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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD JULY, AUGUST, SEPTEMBER, 1948

By

W. Singlevich
March 10, 1949

HEALTH INSTRUMENT DIVISIONS
GENERAL ELECTRIC COMPANY
HANFORD WORKS

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE QUARTER JULY, AUGUST, SEPTEMBER 1948

INTRODUCTION:

This report summarizes the radioactive contamination measured at the Hanford Works and vicinity for the quarter July, August, and September 1948.

ABSTRACT:

Section I- Meteorological Data:

The wind direction at the separations area again prevailed from the northwest as usually observed in the past. The measured wind directions in the 100 Areas differed from that observed in the 200 West Area. Complete summaries of the wind directions, velocities, and atmospheric dilutions as measured during actual hours of metal dissolution are included.

Section II- Airborne Contamination and Air Radiation Levels:

There were no outstanding differences or trends in comparing the overall air contamination levels of this quarter with that of the previous three months. Activity measured on the filters from the 300 Area proper indicated positive quantities of uranium as high as 182 ug uranium on one filter representative of 20,000 cubic feet of air sampled. Indications of the presence of 200 Area stack discharge active particles on the filters is discussed. Complete data for the radiation levels measured and for the radioactive contamination detected on the filters is summarized.

Section III- Alpha and Beta Contamination In the Columbia River:

The flow trend of the Columbia River is discussed; the current flow rate is back to normal after the flood stage noted in June of 1948. With the "start-up" of 100-B Area a slight increase was noted in the radioactive contamination level of the river water entering the 100-D Area. All other locations remained essentially the same as that noted in the past quarter. A summary of the radioactive contamination detected in the river samples at all locations is presented; the activity in those samples is primarily from the short half-lived (14.8 hours) radiosodium (Na^{24}). Preliminary indications of non-uniformity of the distribution of the radioactivity in the river based on a spot check survey is discussed. A material balance of the radioactive wastes discharged into the Columbia River as calculated based on analyses of the 107 Waste Basins in the 100 Areas versus the activity actually measured in river samples taken at various locations along the river is presented; the overall agreement in this comparison seemed to be good. A study of the beta-gamma activity measured in the raw samples of the 100 and 200 Areas is reviewed; it is shown that the activity in these sanitary water samples increase as one progresses from the 100-B Area to the 100-F Area; the activity in the 200 Area Sanitary system supplied from the same source is lower than that detected in the 100 Areas.

Section IV- Beta Contamination in the Rain:

Because of the subnormal rainfall during this quarter, fewer rainfall measurements were made for radioactive contamination. Of the data available, no significant trends or changes were noted in an overall comparison of the current period with that of three months ago. Slightly higher beta activity was detected in samples from the 200 West Area than from the 200 East Area.

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Section V- Alpha and Beta Contamination in Drinking Water:

The complete results of the assay for radioactive contamination in drinking water sources is tabulated. No unusual trends or changes were observed; trace quantities of uranium presumably occuring as natural uranium continued to be found in samples of the drinking water. Results of data analysis of the trace quantities of the beta-gamma activity (in all cases less than 5×10^{-5} μc/liter) indicated that Richland Well # 15 is probably higher than any other Richland Well; the average alpha and beta activity in this well was 10 dis/min/liter and 9.7×10^{-6} μc/liter, respectively.

Section VI- Beta Contamination on Vegetation:

The overall average deposition of radioactive contamination during this quarter on vegetation remained essentially the same as noted during the previous three month average although it was calculated that more radioiodine was formed in the metal dissolved during this quarter as compared with the last quarter. A review of the beta activity detected in vegetation samples from the Wahluke Slope is presented covering the period from May through September, 1948; the overall average results indicate trace quantities of activity of about 0.04 uc/kg in the Slope during the period considered. Surveys of "off plant" locations including Yakima, Ellensburg, The Dalles, Pasco and Richland indicate contamination levels below the detectable limit of 0.04 uc/kg. Occurence of the isotope K^{40} of potassium in natural quantities in vegetation is mentioned. Results of analyses of 662 soil samples for radioactive contamination is summarized; the average beta activity ranged from about 0.01 to 0.02 uc/kg.

Section VII- Alpha and Beta Contamination in Hanford Wastes:

The measurements for radioactive wastes in the 100, 200, and 300 Area waste systems are reviewed. The levels of activity measured are of the same order of magnitude as normally found with only small changes noted such as that caused by the start-up of 100-B Area and small fluctuations noted in the laundry wastes. The uranium measured in the principal 300 Area Waste line averaged about 1385 ug uranium per liter of waste; this level would indicate that 1¼ pounds of uranium would be discharged every eight hours for the average flow of 275 gallons per minute.

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Development Division
Health Instrument Divisions

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SECTION I

METEOROLOGICAL DATA

A summary of the meteorological data taken by the Meteorology Group of the Health Instrument Divisions is presented on Figures 1 through 5. The data summarized is representative of the meteorological conditions only during the period of actual metal dissolution in the separations area.

During the quarterly period, July, August, September, 1948, the wind prevailed from the north-west and the west seventy-four percent of the time as observed at the Meteorology Station in the 200 West Area. As usually observed in the past, the wind from the east was practically negligible. Figure 1 graphically shows the average wind directions measured in the 200-West Area during metal dissolution periods; the corresponding average wind velocity for each direction is also shown. It should be pointed out that the maximum average wind velocities accompanied the prevailing westerly quadrant, exceeding ten miles per hour throughout the period.

Figure 2 is a monthly breakdown of the average wind direction and velocity reported for the entire quarter in Figure 1. No outstanding trends in this quarter were observed in the month-to-month analysis of wind direction and velocity. However, the trend of deposition of radioactive contamination from the 200-Area stack effluents on the vegetation away from the stacks followed the pattern of the prevailing winds. Individual monthly average iso-activity maps showing the estimated distribution of stack effluent wastes on the surrounding vegetation on a month-to-month basis as correlated with the average wind directions are included in the H. I. Monthly Environs Reports[(2)(3)(4)].

Figure 3 shows the average wind directions and corresponding wind velocities in miles per hour as observed at the 100-B, D, and F Areas. It can be readily seen that there are significant differences in directions of wind when comparing the 100

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Areas with each other or with the Meteorology Station in the 200-West Area. At the 100-F Area, winds from the south and southeast seem to prevail; these wind directions would be ideal for carrying 200 Area air-borne radioactive contamination over the Wahluke Slope Area where occasionally, positive traces of 8 day radioiodine can be detected on the vegetation in that region. It is of interest to point out that the velocities of the winds in the 100 Areas do not vary significantly with the prevailing winds which is contrary to that observed at the Meteorology Station where maximum wind velocities generally accompany the prevailing winds.

Figure 4 is a graphical picture of the estimated atmospheric dilution factors during the periods of metal dissolution in the separation areas. Atmospheric dilution factors which exceeded a ratio of 2000:1 prevailed during the quarter. The aloft condition (wind dilution factors > 2000:1) occurred about fifty-two percent of the time during the quarter as compared to the other lesser dilution factors grouped in ratios of 500:1, 500-1000:1 and > 1000 but < 2000:1.

Figure 5 portrays the atmospheric dilution factors discussed in Figure 4 in a slightly different manner. The data were grouped in 100:1 ratio intervals of dilution factors generally reported in groups of less than 500:1 (considered as an undesirable atmospheric condition for metal dissolving), 500 - 1000, 1000:1 and aloft; these groupings were then analyzed by averaging the month-by-month observations and the quarterly average. The outstanding point emphasized by the grouping of the data indicated that during the total time of dissolving, metal dissolution was in progress 8.9 percent of the total time when the atmospheric dilution factor was less than 500:1; this represents a fractional time period four times as great as that calculated for the last quarter when metal was dissolved when the dilution factors were less than 500:1. The ideal condition for the dissolving of metal, the aloft condition, prevailed somewhat more than one-half the total time of dissolving during this reported period.

[redacted]

Since the atmospheric conditions discussed in this section represent those times when the irradiated uranium was in the process of dissolution, it should be pointed out that for meteorological data summarizing the daily twenty-four hour periods, the monthly summaries issued by the Meteorological Group should be consulted. Ref. (5)(6) and (7).

SECTION I

(See Figures 1, 2, 3, 4, and 5)

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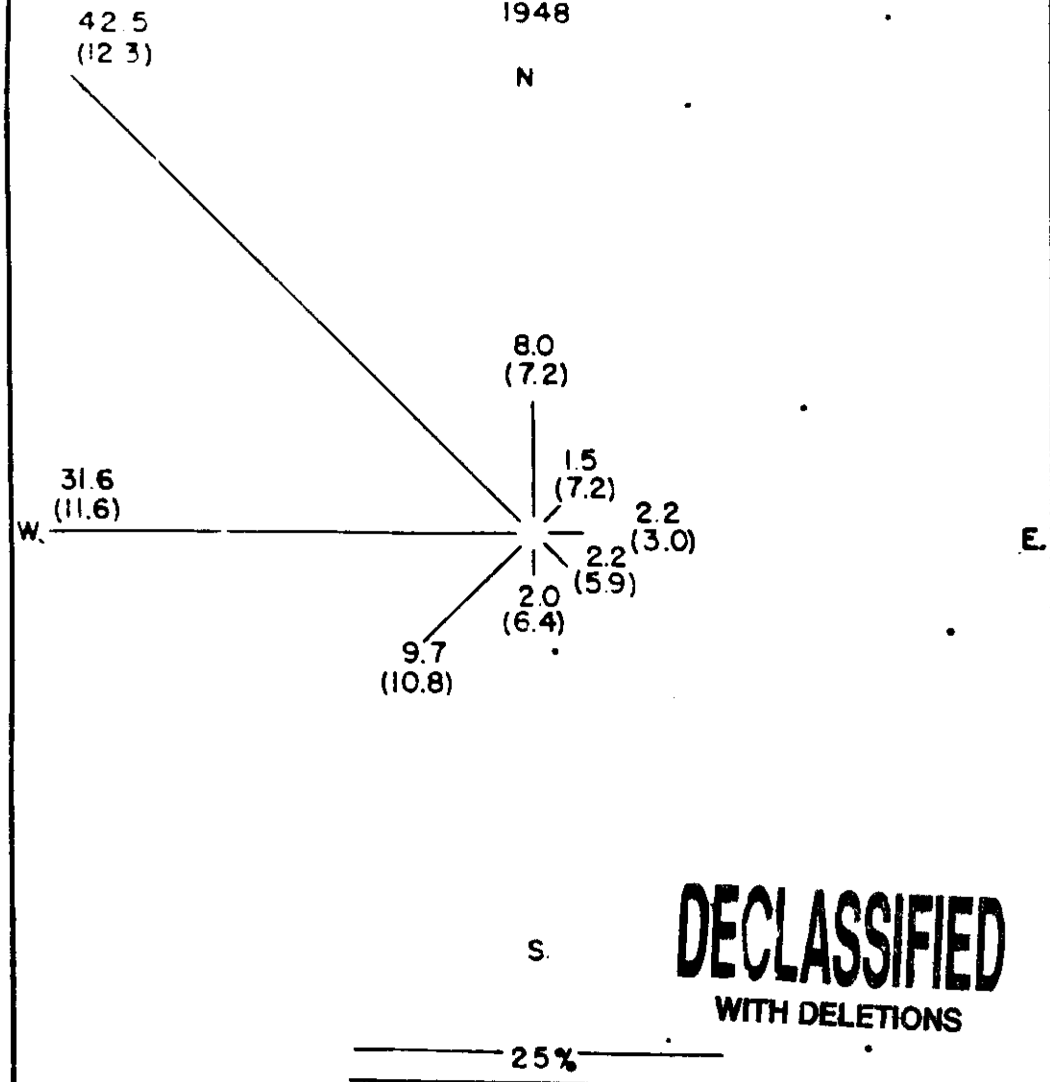
WIND DIRECTION & VELOCITY
DISSOLVING HOURS ONLY

FIGURE I

200-WEST
JULY — AUGUST — SEPTEMBER
1948



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( ) VELOCITY M.P.H.
FIGURES = % TIME OBSERVED

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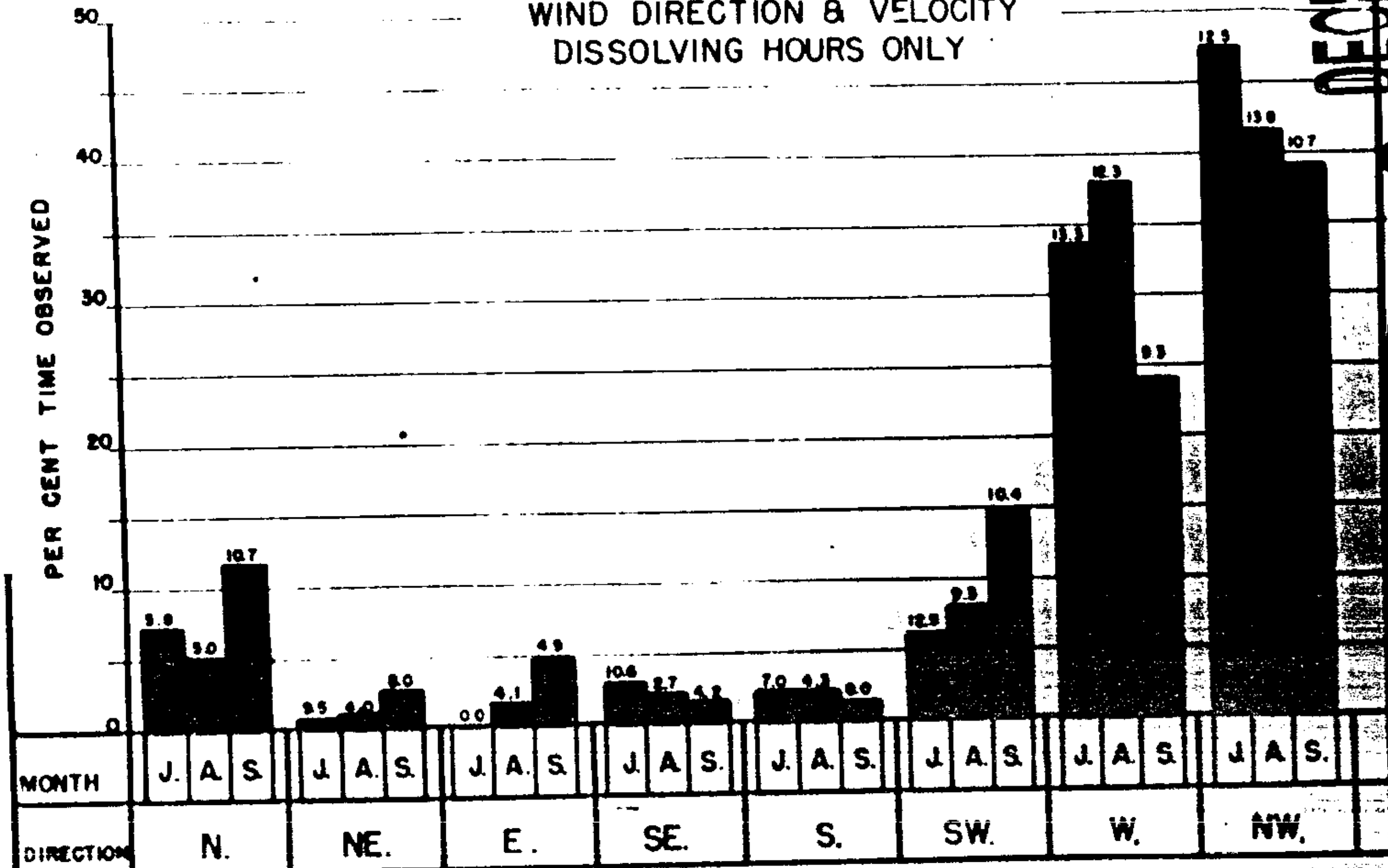
FIGURE 2

SUMMARY AIR CONDITIONS —— 200-W
JULY — AUGUST — SEPTEMBER
1948

WIND DIRECTION & VELOCITY
DISSOLVING HOURS ONLY



FIGURES ATOP COLUMNS ARE AVERAGE VELOCITY M.P.H.

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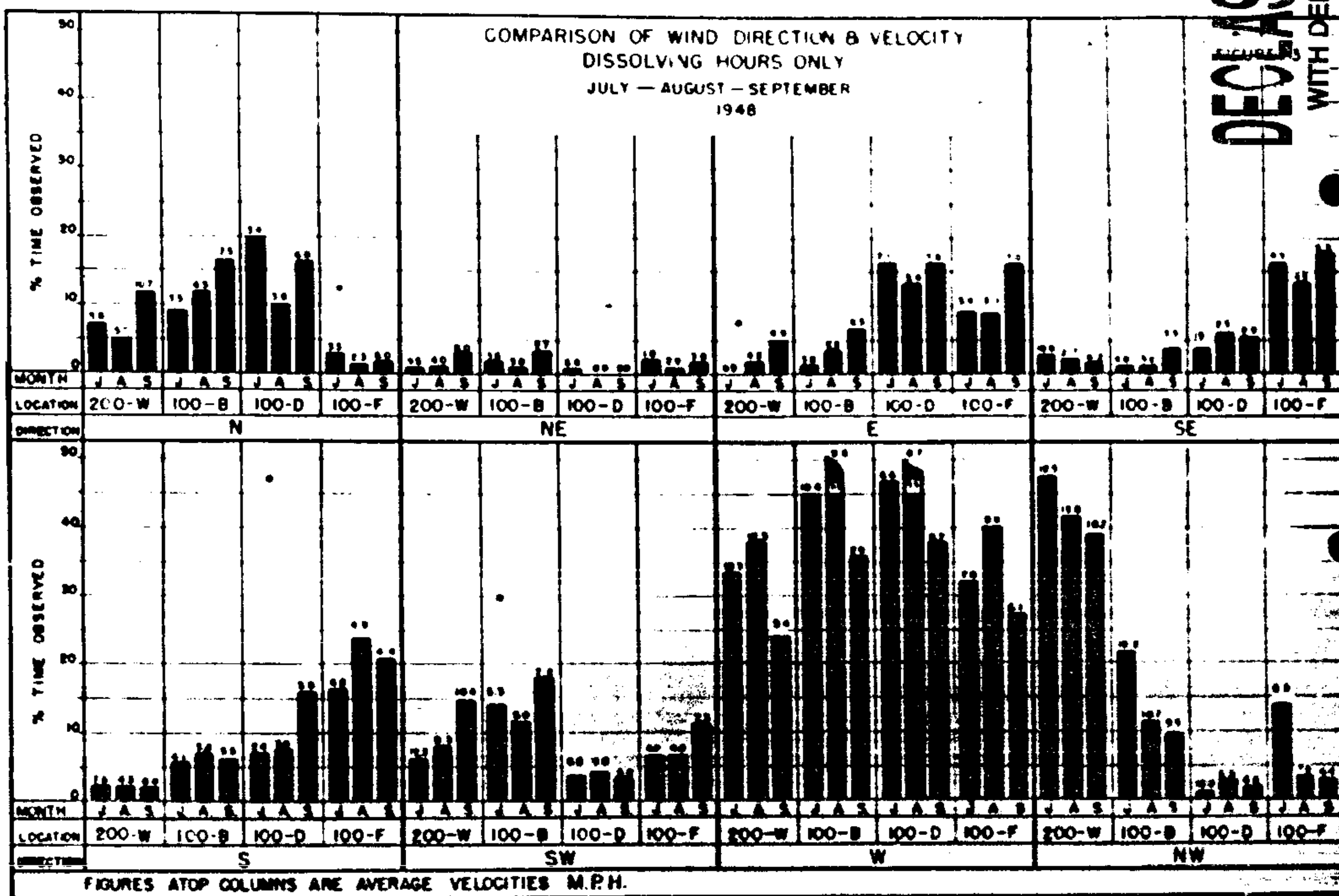

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FIGURE 4

WIND DILUTION ANALYSIS
622 BLDG.—200—W AREA
DISSOLVING HOURS ONLY
JULY—AUGUST — SEPTEMBER
1948

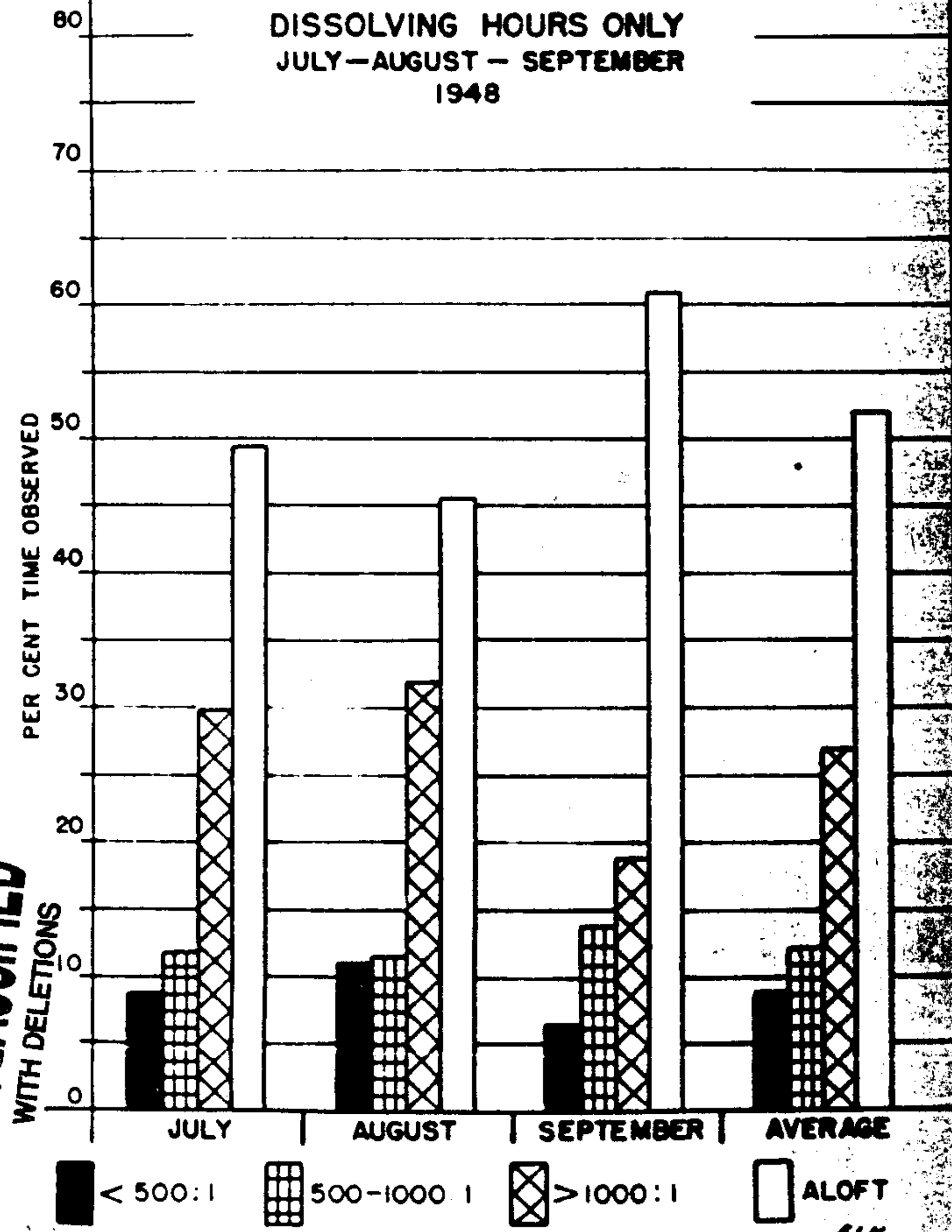

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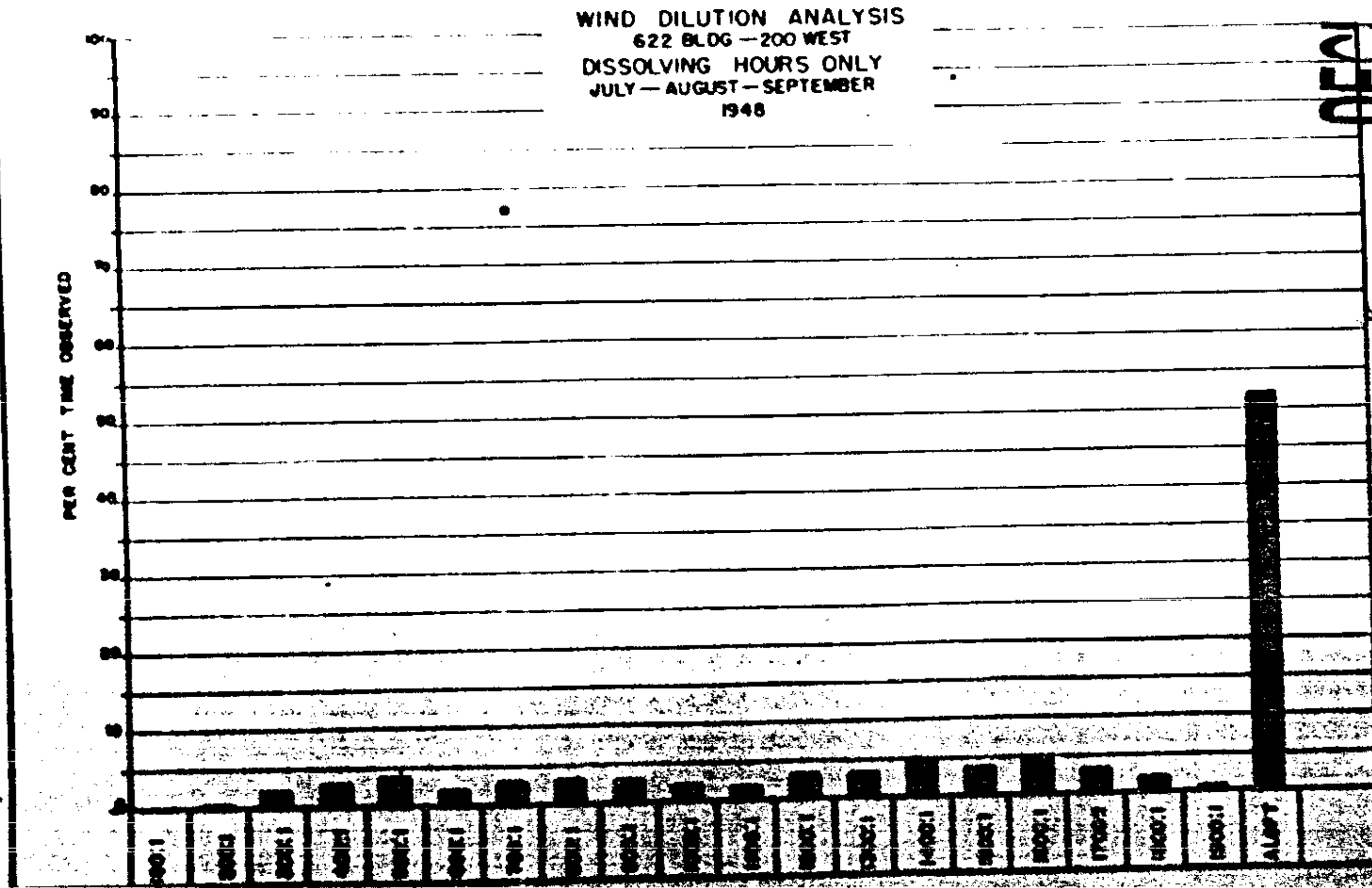
FIGURE 5



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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. The beta activity levels listed for the air filters represent the total beta activity as measured on the filters using thin mica window Geiger counters. It has been shown that the efficiency of the above mentioned filters (C.W.S. #5 filters) will only collect the gas I^{131} with an efficiency of approximately 3 to 4 percent[8]; hence, the total beta activity levels tabulated for the air filters will represent the activity from relatively long-lived beta emitters plus the activity from the stack discharge active particles collected at random on the filters.

Table I is a summary of the radiation levels measured at the various locations. A comparison of the current overall average dosage rates calculated from the "M" and "S" chambers with the dosage rates obtained during the last quarter indicated no significant changes or trends. Once again the radiation levels measured by the "M" and "S" chambers are slightly higher in the areas lying southeast of the separations area stacks; this pattern of radioactivity in the air follows that observed in the deposited activity on the vegetation.

Dosage rates as calculated from the "C" type ionization chambers again indicated no significant changes or trends when compared to the readings obtained the last six months at each of the ion-chamber locations. The actual readings obtained with these "C" type ionization chambers (the walls of the "C" chamber transmit only about 25 percent of the beta radiation from I^{131}) varied between 0.3 mrep per 24 hours and 0.5 mrep per 24 hours which is within the range of the background level for this type of ionization chamber.

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A summary of the total beta activity measured on the filters of the air sampling devices is summarized in Table II. In general, no outstanding differences are found in comparing the average levels of activity measured during this quarter with that of the previous quarter. In the last quarterly report, it was stated that the increase in the beta activity on filters collected from the 300 Area was probably due to uranium collected on the filter.(9) Two filters collected from the 300 Area on June 7 and 28 indicated beta activity levels of 1.2×10^{-9} and 1.8×10^{-9} uc/liter, respectively. Estimations from decay curves indicated that about fifty percent of the activity decayed in less than thirty days (fission product activity) whereas the remainder was of a very long half-life. Analysis of the activity on the filter for uranium both by ether-extraction and fluorophotometer analyses indicated about 80 ug and 182 ug uranium for the filters of June 7 and 28, respectively. A recheck a month later confirmed the presence of uranium on these 300 Area filters. It is assumed that this uranium originates in the stacks of the 314 Building, the Melt Plant. It was estimated that during the severest operating condition in the Melt Plant as much as 0.2 grams of uranium per minute could be expelled from the Melt Plant Stack into the atmosphere(2)(3). It is of interest to add that analyses of the air filters from other locations excepting those from the 300 Area did not indicate positive quantities of alpha activity.

Radioautograph studies of the air filters continued to indicate the presence of stack discharge active particles. Estimations of the total number of active particles on each filter were made by visually counting the dark spots on the Xeray film which was exposed to the filters for an exposure time of 168 hours. Preliminary estimations indicated that during the month of September, 1948, as many as 100 to 200 particles were present on filters collected from the separation areas with fewer particles being found on Gable Mountain, the 100 Areas, and Hanford. Occasionally, an active particle will be found on a filter from such locations as Pasco, Richland, and Benton

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City. The estimated activities of those small active particles (fission product activity) seems to be in the range of 10^{-5} to 10^{-6} microcuries per particle. Surveys of the distribution of these active particles is currently being more extensively followed by the H. I. Plant Assistance Group of the H. I. Operations Divisions.

Figure 6 is a bar graph indicating the total beta activity measured on filters from representative locations on the project and environs. Each 1 1/2 inch filter samples about 20,000 cubic feet of air of a representative location at the rate of 2 cubic feet per minute.

In addition to showing the relative levels of beta activity on the filters, the figure also includes a condensed summary of a statistical analysis of the data in which each location is compared with the other wherever statistically feasible. Five symbols are used to designate the result of the statistical comparison; a summary and a brief discussion of the significance of each symbol follows:

1. <u>Current Variance Invalidates Test</u>: Each set of data under comparison was tested by a standard "F" test to determine whether the variance within the sets of data were indicative of only that amount of fluctuation that could be accounted for by chance causes. If the tests indicated the possibility of "other than chance fluctuations", such as the sampling from two entirely different populations, a "diamond" symbol was shown indicating that the current data testing is not valid in comparing the values listed.

2. <u>Current Difference Approaches Significance</u>: The average beta activity measured at each of any two locations is compared and submitted to the standard T test for evaluating the relative degree of difference between the two locations compared. If the T test value at the 99 percent confidence level is above the significance level, it is then said that <u>the difference is significant</u>; if the T test value falls between the no significant and the significant value, it is then assumed that the difference in the beta activity between the two filters approaches a significant difference. A blank space in the "squares" of table indicates no significant difference

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as based on the current statistical method of analysis.

(3) Similar reasoning is used in comparing the three month average beta activity measured on filters from the given locations with the average activity of the previous three month quarter except that "arrow-like" symbols are used to note the results of the data analysis.

A review of Figure 6 indicates that the data obtained by use of air filters does not submit to statistical analyses too easily as most comparisons fall in the category of too much variation or spread of individual values to perform a valid T test. However, obvious differences are noted; for example, the levels of activity on the filters from the 200 Areas are certainly higher than those from other locations even though this type of data is not suitable for the standard statistical analyses desired.

Using statistics as a tool in interpreting these data is still valuable, however, in comparing the three month period averages where the greater number of observations assign more significance to the average values. For example, it can be stated that the contamination on filters from Pasco, Richland, 300 Area, Gable Mountain, 200-West Area Gate and Hanford are about the same for this quarter as they were during the last quarter on an overall average basis. Similarly, an analysis would indicate a questionable decrease in the White Bluffs Area and a questionable increase in the 105-DR construction area. The analysis also tends to inform the reader of the approximate variation possible in gathering data of this type and assists in the ultimate interpretation and appraisal of the results reported.

SECTION II

(See Tables I and II and Figure 6)

TABLE I

RADIATION LEVEL OBSERVED WITH DETACHABLE IONIZATION CHAMBERS

(mrep per 24 hours)

"C" CHAMBER READINGS

LOCATION	JULY	AUGUST	SEPTEMBER	QUARTERLY AVERAGE
100-B Area	<0.3	<0.3	0.3	<0.3
100-D Area	0.4	0.3	0.4	0.4
100-F Area	0.4	0.3	0.4	0.4
200-E Area	0.6	0.5	0.6	0.6
200-W Area	0.3	0.3	0.4	0.3
300 Area	0.4	0.4	0.4	0.4

"L" AND "S" CHAMBER READINGS

LOCATION	JULY	AUGUST	SEPTEMBER	QUARTERLY AVERAGE	GROUP AVERAGE
100 Areas and Environs					
Route 1, Mile 8	0.4	0.6	0.6	0.5	
Route 2N, Mile 10	0.5	0.4	0.5	0.5	
Route 2N, Mile 5	0.5	0.5	- -	0.5	0.54
Route 11A, Mile 1	0.7	1.2	0.6	0.8	
Route 1 & Route 4N	0.3	0.4	0.4	0.4	
Within 5 Miles 200-East Area					
Route 4S, Mile 6	0.8	0.6	0.5	0.6	
Route 11A, Mile 6	0.7	0.6	0.7	0.7	0.69
Route 3, Mile 1	1.1	0.8	0.7	0.9	
Meteorology Tower 200'	0.5	0.7	0.6	0.6	
Within 10 Miles 200 East Area					
Route 4S, Mile 10	0.7	0.7	0.7	0.7	
Route 10, Mile 1	0.9	0.7	0.6	0.7	0.80
Route 10, Mile 3	0.9	- -	- -	0.9	
Route 2S, Mile 4	0.9	1.1	0.8	0.9	
Near 300 Area					
Route 4S, Mile 16	0.6	0.7	0.9	0.7	0.65
Route 4S, Mile 22	0.6	0.6	0.5	0.6	
Special Zones					
Hanford	0.6	0.5	0.5	0.5	
700 Area	0.8	0.7	0.5	0.7	
Benton City	0.5	0.5	0.8	0.6	
Riverland	0.5	0.5	0.5	0.5	

*All of the above values include the background measurements of the instruments which vary from about 0.3 to 0.5 mrep per 24 hours.

TABLE II

SUMMARY OF RESULTS OF AIR FILTER SAMPLING PROGRAM

AEROSOL BETA ACTIVITY

July - August - September

1948

LOCATION	AVERAGE μc PER LITER
Pasco	1.4×10^{-10}
100-D Area	1.6×10^{-10}
300 Area	5.9×10^{-10}
200-East - Tower 18	4.9×10^{-9}
200-West - Gatehouse	9.5×10^{-10}
Benton City	8.0×10^{-11}
Hanford	7.0×10^{-10}
White Bluffs	1.3×10^{-10}
105-DR Construction Zone	5.9×10^{-10}
Gable Mountain	5.3×10^{-10}
Richland	2.2×10^{-10}
200-West, Tower 4	8.2×10^{-10}
200-East, Southeast	8.1×10^{-9}
Hanford 101 Building	2.4×10^{-11}

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AIR FILTER CONTAMINATION
HANFORD WORKS & VICINITY
JULY—AUGUST—SEPTEMBER 1948

FIGURE 6

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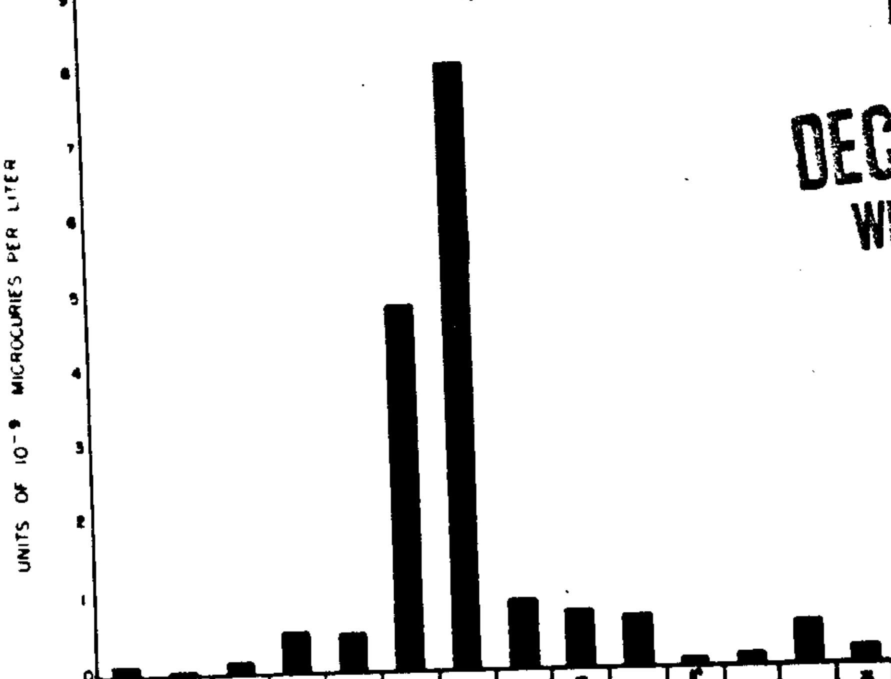

	PASCO	BENTON CITY	RICHLAND	300 AREA	GABLE MT	200-E Tower 18	200 E. SE	200-W Gate	200-W Tower 4	HANFORD	WHITE BLUFFS	100-D	105-DR	HANFORD 101
PASCO	⟷		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ			Δ	
BENTON CITY		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ			Δ	Δ
RICHLAND	Δ	Δ	⟷			Δ	Δ	Δ			Δ	Δ		Δ
300 AREA	Δ	Δ		⟷		Δ	Δ				Δ	Δ		★
GABLE MT	Δ	Δ			⟷	Δ	Δ	★			Δ	Δ		★
200-E Tower 18	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	Δ	Δ	Δ	Δ
200-E SE	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
200-W Gate	Δ	Δ	Δ		★	Δ	Δ	⟷			Δ	Δ		Δ
200-W Tower 4	Δ	Δ				Δ	Δ		Δ		Δ	Δ		Δ
HANFORD	Δ	Δ				Δ	Δ			Δ	Δ	Δ		Δ
WHITE BLUFFS			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	↓		Δ	
100-D			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	
105-DR	Δ	Δ				Δ	Δ				Δ	Δ	↑	★
HANFORD 101		Δ	Δ	★	★	Δ	Δ	Δ	Δ	Δ			★	⟷

Δ CURRENT VARIANCE INVALIDATES TEST
★ CURRENT DIFFERENCE APPROACHES SIGNIFICANCE
⟷ NO SIGNIFICANT DIFFERENCE SINCE PREVIOUS QUARTER
↑ QUESTIONABLE INCREASE SINCE PREVIOUS QUARTER
↓ QUESTIONABLE DECREASE SINCE PREVIOUS QUARTER
□ NO SIGNIFICANT DIFFERENCE BETWEEN CURRENT AVERAG

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SECTION III

ALPHA AND BETA CONTAMINATION IN THE COLUMBIA RIVER

The average flow rate of the Columbia River as measured by the Power Division near Richland for the period, July, August, September, 1948, was 1,600,000 gallons per second. This is a relatively normal flow for the Columbia during this seasonal period and represents an enormous drop from the peak flow of somewhat greater than five million gallons per second observed during the flood in June of this year. Figure 7 is a plot of the Columbia River flow from April to September inclusive of 1948. The peak flow of the Columbia during this quarter was on July 1 when the flow rate was slightly more than three million gallons per second; the minimum flow rate during this period was about 560,000 gallons per second as observed in the latter part of September.

Analyses of the water samples taken from the Columbia River during the quarter indicated, in general, that the overall average beta contamination in the river samples from all locations remained essentially the same when compared with the previous quarter; two specific locations are excepted from this general picture; a definite increase was noted in the activity level at the water intake of the 100-D Area, with a probable increase at 100-F Area. This increase in activity is partially due to the decreased river flow with subsequent smaller dilutions of 100 Area effluent water when it is introduced into the river, and also to the "start-up" of pile operations in the 100-B Area. It is surprising to note that the added radioactive waste solutions into the river from the 100-B Area (the average 107-B effluent solution contained approximately 0.19 uc/liter of beta-gamma activity) at a flow rate of about 500 gallons per second did not cause measurable increases in the river contamination levels below the 100-F Area.

Figure 8 is a bar type graph summarizing the average beta activity measured in the river samples from the listed locations. The tabulation below the graph presents a summary of the data analysis to indicate the relative degree of difference in the activity measurements between any two locations. The symbols used on this chart follow the same interpretation as briefly outlined in the section on air filters Section II of this document. The level of activity measured in river samples from above the 100-B Area represents the general background level of the Columbia River. The data again shows that positive trace amounts of radioactive contamination are found in the river at Pasco when the data is compared to the results obtained above 100-B. This activity is known to be primarily radiosodium (Na^{24} - 14.8 hour half-life) and is well below the current permissible concentrations in drinking water.

In the last quarter's report (9) there was some discussion centered about the distribution of the radioactive contamination in the Columbia River. A preliminary survey of the Columbia River was made on September 11, 1948 (4) in the vicinity of the 100 Areas to further evaluate this distribution. River samples of 500 ml. volumes were taken at intervals from the east to the west bank of the river at surface levels and at varied depths. The results of this survey indicated a wide variation in activity of the samples analyzed depending on the specific location of the river sample. For example, it was found that during this particular survey, river samples taken near the 100-F Area were most active when taken twenty-five feet below the surface of the river rather than at the surface. Similar variations in activity in the river samples were found in cross-section surveys of the river one mile above 100-F Area. Some representative values measured in some of these samples is tabulated below:

ONE MILE ABOVE 100-F AREA-COLUMBIA RIVER SURVEY

Beta-Gamma Activity in Columbia River
September 11, 1948

Sample Description	Units of 10^{-5} uc/liter		
	East Bank	Middle River	West Bank
Surface	73	116	193
25' Below Surface	105	164	295
50' Below Surface	——	210	——

The above preliminary data suggests a relative non-uniform distribution of the radioactive contamination in the river at the locations sampled. Plans are under way to make similar surveys of the Columbia starting at a point above the 100-B Area and extending the survey as far down the river as Pasco. These surveys should indicate the approximate location where uniform dispersion of the activity in the river takes place and will also show the channelling effects of the river on the activity concentrations so that the most representative location can be chosen for the sampling.

It should be possible to obtain a material balance for the amount of activity measured in the river samples at the given sampling locations versus the amount of activity put into the river from the 107 basins. The following average values for the 107 beta-gamma concentrations were measured in the samples taken during this period.

107-B	0.19 uc/liter
107-D	0.18 uc/liter
107-F	0.22 uc/liter

In order to estimate the concentration at any point, the activity in the water is assumed to be uniformly dispersed at the sampling point, that the activity decays with a 14.8 hour half-life and that the river flows at 5 mph. on the average. A table of values calculated in this manner along with the actual measured activity value is tabulated below:

COLUMBIA RIVER SURVEYS-BETA-GAMMA ACTIVITY
JULY, AUGUST, SEPTEMBER
1948

Sample location	Distance from 100-B Area River Miles	Theoretical Activity in River uc/ liter	Measured Activity in River Samples uc/liter
At 100-B	0	6×10^{-5}	1×10^{-5}
Below 100-D	6	11×10^{-5}	12×10^{-5}
Below 100-F	14	17×10^{-5}	23×10^{-5}
Hanford	21	16×10^{-5}	46×10^{-5}
300 Area	39	14×10^{-5}	16×10^{-5}
Richland	45	13×10^{-5}	14×10^{-5}
Pasco	54	12×10^{-5}	7×10^{-5}

*. The above data indicate a relatively remarkable agreement in the vicinity of the 100 Areas when comparing the theoretical with the measured activity levels in the river. The measured activity in the Columbia River at Hanford is higher than the theoretical value calculated by a factor of about 3; this discrepancy is probably primarily due to the channelling effect of the river on the distribution of the activity and indicates the probability of a sampling location that is not truly representative of the average activity in the river at that general location. The apparent good agreement in the activity levels of the river from 300 Area to Pasco indicates the probability of a more uniform dispersion of the radioactive contamination in that portion of the Columbia River.

Along with the routine samples taken from the Columbia River proper, samples were also taken from the Sanitary Water System in the 100 and 200 Areas as supplied by the Columbia River. Samples were taken from the 183 buildings in the 100 Areas and from the 283 buildings in the 200 Areas. It is worthwhile to mention that this sanitary water which is taken from the Columbia River after the river water is processed for sanitary reasons (filtration, chlorination, etc.) becomes the source of supply for drinking purposes in the 100 and 200 Areas. A total of about 180 water samples were taken for radioactive contamination assay during July, August, and September. The average beta-gamma activity in the raw water did not exceed the normal reporting level of 5×10^{-5} μc/liter at any location. However, by analyzing statistically the accumulated data on a number of these low level samples, it was found that the trace amounts of radioactive contamination detected in the sanitary water samples increased in activity as one proceeded from the 100-B Area to the 100-F Area. It was found that the average beta-gamma activity measured in the raw water samples from the 200 East and West Areas as supplied from the 100 Areas was lower than any of the 100-Area samples; no significant difference was found in comparing the radioactive contamination in the 200-East samples with 200-West samples.

[redacted]

Figure 11 summarizes the beta contamination detected in the raw water samples; the table shown on Figure 11 shows the results of comparing the raw water data. etails of the results of the raw water data is presented in Table III which in- cludes the total number of samples considered in the analysis.

The overall average alpha activity detected in Columbia River samples as well as in the raw water samples was less than 6 dis/min/liter.

SECTION III
(See Table III and Figures 7,8, and 11)

[redacted]

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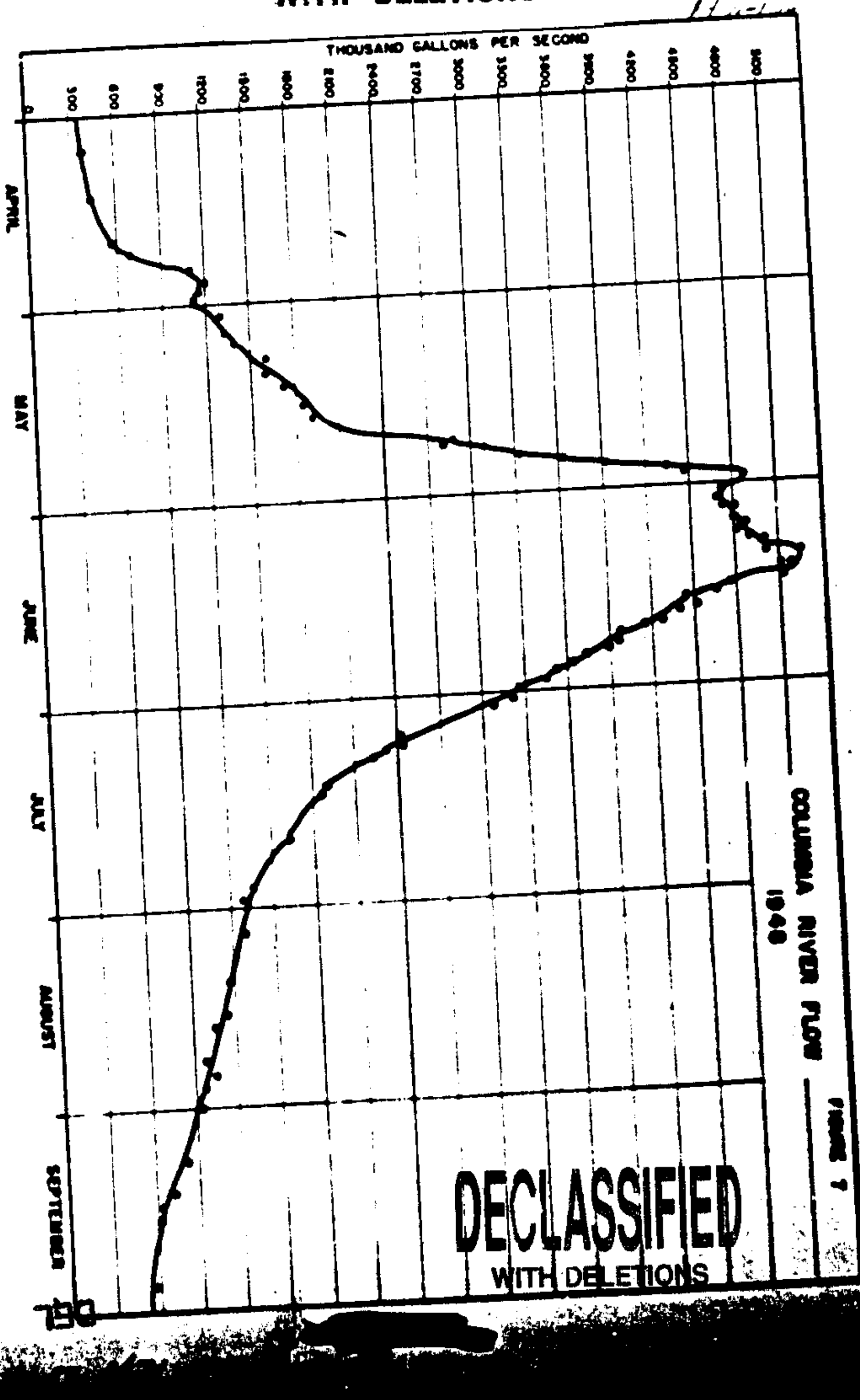

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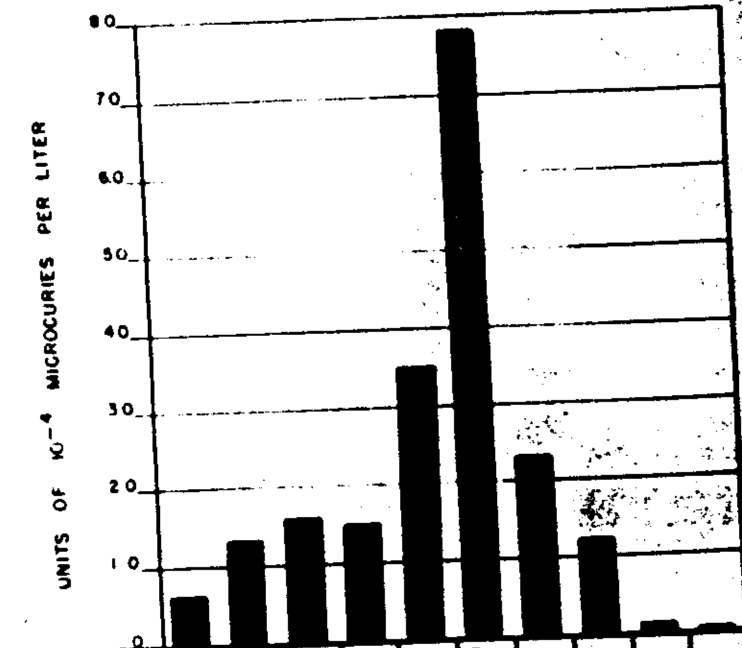
FIGURE

BETA CONTAMINATION IN COLUMBIA RIVER
JULY—AUGUST—SEPTEMBER
1948



	PASCO	RICHLAND	300 AREA	HANFORD NO BANK	HANFORD MIDDLE	HANFORD SO BANK	100-F AREA	100-D AREA	100-B AREA	ABOVE 100-B
PASCO	⟷	Δ	Δ	Δ	Δ	Δ	Δ	Δ	☆☆	Δ
RICHLAND	Δ	⟷			Δ	Δ	☆		Δ	Δ
300 AREA	Δ		⟷		Δ	Δ			Δ	Δ
HANFORD NO BANK	Δ			⟷	Δ	Δ			Δ	Δ
HANFORD MIDDLE	Δ	Δ	Δ	Δ	⟷	☆	Δ	Δ	Δ	Δ
HANFORD SO BANK	Δ	Δ	Δ	Δ	☆	⟷	Δ	Δ	Δ	Δ
100-F AREA	Δ	☆			Δ	Δ	⁝	☆	Δ	Δ
100-D AREA	Δ				Δ	Δ	☆	↑	Δ	Δ
100-B AREA	☆☆	Δ	Δ	Δ	Δ	Δ	Δ	Δ	⟷	Δ
ABOVE 100-B	Δ	Δ	Δ	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
↑ SIGNIFICANT INCREASE SINCE PREVIOUS QUARTER
⁝ QUESTIONABLE INCREASE SINCE PREVIOUS QUARTER
⌐ NO SIGNIFICANT DIFFERENCE BETWEEN CURRENT AVERAGES

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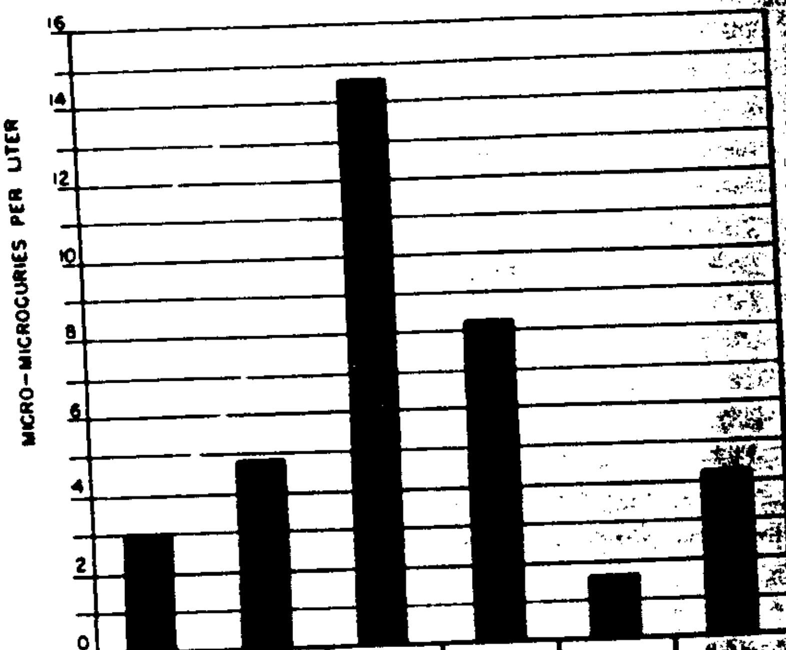
FIGURE [illegible]

BETA CONTAMINATION IN RAW WATER

JULY—AUGUST—SEPTEMBER 1948



	100-B	100-D	100-F	100-H	200-W	200-E
100-B	⟷		△	☆		
100-D		⟷	△		☆	
100-F	△	△	⟷	☆	△	△
100-H	☆		☆	NEW LOCATION	☆☆	☆
200-W		☆	△	☆☆	△	
200-E			△	☆		⟷

△ CURRENT VARIANCE INVALIDATES TEST
☆ CURRENT DIFFERENCE APPROACHES SIGNIFICANCE
☆☆ CURRENT DIFFERENCE HIGHLY SIGNIFICANT
⟷ NO SIGNIFICANT CHANGE SINCE PREVIOUS QUARTER
□ NO SIGNIFICANT DIFFERENCE BETWEEN CURRENT AVERAGES

[redacted]

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TABLE III

RESULTS OF ANALYSIS OF RADIOACTIVE CONTAMINATION FOUND IN RAW WATER SAMPLES*

JULY - AUGUST - SEPTEMBER

1948

BETA ACTIVITY

Locations Compared	Number of Samples	Average Activity µc/liter	T Test	Result of Comparison
100-B 100-D	12 12	3.0×10^{-6} 4.8×10^{-6}	1.08	No significant difference.
100-B 100-F	12 11	3.0×10^{-6} 1.5×10^{-5}	3.15	Average at 100-B significantly lower than average at 100-F Area.
100-B 100-H	12 30	3.0×10^{-6} 8.2×10^{-6}	2.71	Difference approaches significance.
100-F 100-H	11 30	1.5×10^{-5} 8.2×10^{-6}	2.26	Difference approaches significance.
200-W 200-E	12 11	1.6×10^{-6} 4.2×10^{-6}	1.71	No significant difference.

ALPHA ACTIVITY

Locations Compared	Number of Samples	Average Activity d/m/liter	T Test	Result of Comparison
100-B 100-D	11 12	2.4 1.5	1.57	No significant difference between any locations compared.
100-B 100-F	11 12	2.4 2.6	0.24	
100-B 100-H	11 35	2.4 2.0	0.33	
100-F 100-H	12 35	2.6 2.0	1.11	
200-W 200-E	12 11	5.8 2.4	0.97	

*The Columbia River is the source of the raw water. This raw water may be pumped from either the 100-B, 100-D, or 100-F Areas.

 [redacted]

SECTION IV

BETA CONTAMINATION IN THE RAIN

Eighty-two rain samples were collected from thirty different locations on the project proper and nearby vicinity during the Period July - September, 1948. Fewer rain samples were taken during this period than normal, since July - September are representative of the dry season in this locality. In addition, an unusually dry month was encountered during September, only 0.16 inches of rain fell; this is less rainfall than the average for the month of September for the past thirty-four years. The tabulation below indicates the overall rainfall conditions encountered in this area during the seasonal period under study:

RAINFALL - 200 WEST AREA (INCHES)

Month	34 Year Average	1946	1947	1948
July	0.16	0.15	0.71	0.40
August	0.20	0.35	0.68	0.39
September	0.34	0.52	1.34	0.16

A comparison of the radioactive contamination measured in the rain samples this period with that measured in samples of the previous period indicated no outstanding differences or trends. The order of magnitude of the radioactive contamination measured in rain samples from 200-West Area Region was about 17 mμc/liter (0.017 μc/liter) of beta-gamma activity as measured on an evaporated sample with a 4 mg/cm^2 mica-window Geiger counter. This level of activity was higher than that detected in the 200-East Area rain water (~3 mμc/liter). Figure 9 summarizes the overall average beta-gamma activity detected in the rain samples from given grouped areas.

These data on activity in rain should be regarded as relative qualitative measurements since the variance among the data makes it somewhat unsuitable for statistic analysis. The variance in this data is primarily influenced by uncontrolled factors such as the wind direction and velocity, atmospheric dilution, quantity and duration of rainfall, operating conditions during rainfall and other similar factors. To date, no quantitative correlations with rainfall against variables were tried, however on a qualitative basis, the activity in the rain is definitely greater near the separations area (within a circled area of a radius 5 to 10 miles) than at any other location.

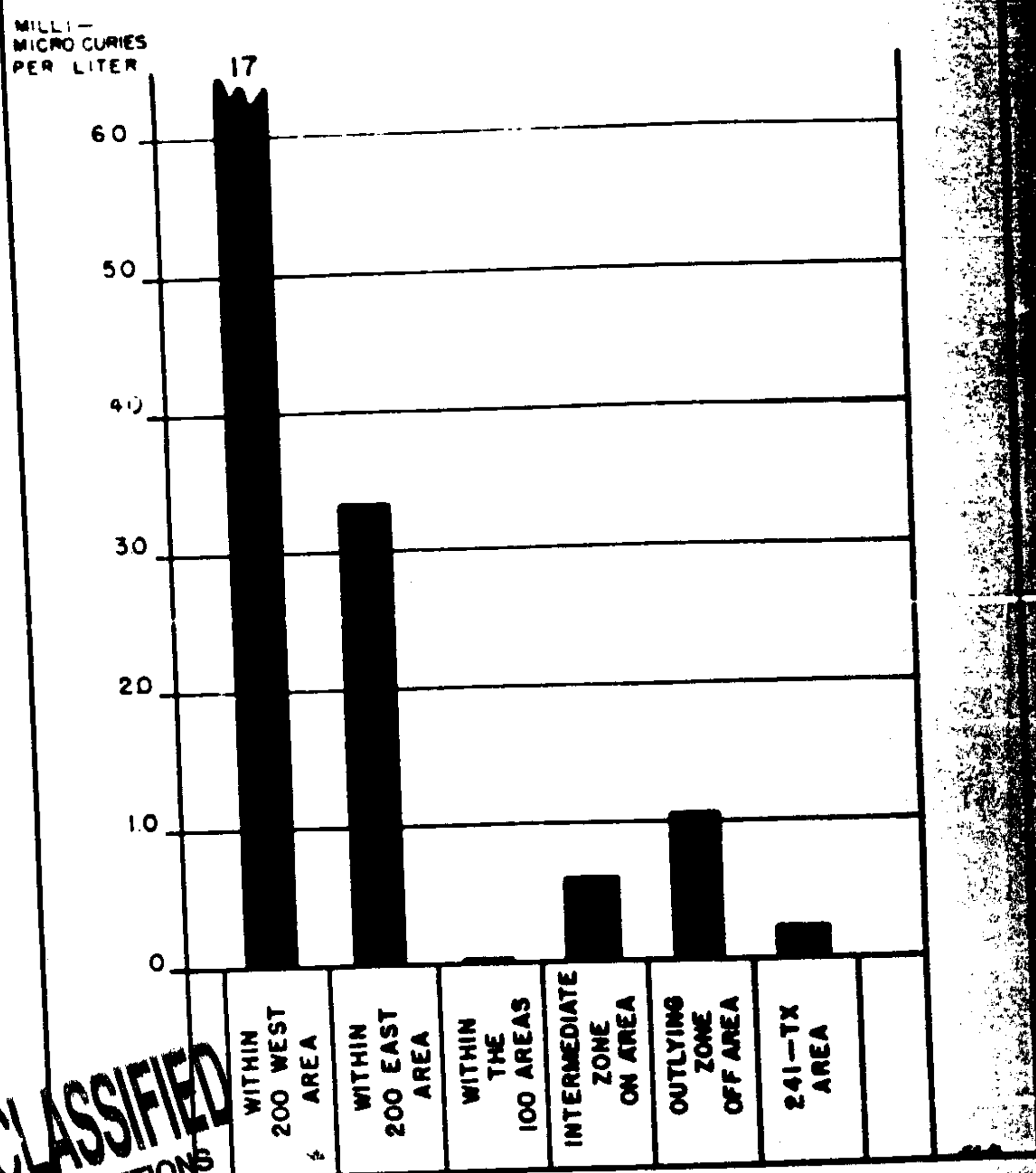
SECTION IV

(Refer to Figure 9)

[redacted]

AVERAGE BETA ACTIVITY
IN
RAIN
HANFORD WORKS & VICINITY
JULY — AUGUST — SEPTEMBER
1948

FIGURE 9



[redacted]

SECTION V

ALPHA AND BETA CONTAMINATION IN DRINKING WATER

Samples of drinking water sources are routinely taken from representative sources on and off the project and analyzed for radioactive contamination. An ether-extraction chemical analysis is performed on the water samples for the major emitters (plutonium and uranium) and the extracted alpha emitters are counted on standard 52 per cent geometry alpha counters. Fluorophotometer analyses are also run on the water samples to determine the alpha activity specifically from uranium. All the results for alpha activity are corrected for overall geometry of counting and extraction yields; the self-absorption losses are negligible because of the absence of significant quantities of residue on the counting. The beta-gamma emitters in the water samples are analyzed by evaporating a 500 ml. sample of water to near dryness, transferring the residue directly to one and one-half inch diameter stainless steel counting plates, and counting the activity, if any, on the plate directly using a thin-mica window Geiger counter. No corrections were made for self-absorption losses in the samples.

The sampling frequency for the drinking water sources varies according to the type of well, the location and the probability of finding any radioactive contamination in the water. Table IV lists the total number of samples taken from each of the sampling locations during the period July, August, September, 194[illegible].

On an overall average basis, the beta-gamma activity detected in all drinking water samples was below the reporting level of 5×10^{-5} μc/liter. The alpha activity measurements indicated the general level of alpha activity in water samples usually found in the past surveys. With the exception of the 300 Area Well samples the positive alpha activity measured in the drinking water samples was confirmed to be from uranium by fluorophotometer analysis and is presumably from uranium occurring in natural quantities. On the other hand, the uranium measured in the 300 Area Well samples is almost certainly Hanford uranium seeping into the water from the 300 Area ponds.

Table IV is a tabulation of the alpha and beta-gamma activity detected in the water samples taken. The overall average results are relatively comparable to the results of previous surveys. In many cases where the maximum results tabulated appear out of line, it was believed that contamination was probably introduced into the samples because of currently crowded laboratory conditions.

Figure 10 is an overall average summary of a comparison of each drinking water source with all other sources on the sampling program. This comparison considers the beta activity measurements only and summarizes not only a comparison for the current period but also compares the overall three month average of this period with that of the previous three month average. The symbols noted on Figure 10 are self-explanatory relative to the results of the statiscal comparisons made throughout. A quick glance at the chart indicates no significant trend of increasing or decreasing activity level at any location. The comparisons of one location versus other locations do, however, indicate significant differences even though the activity levels considered are in all cases less than the current reporting level of 5×10^{-5} μc/liter.

Richland Well #15 (9.7×10^{-6} μc/liter) is significantly higher than any other Richland Well; the specific source of this beta activity is currently not known although it is known that uranium is present in trace quantities in these samples. The somewhat positive traces of beta activity in the Pasco and Kennewick sources is primarily from 14.8 hour sodium (Na^{24}) originating in the Columbia River which is used as the source of drinking water in the Pasco and Kennewick Areas.

SECTION V.

(See Figure 10 and Table IV)

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TABLE IV

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

July - August - September

1948

Location	No. Samples	Beta-Gamma Activity μc/liter		Alpha Activity dis/min/liter	
		Maximum	Average	Maximum	Average
Richland Well #2	30	1.5×10^{-5}	4.9×10^{-6}	40	11
#4	11	1.2×10^{-5}	5.3×10^{-6}	14	10
#5	7	5.9×10^{-6}	2.1×10^{-6}	11	7
#12	10	9.1×10^{-6}	3.7×10^{-6}	18	8
#13	59	1.4×10^{-5}	3.8×10^{-6}	17	7
#14	10	9.1×10^{-6}	6.3×10^{-6}	18	11
#15	12	2.2×10^{-5}	9.7×10^{-6}	20	10
#16	10	1.1×10^{-5}	2.7×10^{-6}	17	5
#18	11	1.3×10^{-5}	5.9×10^{-6}	11	6
Tract House K-748	12	1.4×10^{-5}	6.9×10^{-6}	17	6
J-685	4	5.9×10^{-6}	2.3×10^{-6}	3	2
Sanitary Water 100-B	15	4.9×10^{-5}	2.9×10^{-6}	4	<1
100-D	12	1.7×10^{-5}	3.1×10^{-6}	3	<1
100-F	13	4.6×10^{-6}	2.0×10^{-6}	4	1
100-H	29	1.3×10^{-5}	3.6×10^{-6}	40	8
200-E	13	7.7×10^{-6}	9.0×10^{-7}	5	1
200-W	13	6.8×10^{-6}	3.0×10^{-6}	5	1
300 Area Well #1	62	1.1×10^{-5}	5.4×10^{-6}	280	84
#2	58	5.3×10^{-5}	8.1×10^{-6}	440	170
#3	54	3.6×10^{-5}	5.8×10^{-6}	104	47
#4	54	2.6×10^{-5}	7.5×10^{-6}	260	159
300 Area Sanitary	62	1.7×10^{-5}	5.3×10^{-6}	450	90
Pasco H & R Depot	12	2.0×10^{-5}	8.5×10^{-6}	36	5
Kennewick 614 Building	13	1.7×10^{-5}	8.4×10^{-6}	6	2
Kennewick Std. Station	13	1.2×10^{-5}	5.8×10^{-6}	21	9
Benton City	13	9.6×10^{-6}	3.6×10^{-6}	43	20
Cobbs Corner	11	1.1×10^{-5}	3.8×10^{-6}	9	4

[redacted]

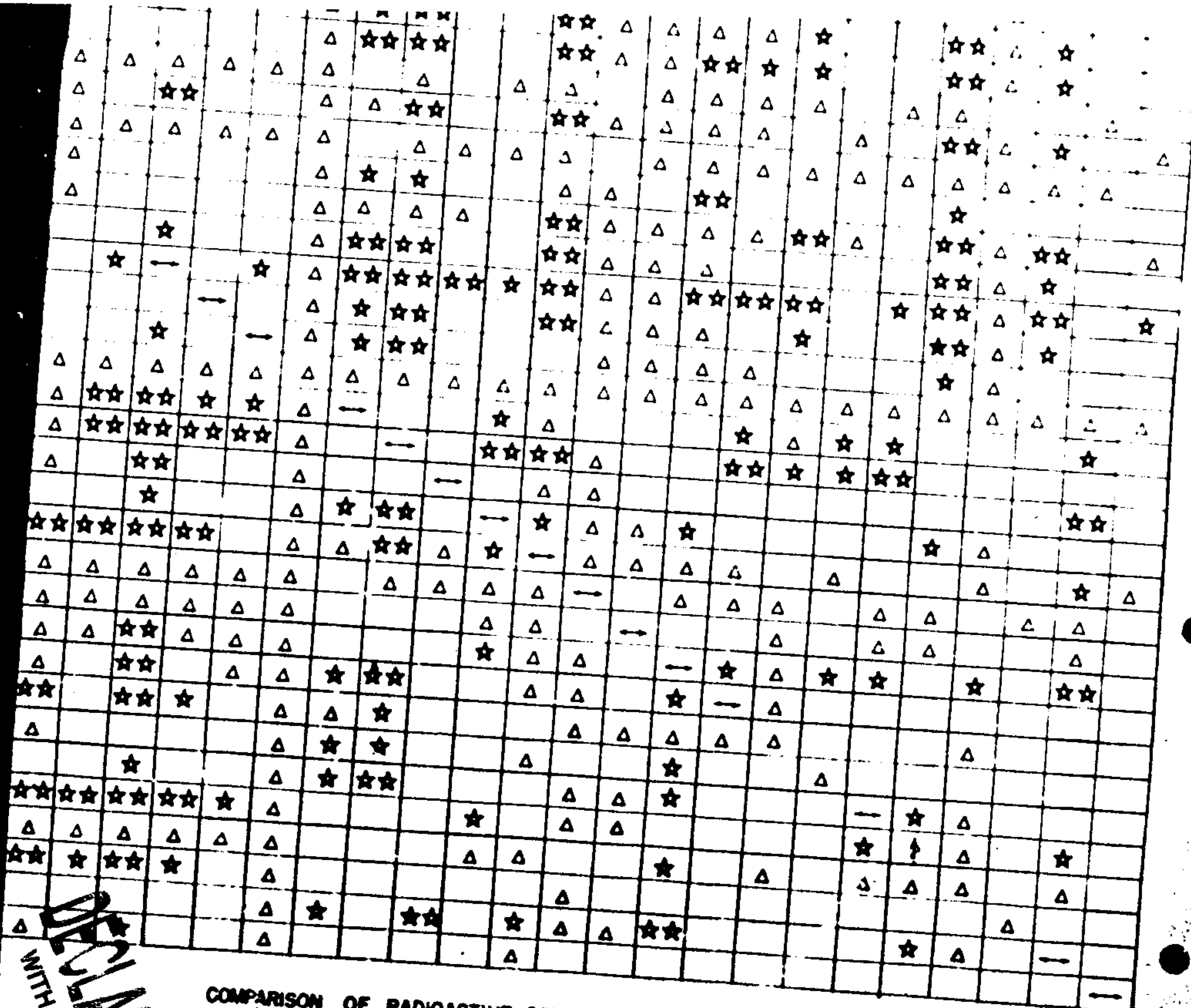
TABLE IV (CONTINUED)

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

July - August - September

1948

Location	No. Samples	Beta-Gamma Activity uc/liter		Alpha Activity dis/min/liter	
		Maximum	Average	Maximum	Average
Columbia Camp	10	7.3×10^{-6}	2.7×10^{-6}	9	4
Headgate	12	9.6×10^{-6}	2.5×10^{-6}	6	2
Hanford	11	2.6×10^{-5}	7.5×10^{-6}	9	5
White Bluffs (R-1515)	61	1.0×10^{-5}	3.8×10^{-6}	27	15
3000 Area Well A	5	1.5×10^{-5}	7.1×10^{-5}	9	5
Well B	5	1.0×10^{-5}	2.6×10^{-6}	6	4
Well C	6	6.4×10^{-6}	3.9×10^{-6}	8	3
Well D	4	6.4×10^{-6}	5.8×10^{-6}	8	6
Well E	4	6.8×10^{-6}	4.6×10^{-6}	4	3
Durand #1	4	5.5×10^{-6}	3.6×10^{-6}	6	2
Ranney "D"	4	6.8×10^{-6}	2.8×10^{-6}	5	3
Durand #5	34	3.0×10^{-5}	5.0×10^{-6}	18	6
Riverland	11	1.8×10^{-5}	5.5×10^{-6}	11	3
Midway	13	1.0×10^{-5}	2.9×10^{-6}	7	2
Lower Knob	13	1.9×10^{-5}	5.6×10^{-6}	5	2
Wills Ranch	13	9.6×10^{-6}	3.2×10^{-6}	6	2
Segerson's Ranch	12	1.0×10^{-5}	3.2×10^{-6}	6	2
Pistol Range	14	1.0×10^{-5}	5.5×10^{-6}	11	4
B-Y Well	12	1.1×10^{-5}	4.0×10^{-6}	10	7
Spring #13	14	1.2×10^{-4}	2.1×10^{-5}	33	4
Ranch #13	3	1.0×10^{-5}	7.6×10^{-6}	6	3
Snively Ranch	2	1.7×10^{-5}	8.6×10^{-6}	18	6
Rattlesnake Springs	3	2.7×10^{-6}	9.0×10^{-7}	15	8
McGee Well	3	7.3×10^{-6}	5.0×10^{-6}	21	8
Ford Well	3	3.6×10^{-5}	1.6×10^{-5}	3	<1
Hooker	3	6.4×10^{-6}	5.9×10^{-6}	4	4
200-North #5	2	1.0×10^{-5}	8.2×10^{-6}	6	6



COMPARISON OF RADIOACTIVE CONTAMINATION
MEASURED IN SAMPLES
from
DRINKING WATER SOURCES
of

Figure 10 [redacted]

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DEL

- [illegible] WELL
- [illegible] RANCH WELL
- 3[illegible] AREA WELL A
- 3000 AREA DURAND WELL NO. 5
- TRACT HOUSE K-748 WELL
- COBBS CORNER WELL
- SEGERSON WELL
- PISTOL RANGE WELL
- 300 AREA SANITARY
- 300 AREA WELL NO. 4
- 300 AREA WELL NO. 3
- 300 AREA WELL NO. 2
- 300 AREA WELL NO. 1
- BENTON CITY WELL
- KENNEWICK SANITARY - STANDARD STA
- KENNEWICK SANITARY - 614 BLDG
- PASCO SANITARY - H & H DEPOT
- SPRING NO. 1[illegible]
- B-Y WELL
- 200 WEST SANITARY WATER
- 200 EAST SANITARY WATER
- 100-H SANITARY
- 100-F SANITARY

[illegible]ASSIFIED
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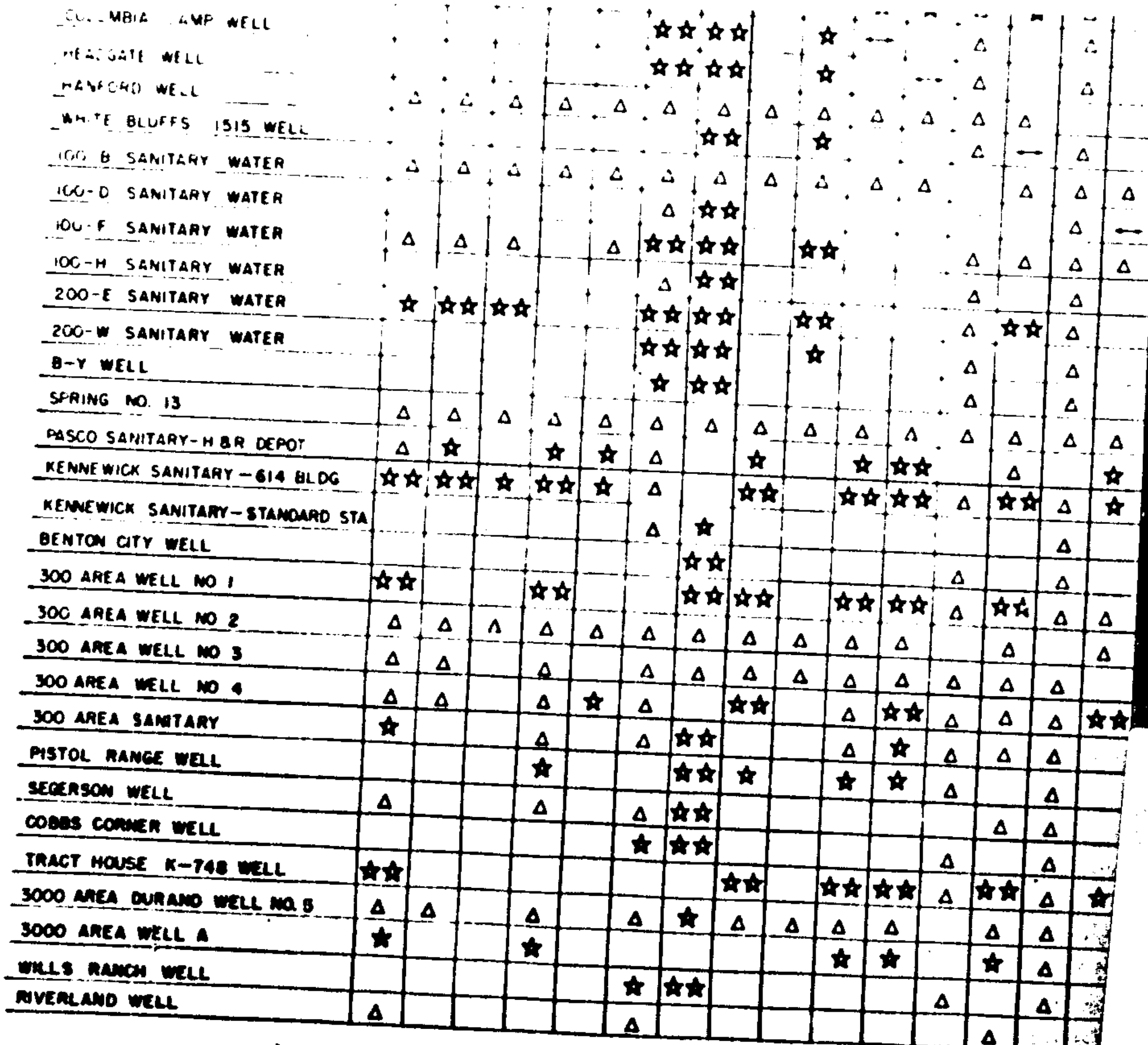

△ CURRENT VARIANCE INVALIDATES TEST
☆ CURRENT DIFFERENCE APPROACHES SIGNIFICANCE
☆☆ CURRENT DIFFERENCE HIGHLY SIGNIFICANT
—— NO SIGNIFICANT CHANGE SINCE PREVIOUS QUARTER

DEL

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Page 36

	RICHLAND WELL NO 13	RICHLAND WELL NO 2	RICHLAND WELL NO 4	RICHLAND WELL NO 5	RICHLAND WELL NO 12	RICHLAND WELL NO 14	RICHLAND WELL NO 15	RICHLAND WELL NO 16	RICHLAND WELL NO 18	COLUMBIA CAMP WELL	HEADGATE WELL	HANFORD WELL	WHITE BLUFFS 1515 WELL	100-B SANITARY WATER	100-D SANITARY WATER	100-F SANITARY WATER	100-H SANITARY WATER	200-E SANITARY WATER	200-W SANITARY WATER	B-Y WELL	SPRING NO. 13	PASCO SANITARY-H.B.R. DEPOT	KENNEWICK SANITARY-614 BLDG.	KENNEWICK SANITARY-STANDARD STA	BENTON CITY WELL
100-D SANITARY WATER						△	☆☆							△	|	△					△	☆	☆		
100-B SANITARY WATER	△	△	△	△	△	△	△	△	△	△	△		△	△	△	△	△	△	△	△	△		△	△	
WHITE BLUFFS 1515 WELL							☆☆		☆			△	|	△		△		☆☆			△	△	☆☆		
HANFORD WELL	△	△	△	△	△	△	△	△	△	△	△	△	△			△	△	△	△	△	△		△		
HEADGATE WELL						☆☆	☆☆		☆		|	△		△							△	☆☆	☆☆		
COLUMBIA CAMP WELL						☆☆	☆☆		☆	|		△		△							△	☆	☆☆		
RICHLAND WELL NO 18				☆			☆		|	☆	☆	△	☆	△		☆☆		☆☆	☆		△				
RICHLAND WELL NO 16						☆	☆☆	|				△		△							△	☆	☆☆		
RICHLAND WELL NO 15	☆☆	☆☆	☆	☆☆	☆☆	☆	—	☆☆	☆	☆☆	☆☆	△	☆☆	△	☆☆	☆☆	☆☆	☆☆	☆☆	☆☆	△			☆	☆☆
RICHLAND WELL NO 14	△	△		☆☆		△	☆	☆		☆☆	☆☆	△		△	△	☆☆	△	☆☆	☆☆	☆	△	△	△	△	
RICHLAND WELL NO 12					|		☆☆					△		△		△					△	☆	☆		
RICHLAND WELL NO 5				|		☆☆	☆☆		☆			△		△							△	☆	☆☆		
RICHLAND WELL NO 4			|				☆					△		△		△		☆☆			△		☆		
RICHLAND WELL NO 2		~				△	☆☆					△		△		△		☆☆			△	☆	☆☆		
RICHLAND WELL NO 13	△					△	☆☆					△		△		△		☆			△	△	☆☆		

SECTION VI

BETA CONTAMINATION ON VEGETATION

Approximately three times as much 8 day iodine was calculated to be in the metal dissolved during the quarter July thru September, 1948, as compared with the calculated quantities found during the quarter, April thru June, 1948.

A tabulated breakdown of several radioactive gases and vapors involved during metal dissolution follows:

RADIOIODINE AND XENON IN METAL DISSOLVED
AS CALCULATED BASED ON WEIGHT IRRADIATED URANIUM

1948 Month	200 East Area	200 West Area	Totals
	Curies I^{131}	Curies I^{131}	Iodine
April	79	147	226
May	15	84	99
June	72	63	135
July	295	122	417
August	293	209	502
September	237	210	447

The cooling period for the irradiated uranium varied from about 85 to 100 days during the quarter; most of the metal dissolved averaged approximately 90 days for the cooling time. During this period, filter units with fiber glass fronts were installed in fourteen cells in the 200 East Area; the sand filters are not to be installed until October. These units will add another factor towards estimating the total quantities of radioactive gases and particles expelled from the stack. Currently, no figures are available for the estimated quantities of the radioactive materials leaving the stack on a daily basis. Figure 12 is a graph showing the calculated quantities of 8 day iodine formed during the metal dissolution based on the weight of uranium dissolved during each dissolving in the separation areas.

The deposition of the I^{131} from the stacks is the principal contaminant measured in the vegetation surveys mentioned in this section.

For purposes of calculation, the residual activity on the vegetation from sources whose half-life is greater than eight days is currently neglected and the assumption is made that all of the activity measured on the vegetation is from 8 day iodine. Procedures are being established to make specific chemical analysis for the I^{131} and residual longer half-lived materials. The present method of analysis consists of mounting a one gram sample of vegetation on a counting card and counting the sample directly, using a thin mica-window Geiger counter. Corrections are applied for 8 day decay, geometry, and self-absorption.

Figure 13 summarizes the overall average beta activity detected on the vegetation samples from the locations listed. Only two locations exceeded 0.1 µc/kg. The overall average activity on vegetation in Pasco, Kennewick, Benton City and Richland was below the reporting level of 0.04 µc/kg. The overall average in the 200-East Area was 0.31 µc/kg compared with the average of 0.08 µc/kg detected on vegetation in the 200-West Area. On an overall basis, there was no outstanding change in the level of beta activity on vegetation measured during the period July - September compared with the average of the preceding quarter.

Special surveys were taken of Rattlesnake Mountain at the Benton Gap Region during this period. The average beta activity on the vegetation based on the analyses of seventy samples was 0.05 µc/kg; this value is not different from that obtained in the survey of the previous quarter. Figure 14 graphically portrays the activity detected in the samples at the various altitudes of the Gap of Rattlesnake Mountain. No correlation was found in these surveys between the activity on the vegetation and the altitude at which the sample was taken.

Four individual surveys were made for beta activity on vegetation in the Wahluke Slope Area. Perhaps the summation of the surveys can best be portrayed by including the following table:

WAHLUKE PLATEAU SURVEY

Beta Activity on Vegetation

μc/kg

Date Survey	No. Samples	Average Beta Activity
5-18-48	108	* 0.02 μc/kg
7-18-48	95	0.05 μc/kg
7-24-48	127	0.04 μc/kg
8-21-48	89	0.04 μc/kg
9-18-48	95	0.04 μc/kg

* This level of activity is not significant for an individual sample; the figure quoted is the average value for 108 samples and should be representative of a good estimate of the overall average contamination level on Wahluke Slope.

The survey of May 18, 1948, indicated a level of activity comparable to that of the previous month and below the usual "reporting level" of 0.04 μc/kg. However, during July, the Survey results indicated a trace amount of positive radioactive contamination on the vegetation that was significantly higher than that measured during May. Other surveys taken in July, August, and September confirmed the average level of activity detected in July. Slightly higher activity levels were detected on vegetation samples from the Hanford Area (which is nearest the Wahluke Plateau as far as comparative sampling locations are concerned) about the same time that an increase was noted in the Wahluke Plateau Region.

Vegetation samples were also taken from "off-plant" locations during this period. Yakima, Ellensburg, Moses Lake, Ritzville, Goldendale, The Dalles, Umatilla, Pasco, and Richland were included in the areas sampled. Figure 14-A summarizes the results of the measurements for beta activity on the vegetation samples for the individual locations checked. The overall average activity of all areas samples was less than 0.04 μc/kg although individual samples indicated beta activity as high as 0.15 μc/kg. Statistical analyses indicated that these high values were not significantly (99 per cent probability) greater than the overall average. Current work in the laboratory shows that the varying amounts of naturally occuring potassium salts in the vegetation can sometimes yield values when the inital counts per minute are converted to microcuries, as high as 0.015 to 0.02 μc/kg. This phase of the problem is currently being investigated.

Figure 15 is the iso-activity chart approximating the relative distribution of the radioactive contamination on the vegetation in the environs of the Hanford Works. The accompanying wind rose indicates that the prevailing wind is from the northwest, the spread of contamination follows the wind rose pattern reasonably well.

<u>Soil Sampling Program:</u>

Samples of soil were taken from locations identical to the vegetation sampling spots in an effort to correlate the deposited activity on vegetation with that on the corresponding soil. Top soil was taken for the sample; a representative one-gram portion was taken, deposited on a 1 and 1/2 inch diameter stainless steel plate and counted directly for beta activity using a thin mica-window Geiger counter. No corrections were made for self-absorption losses, backscatter or self-scatter, or for the beta activity from K^{40} present in the potassium salts of the soil. The direct count represented a qualitative measurement and was good for relative measurements. Of the six hundred and sixty-two soil samples analysed, the average beta activity ranged from about 0.01 to 0.02 μc/kg. No significant differences were found in comparing the average activity of one given area with that of another area. Table V is a summary of the average beta activity detected in the soil samples from each given locality.

TABLE V

BETA ACTIVITY ON SOIL AT HANFORD WORKS

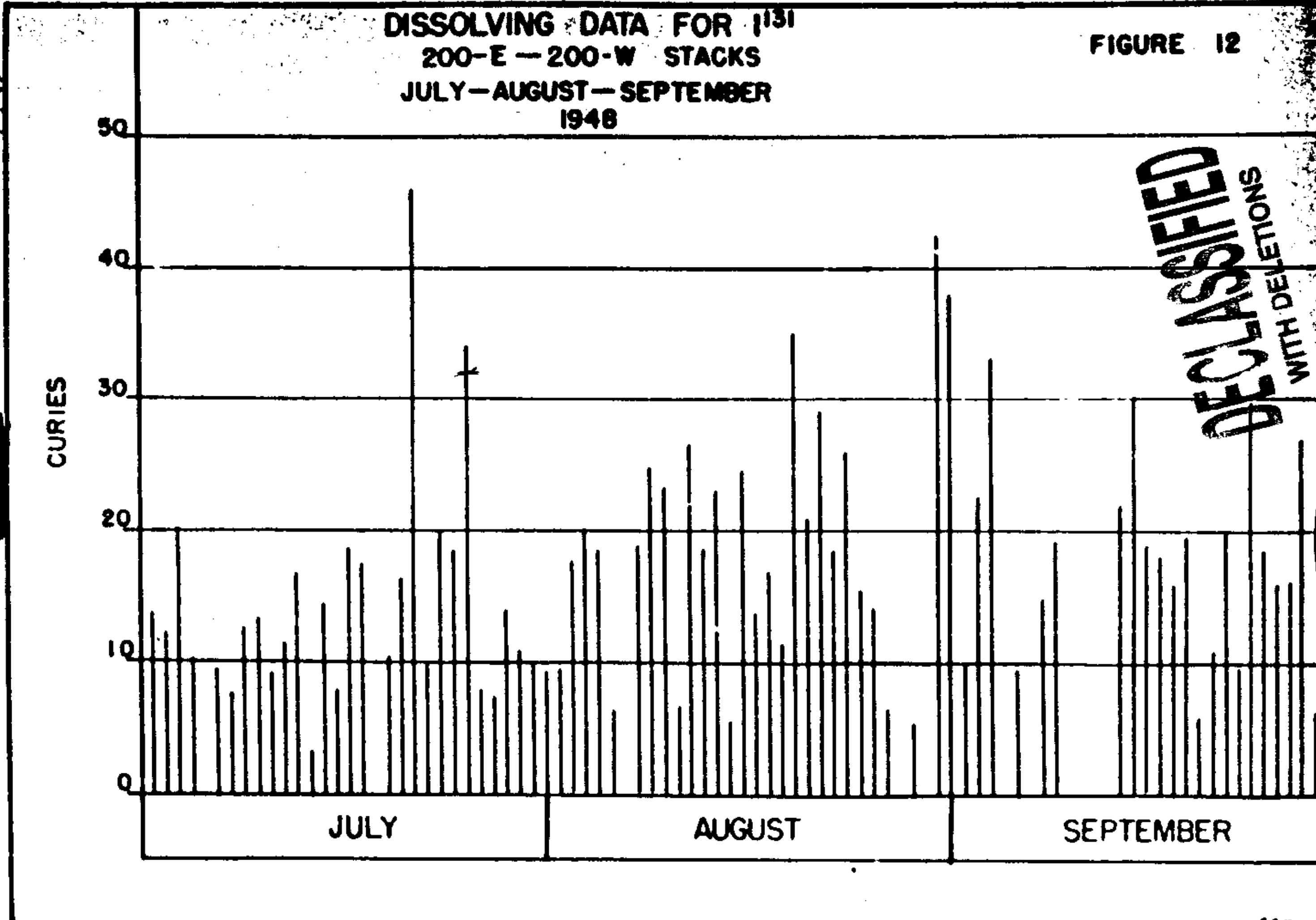
July - August - September - 1948

Location	Number of Samples	Average μc/kg [illegible]
Richland	39	0.011
Kennewick	32	0.012
Pasco	32	0.013
Richland Y	7	0.014
Benton City Road	64	0.012
Benton City	24	0.010
Gable Mountain	31	0.013
Riverland	9	0.013
Midway	9	0.013
Meteorology	8	0.012
200-West Area	40	0.020
200-East Area	16	0.015

SECTION VI

(See Figures 12, 13, 14, 14-A, and 15)

FIGURE 12



DEL

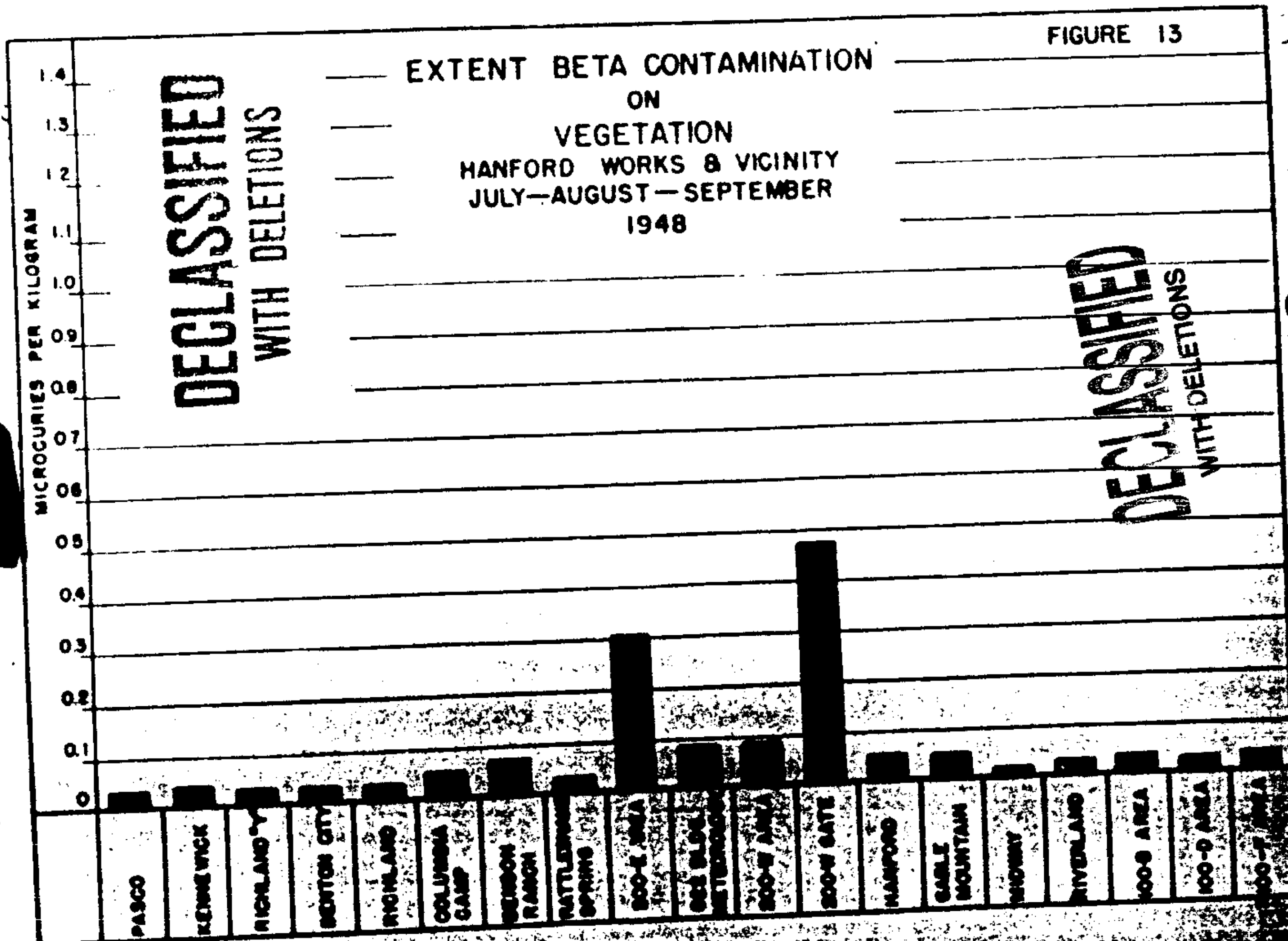
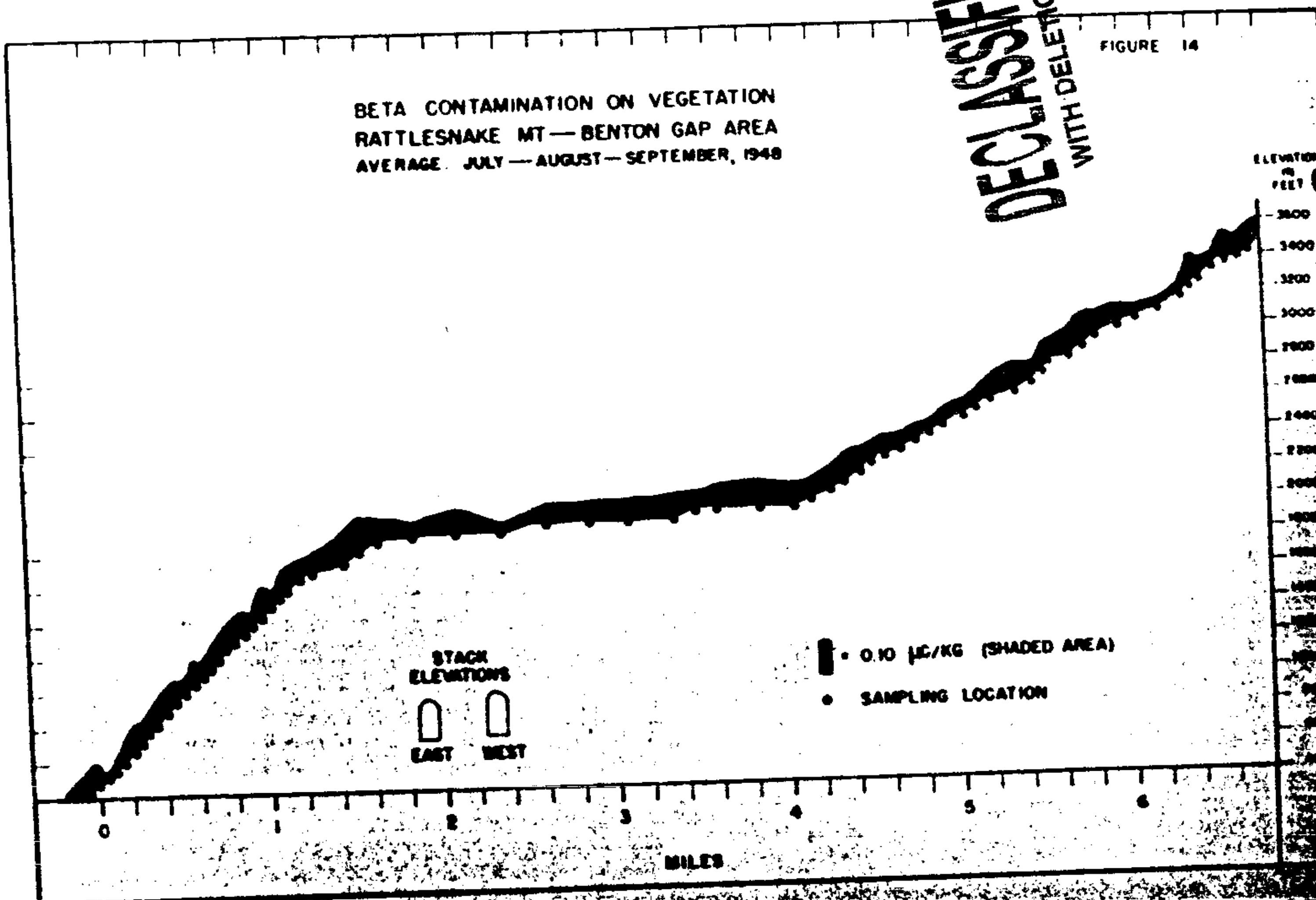


FIGURE 13
EXTENT BETA CONTAMINATION
ON
VEGETATION
HANFORD WORKS & VICINITY
JULY—AUGUST—SEPTEMBER
1948
MICROCURIES PER KILOGRAM
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
PASCO
KENNEWICK
BENTON CITY
RICHLAND
COLUMBIA CAMP
200-W GATE
HANFORD
GABLE MOUNTAIN
MIDWAY
RIVERLAND
100-B AREA
100-D AREA

FIGURE 14


BETA CONTAMINATION ON VEGETATION
RATTLESNAKE MT — BENTON GAP AREA
AVERAGE JULY — AUGUST — SEPTEMBER, 1948
ELEVATION IN FEET
3600
3400
3200
3000
STACK ELEVATIONS
EAST
WEST
= 0.10 μC/KG (SHADED AREA)
SAMPLING LOCATION
0
1
2
3
4
5
6
MILES

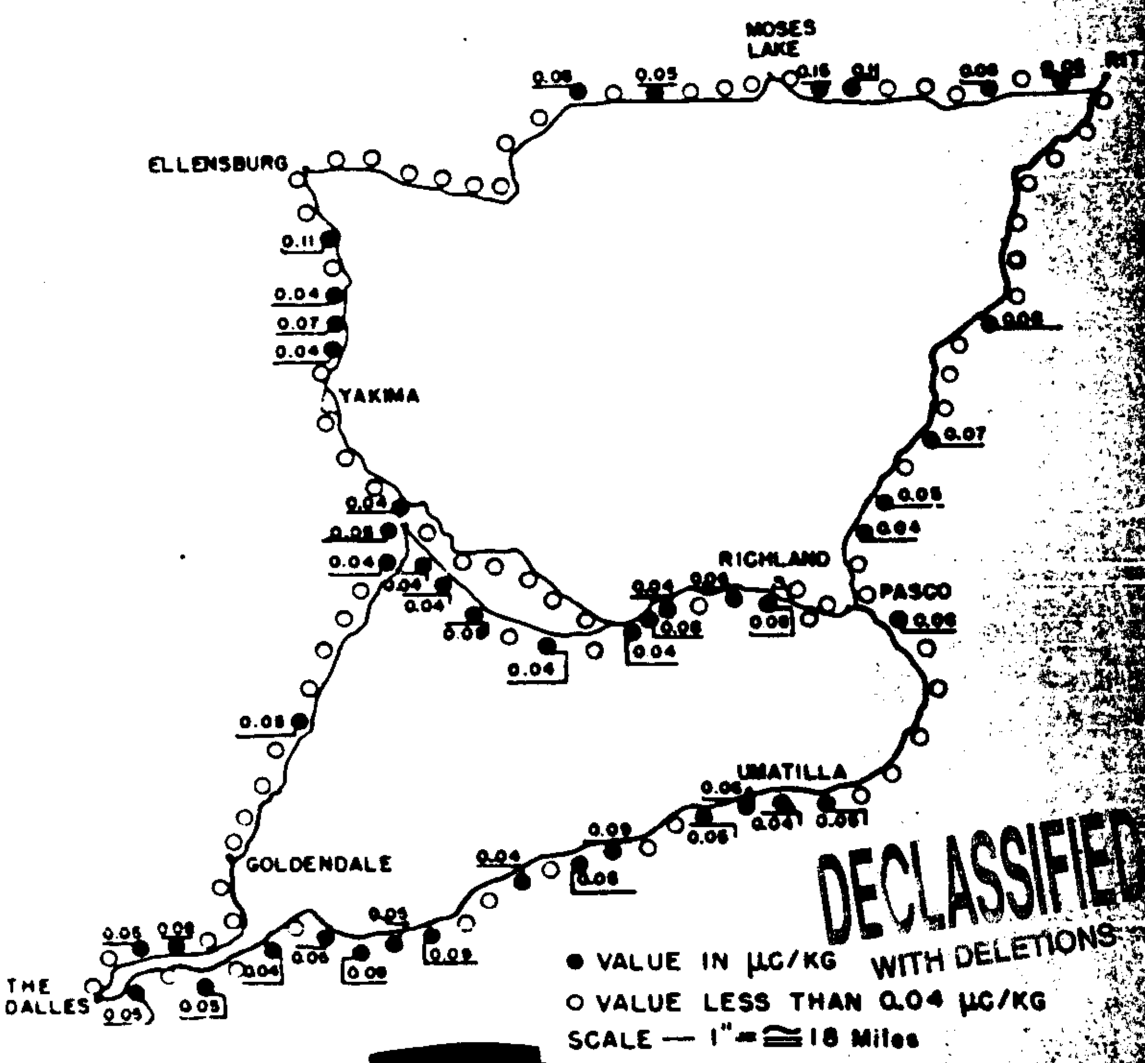
[redacted]

HW
Page

EXTENT BETA CONTAMINATION ON VEGETATION OFF AREA

JULY—AUGUST—SEPTEMBER
1948

Figure 14-A



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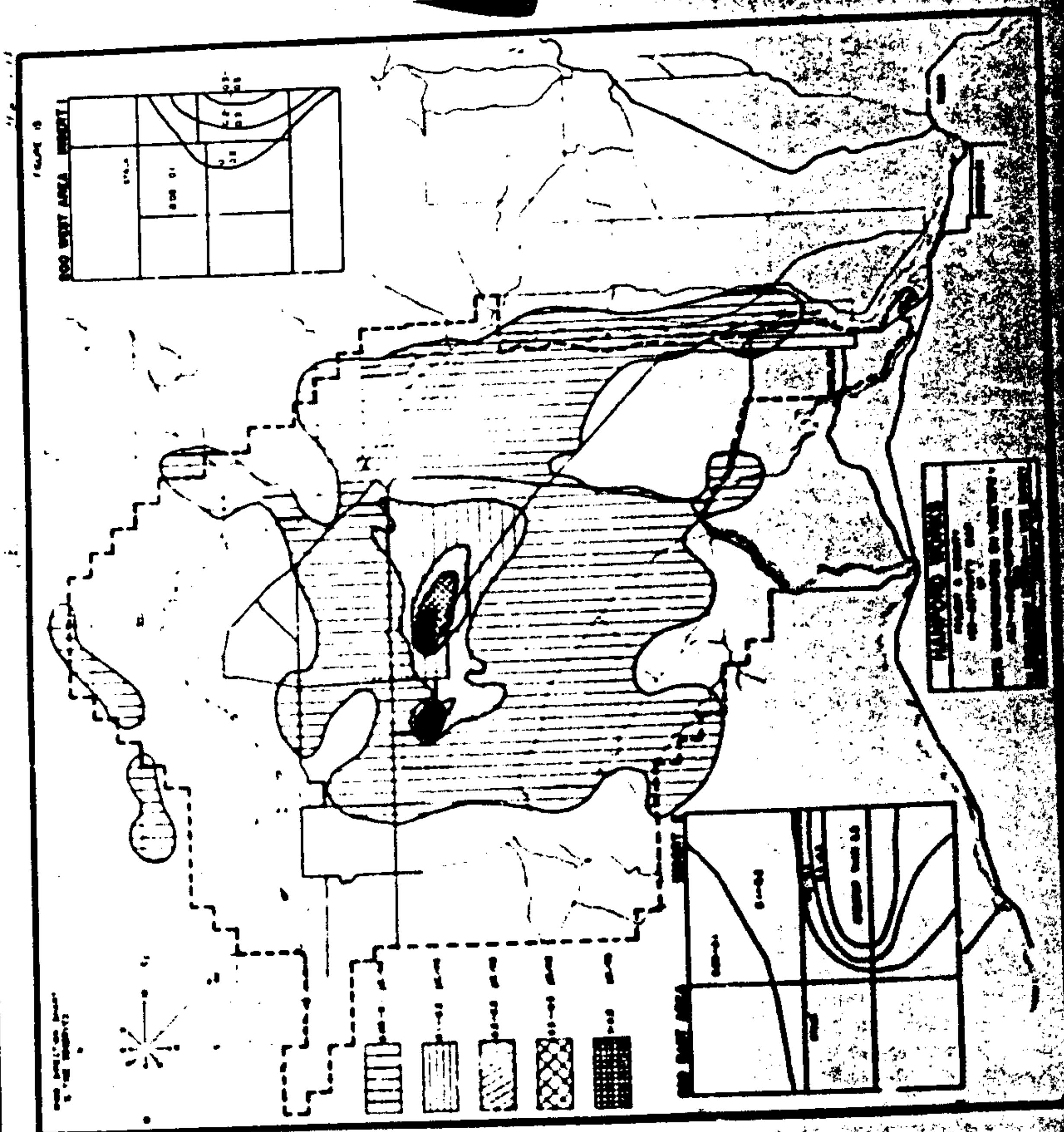

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SECTION VII

ALPHA AND BETA CONTAMINATION IN HANFORD WASTES

100 AREAS:

Analyses of 107 basin samples in the 100 Areas for radioactive contamination indicated an average beta-gamma activity of about 190, 180, and 220 muc/kg at the 100-B, 100-D, and 100-F Area, respectively. These levels are relatively comparable with the levels measured in the previous quarter except for the anticipated increase in the 100-B Area effluent; this increase was a normal one, 100B changing from a standby to an operating condition. The activity levels detected in samples from the 1904 spillways are statistically comparable with the activity in the 107 samples. Figure 16 is a graphic portrayal of the three month average beta-gamma activity detected in the 100 Areas effluent water samples.

200 AREA WASTE SYSTEMS:

A summary of the alpha and beta contamination detected in the waste samples of the 200 Areas follows:

RADIOACTIVE CONTAMINATION IN RETENTION BASINS
SEPARATION AREAS

July, August, September, 1948

Location	Beta Activity uc/liter		Alpha Activity dis/min/liter	
	Maximum	Average	Maximum	Average
271-B				
NE Corner	3×10^{-4}	8×10^{-5}	<6	<6
NW Corner	3×10^{-4}	1×10^{-4}	<6	<6
SE Corner	2×10^{-4}	7×10^{-5}	<6	<6
SW Corner	2×10^{-4}	7×10^{-5}	<6	<6
271-T				
NE Corner	5×10^{-5}	5×10^{-5}	23	<6
NW Corner	6×10^{-5}	1×10^{-5}	128	27
SE Corner	5×10^{-5}	5×10^{-5}	10	<6
SW Corner	5×10^{-5}	5×10^{-5}	110	20

[redacted]

The above samples were taken at random times during any 24 hour period with a frequency of about one sample from each location, hence the maximum and average values tabulated above are results of spot sampling only, and the average values listed do not necessarily refer to the overall average activity in the basin for the 3 month period considered in this report.

The radioactive contamination detected in the samples from the U and T Swamps and the 200-West Area Laundry Ditch are summarized in the table below:

SWAMP SURVEYS

July, August, September, 1948

Location	Total Beta Activity uc per liter Maximum	Total Beta Activity uc per liter Average	Total Alpha Activity dis/min/liter Maximum	Total Alpha Activity dis/min/liter Average
Laundry Ditch Inlet	9×10^{-4}	1×10^{-4}	2057	419
Laundry Ditch 600'	9×10^{-5}	3×10^{-5}	316	75
231 Ditch Pipe Outlet	6×10^{-4}	6×10^{-5}	143	33
231 Ditch Underpass	5×10^{-5}	4×10^{-6}	44	10
"T" Swamp Inlet	4×10^{-4}	4×10^{-5}	142	23
"T" Swamp So. Side	4×10^{-5}	9×10^{-6}	67	24
"T" Swamp W. Side	2×10^{-4}	3×10^{-5}	373	44
"U" Swamp Inlet	5×10^{-5}	1×10^{-5}	123	35
"U" Swamp W. Side	4×10^{-5}	4×10^{-6}	100	39

Slight increases in the alpha activity detected at the inlet side of the Laundry Ditch were noted during the quarter. All other values are relatively comparable with the results of previous surveys.

300 AREA WASTES:

A summary of the results of analyses of water and mud samples taken from the 300 Area Retention Basin is tabulated on following page:

300 AREA POND

July - August - September

1948

Location & Type Sample	Total Beta-Gamma Activity uc/liter		Alpha Activity dis/min/liter	
	Maximum	Average	Maximum	Average
Pond Inlet-Water	2×10^{-3}	9×10^{-4}	9100	2500
N.W. Corner-Water	4×10^{-4}	1×10^{-4}	2600	1240

	uc/kg		dis/min/kg	
Pond Inlet - Mud	2	0.25	10300	1500
N.W. Corner - Mud	2×10^{-2}	1×10^{-2}	180	30

The above values are comparable to the general level of activity noted in surveys of the past, fluctuations in activity from sample to sample in this particular group is relatively great.

Radioactive Contamination in the 300 Area Waste Line:

The amount of radioactive wastes discharged from the 300 Area was estimated by analyzing samples taken from the 300 Area Pond into which the wastes of the 300 Area were discharged. The inaccessability of the pond for representative samples as well as the wide variation in quantities of radioactive contamination measured in the individual 300 Area Pond samples indicated that another source for sampling the wastes discharged would be desirable. It was decided to sample the wastes directly from the main eighteen-inch waste line in the 300 Area at a manhole adjacent to the 3706 Building. This waste is representative of the wastes discharged from 303 Operating Area and the 3706 laboratories building. The wastes discharged by the 321 Building (Redox Development Group) were not included in this sampling point as these wastes entered the eighteen-inch waste line at a point below the manhole taken for the sampling location.

The average flow rate through this waste line was taken to be about 275 gallons per minute based on Power Division estimates of 250 - 300 gallons per minute average flow at the sampling point.

Preliminary analyses of samples taken from the waste line indicated an average uranium contamination level of 1385 ug/liter neglecting the approximate one-half pound uranium discharged into the pond monthly by the 321 Building. Assuming the 275 gallons per minute flow rate, it was estimated that about 1.5 pounds uranium would be discharged into the 300 Area Pond every eight hours. Expanding the calculation to a yearly basis, assuming uniform operation throughout the year, a figure approximating 0.8 tons uranium would be discharged into the 300 Area Pond in one year excluding any uranium discharged from the 321 Building (currently estimated at about six pounds per year).

A brief summary of a study of the data collected from analyses of the samples taken from the 300 Area process line between August 23, 1948, and January 21, 1949, indicated that one hundred and sixty-three waste line samples were analyzed for beta-gamma activity with the activity in the individual samples varying from 30 to 300 μμc/liter. The overall average of the samples was about 120 μμc/liter.

The normal range of the alpha activity detected in these waste line samples was about 100-2500 dis/min/liter. The average of these one hundred and sixty-three samples was about 1200 dis/min/liter and is slightly lower but in the same order of magnitude as the 1385 ug/liter detected in the preliminary surveys. In general, the alpha activity found in these samples was from uranium as determined by fluorophotometer analyses. Of the few samples analyzed for plutonium by the TTA process, only two results above 6 dis/min/liter (11 and 8 dis/min/liter) were obtained which would indicate a trace amount of plutonium in the waste line water.

SECTION VII

(See Figure 16)

[redacted]

[redacted]

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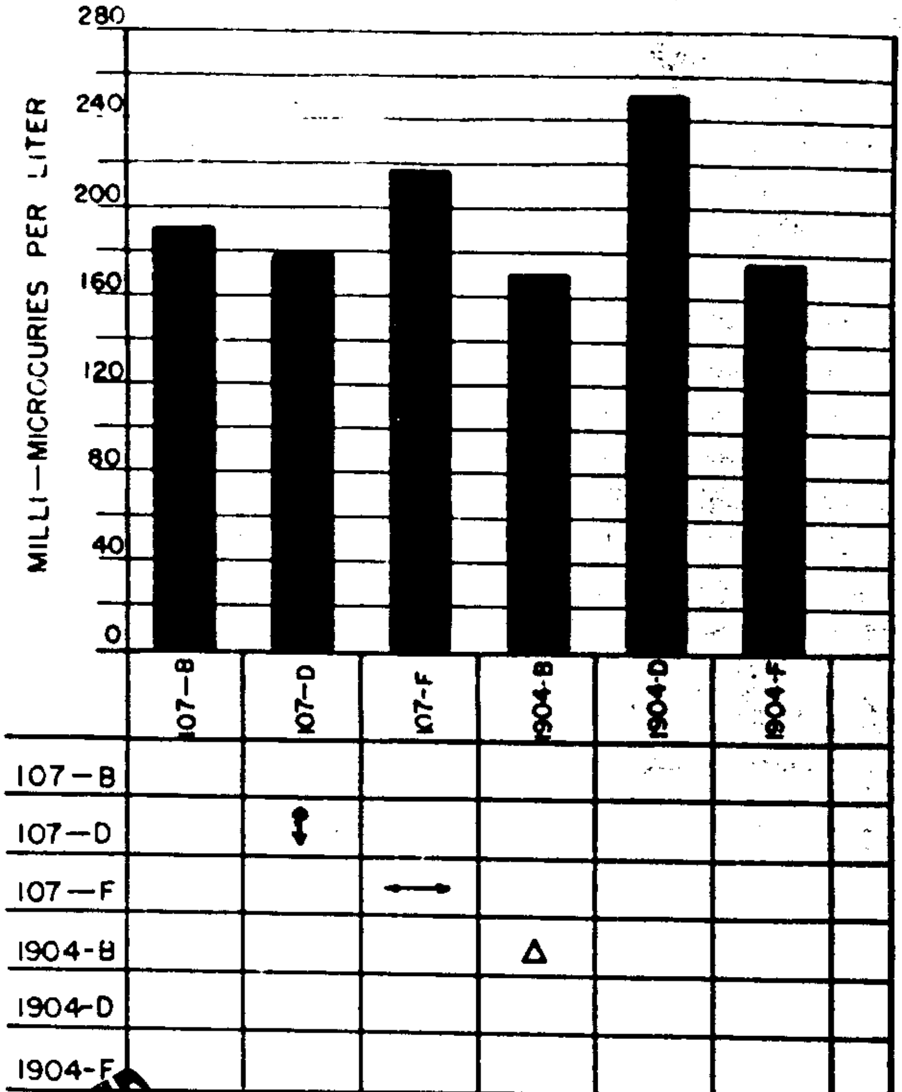
EXTENT BETA CONTAMINATION
IN
100 AREAS WASTE EFFLUENT
JULY — AUGUST — SEPTEMBER
1948

FIGURE 16



NO SIGNIFICANT DIFFERENCE BETWEEN CURRENT AVERAGES
Δ CURRENT VARIANCE INVALIDATES TEST
⟷ NO SIGNIFICANT CHANGE SINCE PREVIOUS QUARTER
↓ QUESTIONABLE DECREASE SINCE PREVIOUS QUARTER

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HW-File [redacted] HW-

ACKNOWLEDGMENT

The tabulation and statistical analyses of the data discussed in this document were performed by H. J. Paas and W. R. Portch. E. L. Keene, cartographer for the group, drew up the attached graphs and maps.

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