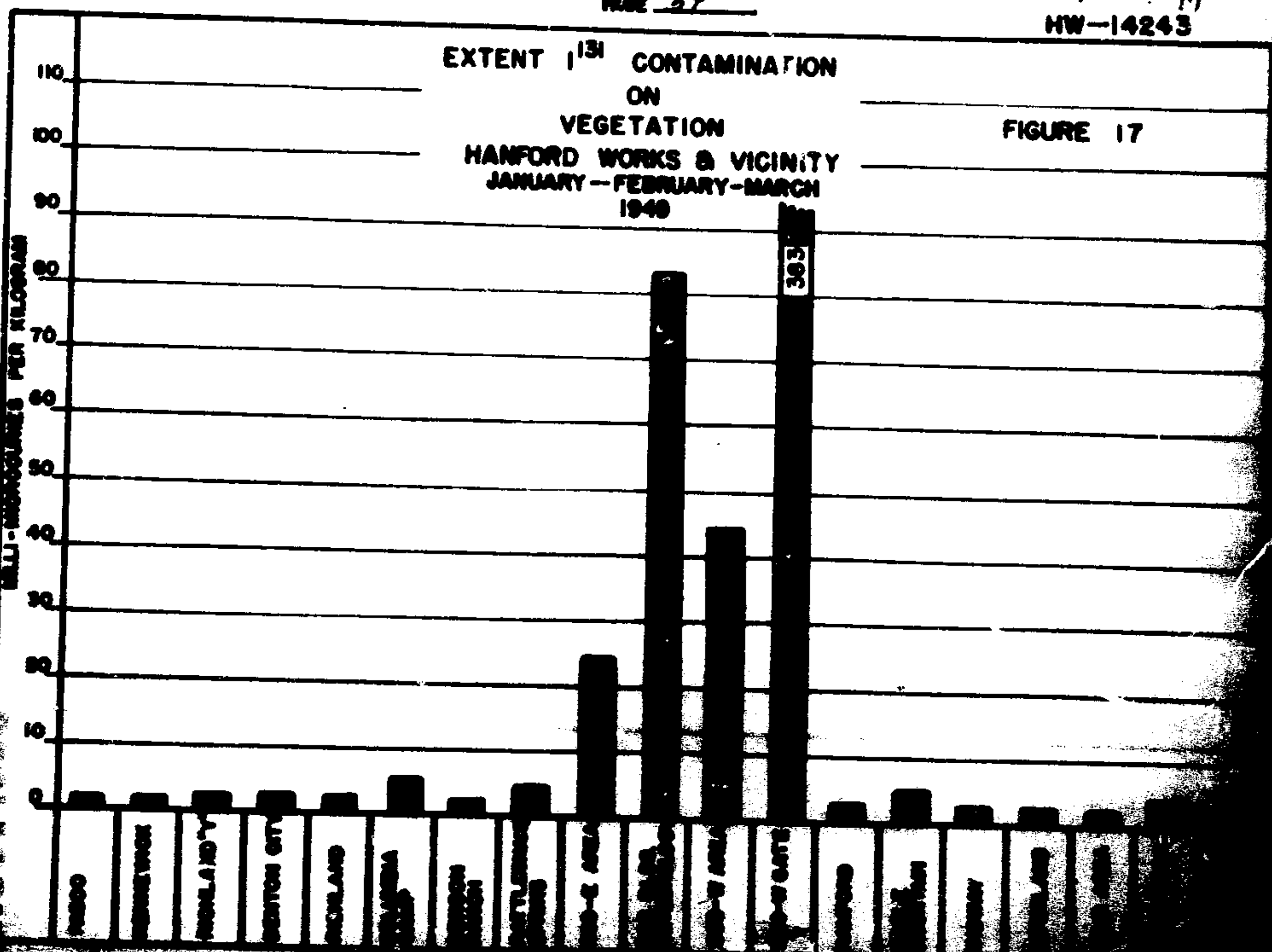
[redacted]

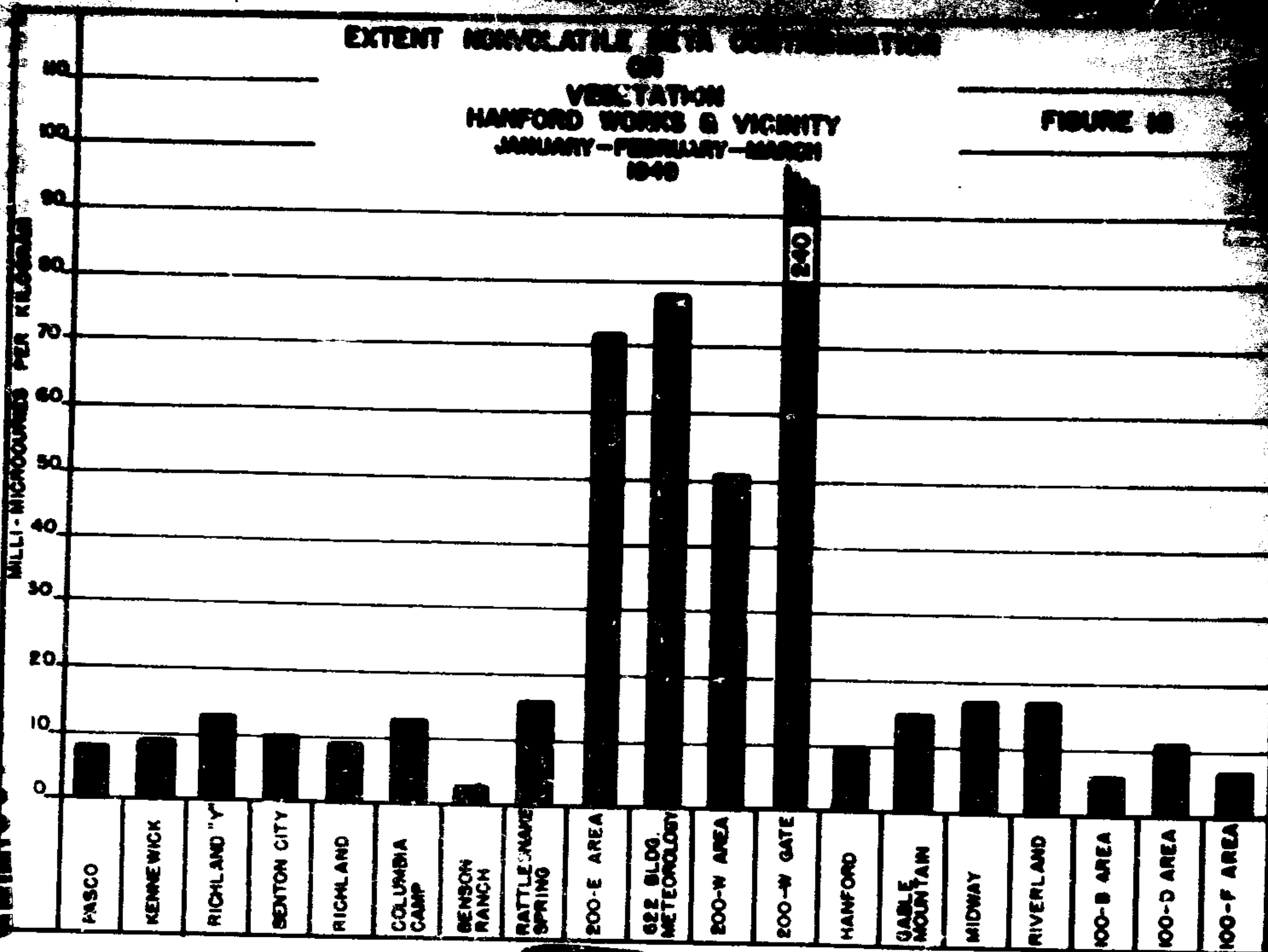
In an effort to determine specific patterns of deposition of radio… luent from the separation area stacks, controlled sampling of vegetation … the areas was initiated. The first survey was taken early in February; … samples were taken at half mile intervals in an area enclosing about … miles in and near the separation areas. A similar survey was made in March; … surveys, all samples were analyzed for I^{131} and non-volatile beta activity. … sults of these surveys are illustrated on Figure 21, which summarizes the … sults by means of an iso-activity chart in which the distribution of the dep… activity is estimated. The controlled sampling clearly indicated that the dep… pattern is a function of the operating condition and wind direction. As antici… the pattern for the deposition of I^{131} varied from month to month while the … for deposition of the longer half-lived elements remained relatively constant. … overall pattern for the estimated distribution of the longer half-lived isot… representative of the overall predominant average deposition of the radioact… uent from the 200 Area stacks; this deposition pattern corresponds to the … obtained by the present random sampling of vegetation for I^{131} activity. The … trolled sampling indicated that the current sampling method employed in evaluat… average deposition of eight day iodine and the non-volatile fission products on … etation is satisfactory. Figures 24 and 25 are sampling location maps indica… where vegetation samples are taken approximately once a week within the … the Hanford Project.

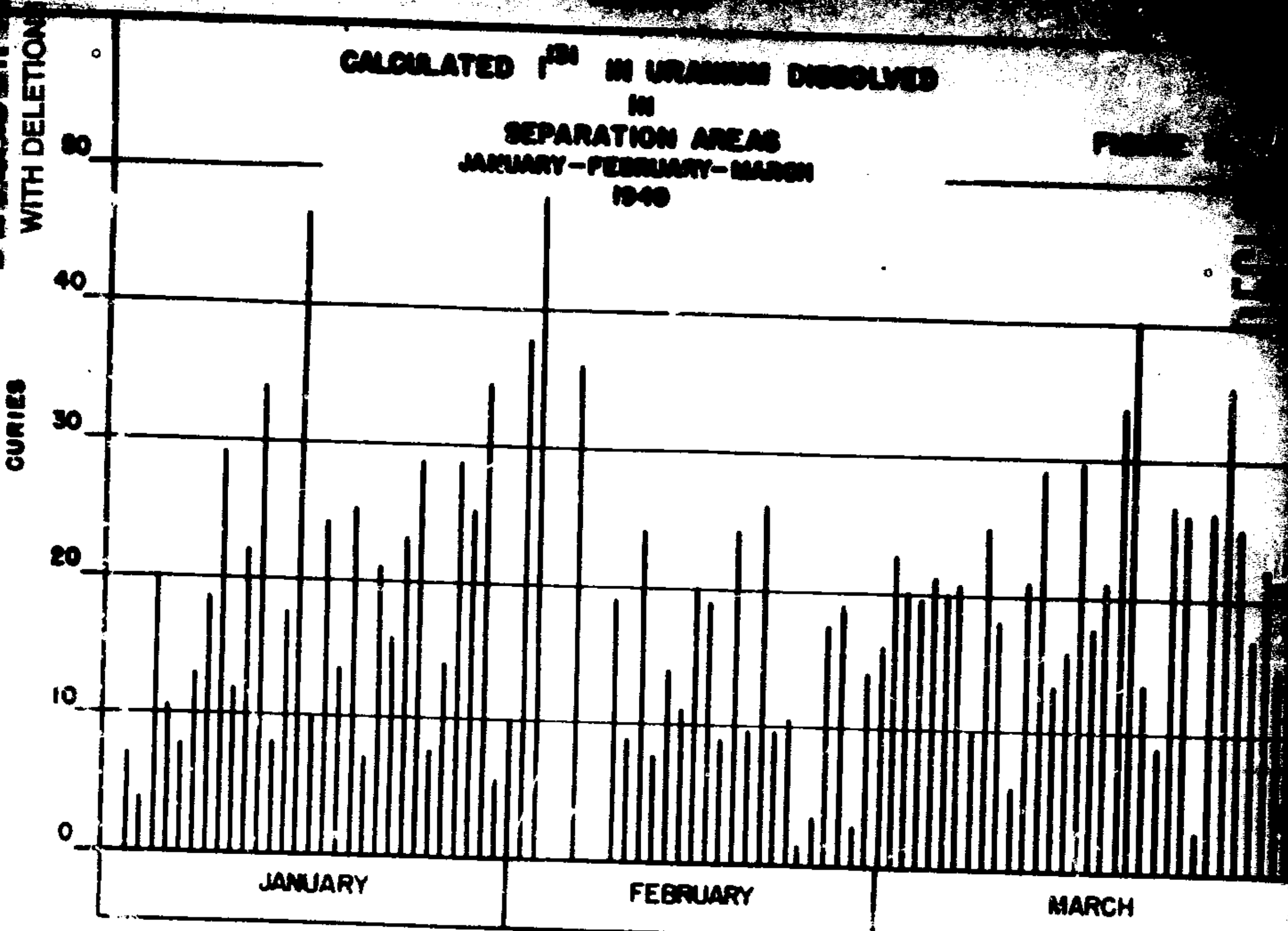
SECTION VI

(See Figures 17,18,19,20,21,22,23,24,25;& Table VII)

HW-14243[17]


EXTENT I131 CONTAMINATION
ON
VEGETATION
HANFORD WORKS & VICINITY
JANUARY--FEBRUARY-MARCH
1949
FIGURE 17
110
100
90
80
70
60
50
40
30
20
10
0
383


EXTENT NONVOLATILE
VEGETATION
HANFORD WORKS & VICINITY
JANUARY—FEBRUARY—MARCH
FIGURE
MILLI-MICROCURIES PER KILOGRAM
0
10
20
30
40
50
60
70
80
90
100
110
240
PASCO
KENNEWICK
RICHLAND "Y"
BENTON CITY
RICHLAND
COLUMBIA CAMP
BENSON RANCH
RATTLESNAKE SPRING
200-E AREA
622 BLDG. METEOROLOGY
200-W AREA
200-W GATE
HANFORD
GABLE MOUNTAIN
MIDWAY
RIVERLAND
100-B AREA
100-D AREA
100-F AREA



CALCULATED I^{131} IN URANIUM DISSOLVED
IN
SEPARATION AREAS
JANUARY–FEBRUARY–MARCH
1949

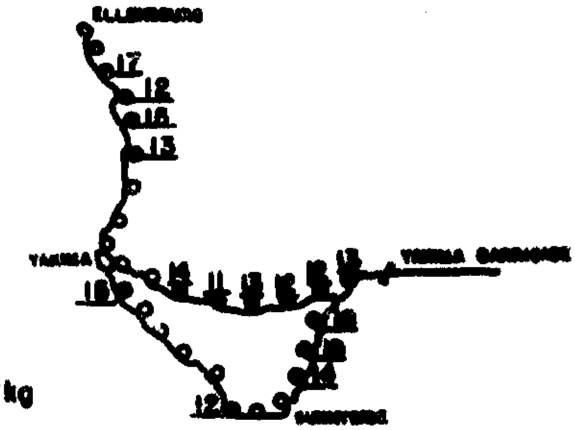
[redacted]

PAGE 54

FIG.

BETA CONTAMINATION ON VEGETATION OFF AREA MARCH 1949

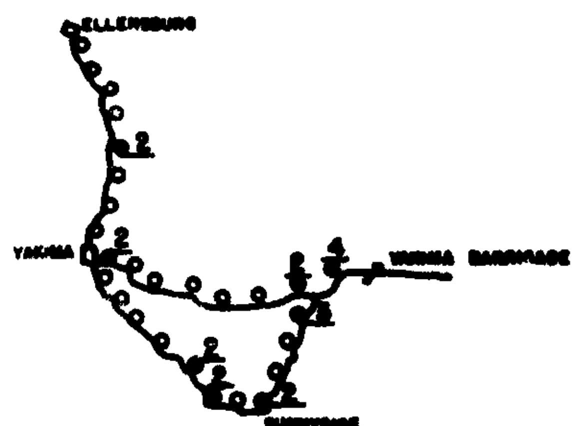
NONVOLATILE BETA CONTAMINATION



○ VALUE IN mμc/kg

○ VALUE LESS THAN 10 mμc/kg

I^{131} CONTAMINATION

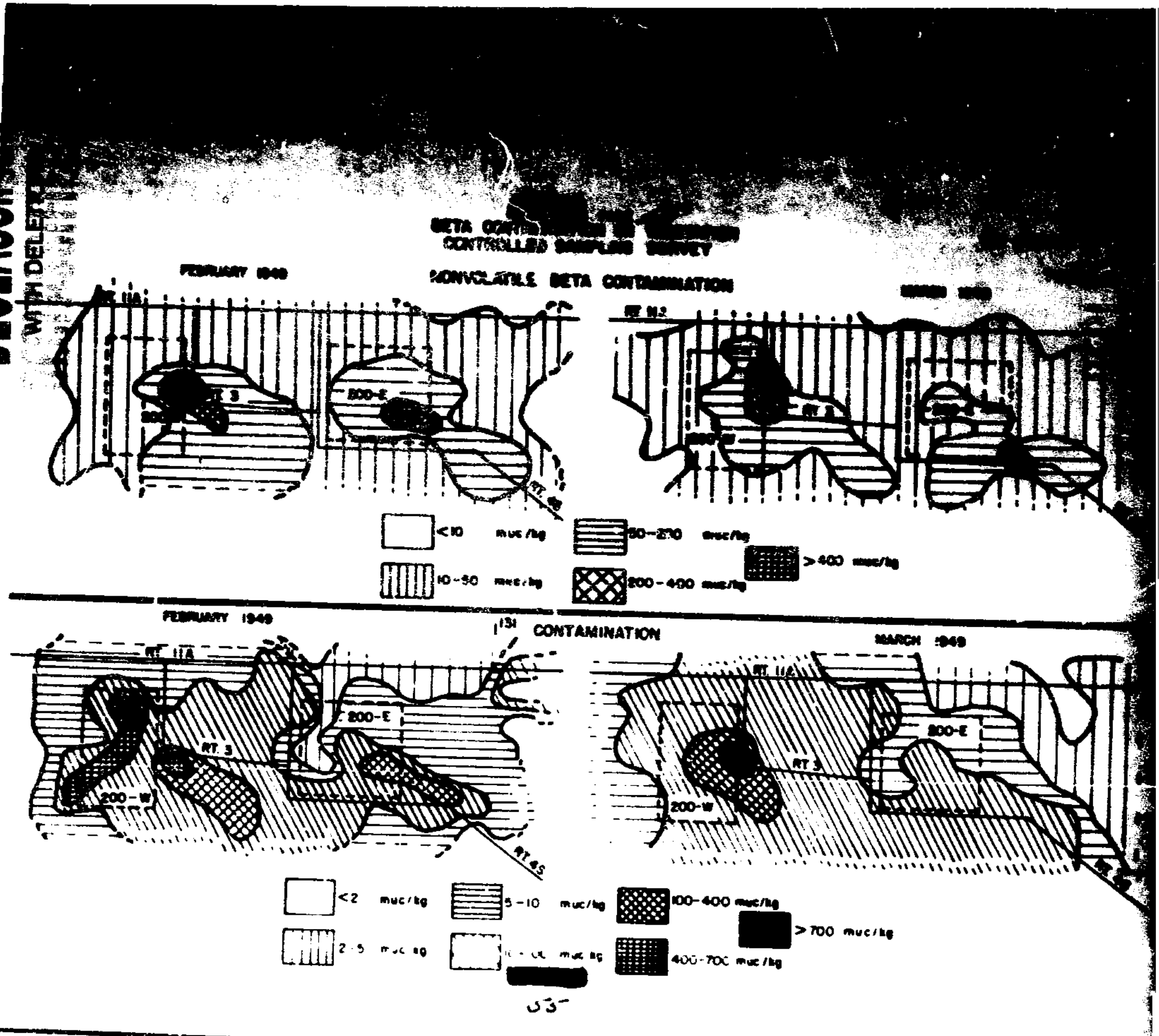


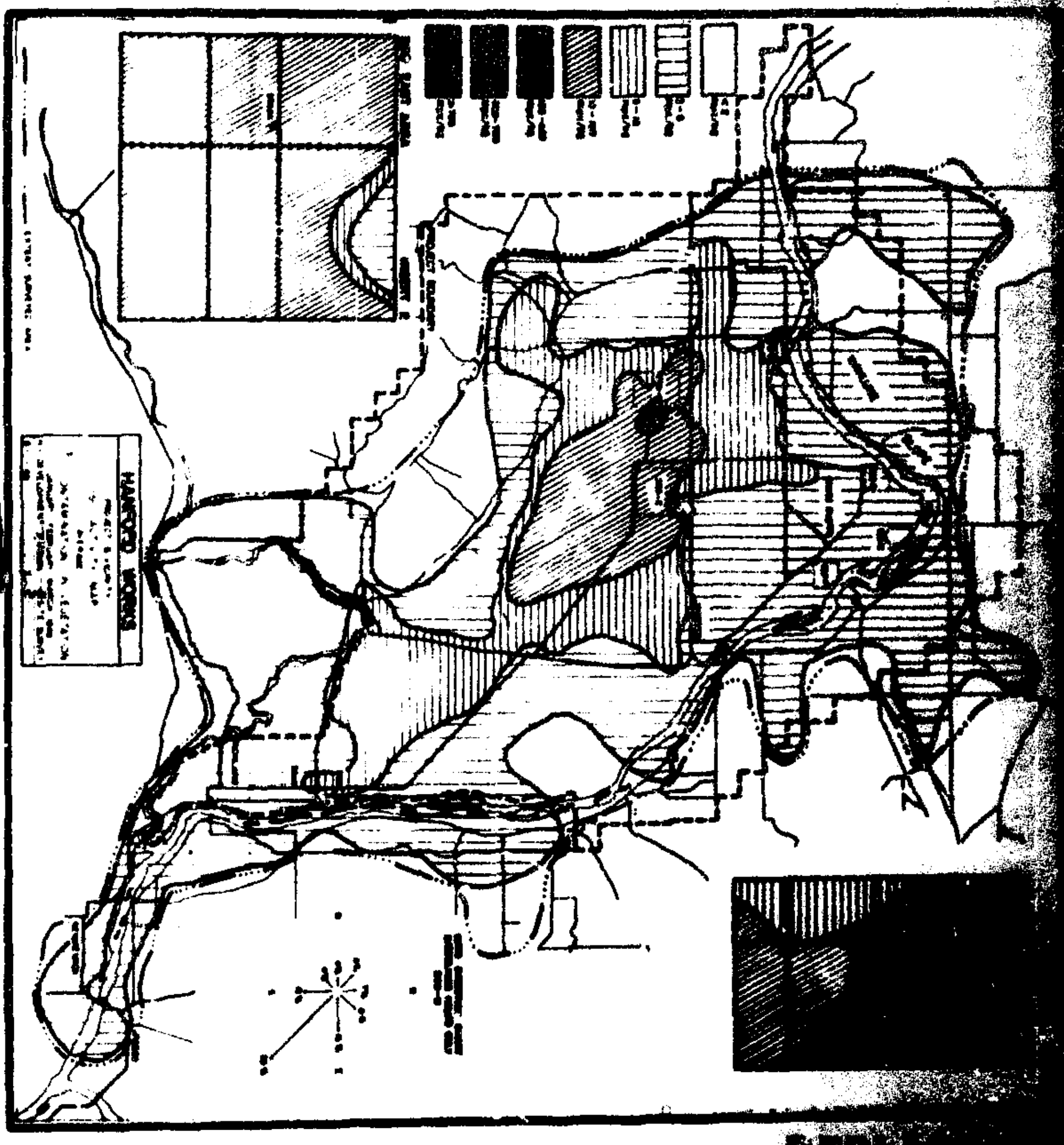
○ VALUE IN mμc/kg

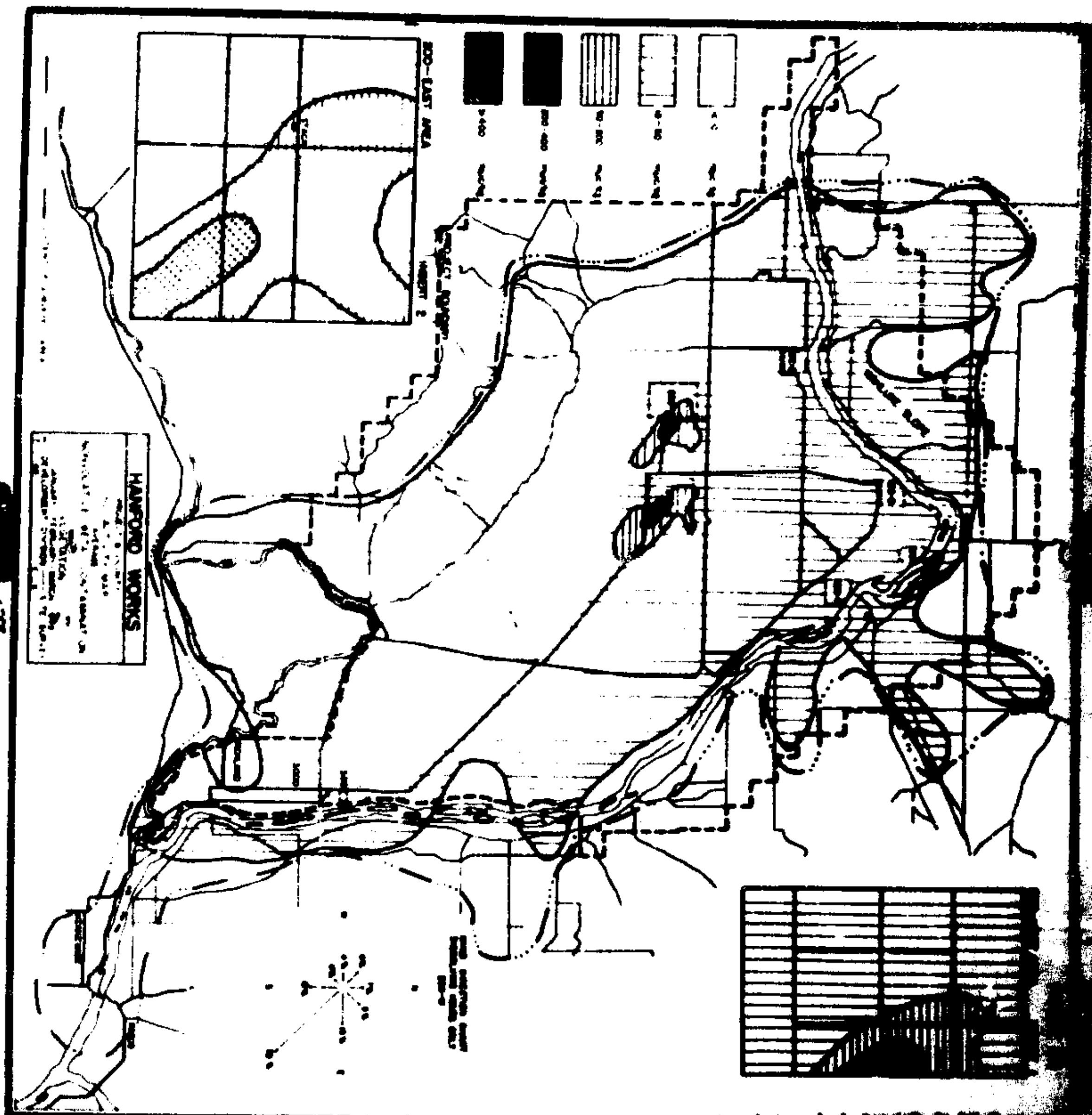
○ VALUE LESS THAN 2 mμc/kg

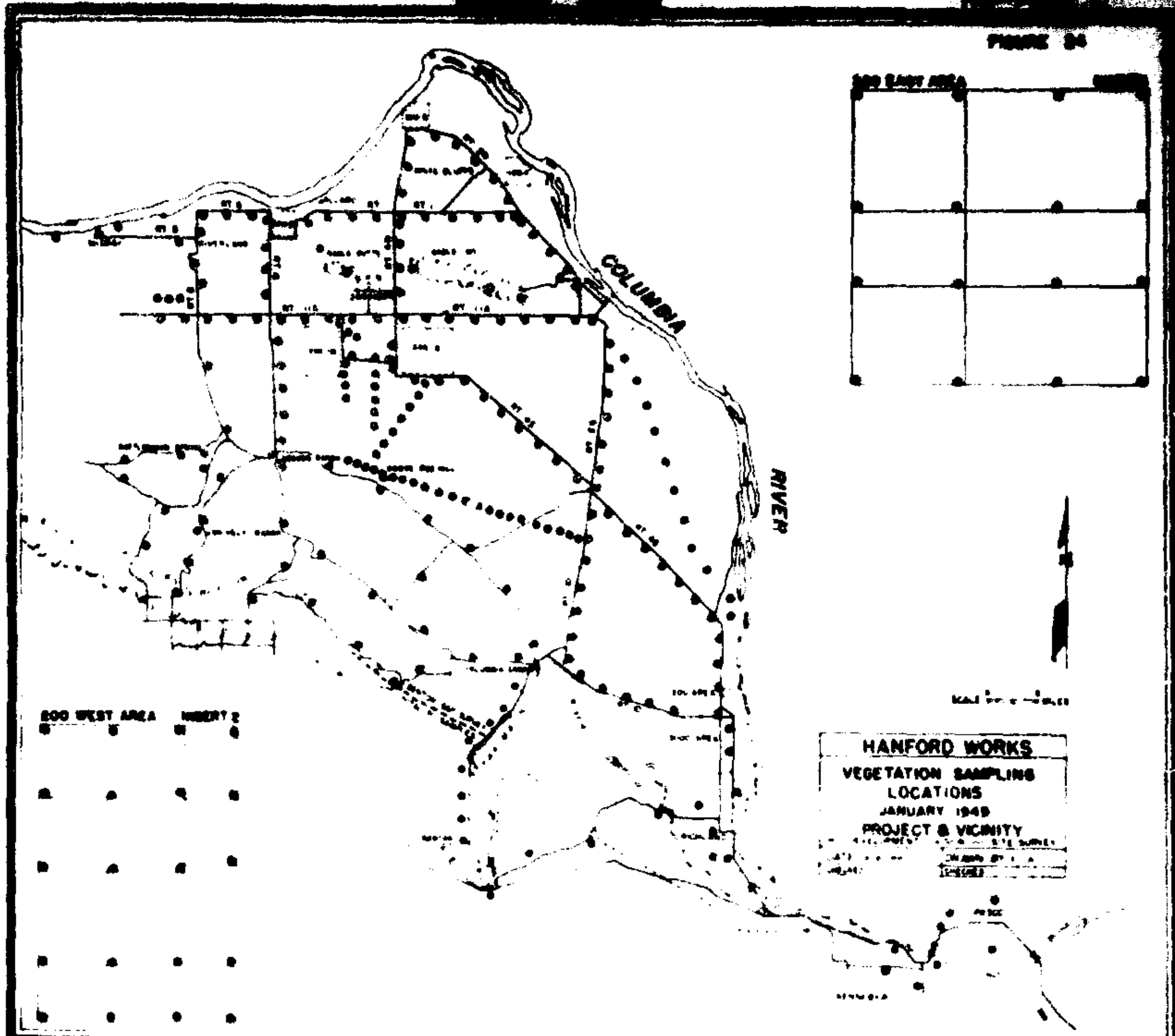
Scale: 1" = ca. 18 Miles

[redacted]

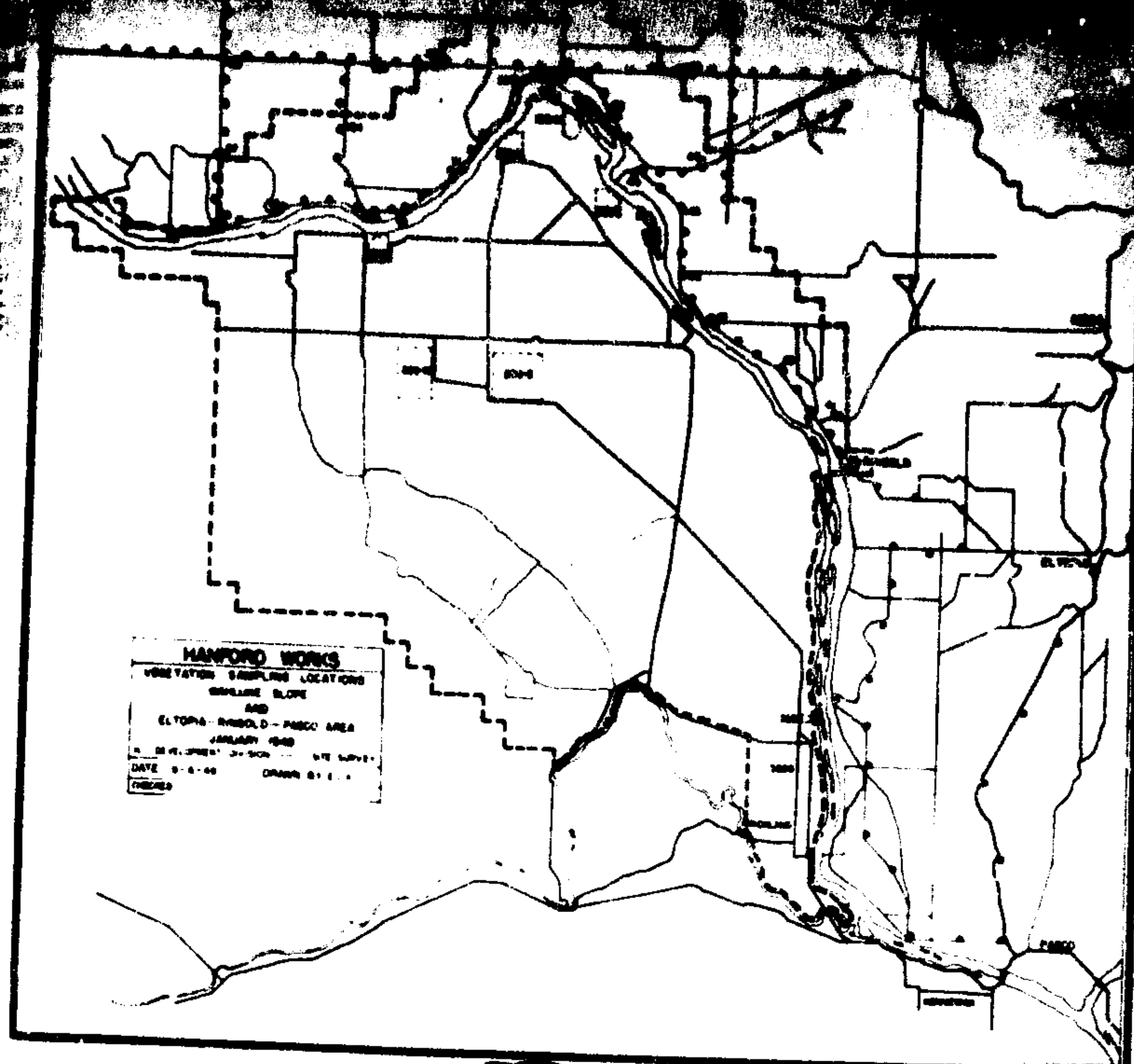

CONTROLLED SAMPLING SURVEY
NONVOLATILE BETA CONTAMINATION
FEBRUARY 1949
RT. 11A
RT. 3
200-E
RT. 4S
<10 muc/kg
10-50 muc/kg
50-200 muc/kg
200-400 muc/kg
>400 muc/kg
FEBRUARY 1949
I131 CONTAMINATION
MARCH 1949
RT. 11A
RT. 3
200-E
200-W
RT. 4S
<2 muc/kg
2-5 muc/kg
5-10 muc/kg
100-400 muc/kg
400-700 muc/kg
>700 muc/kg




HANFORD WORKS



DECLASSIFIED


HANFORD WORKS
VEGETATION SAMPLING LOCATIONS
AND
DATE
DRAWN
CHECKED
PASCO

"G-File

[redacted]

SECTION VII

ALPHA AND BETA CONTAMINATION IN HANFORD WATERS

100 AREAS:

Results for the alpha and beta contamination measured in samples of the [illegible] waters of the 107 retention ponds during the quarter January, February, and [illegible] 1954, are summarized in the table below. The tabulation includes only those [illegible] which are representative of normal operating conditions in the 100 Areas.

Sample Location	Alpha Activity dis/min/liter		Beta Activity μc/liter	
	Maximum	Average	Maximum	Average
107-B	42*	< 30	0.39	[illegible]
107-D	46*	< 30	0.74	[illegible]
107-F	38	< 30	0.48	[illegible]

* Subsequent samples from these locations indicated <30 dis/min/liter.

Analysis of the above data indicated that the average beta activity detected [illegible] samples from the 107-F effluent water was higher than that detected in the [illegible] 107-D effluent water; also, the average beta activity measured in each of the [illegible] was somewhat higher than that measured during the previous quarter. No single [illegible] rent cause can be assigned to explain this increase, however, previous data [illegible] indicated this range of fluctuation to exist within duplicate samples. The [illegible] amounts of algae in the basin during the periods involved, along with the varying amounts of algae collected in the individual 500 ml. samples could account for the fluctuation in the beta activity detected in the water samples.

The retention pond samples were analyzed for uranium; only one result [illegible] the detection limit of 4 μg/liter. Sufficient volume of this sample was not [illegible] ble for further analyses, although subsequent resamples did not confirm this [illegible]

The 107 retention pond samples were spot checked for plutonium and polonium [illegible] results indicated < 6 dis/min/liter from either source.

Several samples of the 107 effluent water were analyzed for beta activity [illegible] S^{35}, the activity averaged around 10 μμc/liter early in the [illegible]

[redacted]

BEST AVAILABLE COPY

1.0 μμc/liter during late February and March. Samples obtained from the dryer condensate at 100-F Area showed the S^{35} activity to average 0.7μc/ml., with occasional maximums approaching 1.5 μc/ml.

A survey of the 'C' ditch in the 100-F Area was made in early March. This ditch carries waste effluent from the 105 and 190 buildings. Maximum portable readings of 100 mrep/hr. at the inlet from the 105 building, and 60 mrep/hr. at the area perimeter were obtained. Water samples indicated about 50 μμc/liter of beta activity, and 10 dis/min/liter for alpha activity.

Ditches:

The maximum results of portable instrument (VGM's) surveys of the three 200 Area ditches were 32,000 counts/minute and 8.5 mrep/hour (Beckman). These values are consistent with survey results from previous quarters.

Routine portable instrument surveys of the 'T' Ditch 'T' Swamp, and the Laundry Ditch in the 200 West Area showed the readings to vary from background (50 counts/minute), to a maximum of 700 counts/minute.

Routine VGM probe surveys of the test holes around the 200 West Area waste lines resulted in positive readings of from 2 to 10 times the normal background of 50 counts per minute for test holes "D" and "E". These readings are in agreement with previous surveys. The remaining test holes were at background levels.

The following table summarizes the alpha and beta contamination measured in samples obtained from the 241 "T" Swamp in the 200 West Area:

TS-File [redacted]

Location & Type Sample	Total Beta Activity $\mu\mu c$/liter		Total Alpha [illegible] dis/[illegible]	
	Maximum	Average	Maximum	[illegible]
T Swamp, Inlet	0.43	0.11	[illegible]	[illegible]
T Swamp, West Side	0.20	0.10	46	[illegible]
T Swamp, South Side	0.43	0.11	1100	[illegible]
Mud Sample	μc/kg		dis/[illegible]	
T Swamp, West Side	0.05	0.03	1.2 x 10[illegible]	6 x [illegible]
T Swamp, South Side	0.07	0.03	2.7 x 10[illegible]	1 x [illegible]

*Does not include result of 1100 dis/min/liter, which was the only [illegible] the reporting level of 30 dis/min/liter.

No significant changes were noted in the current contamination level [illegible] of the previous quarter. The water sample levels are almost identical to [illegible] previous quarter, while the mud sample results are slightly lower. The one [illegible] sult of 1100 dis/min/liter is unusual but not unprecedented. Analysis of [illegible] for uranium by the fluorophotometer process yielded a result of 1200 [illegible] uranium per liter. This indicates that the total activity was from [illegible]

A summary of the alpha and beta contamination detected in samples from [illegible] Swamp in the 200 West Area and those ditches flowing into the swamp [illegible] low:

Location	Total Beta Activity $\mu\mu c$/liter		[illegible]	
	Maximum	Average	Maximum	[illegible]
Laundry Ditch, Inlet	2.32	0.44	200	[illegible]
600' From Inlet	0.27	0.12	700	[illegible]
231 Ditch, Pipe Outlet	0.08	0.03	30	[illegible]
1st. Underpass	1.90*	0.03	30	[illegible]
'U' Swamp Inlet	0.96*	0.03	3000*	[illegible]
West Side	0.06	0.03	100	[illegible]

*These values were not included in their respective group averages as they [illegible] not confirmed by subsequent resamples.

The average beta contamination found in the Laundry Ditch this quarter [illegible] what higher than last quarter, however the sample levels varied so widely [illegible] nificance in the difference was established. Fluorophotometer analysis [illegible] trace quantities of uranium were present in this ditch with a [illegible] μg U/liter.

[redacted]

The alpha and beta activity levels in the 231 Ditch approximate the min... reporting levels of 50 micro-microcuries per liter for beta and 30 dis/min/liter alpha. No significant change in these averages was noted when compared with ... over the past two years.

The increase in beta contamination noted in the Laundry Ditch for this qu... was reflected by an increase in the 'U' Swamp average beta activity for the sa... period. Although, the average beta activity was higher than last quarter by a ... of ten the more frequent results were below the limits of detection. The alpha ... in the swamp was slightly above the minimum reporting level but was consid... ly lower than similar activity detected in the Laundry Ditch. The maximum fl... photometer result was 70 μg U/liter.

Lint samples collected in the vicinity of the Laundry Building in the 200 ... Area indicated beta activity approaching 1.5 μc/kg of lint and alpha activity ... 1.1×10^6 dis/min/kg of lint. Neither of these results were unusual when comp... with the data of the previous quarter.

The average beta activity in the 271-B and 271-T Retention Basins was 0.0... 0.13 μμc/liter with maximums of 0.15 and 0.40 milli-microcuries per liter, resp... ively. One sample from the 271-T Basin showed alpha activity of 40 dis/min/liter, this value being the only result above the reporting level of 30 dis/min/liter at ... location.

300 AREA

The maximum beta activity detected in samples of waste solutions from the ... old 300 Area Retention Ponds was 4.8 and 21.0 μμc/liter respectively. These val... were consistent with those observed last quarter. Alpha activity maximums were ... $\times 10^4$ and 1.6×10^4 dis/min/liter, respectively. Fluorophotometer analyses ... uranium as the contaminant, occasional results as high as 1.6×10^4 μg U/liter ... detected. Waste solid samples taken at the inlet of the old pond yielded ...

[redacted]

values of 9.2 $\mu c/kg$ beta activity, and approximately 2.0×10^7 dis/min/kg for [illegible] alpha emitters.

Samples from the 300 Area Waste Line, which empties into the new retention [illegible] were taken almost daily during the quarter. The detected activity has the possibi[illegible] lity of several sources, as this line carries all 300 Area waste to the ponds. [illegible] results reflect this fact as they show considerable fluctuation. The beta activity [illegible] [illegible] from 0.01 to 1.0 $\mu\mu c$/liter with a maximum activity of 6.6 $\mu\mu c$/liter. The [illegible] [illegible] alpha result was 3.7×10^4 dis/min/liter. Fluorophotometer analysis establi[illegible] [illegible] of this activity to be from uranium, with the maximum result of 2.5×10^4 μg [illegible] [illegible]ter. Analysis of waste line samples for plutonium by the T.T.A. process showed [illegible] result of 100 dis/min/liter.

W. Singlevich

W. Singlevich and H.J. P[illegible]
DEVELOPMENT DIVISION
HEALTH INSTRUMENT DIVI[illegible]

[redacted]

3-File

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[redacted]