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HW-29514

BIOPHYSICS SECTION

RADIOLOGICAL SCIENCES DEPARTMENT

RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS FOR THE PERIOD APRIL, MAY, JUNE 1953

October 2, 1953

HANFORD TECHNICAL RECORD

HANFORD ATOMIC PRODUCTS OPERATION

RICHLAND, WASHINGTON

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HW-29514

Health and Safety

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RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS FOR THE PERIOD APRIL, MAY, JUNE 1953

SPECIAL REVIEW
FINAL DETERMINATION
DECLASSIFIED
BY Weaver DATE 2/12/81
BY J W Jordan DATE 2/13/81

By

H. J. Paas

October 2, 1953

CLASSIFICATION CANCELLED
Per Doc, May 1973
By L. Pope 4/4/94
PM Eick 3-13-98
P.D Amaro 5-18-98

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

Operated for the Atomic Energy Commission by the General Electric Company under Contract # W-31-109-Eng-52

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ABSTRACT

SECTION I - RADIOACTIVE CONTAMINATION IN EFFLUENT GASES:

An average of 1.9 curies of I^{131} per day was discharged to the atmosphere from separations facilities. Maximum emission was measured at the S-facility where the three month average of 1.7 curies per day included a one day emission of 19 curies. Ruthenium emission at the S-plant averaged 0.2 curie per day including a maximum of 3.1 curies over one 24 hour period. Increases in ruthenium emission were coincident with changes in the ruthenium oxidation process during May. C^{14} and S^{35} emission from the reactor stacks averaged below the detection limits of 4.5×10^{-3} and 4.5×10^{-4} curie per day, respectively. A total of 0.28 curie of tritium oxide was emitted daily from the five reactor stacks; the maximum emission was 0.32 curie per day from the 105-D stack during the month of April. Miscellaneous spot measurements at the reactor stacks for various contaminants other than those mentioned did not represent any significant change from previous observations.

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION:

Radioactive iodine deposited on vegetation during April and early May barely exceeded the detection limit of 3×10^{-6} μc/g throughout the environs; significant increases in this activity were noted after May 26 and were associated with fallout of particulate contamination from the Nevada nuclear explosions. Average values during June were on the order of 10^{-4} μc/g with maximum measurements approaching 5×10^{-3} μc/g at random locations. Significant increases in the activity density from non-volatile beta particle emitters were also observed during the latter part of the quarter. Individual samples showed values of 1 to 2×10^{-2} μc/g in the immediate environs and values as high as 3.6×10^{-2} at remote locations in eastern Washington. The activity density of alpha particle emitters averaged between 1×10^{-7} μc/g and 1.3×10^{-6} μc/g in the immediate environs; the maximum measurement of 6.2×10^{-6} μc/g was found near the 300 Area.

SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE:

Dosage rates measured with detachable ionization chambers averaged between 0.4 and 3.1 mrep per day near the manufacturing facilities; similar measurements showed average values of 0.4 mrep per day in residential areas. The activity density of filterable beta particle emitters in air averaged between 6.3×10^{-13} μc/cc to 2.4×10^{-11} μc/cc at environmental locations during the quarter. Maximum measurements coincident

with the fallout from the Nevada tests showed values ranging from 2×10^{-11} to 3.3×10^{-10} μc/cc over a one week period after May 26. Increases in particulate contamination by factors ranging from 5 to 10 over previous quarterly averages were noted in the immediate environs during this period. Again, the influx of particulate contamination from outside sources during late May and early June affected the magnitude of the local increase and caused a general particulate contamination increase which was noted at all remote monitoring stations in the Pacific Northwest. Airborne I^{131} concentrations continued to be less than 1×10^{-13} μc/cc in residential areas and averaged less than 1.2×10^{-12} μc/cc at all locations near manufacturing facilities. Air samples collected in the downstream effluent from the Redox facility showed values as high as 1.5×10^{-9} μc/cc at distances within 1,000 ft. of the stack. No significant changes were noted in the average activity density of alpha particle emitters in the atmosphere during this quarter.

SECTION IV - RADIOACTIVE CONTAMINATION IN HANFORD WASTES:

Significant increases in the activity density of gross beta particle emitters were noted in reactor effluent discharged to the river at the 100-C and 100-F areas. Maximum measurements were obtained at the 100-DR and 100-C areas where individual samples showed 8.9×10^{-3} and 7.6×10^{-3} μc/cc, respectively. The average activity density of alpha particle emitters in reactor effluent was $< 5 \times 10^{-9}$ μc/cc at all areas; trace indications of these emitters were noted at each basin during some part of the quarter. Uranium detected in only 6 out of 132 samples showed values in the range of 2×10^{-9} to 3.8×10^{-9} μc/cc. Plutonium and polonium contamination was negligible. I^{131} discharged to the river from the Biology farm averaged 2.7×10^{-6} μc/cc. With the exception of the 234-5 ditch and the Redox swamp where contamination continued to be significantly higher than that measured in 1952, the gross contamination from alpha and beta particle emitters in separation areas wastes remained on the order of magnitude previously noted. Portable GM instrument surveys along the perimeter of the waste ditches and swamps showed counting rates ranging from background to 4,000 c/m above background. Ground contamination surveys at a number of locations in the separations areas showed the majority of values to be < 500 c/m above background; isolated locations in the vicinity of the S facility showed instrument readings from 10,000 to 75,000 c/m; dosage rates ranged from 6 mrep per hour to 25 mrep per hour at the latter locations. The amounts of contamination in 300 Area waste sources was comparable to that found during the past year.

SECTION V - RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER:

Expected seasonal decreases were observed in the activity density of gross beta particle emitters at all monitoring locations in the Columbia River. Maximum measurements were found below the 100-F reactor where an average of 8.3×10^{-6} μc/cc included one value of 2.1×10^{-5} μc/cc. Trace activity on the order of 6×10^{-8} μc/cc was measured in the Portland-Troutdale area during April but was not detected during May and June; values obtained at locations between Arlington and Bonneville ranged from less than 5×10^{-8} to 1.7×10^{-7} μc/cc during the quarter. The activity density of alpha particle emitters in the Columbia River averaged less than 5×10^{-9} μc/cc at all locations. Radioactive contamination in mud samples taken from the river showed little change from previous measurements. One mud sample collected near the 300 Area showed the activity density of beta particle emitters to be 8.4×10^{-3} μc/g. Average values for the activity density of alpha particle emitters in mud samples were below the detection limit of 5×10^{-9} μc/cc in all cases. Decreases in average activity density of beta particle emitters in raw water were related to the progressive increases in flow rate of the Columbia River during the period; maximum measurements were found at the 100-F area where the average over the three month period was 3.2×10^{-7} μc/cc.

SECTION VI - RADIOACTIVE CONTAMINATION IN RAIN:

The activity density of beta particle emitters measured in rainfall collected before May 26 averaged less than 5×10^{-6} μc/cc at nearly all locations; samples collected after May 26 showed values approximately 10 to 1,000 times greater than those normally expected. The maximum measurement was found near the 300 Area where a value of 9.9×10^{-2} μc/cc was obtained. Mud samples collected from remote locations immediately following the rain and fallout showed the activity density of beta particle emitters to be in the range of 1.6×10^{-4} μc/g to 7.3×10^{-3} μc/g; alpha particle emission detected in mud and rain samples was negligible.

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

Trace alpha particle emission on the order of 10^{-9} μc/cc in Richland and Benton City water supplies was identified as uranium. Several samples of water from Benton City showed the presence of radon indicating the presence of uranium in its natural state. Drinking water supplies which showed detectable beta particle emission were confined to

those which use the Columbia River as an initial source of water; average values at Pasco and Kennewick were 3.4×10^{-7} and 1.1×10^{-7} μc/cc, respectively. Samples collected at the Pasco filter plant showed the activity density of gross beta particle emitters to average 4.3×10^{-7} μc/cc and 1.7×10^{-2} μc/g in the liquid and solid portions of backwash material from the sand filter; similar measurements obtained from the coal filter averaged 3.6×10^{-7} μc/cc and 1.9×10^{-2} μc/g. The filtration process decreased the contamination in the water from an average of 2.1×10^{-6} μc/cc entering the plant to an average value of 3.4×10^{-7} μc/cc in the water leaving the plant for consumption.

INTRODUCTION

The results obtained from a three month study of monitoring the Hanford environs for radioactive contamination are summarized in this publication. This study represents the combined efforts of Regional Survey, Control Laboratory, and Control Services personnel of the Control Unit, Biophysics Section, Radiological Sciences Department. Samples were collected in the liquid, solid, and gaseous state and analyzed by radiochemical methods as described in HW-20136. Correction factors applied to the counting rates determined by the Control Laboratory followed those described in HW-22682, HW-23769, and HW-27584. Monitoring methods employed by Regional Survey forces followed those discussed in previous publications of this series. (HW-24203, HW-25866, HW-27510, HW-27641, and HW-28009).

Data obtained from the radiochemical analyses of the various samples were supplemented with the findings from portable instrument surveys and with measurement of the daily emission of various contaminants at the reactor and separation facilities.

This document includes an appendix which contains a series of project maps showing the location of monitoring stations and sampling locations referred to in the discussion. These maps supersede those previously published in HW-25866 and HW-21214. The project boundaries indicated on the location maps are those defined by the Atomic Energy Commission in drawing SK-7-414.

SECTION I

RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

Estimations of the amounts of radioactive materials discharged to the atmosphere at the various manufacturing areas were obtained from the radiochemical analysis of samples which were collected directly from the stacks and discharge ducts at the separation and reactor areas. Continuous scrubber and filter samples were employed at each of the separation facilities and intermittent daily measurements for specific emitters were maintained at the reactor areas. These data were supplemented with measurements at the inlet and outlet of the S-plant sand filter. The results of these findings are summarized for each facility at which monitoring was maintained.

SEPARATION AREAS

200 EAST AREA

A summary of the results from monitoring at the fifty foot level of the Semiworks stack during the quarter are presented in Table I.

TABLE I

SUMMARY OF RESULTS FROM STACK MONITORING

SEMIWORKS STACK

APRIL, MAY, JUNE

1953

	Curie of Gross Beta Particle Emitters Emitted Daily		Curie of I^{131} Emitted Daily		Curie of Ruthenium Emitted Daily	
Month	Maximum	Average	Maximum	Average	Maximum	Average
April	8.8×10^{-2}	$< 1.2 \times 10^{-2}$	2.6×10^{-3}	$< 4.6 \times 10^{-4}$	5.5×10^{-2}	$< 5.6 \times 10^{-3}$
May	5.8×10^{-2}	$< 2.4 \times 10^{-3}$			9.7×10^{-4}	4.1×10^{-4}
June	8.3×10^{-4}	$< 3.7 \times 10^{-4}$				
Quarter	8.8×10^{-2}	$< 4.0 \times 10^{-3}$	2.6×10^{-3}	$< 4.6 \times 10^{-4}$	5.5×10^{-2}	$< 4.7 \times 10^{-3}$
Last Quarter	1.5×10^{-3}	$< 6.6 \times 10^{-4}$	4.2×10^{-4}	5.9×10^{-5}	4.3×10^{-4}	$< 1.3 \times 10^{-4}$

Due to the small amounts of irradiated metal processed, the daily emission was considerably lower than at other separations facilities. During June, analysis of the scrubber and filter samples for I^{131} and ruthenium was discontinued for all samples which indicated that less than 1×10^{-2} curie per day of gross beta particle emitters was being discharged to the atmosphere from the Semiworks stack. In general, the reported values do not represent a significant departure from previous findings.

200 WEST AREA - T-PLANT

Results obtained from I^{131} monitoring at the fifty foot level of the T-Plant are summarized in Table II.

TABLE II

SUMMARY OF RESULTS FROM I^{131} MONITORING

T-PLANT STACK

APRIL, MAY, JUNE

1953

	Curies of I^{131} Dissolved Per 24 Hours		Curies of I^{131} Emitted Daily	
Month	Maximum	Average	Maximum	Average
April	1100	170	0.19	0.06
May	1600	240	1.2	0.33
June	1200	250	0.82	0.24
Quarter	1600	220	1.2	0.20
Last Quarter	430	38	11	0.21

The significant reduction of 19 days in the average cooling period of the uranium dissolved at T-plant during this quarter from the average of last quarter was responsible for the increased amounts of I^{131} available in the metal dissolved.

The average daily I^{131} emission for this quarter does not appear to reflect the increased amount of I^{131} available in the dissolvers because the average value for the previous quarter was weighted by the one unusually high daily emission of 11 curies. The average for the previous quarter would have been 0.09 curie per day if this one high value had been eliminated.

200 WEST AREA - S PLANT

Table III is a summary of the results obtained from I^{131} monitoring at the fifty foot level of the S-plant stack.

TABLE III
SUMMARY OF RESULTS FROM I^{131} MONITORING
S-PLANT
APRIL, MAY, JUNE
1953

Month	Curies of I^{131} Emitted Daily		Curies of I^{131} Dissolved per 24 Hours	
	Maximum	Average	Maximum	Average
April	19	3.3	690	220
May	2.2	1.1	400	190
June	2.4	0.61	450	140
Quarter	19	1.7	690	180
Last Quarter	17	1.7	2400	100

The average cooling period of the irradiated metal processed at the S-plant facility was 10 days less than that of the previous quarter. During the latter part of the previous quarter, several intervals of high I^{131} emission were noted when the A-cell silver reactor was in operation with lesser, but still significant amounts being emitted when the B-cell silver reactor was used. During the first week of the present quarter, 19 curies of I^{131} were emitted to the atmosphere from the S-plant stack over a 24 hour period when both A and B cell silver reactors were in use. Regeneration of both of these reactors reduced the average daily I^{131} emission to the order of one curie per day for the remainder of the quarter.

[redacted]

Table IV summarizes the results obtained from monitoring for ruthenium at the S-plant stack during the quarter.

TABLE IV

SUMMARY OF RESULTS FROM RUTHENIUM MONITORING

S-PLANT STACK

APRIL, MAY, JUNE

1953

	Units of 10^{-2} curie/day					
	Filter Collection		Scrubber Collection		Total	
Month	Maximum	Average	Maximum	Average	Maximum	Average
April	9.1	1.6	9.0	< 1.6	9.2	< 3.3
May	130	24	46	< 2.4	130	<27
June	310	32	7.4	< 1.0	310	<33
Quarter	310	19	46	< 1.6	310	< 21
Last Quarter			< 4.7	< 1.1	< 4.7	< 1.1

Coincident with the change in the ruthenium oxidation process at the S-plant stack during May, 1953, a sharp increase was noted in the amount of ruthenium emitted from the 291-S stack. The filter sampler in series with the caustic scrubber collected most of the additional ruthenium indicating that the majority of it was either in particulate form or was sufficiently reduced by the organic matter of the filter paper to be deposited on it. Comparison of constant monitor counting rate charts with process conditions revealed that, in some cases, ruthenium was admitted to the stacks through the vessel vent line when transfer of the centrifuge cake waste was in progress. At other times, a significant portion of the total ruthenium emitted was evolved during the first potassium permanganate addition in the oxidizer vessel.

The results obtained from filter measurements at the inlet to the S-plant sand filter are presented in Table V.

TABLE V

SUMMARY OF FILTER MEASUREMENTS
S-PLANT SAND FILTER INLET
APRIL, MAY, JUNE
1953

Period	Gross Beta Particle Emitters 10^{-3} μc/ft^3		mrep/hr/μc*	
	Maximum	Average	Maximum	Average
April	0.74	0.31	290	130
May	45	13	81	59
June	90	12	590	44
Quarter	90	8.2	590	74
Last Quarter	3.9	1.2	115	53

* Dosage determined from CP instrument surface readings.

There was a highly significant increase in the activity density of gross beta particle emitters in the gas passing into the S-plant sand filter during May. Although this increase was coincident with the resumption of the ruthenium oxidation process, ruthenium accounted for only about 10 per cent of the activity collected on these filters. I^{131}, rare earths, and yttrium constituted a major portion of the isotopes collected at this location. Table VI is a summary of the radiochemical analysis of a filter collected on June 10, 1953.

TABLE VI

SUMMARY OF RADIOCHEMICAL ANALYSIS OF FILTER FROM S-PLANT SAND FILTER INLET

JUNE -- 1953

Emitter	µc Per Filter	Percentage Composition	Curies Per 24 Hours* Passed to Sand Filter
Gross Beta Particle Emitters	89	100	1.76
I^{131}	27	30	0.53
Ru^{103} - Ru^{106}	8.2	9.2	0.16
Rare Earths Plus Yttrium**	31	35	0.61
Zirconium	3.2	3.5	0.063
Strontium	9.4	11	0.19
Barium	1.0	1.1	0.019
Unknown	8.6	10	0.17

* Based on an estimated 40,000 cfm of gas passing into the sand filter.

** Not corrected for self absorption or air and mica window absorption.

Spot checks of the number of radioactive particles collected on sampling filters operated at the outlet of the S-plant sand filter showed that an increase in the concentration of these particles occurred at the same time that the increase in activity density of gross beta particle emitters was noted in the inlet gas. The average radioactive particle concentration in the outlet gas, expressed as units of 10^4 particles per day, was 0.3 in April, 9.6 in May, and 45 in June. The average emission rate was 1.4×10^5 particles per day during the present quarter as compared to 1.5×10^4 during the previous quarter.

200 WEST AREA - U-PLANT

Table VII is a summary of the results obtained from filter measurements at the ten foot level of the 291-U stack.

TABLE VII

SUMMARY OF FILTER MEASUREMENTS

U-PLANT STACK

APRIL, MAY, JUNE

1953

	Curies Emitted Per Day					
	Gross Alpha Particle Emitters Units of 10^{-8}		Gross Beta Particle Emitters Units of 10^{-5}		Radioactive Particles Units of 10^{4} Particles/Day	
Month	Maximum	Average	Maximum	Average	Maximum	Average
April	2.6	1.3	2.1	0.6	1.8	0.2
May	25	7.3	0.9	0.4	4.9	1.7
June	4.3	1.5	3.4	1.5	3.2	1.7
Quarter	25	3.1	3.4	0.8	4.9	1.4
Last Quarter	4.1	1.2	3.9	0.4	4.1	0.6

The average activity density of gross alpha and gross beta particle emitters and the concentration of radioactive particles in the 291-U stack gases increased significantly during the quarter although the current average values were almost identical to those recorded for the fourth quarter of 1952. The number of radioactive particles emitted compares favorably with that measured during March, 1953, for both the average and maximum values and may represent the start of an upward trend. There is no immediate explanation for these periodic fluctuations in activity density and particle concentration.

REACTOR AREAS

Samples of the reactor areas stack gases were collected from main ventilation ducts near the stack breeching. Results of the analysis of these samples for tritium oxide, S^{35}, C^{14}, radioactive particles, and gross alpha and beta particle emitters are summarized in Tables VIII through XII.

TABLE VIII

SUMMARY OF STACK MONITORING RESULTS

105-F STACK

APRIL, MAY, JUNE

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Total Alpha Units of 10^{-7}	Filterable Particle Emitters: Total Beta Units of 10^{-5}	Filterable Particle Emitters: Radioactive Particles Units of 10^{5} particles/day
April						
Maximum	0.13	< 4.5	< 4.5	22	4.8	12
Average	0.08	< 4.5	< 4.5	6.5	2.3	3.5
May						
Maximum	0.18	< 4.5	< 4.5	7.3	2.8	9.6
Average	0.06	< 4.5	< 4.5	5.2	1.3	3.3
June						
Maximum	0.12	< 4.5	< 4.5	8.6	10	4.2
Average	0.06	< 4.5	< 4.5	4.4	4.0	1.6
Quarter						
Maximum	0.18	< 4.5	< 4.5	22	10	12
Average	0.07	< 4.5	< 4.5	5.4	2.6	2.8
Last Quarter						
Maximum	1.3	< 4.5	6.1	22	36	32
Average	0.2	< 4.5	< 4.5	6.9	7.1	5.1

TABLE IX

SUMMARY OF STACK MONITORING RESULTS

105-D STACK

APRIL, MAY, JUNE

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters		Radioactive Particles
				Total Alpha Units of 10^{-7}	Total Beta Units of 10^{-5}	Units of 10^{5} particles/day
April						
Maximum	0.32	<4.5	14	13	470	4.1
Average	0.09	<4.5	<4.5	4.5	330	1.8
May						
Maximum	0.22	<4.5	<4.5	5.2	420	21
Average	0.07	<4.5	<4.5	2.9	160	7.3
June						
Maximum	0.10	<4.5	8.3	4.5	450	13
Average	0.05	<4.5	5.3	2.3	210	4.9
Quarter						
Maximum	0.32	<4.5	14	13	470	21
Average	0.07	<4.5	<4.5	3.3	240	4.3
Last Quarter						
Maximum	0.3	<4.5	<4.5	16	1800	5.1
Average	0.1	<4.5	<4.5	5.2	480	0.8

TABLE X

SUMMARY OF STACK MONITORING RESULTS

105-DR STACK

APRIL, MAY, JUNE

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters		Radioactive Particles Units of 10^{5} particles/day
				Total Alpha Units of 10^{-7}	Total Beta Units of 10^{-5}	
April						
Maximum	0.20	<4.5	<4.5	2.2	0.5	0.8
Average	0.08	<4.5	<4.5	1.0	0.2	0.4
May						
Maximum	0.07	<4.5	7.9	2.6	0.3	0.9
Average	0.03	<4.5	<4.5	1.5	0.2	0.2
June						
Maximum	0.04	<4.5	<4.5	1.0	0.3	<0.8
Average	0.02	<4.5	<4.5	0.5	0.1	<0.2
Quarter						
Maximum	0.20	<4.5	7.9	2.6	0.5	0.9
Average	0.05	<4.5	<4.5	1.0	0.2	0.2
Last Quarter						
Maximum	1.1	12	<4.5	120	6.1	3.4
Average	0.1	<4.5	<4.5	12	0.9	0.5

TABLE XI

SUMMARY OF STACK MONITORING RESULTS

105-H STACK

APRIL, MAY, JUNE

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters		Radioactive Particles
				Total Alpha Units of 10^{-7}	Total Beta Units of 10^{-5}	Units of 10^{5} particles/day
April						
Maximum	0.29	<4.5	<4.5	43	6.5	57
Average	0.11	<4.5	<4.5	15	3.6	15
May						
Maximum	0.10	<4.5	<4.5	24	6.1	47
Average	0.04	<4.5	<4.5	10	3.1	12
June						
Maximum	0.17	<4.5	10	6.3	5.5	56
Average	0.05	<4.5	<4.5	4.5	1.8	17
Quarter						
Maximum	0.29	<4.5	10	43	6.5	57
Average	0.07	<4.5	<4.5	10	2.8	15
Last Quarter						
Maximum	0.6	22	<4.5	30	7.5	11
Average	0.09	<4.5	<4.5	9.6	3.3	1.5

TABLE XII

SUMMARY OF STACK MONITORING RESULTS

105-C STACK

APRIL, MAY, JUNE

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Total Alpha Units of 10^{-7}	Filterable Particle Emitters: Total Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
April*						
Maximum				0.3	0.7	1.1
Average				0.1	0.01	1.1
May						
Maximum	0.03	<4.5	<4.5	3.3	35	100
Average	0.02	<4.5	<4.5	1.5	15	48
June						
Maximum	0.09	<4.5	12	3.1	6.8	47
Average	0.02	<4.5	5.3	1.8	4.9	45
Quarter						
Maximum	0.09	<4.5	12	3.3	35	100
Average	0.02	<4.5	<4.5	1.3	6.4	39

* Sample flow rate was probably low during April.

Measurements for C^{14} revealed that emission rates of this isotope from the reactor stacks were below the detection limit of 4.5×10^{-3} curie per day throughout the present quarter. Occasional positive S^{35} measurements were obtained at all the reactor stacks monitored with the exception of 105-F; the maximum measurement was obtained at the 105-D stack where 1.4×10^{-3} curie was emitted to the atmosphere over a 24 hour period during April. Total tritium oxide emission from the reactor stacks averaged 0.28 curie per day during the present quarter. Maximum daily emission was measured at the 105-D stack where 0.32 curie per day was emitted during April. Many of these values represent a significant decrease and indicate a reversal of the trend noted last quarter when there were small general increases in the tritium oxide emission rates from the reactors.

There were no significant changes in the activity density of gross alpha particle emitters in the reactor area stack gases during the quarter. The values for the previous quarter at 105-DR were weighted by the one unusually high measurement obtained during March.

There were general decreases in the activity density of gross beta particle emitters in the reactor area stack gases during the present quarter. The discharge rate of these emitters from the 105-D stack continues to be higher than that found at the other reactor areas by a factor of 100.

The concentrations of radioactive particles in the reactor area stack gases decreased to values approximately one-half of those determined for the previous quarter at 105-F and 105-DR stacks; the concentration increased by a factor of 4 at the 105-D stack and by a factor of 10 at the 105-H stack.

Samples of the 105-C stack gases were collected on a routine basis for the first time during the present quarter (Table XII) and comparisons with previous spot measurements were not attempted.

SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

Nearly 3,000 samples were analyzed to determine the activity density of I^{131} and non-volatile beta particle emitters deposited on vegetation in the Hanford environs. Two thousand of these samples were collected from locations on and adjacent to the project; the balance of the samples was collected from remote locations in eastern and southeastern Washington and northern Oregon. All samples were analyzed for the activity density of I^{131} and nearly 80 per cent of the samples was analyzed for the activity density of non-volatile beta particle emitters. The activity density of alpha particle emitters on vegetation was measured in samples which were collected from selected locations in the immediate environs.

Table I summarizes the results obtained from the beta particle measurements at general locations during the quarter and includes average results from the previous quarter. Detailed summaries of these same data appear in subsequent tables.

TABLE I

RADIOACTIVE CONTAMINATION ON VEGETATION

APRIL, MAY, JUNE

1953

Location	Radioactive Iodine Units of 10^{-6} µc/g				Non-Volatile Emitters Units of 10^{-6} µc/g		
	Samples	Max.	Avg.	Last Qtr. Avg.	Max.	Avg.	Last Qtr. Avg.
North of 200 Areas	235	2300	51	4	15000	2200	48
Near the 200 Areas	181	1200	70	7	15000	940	53
Route 3	14	110	16	25			
200 West Gate	68	2100	65	42	11000	460	77
200 East Tower #16	67	540	27	9	8300	330	50
Batch Plant	42	680	26	16	4200	220	57
Meteorology Tower	16	1100	82	21			
South of 200 Areas	378	1600	32	4	1700	810	33
Richland	198	1200	39	<3	11000	520	32
Pasco Environs	92	1200	39	<3	15000	720	28
Kennewick Environs	128	930	31	3	12000	720	29
Benton City - Kiona	43	640	33	<3	11000	920	34
Richland "Y"	14	65	7	<3			
Hanford	14	38	3	<3			
200 East Area	79	14	4	6	870	68	51
200 West Area	66	87	17	26	1200	250	180
Redox Area	94	4800	120	26	13000	13000	
Wahluke Slope	108	15	<3	<3	480	130	39
Goose Egg Hill	62	58	4	15	380	110	31
Rattlesnake Mountain	30	7	<3	18	54	37	38
PSN-300-310-330	40	2400	69	15	1600	210	80
OFF AREA SAMPLING							
Pasco to Ringold	75	18	<3	<3	630	96	47
Prosser to Patterson - McNary	267	1100	31	<3	21000	1200	31
Eastern Washington	244	4400	260	3	36000	4600	40
So. Washington and No. Oregon	228	1500	45	<3	35000	2000	33
Yakima Barricade to Ellensburg	17	870	320		12000	4100	

The activity density of radioactive iodine deposited on vegetation increased significantly during this period. The general increase noted throughout the environs was largely caused by the influx of particulate contamination from the Nevada nuclear explosion tests during the latter part of the quarter. The magnitude of this increase may be appraised from the results summarized in Table II which shows the same data on a month to month basis.

TABLE II

ACTIVITY DENSITY FROM I^{131} AND I^{133} ON VEGETATION

APRIL, MAY, JUNE

1953

Units of 10^{-6} μc/g

	April		May		June	
Location	Max.	Avg.	Max.	Avg.	Max.	Avg.
North of 200 Areas	5	<3	15	<3	2300	130
Near the 200 Areas	11	<3	9	<3	2100	180
Route 3	5	<3	24	13	100	31
200 West Gate	10	<3	24	9	2100	180
200 East Tower # 16	20	4	7	<3	540	75
Batch Plant	9	4	9	5	680	80
Meteorology Tower	3	<3	19	6	1100	180
South of 200 Areas	18	<3	10	<3	1600	86
Richland Environs	8	<3	5	<3	1200	110
Pasco Environs	7	<3	5	<3	1200	100
Kennewick Environs	15	<3	48	<3	930	90
Benton City - Kiona	4	<3	4	<3	640	53
Richland "Y"	4	<3	3	<3	65	18
Hanford	6	<3	3	<3	38	8
200 East Area	14	5	12	4	12	4
200 West Area	17	4	35	10	88	37
Redox Construction Area	79	12	36	11	4800	320
Wahluke Slope	15	<3	7	<3	13	4
Goose Egg Hill	58	6	5	<3	14	4
Rattlesnake Mountain	7	<3				
PSN-300-310-320	20	5	5	3	2400	170
OFF AREA SAMPLING						
Pasco to Ringold	16	4	7	<3	18	<3
Prosser to Patterson-McNary	8	<3	9	<3	1100	84
Eastern Washington	5	<3	5	<3	4400	550
So. Washington and No. Oregon	8	<3	5	<3	1500	110
Yakima Barricade to Ellensburg					370	320

Radioactive iodine on vegetation during April and early May barely exceeded the detection limit of 3×10^{-6} μc/g throughout the environs and was a continuation of the negligible contamination which existed at residential locations during the first three months of 1953. Samples collected after May 26 showed values several hundred times greater than those found prior to that date. Supplementary methods of monitoring indicated considerable fallout of particulate contamination from the Nevada Proving Grounds on this date. Detailed summaries showing the magnitude of the contamination which resulted from the fallout may be referred to in publication (HW-28925). Data accumulated on a daily basis from control plots in the residential areas around the plant perimeter indicated that the combined activity density of I^{131} and I^{133} on vegetation had decreased to values below the detection limit of the measurement by the middle of June.

Iso-activity maps showing the estimated deposition pattern during each of the three months in the quarter as well as the over-all average deposition during the period may be referred to in Figures 1 through 4. The random occurrences of radioactive iodine at isolated locations as shown in Figures 3 and 4 was largely caused by the varying frequency of the sampling program during the latter part of the quarter and did not appear to be related to plant emission or meteorological conditions.

Highly significant increases in the activity density of non-volatile beta particle emitters at the locations indicated in Table I were also attributed to the fallout previously mentioned, (HW-28925). Table III summarizes the same data on a month to month basis and clearly shows the significance of the increase in contamination caused by the fallout from the nuclear explosion tests.

TABLE III

ACTIVITY DENSITY FROM NON-VOLATILE BETA PARTICLE EMITTERS ON VEGETATION

APRIL, MAY, JUNE

1953

Units of 10^{-6} μc/g

Location	April		May		June	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
North of 200 Areas	56	34	55	35	15000	4900
Near 200 Areas	131	32	67	33	15000	2600
Route 3						
200 West Gate	72	19	120	38	11000	1300
200 East Tower #16	62	27	220	45	8300	930
Batch Plant	45	25	56	31	4200	610
Meteorology Tower						
South of 200 Areas	79	31	100	41	17000	2900
Richland Environs	59	24	110	47	11000	1500
Pasco Environs	62	27	120	51	15000	2000
Kennewick Environs	65	25	160	58	12000	1900
Benton City - Kiona	40	34	73	37	8300	1300
Richland "Y"						
Hanford						
200 East Area	55	25	84	47	870	120
200 West Area	163	37	88	55	1200	670
Redox Construction Area					13000	13000
Wahluke Slope	90	5	71	44	480	170
Goose Egg Hill	62	49	48	37	380	170
Rattlesnake Mountain	55	37				
PSN 300-310-320	63	33	60	31	1600	430
OFF AREA SAMPLING						
Pasco to Ringold	59	37	220	76	630	180
Prosser to Patterson-McNary	55	28	320	48	21000	2900
Eastern Washington	63	26	100	32	36000	8100
South Washington and North Oregon	91	29	67	28	35000	4500
Yakima Barricade to Ellensburg					12000	4100

The activity density of non-volatile beta particle emitters on samples collected during early June was among the highest ever detected in the environs. In general, these values seldom exceed 1×10^{-4} μc/g during periods of normal Hanford operation and rarely exceed 1×10^{-3} μc/g during periods when particulate contamination from other sources enters the environs. Samples collected from control plots at three residential locations near the plant showed that the activity density of non-volatile beta particle emitters had decreased from values on the order of 1×10^{-2} μc/g on May 27 to values on the order of 2×10^{-4} μc/g on June 24. This decrease in activity was partially accounted for by decay and may have been influenced by atmospheric conditions. Figure 5 shows the estimated deposition pattern of non-volatile beta particle emitters as measured immediately following the fallout incident referred to in the above discussion.

Table IV summarizes the results obtained from analyzing samples which were collected at remote locations.

TABLE IV

RADIOACTIVE CONTAMINATION ON VEGETATION

OFF AREA LOCATIONS

APRIL, MAY, JUNE

1953

Units of 10^{-6} μc/g

Location	No. Samples	I^{131} - I^{133} Max.	I^{131} - I^{133} Avg.	Non-Volatile Emitters Max.	Non-Volatile Emitters Avg.
Wallula	8	1800	320	16000	8000
Touchet*	5	9	3	220	92
Louden	7	490	70	12000	3100
Walla Walla	12	10	<3	19000	2800
Dixie*	6	12	<3	290	110
Waitsburg	17	1800	380	40000	9900
Pomeroy	17	2000	370	61000	14000

TABLE IV (contd.)

Location	No. Samples	I^{131} - I^{133} Max.	I^{131} - I^{133} Avg.	Non-Volatile Emitters Max.	Non-Volatile Emitters Avg.
Lewiston*	12	<3	<3	88	37
Dayton	17	1700	320	28000	8800
Pullman	15	1200	130	17000	3400
Colfax	8	2900	470	13000	3700
Steptoe*	6	4	<3	38	38
Rosalia*	6	10	<3	61	54
Spokane	13	750	59	6200	910
Cheney	13	1300	100	15000	2200
Sprague	14	1700	220	16000	3100
Ritzville	13	290	23	6600	980
Uniontown*	6	8	<3	240	130
Lind	13	2300	180	8300	1300
Connell	16	440	70	9100	1500
Moxee	14	100	12	1200	270
Union Gap	8	80	17	940	350
Wapato	12	11	<3	790	220
Toppenish	12	6	<3	2000	380
Toppenish to Goldendale	27	33	5	870	200
Goldendale*	12	4	<3	110	57
Goldendale to Wishram*	9	5	<3	--	--
Lyle*	6	3	<3	15	13
Bingen*	6	<3	<3	70	38
Camas*	12	4	<3	55	29
Vancouver*	12	4	<3	67	40
Portland*	11	6	<3	97	60
Troutdale*	6	4	<3	100	67
Bonneville*	6	5	<3	57	41
Hood River*	6	<3	<3	24	19
The Dalles*	12	5	<3	26	20
Moody*	6	3	<3	51	36
Rufus*	6	7	<3	18	18
Blalock*	6	<3	<3	87	58
Arlington*	6	<3	<3	130	70
Heppner Junction*	6	5	<3	85	85
Boardman*	6	4	<3	54	36
Hermiston*	2	<3	<3	17	17
Stanfield*	2	<3	<3	49	49
Pendleton*	4	<3	<3	80	59
Meacham*	2	7	5	57	57

* These locations were not sampled after the significant deposition from fallout during late May.

TABLE IV (contd.)

Location	No. Samples	I^{131} - I^{133} Max.	I^{131} - I^{133} Avg.	Non-Volatile Emitters Max.	Non-Volatile Emitters Avg.
(The following samples were collected after May 26 fallout)					
Yakima Barricade to Moxee City	5	840	520	4800	3900
Yakima	1	61	61	810	810
Union Gap to Sunnyside	5	240	140	3900	2700
Sunnyside	2	370	290	11000	7400
Grandview	1	160	160	12000	12000
Prosser	2	130	120	8100	5800
Prosser to Benton City	2	480	360	7400	5300
Benton City to Richland	4	980	540	21000	16000
Junction 395 and 730 to Pendleton	6	470	280	12000	7400
Pendleton	1	390	390	5300	5300
Pendleton to Walla Walla	6	1500	770	35000	17000
Walla Walla to Louden	3	1300	1100	23000	12000
Yakima to Ellensburg	2	870	650	5500	4500
Ellensburg	1	35	35	830	830
Ellensburg to Moses Lake	4	1900	970	8300	6500
Moses Lake	1	250	250	3800	3800
Moses Lake to Ritzville	2	720	570	6400	5600
Ritzville to Spokane	5	2000	970	28000	19000
Spokane to Lind	5	3300	2100	23000	16000
Pasco to Connell	7	3700	1200	31000	17000
Connell to Washtucna	6	730	450	6200	3700
Washtucna	1	320	320	3600	3600
Washtucna to Colfax	8	3400	2000	36000	18000
Colfax to Pullman	2	4400	2700	36000	27000
Pullman to Lewiston	5	2100	960	9200	5200
Lewiston to Clarkston	3	860	500	9000	5400
Lewiston to Pomeroy	4	1600	1100	30000	23000

The increase in the activity density of radioactive iodine and non-volatile beta particle emitters noted in the immediate environs during the latter part of the quarter was also reflected in the data obtained from samples collected at remote locations. In many instances, the activity density of non-volatile beta particle emitters at remote locations exceeded that which was detected in the immediate vicinity. Considerable variation in the amount of precipitation which accompanied the fallout over the Pacific Northwest along with the different times at which the samples were collected tended to influence the magnitude of activity measured at locations shown in Table IV.

The activity density of gross alpha particle emitters on vegetation was measured from samples collected at nine locations. These results are presented in Table V.

TABLE V

ACTIVITY DENSITY FROM GROSS ALPHA PARTICLE EMITTERS ON VEGETATION

APRIL, MAY, JUNE

1953

Units of 10^{-8} μc/g

Location	April	May	June	Quarterly Average	Maximum Result
Near 200 Areas					
200 West Gatehouse	68	17	12	37	120
Batch Plant	84	5	14	41	220
Route 4S Mile 4	15	8	9	10	22
Meteorology Tower	20	11	7	12	31
Route 4S Mile 6	8	8	12	9	12
300 Area	310	53	57	130	620
Outlying					
Richland	16	5	7	10	46
Pasco	24	11	<5	13	54
Benton City	36	8	6	20	84

Although considerable fluctuation was observed in the activity density of alpha particle emitters on vegetation during this period, the only significant change was noted at the 300 Area location where the average of 1.3×10^{-6} μc/g represented a significant decrease from the previous quarterly average of 5.9×10^{-6} μc/g. Average values during the month of April were comparable to those found during February and March of the previous quarter whereas the June measurements paralleled the lower values found during January.

Five special vegetation samples were collected during and immediately after a fire which occurred in the 300 Area burning pit on May 29. These samples were collected at locations ranging from 100 ft. to 500 ft. downwind from the fire. The results of these samples showed values ranging from 1.4×10^{-6} μc/g to 3.9×10^{-6} μc/g; statistical analysis showed no significant difference between these measurements and the quarterly average at a nearby location.

SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Dosage rates from plant effluent gases and from radioactive material on the ground in the Hanford environs were determined from readings obtained with portable and fixed ionization chambers. Victoreen Integrons were operated continuously at each of the manufacturing areas and detachable ionization chambers were employed at intermediate and perimeter residential locations. Table I summarizes the average dosage rates obtained from the accumulated readings from Victoreen Integrons.

TABLE I

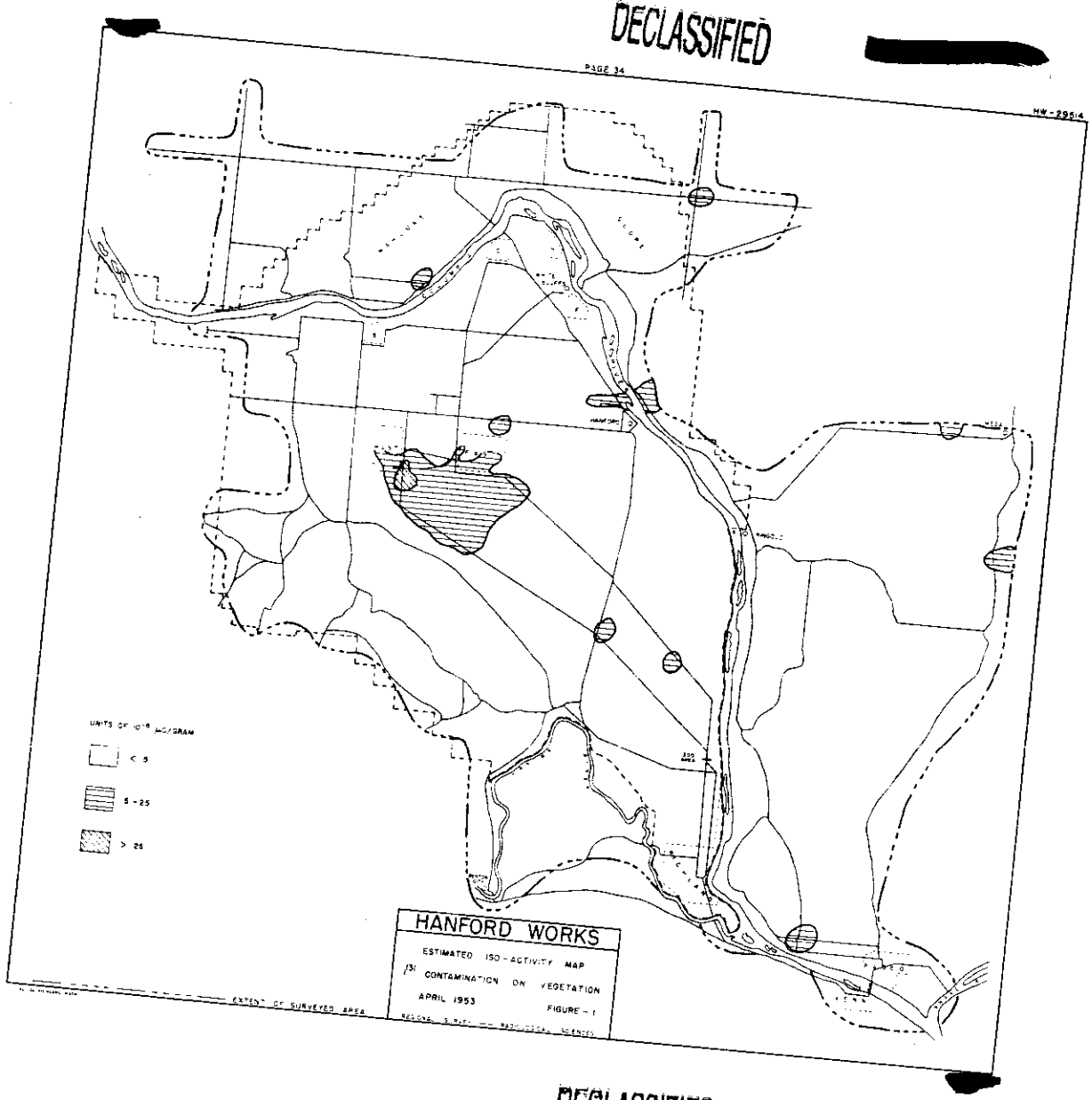
AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS

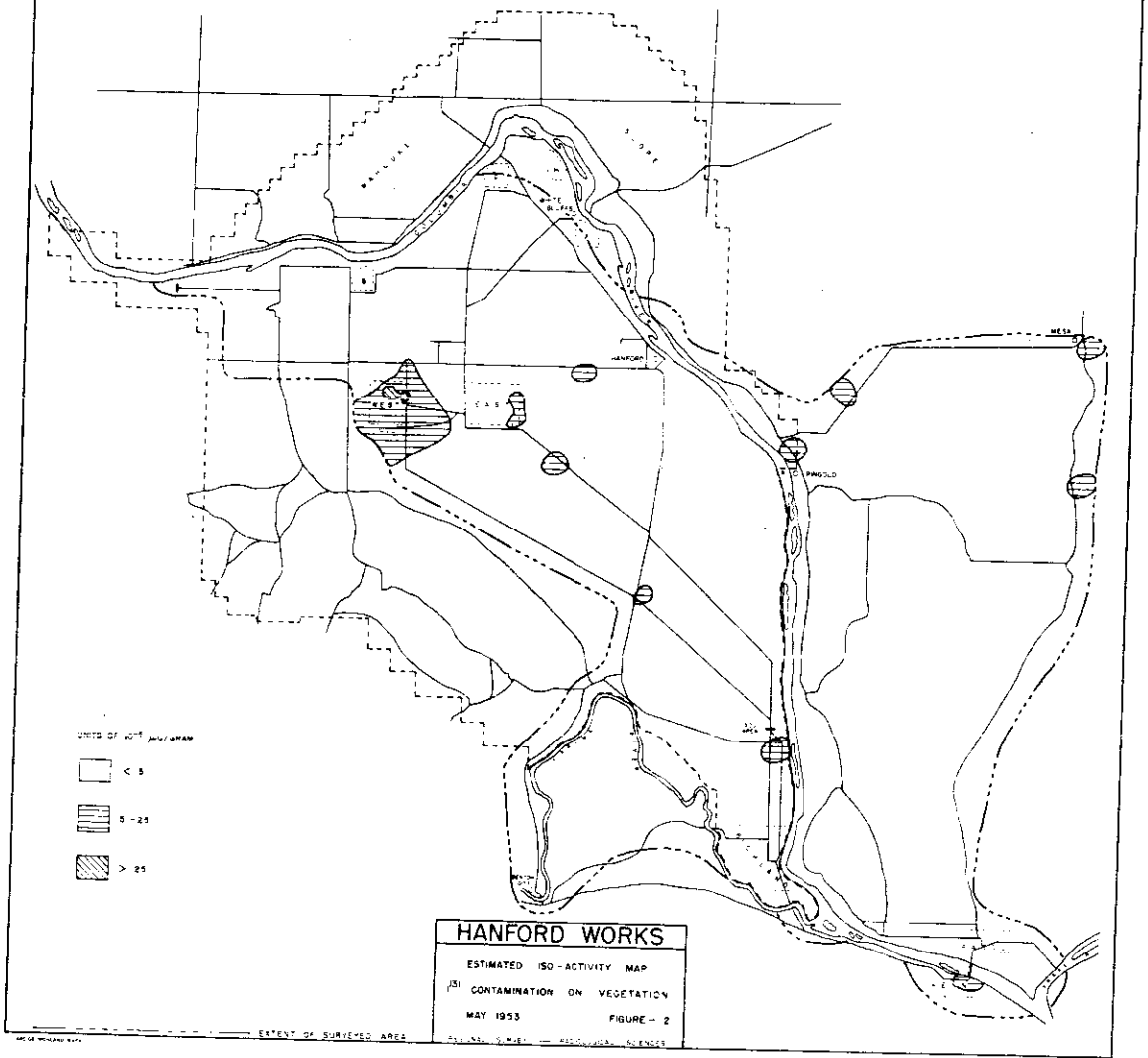
APRIL, MAY, JUNE

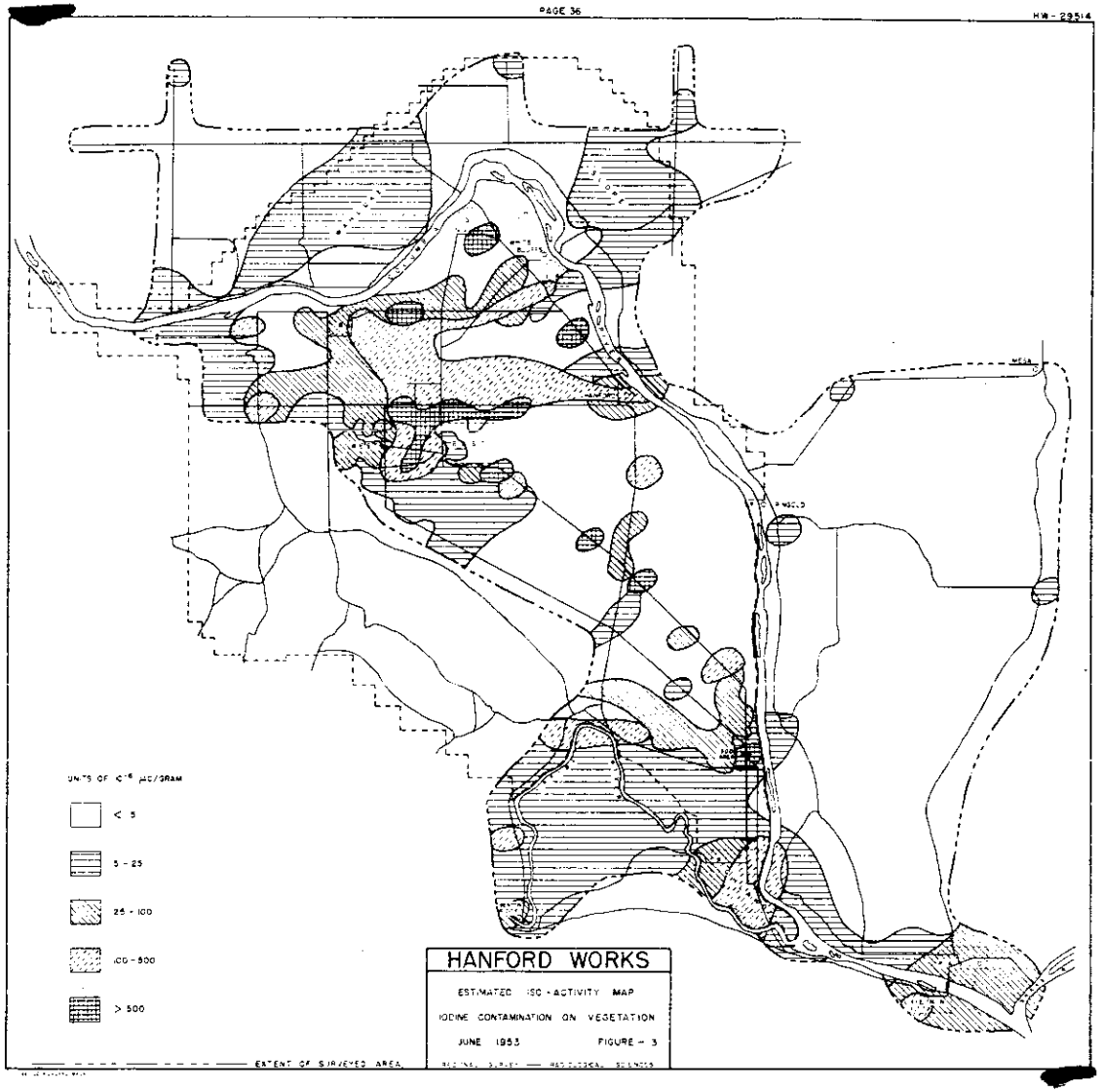
1953

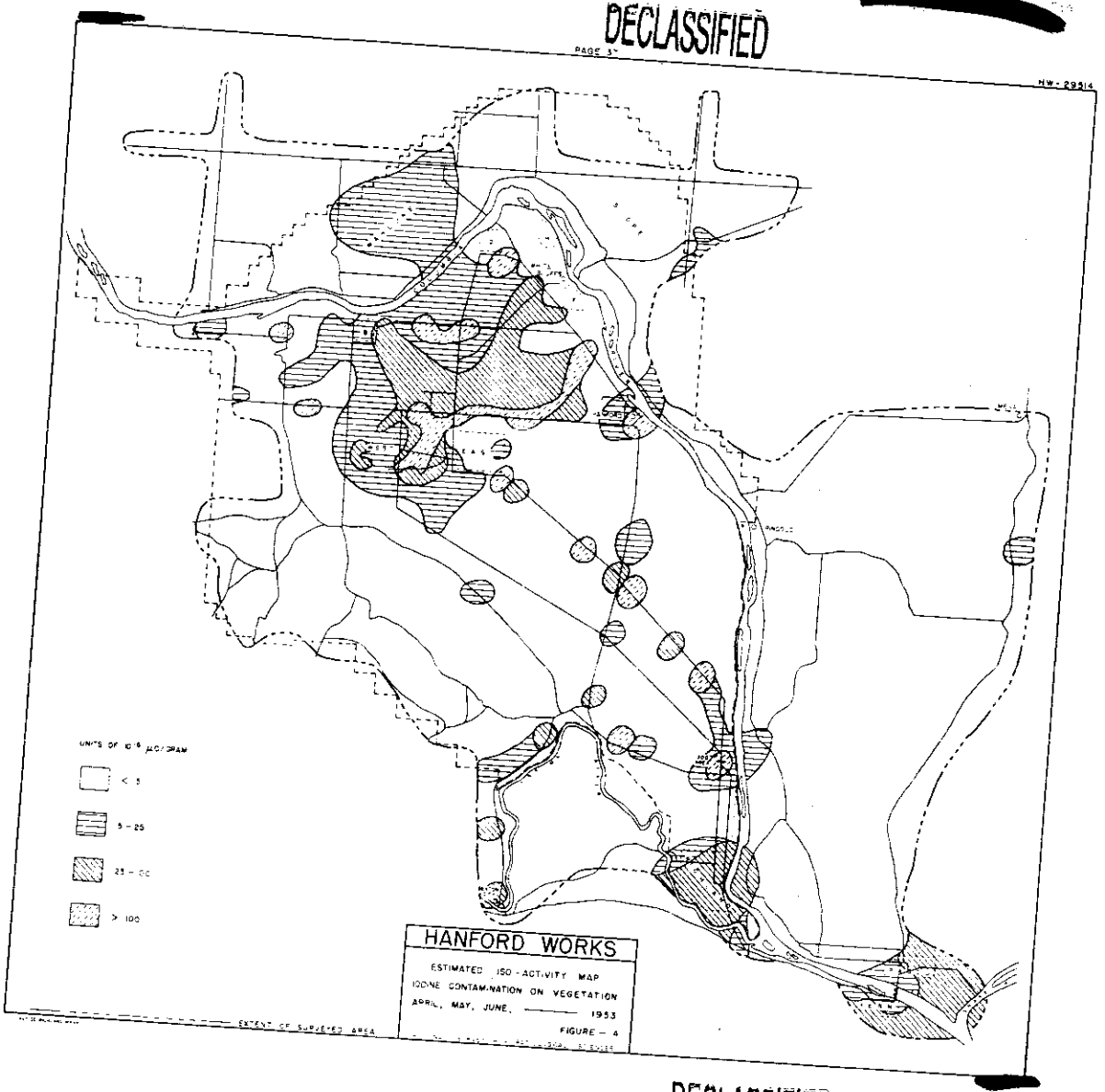
Units of mrep per 24 hours

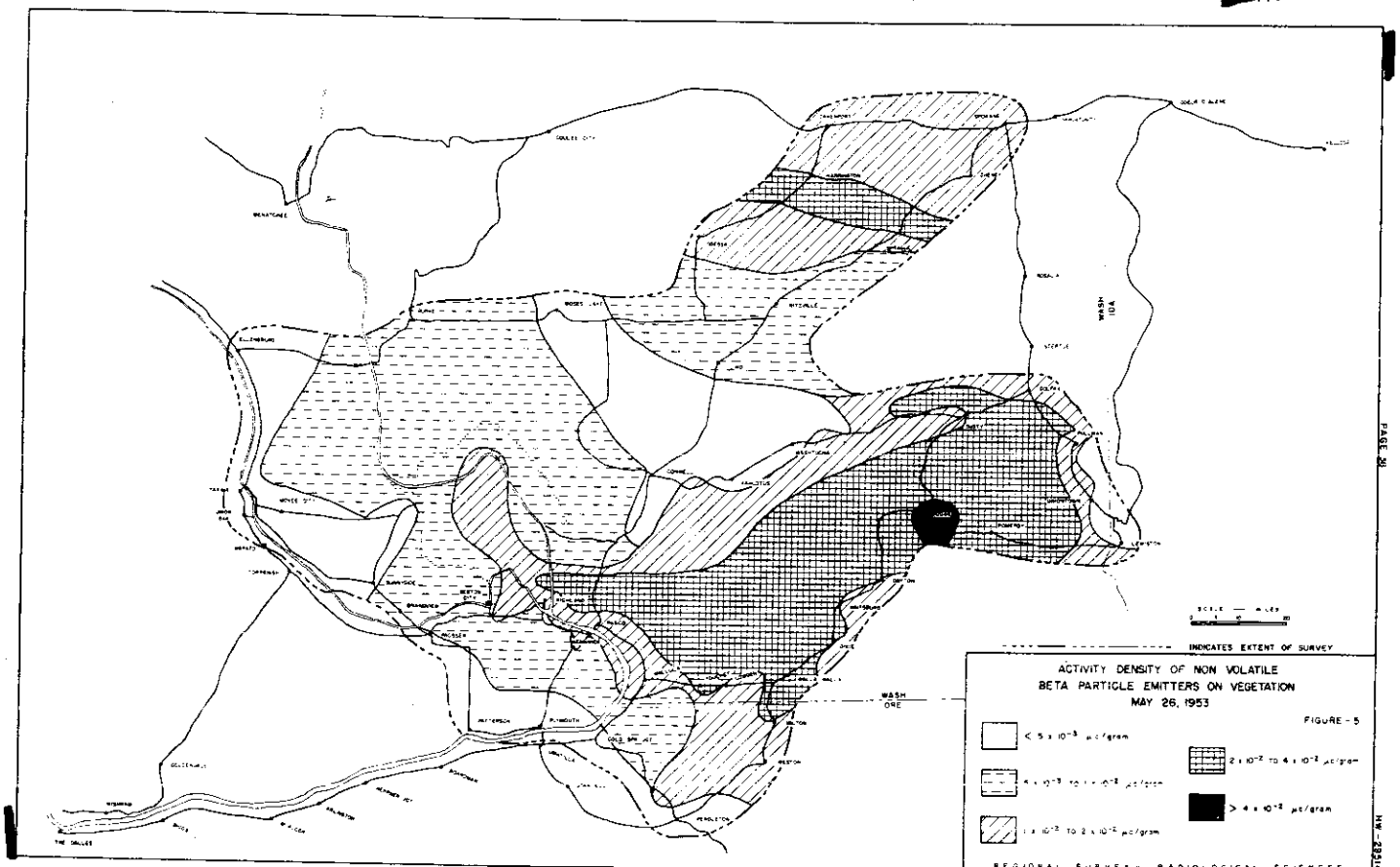
Location	No. of Units	April	May	June	Quarterly Average
100-B Area	3	1.6	0.2	0.3	0.7
100-D Area	3	0.3	0.2	0.9	0.5
100-F Area	3	0.2	0.7	0.1	0.3
100-H Area	3	0.4	0.5	0.5	0.5
200 West Area	2	0.3	1.2	2.9	1.5
200 East Area	2	0.6	1.0	1.1	0.9
200 East Semiworks	1	0.1	2.3	0.1	0.8
300 Area	1	0.2	0.1	0.3	0.2
Riverland	1	0.6	0.1	0.4	0.4
Richland	1	0.4	0.6	1.2	0.7
North Richland North	1	<0.1	<0.1	<0.1	<0.1
Pasco	1	0.2	<0.1	0.8	<0.4
Kennewick	1	0.3	0.5	0.6	0.5
Benton City	1	0.9	1.8	2.9	1.9
Hanford	1	0.1	0.5	0.1	0.2











Average dosage rates for the present quarter were not significantly different from those measured during the first quarter of 1953. Radiation levels measured in June were not significantly higher when comparing the data on a month to month basis but there appeared a significant increase in these levels at several locations during the first week of June when considerable fallout contamination entered the immediate environs from the atomic tests which were conducted at the Nevada Proving Ground. This condition was temporary and the dosage rates tended to return to expected values after the first week of June.

Recorded data obtained from a Victoreen Integron operated at a location along the perimeter fence of the 202-S facility were deleted from the tabulation because they were extremely difficult to interpret due to intermittent leakage of the ionization chamber during this period. In several instances, dosage rates in excess of 5 mrep/hr were indicated in the recorded data and it appeared valid to assume that there was a contribution from chamber leakage to this reading; the exposure of film packs and detachable chambers at the same location during periods when the Integron data indicated dosage rates in excess of 5 mrep/hr tended to invalidate most of the recorded data since no significant dosage rates were in evidence from the supplementary types of monitoring.

Table II summarizes the results obtained from reading detachable C-type ionization chambers which were placed inside the air monitoring stations located around the perimeter of the manufacturing areas.

TABLE II

AVERAGE DOSAGE RATES MEASURED BY "C" TYPE DETACHABLE IONIZATION CHAMBERS

APRIL, MAY, JUNE

1953

Units of mrep per 24 hours

Location	April	May	June	Quarterly Average
Within				
100-B Area	0.5	0.6	0.6	0.6
100-D Area	0.5	0.5	0.5	0.5
100-F Area	0.4	0.3	0.4	0.4
100-H Area	0.5	0.5	0.5	0.5
200 West Area	0.3	0.4	0.7	0.5
200 East Area	0.4	0.5	0.5	0.5
200 East Semiworks	0.3	0.6	0.9	0.6

Dosage rates measured with C-type ionization chambers were not significantly different from those measured during the past several months. Radiation dosage rates at intermediate locations and in residential areas around the plant perimeter were determined from the readings obtained from M and S-type detachable ionization chambers. Two chambers were employed at each monitoring station and the dosage rate was evaluated from the chamber which showed the minimum discharge. Table III summarizes the results of these findings.

TABLE III

RADIATION LEVELS OBSERVED WITH "M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS

APRIL, MAY, JUNE

1953

Units of mrep per 24 hours

Location		April	May	June	Quarterly Average	Group Average
100 Areas and Environs						
Route 1, Mile 8	(M)	0.49	0.42	0.50	0.47	
Route 2N, Mile 10	(M)	0.48	0.42	0.49	0.46	
Route 2N, Mile 5	(M)	0.37	0.38	0.41	0.39	
White Bluffs	(M)	0.38	0.39	0.60	0.46	
Route 11-A, Mile 1	(S)	0.91	0.74	1.86	1.17	
Hanford 614 Building	(S)	0.35	0.56	0.74	0.55	
Intersection Route 1 and 4N	(M)	0.37	0.42	0.51	0.43	
Hanford 101 Area	(M)	0.41	0.41	0.60	0.47	
100-H Area	(M)	0.50	0.49	0.52	0.50	
P-11 Area	(M)	0.40	0.40	0.49	0.43	0.53
Within 5 Miles of 200 East						
Route 4S, Mile 6	(S)	0.95	0.43	1.46	0.95	
Batch Plant	(M)	0.85	0.49	0.82	0.72	
Route 11-A, Mile 6	(S)	1.27	1.39	1.34	1.33	
Route 3, Mile 1	(S)	0.70	0.56	3.67	1.64	
Meteorology, 200'	(M)***					
Route 4S, Mile 2.5	(S)	0.52	0.43	1.07	0.67	
Redox Area	(S)	0.42	0.58	0.88	0.63	
Route 4S, Mile 4.5	(S)	0.50	0.38	1.21	0.70	
Semi-Works # 1	(S)	0.51	***		0.51	
Semi-Works # 2	(S)	0.83	***		0.83	
Military Camp PSN 300	(S)	1.08	1.24	1.40	1.24	
Military Camp PSN 310	(S)	0.48	0.67	2.74	1.30	
Military Camp PSN 320	(S)	0.51	1.21		0.86	
Military Camp PSN 330	(S)	0.59	0.97	1.63	1.06	
Redox Outside		3.10	1.59	4.63	3.11	1.11

TABLE III (contd.)

Units of mrep per 24 hours

Location		April	May	June	Quarterly Average	Group Average
Within 10 Miles of 200 East						
Route 4S, Mile 10	(S)	0.75	0.59	1.99	1.11	
Route 10, Mile 1	(S)	1.11	0.86	1.52	1.16	
Route 10, Mile 3	(S)	0.98	0.89	3.58	1.82	
Route 2S, Mile 4	(S)	0.56	0.56	0.92	0.68	
						1.19
Near 300 Area						
Route 4S, Mile 16	(S)	0.35	0.42	1.40	0.72	
Route 4S, Mile 22	(S)	0.55	0.56	1.81	0.97	
North Richland, North	(S)	0.49	0.50	0.53	0.51	
North Richland, South	(S)***					
300 Area	(S)	0.38	0.57	0.44	0.46	
						0.66
Outlying						
Richland	(S)	0.47	0.48	0.51	0.49	
Benton City	(S)	0.27	0.34	0.29	0.30	
Pasco	(S)	0.36	0.33	0.77	0.49	
Kennewick	(S)	0.31	0.31	0.75	0.46	
						0.44

*** Discontinued

The average dosage rates measured in the five general areas indicated in Table III were not significantly different from those measured at these same locations earlier in the year. Increases at several locations approached a factor of 2 during June. Fallout from the Nevada test apparently contributed to the increase in dosage although the location where the most significant increases were noted was predominantly downwind of the separation plants. These included Rt. 3, Mile 1, Military Camp PSN 310, and Rt. 4S, Miles 16 and 22. The effect of the fallout did not appear at all stations since many of the monitoring stations were not serviced on the first two days following the fallout because the emphasis of the monitoring program was shifted from the immediate environs to perimeter residential areas and the more remote environs.

The activity density from filterable gross beta particle emitters in the atmosphere was determined from the analysis of air filters which were operated at representative locations for weekly periods. These filters were counted several days after sample removal to allow for the decay of the daughter products of natural airborne particle emitters. Table IV summarizes the results obtained from these measurements during the three month period.

TABLE IV

AVERAGE FILTERABLE BETA PARTICLE EMITTERS IN AIR

APRIL, MAY, JUNE

1953

Activity Density - Units of 10^{-14} μc/cc

Location	April	May	June	Quarterly Average	Weekly Maximum
100 Areas and Vicinity					
100-D	71	120	68	84	160
100-H	58	100	880	370	2600
Hanford 101 Bldg.	27	57	450	190	2000
Hanford 614 Bldg.	16	45	160	77	570
White Bluffs	45	63	400	180	1800
200 Areas and Vicinity					
200 West Tower # 4	85	310	900	440	4000
200 West Redox Area	110	640	870	610	2300
Gable Mountain	54	98	870	360	2400
200 East Tower #15	99	110	190	110	210
200 East Semiworks	1200	67	74	440	3200
PSN 320	18	130	23	63	320
300 Area 614 Bldg.	32	60	440	180	1600
Outlying					
North Richland	20	54	340	140	1400
Pasco	33	36	270	120	1100
Kennewick					
Benton City	7	33	120	56	590
Riverland	35	66	6600	2400	33000

Significant increases in the average activity density from filterable beta particle emitters in air samples were observed at nearly all monitoring locations during this quarter. The increase in activity occurred progressively during the quarter with maximum values being measured during the last few days of May and the first part of June. This trend was related to the series of nuclear explosions performed by the Atomic Energy Commission at the Nevada Proving Ground during the period. Monitoring during the early part of the quarter did not reflect the amount of fallout that was noted during the latter part; maximum measurements noted during the weeks ending May 30 and June 6 represented a period when considerable contamination from the Nevada tests entered the Pacific Northwest with higher concentrations apparently occurring in the immediate environs when rain accompanied the radioactive cloud on the morning of May 26. The results obtained from detailed monitoring during the period when the exceptional fallout occurred may be referred to in a special document covering the incident (HW-28925). The maximum airborne concentrations indicated in Table IV were generally equal to or in excess of the maximum measurement noted for similar monitoring in the Hanford environs during the past twelve months. The value of 3.3×10^{-10} μc/cc observed at the Riverland station was ten times higher than the maximum value measured locally during the past year.

Supplementary evaluations of the activity density from filterable beta particle emitters in the atmosphere were obtained from the analysis of air filters which were removed from the dual counting rate monitors in the environs. Table V summarizes the results obtained from these analyses.

TABLE V

AVERAGE FILTERABLE BETA PARTICLE EMITTERS IN AIR

DUAL UNIT AIR MONITORS

APRIL, MAY, JUNE

1953

Activity Density - Units of 10^{-14} μc/cc

Location	April	May	June	Quarterly Average	Weekly Maximum
200 West Area #1	54	1500	280	600	7000
200 West Area #2	64	400	210	210	1100
200 East Area #1	51	120	410	200	1500
200 East Area #2	39	77	86	67	280
Richland #1	14	50	390	160	1200
Richland #2	28	60	440	180	2000

The data summarized in Table V reflect the same trend as that noted in the air filter results shown in Table IV. In general, the period during which the maximum measurements occurred and the causes associated with the increase in trend noted during the period were identical to those previously discussed.

The number of radioactive particles in the atmosphere was determined by radioautographing air filters which were operated for daily or weekly periods during the quarter. Type K X-ray film was used for the radioautograph and the filtering medium was CWS #6 paper. Tables VI and VII summarize the results of these measurements for locations on and off the project.

TABLE VI

SUMMARY OF PARTICLE DEPOSITION NEAR THE SEPARATION AREAS

APRIL, MAY, JUNE

1953

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

Location	Total Volume of Air Sampled m^3	April	May	June	Present Quarterly Averages	Previous Quarterly Averages
200 East and Vicinity						
2704 Outside	9275	27	98	240	130	15
BY - SE	9287	20	88	190	110	12
BY - NE	9198	28	91	160	99	9.2
"B" Gate	9283	32	110	160	100	11
2701 Outside	9275	39	130	250	150	14
2704 Inside	8242	30	94	90	72	13
221-B	9287	3.8	33	69	38	15
200 West and Vicinity						
2701 Outside	9157	27	110	300	160	20
2722	8145	33	71	1100	440	25
"T" Gate	9292	89	80	410	210	24
222-T Outside	9011	44	110	350	190	42
231	8798	54	50	180	100	38
Redox	8901	42	49	1000	430	35
W Guard Tower	9262	31	97	210	120	21
2701 Inside	9283	29	130	420	210	20
272	9283	16	68	510	220	11
222-T Hall	8965	35	62	160	92	28
222-T Lab.	7851	18	17	190	96	13
222-U Lab.	9151	7.4	14	180	77	9.2
222-U Plant Gate	9286	34	86	530	240	20
Meteorology Tower						
3'	37145	9.5	26	120	58	4.4
50'	34289	4.3	28	33	22	2.7
100'	27232	9.4	30	35	25	3.1
150'	23799	14	39	82	45	4.2
200'	21984	15	40	99	51	4.0
250'	19368	14	35	72	40	5.2
300'	20373	8.7	42	90	47	5.2
350'	20373	14	35	70	40	5.7
400'	13714	22	59	61	47	7.5

TABLE VII

SUMMARY OF PARTICLE DEPOSITION OUTSIDE THE SEPARATION AREAS

APRIL, MAY, JUNE

1953

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

Location	Total Volume of Air Sampled m^3	April	May	June	Present Quarterly Averages	Previous Quarterly Averages
Area Locations						
100-B Area	23824	5.5	24	140	40	1.5
100-D Area	37094	12	65	64	48	2.5
White Bluffs	36975	13	50	82	51	2.5
100-F Area	33592	11	48	55	37	2.8
300 Area	37128	21	74	67	55	13
Hanford 101	37111	12	39	76	45	2.0
Off Area Locations						
Benton City, Wash.	36907	8.3	44	41	32	2.0
Pasco, Wash.	37162	7.5	33	45	30	1.7
Richland, Wash.	37077	24	41	77	49	2.5
Boise, Idaho	9037	86	130	290	170	4.5
Klamath Falls, Ore.	9046	32	76	90	68	3.1
Great Falls, Mont.	8547	28	55	73	52	20
Walla Walla, Wash.	9064	19	110	100	82	5.4
Meacham, Ore.	9754	25	49	42	38	3.4
Lewiston, Idaho	8933	15	120	160	100	3.7
Spokane, Wash.	37150	3.8	63	89	55	2.3
Kennewick, Wash.	9512	2.2	54	90	50	1.5
Yakima, Wash.	24548	1.6	31	75	27	1.0

Approximately one week after the start of a series of test explosions at the Nevada Proving Ground during the latter part of March, the number of radioactive particles in the atmosphere in the Hanford environs started to show considerable fluctuation. Small increases were usually observed at some of the monitoring stations several days after a test detonation. These increases did not appear so significant during the early part of the quarter as those did during the latter part of May and early June; a review of meteorological data by the Synoptic and Experimental Meteorology forces at the Hanford station showed that prior to May 25 the air circulation paths precluded contamination from the Nevada tests reaching Hanford monitoring stations except after traveling distances of several thousand miles. Trajectories on May 25, however, favored the bringing of contamination from the detonation of that date into the immediate environs. Fallout on May 26 tended to be weighted considerably by rainfall which prevailed during the early morning hours on that date. These phenomena account for the lower measurements during April and early May and the higher measurements during late May and early June. Detailed summaries of the wind direction, velocity and rainfall data may be referred to in a related report (HW-28925).

Several air samples were taken over one-half and one hour periods during instances when it appeared that fallout from the Nevada tests was occurring in the environs. The maximum measurements showed a value of 7.1 particles/m^3 during a one-half hour period on the morning of May 26. A comparison of these results with recorded data for that date from constant air monitors showed that the arrival time of significant contamination in the Hanford environs was approximately two hours prior to the period when the initial air filter sample was taken and therefore indicates that the measurement of 7.1 particles/m^3 may not have represented the maximum airborne concentration.

Several of the remote monitoring stations and two local monitoring stations were operated on a daily basis throughout the quarter. The results obtained from these locations show several instances where the number of radioactive particles in the atmosphere was on the order of 1 particle/m^3 over a twenty-four hour period. Graphs and tabular summaries showing the day to day trend of particulate contamination in the atmosphere have been presented in an associated publication (HW-28925).

The activity density of I^{131} in the atmosphere was measured by analyzing caustic scrubber solutions through which an airflow of 2 cfm was passed for daily or weekly intervals. Table VIII summarizes the results obtained from these measurements.

TABLE VIII

AVERAGE ACTIVITY DENSITY OF I^{131} DETECTED IN AIR SCRUBBERS

APRIL, MAY, JUNE

1953

Units of 10^{-12} μc/cc

Location	April	May	June	Quarterly Average	Weekly Maximum
200 Area and Vicinity					
200 ESE	0.3	0.2	0.1	0.2	0.6
200 East Tower #16	0.8	0.6	2.0	1.2	1.5
Gable Mountain	<0.1	<0.1	0.2	0.1	0.6
200 West Area Gate	0.2	0.4	0.2	0.3	0.7
200 West Tower # 4	<0.1	0.1	0.3	0.1	0.7
Semi-Works	0.3	0.3	0.3	0.3	0.6
Redox Area	0.8	0.6	0.5	0.7	2.8
Outlying Areas					
100-H Area	<0.1	<0.1	0.2	<0.1	0.8
300 Area	<0.1	<0.1	0.2	<0.1	0.5
North Richland North	<0.1	<0.1	<0.1	<0.1	0.2
Richland	<0.1	<0.1	0.2	0.1	0.8
Pasco	<0.1	<0.1	0.2	<0.1	0.6
Benton City	<0.1	<0.1	<0.1	<0.1	<0.1

A comparison of the average results summarized in Table VIII with the results of similar measurements obtained during the past six months shows no significant difference in the amount of I^{131} in the atmosphere. A review of data accumulated over the past several years indicates that airborne I^{131} concentrations during this period were among the lowest measured since this type of monitoring was initiated.

Thirty-seven special I^{131} scrubber samples were collected during periods when the atmospheric dilution ratio of the separation areas effluent gases was less than 500:1. Although the bulk of these measurements showed values less than 5×10^{-10} μc/cc several samples showed concentrations on the order of 1×10^{-9} μc/cc. Five samples showed values in excess of 1×10^{-9} μc/cc including a maximum measurement of 1.5×10^{-9} μc/cc. The latter result was obtained in a sample collected 1,000 ft. northeast of the Redox stack when the wind velocity was between 10 and 15 mph. Nearly all positive measurements were obtained within a radius of 1,000 ft. from the 202-S stack.

The activity density of alpha particle emitters in the atmosphere was determined by counting the small air filters which were used for the beta measurements discussed in Table IV. Table IX summarizes the results of these findings.

TABLE IX

GROSS ALPHA PARTICLE EMITTERS IN AIR

APRIL, MAY, JUNE

1953

Activity Density - Units of 10^{-15} μc/cc

Location	Number Samples	Weekly Maximum	Quarterly Average
200 West Tower #4	14	39	15
200 East Semi-Works	9	5	< 4
Gable Mountain	14	41	10
Pasco	14	56	14
300 Area	14	23	11
100-D Area	13	28	12
Benton City	14	46	4
Hanford 614 Bldg.	13	< 4	< 4
White Bluffs	14	38	10
North Richland North	14	20	4
200 West Redox Area	13	38	8
100-H Area	14	43	9
Hanford 101 Bldg.	14	15	5
Riverland	15	30	5
200 East Tower #15	10	37	11
PSN 320	10	< 4	< 4
Dual Unit Monitors			
200 WEC #1	15	15	8
200 WEC #2	15	42	12
200 ESE #1	14	31	5
200 ESE #2	14	10	4
Richland #1	14	29	7
Richland #2	14	16	6

A review of the alpha particle monitoring results propose little fluctuation within the period and in general, the average activity density over the three month period was in very good agreement with that measured during January, February, and March.

Two special air filters were exposed in the smoke which evolved from a fire in the 300 Area burning pit on May 29. The activity density of alpha particle emitters in these samples was 8.7×10^{-12} μc/cc and 4.9×10^{-12} μc/cc.

SECTION IV
RADIOACTIVE CONTAMINATION IN HANFORD WASTES

The magnitude and extent of radioactive contamination in Hanford wastes was determined from the results of over 1500 measurements. Liquid and solid samples were obtained directly from open waste areas at frequencies varying from daily to monthly; these samples were analyzed radiochemically for the activity densities from gross alpha and beta particle emitters. These measurements were supplemented with data obtained from portable instrument surveys around the perimeter of the waste storage areas and over open terrain at various locations on the plant. The results of these findings are summarized for each of the three manufacturing areas.

100 AREA WASTES

Table I summarizes the results obtained from the analysis of daily samples collected from the outlet weir at each of the reactor effluent basins for the activity density from gross beta particle emitters. All samples were analyzed on the day that the sample was collected and the subsequent counting rate was corrected for decay back to the time at which the sample was obtained.

TABLE I
RADIOACTIVE CONTAMINATION IN REACTOR EFFLUENT WATER
DURING PERIODS OF NORMAL OPERATION
APRIL, MAY, JUNE
1953
Activity Density from Gross Beta Particle Emitters
Units of 10^{-3} μc/cc

Location	No. Samples	April		May		June		Quarter	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B Area	98	6.3	4.6	6.0	4.7	5.2	3.9	6.3	4.4
100-C Area	104	5.7	3.8	7.6	5.8	6.0	4.5	7.6	4.5
100-D Area	110	4.9	4.3	4.6	3.5	4.4	3.1	4.9	3.7
100-DR Area	84	6.5	5.3	8.9	5.5	6.1	4.7	8.9	5.1
100-F Area	98	5.7	4.3	5.9	4.1	6.5	5.2	6.5	4.5
100-H Area	62	4.8	4.2	4.9	3.9	4.0	3.0	4.9	3.5

Statistical comparison of the quarterly averages summarized in Table I with the results obtained from similar measurements during the previous quarter show that the average activity density from gross beta particle emitters increased significantly at the 100-C and 100-F areas. The increase noted at the 100-DR area was of questionable significance and fluctuations noted at the remaining areas were not significantly different from those previously measured.

The average activity density of alpha particle emitters in reactor effluent was 5×10^{-9} μc/cc at each retention basin. Trace indications of alpha particle emission were noted at each of the individual basins during some part of the quarter; positive values ranged from 7×10^{-9} μc/cc to 2.2×10^{-8} μc/cc except for one sample collected from the 107-DR basin on April 10 which showed 1.1×10^{-7} μc/cc.

One hundred thirty-two reactor effluent samples were analyzed for uranium. Only six of these samples showed positive activity; all positive values were within the range of 2.0×10^{-9} to 3.8×10^{-9} μc/cc. Two positive values were obtained at the 107-DR basin and at the 107-C basin. Samples from the 107-D and 107-H reactor basins did not show detectable uranium at any time during the quarter.

Thirty-six one gallon samples were analyzed for the activity density of polonium. Eleven of these samples showed the presence of this contaminant with individual measurements in the range of 7.3×10^{-10} to 2.6×10^{-9} μc/cc. Polonium was detected at each one of the effluent basins during some time in the quarter.

Radiochemical analyses of over thirty samples from the various reactor basins for the activity density of plutonium showed only one positive measurement. A sample collected from the outlet of the 107-C reactor on May 19 showed a value of 3×10^{-9} μc/cc.

Radiochemical analyses of ninety-five composite samples collected from the waste sump at the Biology Farm in the 100-F Area for the activity density of I^{131} showed an average of 2.7×10^{-6} μc/cc during the quarter. The maximum measurement which was obtained during April was 1.4×10^{-5} μc I^{131}/cc. These measurements represent a decrease to values nearly one-half of those measured during the first quarter of 1953. Current average and maximum measurements were nearly identical to those measured during the same period in 1952.

Portable instrument surveys were maintained on a monthly basis at each of the burning grounds in the reactor areas. Readings obtained over the ground and ashes with VGM and TGM meters showed no evidence of significant contamination since the counting rates were well within the range of natural background which normally varies from 100 to 200 c/m.

A resurvey of a drainage ditch (see HW-28009) west of the 105-F exclusion zone showed instrument readings ranging from 2000 to 20,000 c/m on April 29. Radiochemical analysis of samples of mud collected from this ditch for beta particle emitters showed values on the order of 2.4×10^{-3} μc/g. Each of these measurements represented an increase over previous findings.

200 AREA WASTES

The results obtained from the radiochemical analysis of liquid and solid samples collected at waste sources in the separation areas are summarized in Table II.

TABLE II

RADIOACTIVE CONTAMINATION IN THE 200 AREA WASTES

APRIL, MAY, JUNE

1953

LIQUID SAMPLES

Location	No. Samples	Uranium + Plutonium* Units of 10^{-8} μc/cc Max.	Uranium + Plutonium* Units of 10^{-8} μc/cc Avg.	Beta Particle Emitters Units of 10^{-7} μc/cc Max.	Beta Particle Emitters Units of 10^{-7} μc/cc Avg.
T-Swamp	38	1.9	< 0.5	120	7.0
U-Swamp	26	42	2.8	15	3.5
Laundry Ditch	26	56	4.5	27	3.7
231 Ditch	26	11	1.3	4.2	0.8
200-E "B" Ditch	42	1.0	< 0.5	40	3.4
200-E "B" Swamp	27	1.1	< 0.5	170	10
234-35 Ditch	13	13	2.0	1.4	0.7
200-E Retention Pond	55	1.2	< 0.5	22	5.6
200-W Retention Pond	39	1.2	< 0.5	150	20
234-5 Retention Pond	5	26	10	1.1	0.5
Redox Swamp	12	75	7	87,000	7,400
Redox Retention Basin	22	3.2	0.7	4,600	320
200-E, 201-C Crib	6	140	29	9,600	2,000

SOLID SAMPLES

		Units of 10^{-6} μc/g		Units of 10^{-5} μc/g	
T-Swamp	26	450	61	200	44
Laundry Ditch	14	49	23	30	18
200-E "B" Ditch	42	5	1	330	31
200-E "B" Swamp	29	7	2	410	61
234-35 Ditch	14	180,000	16,000	22	6
Redox Swamp	13	130	38	230,000	73,000

* The values tabulated in this column in the previous quarterly report of this series (HW-28009, p. 52) were erroneously shown in units of 10^{-9} μc/cc. The true values were in units of 10^{-8} μc/cc, similar to those in this and previous publications of this series.

The activity density of alpha and beta particle emitters measured in 200 Area waste remained on the order of magnitude expected at all locations except the 234-5 ditch and the Redox swamp. Values at these two locations were significantly higher than those measured a year ago and represented a continuation of a trend noted during the past two quarters.

Samples from all waste sources indicated in Table II were analyzed specifically for the activity density of uranium. Locations at which liquid samples showed positive values throughout the quarter included the laundry ditch inlet, laundry ditch at 600', U-swamp inlet, U-swamp West side and Redox retention basin outlet. Average values ranged from 2×10^{-9} μc/cc to 5×10^{-8} μc/cc with a predominance of values on the order of 10^{-8} μc/cc at the laundry ditch locations. The maximum measurement obtained at the 600' location along the laundry ditch showed a value of 5.7×10^{-7} μc/cc. Solid samples collected at the edge of the laundry ditch inlet showed the average activity density from uranium to be 4.4×10^{-5} μc/g including a maximum measurement of 1.2×10^{-4} μc/g. Trace quantities of uranium averaging 1×10^{-5} μc/g were also detected at the T-swamp and Redox swamp.

Portable instrument surveys along the perimeter of the ditches and swamps in the 200 West Area showed counting rates ranging from 200 to 3500 c/m on VGM and TGM meters. The maximum measurements were found over mud at a location 500' from the T-ditch inlet. Counting rates on the order of 2000 c/m were detected around the perimeter of the T-swamp and along the edge of the laundry ditch. Similar surveys at locations in the 200 East Area showed counting rates ranging from 150 to 4000 c/m. During the latter part of May, instrument readings along the B-ditch and around the edge of the B-swamp were 4000 c/m over wet mud.

A ground contamination survey in the region northeast of the Redox swamp on April 16, 1953, showed the majority of instrument readings to be in the range of 200 to 400 c/m; 10 readings showed values between 1000 and 3000 c/m. Estimations indicated that approximately one-half of the counting rates on the latter readings was due to background from the nearby Redox swamp. Readings in the air near the perimeter of the danger zone fence around the swamp were as high as 2000 c/m.

A resurvey (HW-28009) of the area east of the Redox exclusion area on April 23 showed that the ground contamination pattern was comparable to that found on March 27, 1953, with the majority of the instrument readings about one-half as high as those noted previously. The maximum counting rate found during the resurvey was 34,000 c/m.

A ground contamination survey was performed over an area of nearly 13,000 sq. ft. located downwind from the 241-U tank farm in the 200 West Area following a blowout of radioactive liquid waste on April 30. Six isolated locations presented significant instrument readings ranging from 10,000 to 75,000 c/m; values ranging from 6 mrep/hr to 25 mrep/hr were indicated on a CP meter.

On May 5, an area south and west of the 241-S tank farm was surveyed to define any radiation hazards involved in new construction work at this location. Most of the readings were 200 c/m or less, with an occasional maximum of 300 c/m being recorded. A spot check of this same area on May 11, 1953, confirmed the original findings.

An extensive ground survey downwind of the Redox facility was performed on May 11, 1953. The pattern of ground contamination found in the area between the Redox exclusion area fence and the 200 West Area fence was similar to that obtained during the survey performed on April 23, reported above. Approximately 20 locations (one square meter each) reading over 500 c/m were located in the 35,000 square foot area surveyed

outside of the 200 West fence; only five of these read over 5,000 c/m and the maximum was 50,000 c/m on a TGM meter and 2 mrep/hr on a CP meter.

On May 21, an area east of the 234-5 facility was surveyed as a prerequisite to constructing the Recuplex Caw waste facility. The maximum reading obtained in the 5000 square foot area surveyed was 400 c/m with the majority of readings in the range of 100 to 300 c/m. Approximately 30 per cent of the surveyed spots was checked for alpha contamination by means of a portable poppy survey meter. All readings were below the detection limit of this meter (1000 d/m).

Two small areas west of the T. B. P. plant were surveyed on June 9, 1953, preliminary to new construction work. All readings were 300 c/m or less except in the vicinity of posted radiation danger zones. The maximum readings obtained were near the open 241-TX-155 diversion box where readings were 5,000 c/m near the ground and 10,000 c/m three to four feet above the ground.

300 AREA WASTES

Table III summarizes the results obtained from the analysis of liquid and solid samples collected at the 300 Area.

TABLE III

RADIOACTIVE CONTAMINATION IN 300 AREA WASTES

APRIL, MAY, JUNE

1953

Location	No. Samples	Beta Particle Emitters Units of 10^{-7} µc/cc Max.	Beta Particle Emitters Units of 10^{-7} µc/cc Avg.	Alpha Particle Emitters Units of 10^{-8} µc/cc Max.	Alpha Particle Emitters Units of 10^{-8} µc/cc Avg.	Uranium Units of 10^{-6} µc/cc Max.	Uranium Units of 10^{-6} µc/cc Avg.
Old Pond Inlet Liquid	12	17	4.6	280	110	2.6	0.94
New Pond Inlet Liquid	11	6.0	3.3	180	73	2.0	0.70
300 Area Waste Line	66	490	30	3200	310	34	3.0
		Units of 10^{-3} µc/g		Units of 10^{-3} µc/g		Units of 10^{-3} µc/g	
Old Pond Inlet Solid	12	4.7	1.3	3.2	0.72	3.5	0.62
New Pond Inlet Solid	12	5.1	2.9	24	2.4	3.4	1.2

A comparison of the above values with the results of similar measurements obtained during the previous quarter show all values to be within a value of 10 of previous measurements. Considerable variation in the amounts of contamination at these sources has been noted in the past and is largely associated with the varying amounts of material entering the waste ponds at the time the samples were collected. The current values were not significantly different from those measured during the past several months.

Radiochemical analysis of 68 samples collected directly from the 300 Area waste line showed the average activity density from plutonium to be 1.7×10^{-8} µc/cc. The maximum measurement was 1.7×10^{-7} µc/cc.

SECTION V
RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER

The amount of radioactive contamination in the Columbia River resulting from the addition of reactor cooling water from the six reactors was determined by the radiochemical analysis of nearly 500 river samples for the activity density of gross beta and gross alpha particle emitters. Samples were obtained at least once each week from twenty-two locations between the reactor areas and Patterson; these measurements were supplemented with the results obtained from monthly samples collected at ten selected locations between McNary Dam and Portland. Daily samples were collected from a control location directly below the reactor areas and evaluations of natural emitters were based on samples collected from a location upstream from the first reactor area. Similar measurements were obtained from the Snake and Yakima Rivers which enter the Columbia in the nearby environs. Table I summarizes the results obtained from the analysis of samples collected in the immediate environs for the activity density of gross beta particle emitters.

TABLE I

AVERAGE CONTAMINATION FROM GROSS BETA PARTICLE EMITTERS IN THE COLUMBIA RIVER

APRIL, MAY, JUNE

1953

Units of 10^{-8} μc/cc

Location	April Avg.	May Avg.	June Avg.	Quarter Avg.	Last Quarter Avg.	Maximum This Quarter
Wills Ranch	< 5	< 5	< 5	< 5	< 5	7
181-B Area	7	< 5	9	7	< 5	23
181-C Area	9	30	21	19	10	110
Allard Station	120	61	16	75	320	240
181-D Area	380	300	110	260	530	810
181-H Area	510	240	150	300	900	840
Below 100-H Area	590	440	240	460	550	1200
181-F Area	650	460	660	590	950	1400
Below 100-F Area	1200	830	200	830	1100	2100
Hanford South Bank	1100	830	320	740	940	1900
Hanford Middle	430	350	140	360	780	640
Hanford North Bank	260	180	26	190	480	300
300 Area	360	330	130	290	370	550
Richland	330	220	130	230	440	570
Kennewick Highlands Pumping Station	260	190	110	190	320	340
Pasco Bridge (Kennewick Side)	260	140	120	170	260	340
Pasco Bridge (Pasco Side)	270	200	140	210	340	340
Sacajawea Park	150	92	180	140	160	570
McNary Dam #1	84	28	32	51	76	120
McNary Dam #2	79	33	28	47	79	110
Patterson	58	17	32	37	70	85
Snake River at Mouth	< 5	10	30	15	13	91
Yakima River at Prosser	< 5	< 5	< 5	< 5	< 5	77
Yakima River at Mouth	6	< 5	44	18	< 5	200

Expected seasonal decreases in the average activity density of gross beta particle emitters in Columbia River water were observed at all monitoring locations shown in Table I. Increased dilution of reactor effluent caused by the increasing flow rate of the Columbia River during this period was largely responsible for this decrease. The average flow rate of the river over the three month period was 1,311,000 gallons per second as compared with an average flow rate of only 547,000 gallons per second during the previous quarter. Average flow rates during April, May, and June were 708,000, 808,000, and 2,480,000 gallons per second, respectively. Maximum flow measured on June 19 was 3,400,000 gallons per second and minimum flow measured on May 3 was 600,000 gallons per second. As expected, the maximum measurements indicated in Table I were found during the latter part of April and early part of May when the flow rate of the Columbia River was lowest. A graph showing the trend of the measured flow rate during the first six months of 1953 may be referred to in Figure 6.

A comparison of these measurements with similar data collected during the same period in 1952 shows that the average values at many of the locations were higher during 1953. These differences were caused by the lower average flow rate of the Columbia River in 1953 and by a general increase in reactor power levels during the past year. The operation of an additional reactor at the 100-C Area contributed significantly to the increase in activity density noted during the present period over that a year ago.

The activity density of beta particle emitters in Columbia River water at remote downstream locations was determined once each month at Arlington, Oregon; Maryhill Ferry, (Oregon side); Celilo Falls, Oregon; The Dalles, Oregon; Hood River, Oregon; Cascade Locks, Oregon; Troutdale, Oregon; Stevenson, Washington; Bonneville, Washington; and Portland, Oregon. The activity density decreased as distance from Hanford increased with the range of individual values during the months of April,

May, and June being $< 5 \times 10^{-8}$ to 1.7×10^{-7} μc/cc, $< 5 \times 10^{-8}$ to 5×10^{-8} μc/cc, and $< 5 \times 10^{-8}$ to 1.3×10^{-7} μc/cc, respectively. Maximum measurements were always found in the Arlington-Maryhill area; trace activity on the order of 6×10^{-8} μc/cc was measured in the Portland-Troutdale area during April but was not detected during May and June. Analyses of the same samples for the activity density of alpha particle emitters showed negligible emission from these emitters in all samples analyzed.

All samples collected from the locations indicated in Table I were also analyzed for the activity density of gross alpha particle emitters. Average values were below the detection limit of 5×10^{-9} μc/cc in all cases; five of the samples showed trace contamination with the values ranging from 6×10^{-9} μc/cc to 1.2×10^{-8} μc/cc. Little significance was attached to the individual positive values since they represented random locations and the positive values occurred at widely spaced intervals during the period.

Average values obtained from the analysis of weekly samples collected from the upstream Columbia, Yakima, and Snake Rivers for purposes of evaluating the activity density of natural occurring alpha and beta particle emitters showed values below the respective detection limits of 5×10^{-9} μc/cc and 5×10^{-8} μc/cc in all cases.

The amount of radioactive contamination deposited by waters of the Columbia River was determined from the radiochemical analyses of mud samples collected each week from fourteen locations between the reactors and Patterson. Samples were collected from an underwater location approximately 5' from the water's edge and also from a location at the point where the water joined the shore. The results obtained from the beta particle measurements are summarized in Table II.

TABLE II

RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER MUD SAMPLES

APRIL, MAY, JUNE

1953

Beta Particle Emitters - Units of 10^{-5} μc/gram

Location	April Avg.	May Avg.	June Avg.	Quarter Avg.	Last Quarter Avg.	Maximum This Quarter
Wills Ranch						
Shore	3.2	3.1	3.1	3.1	3.5	6.3
5' Out	3.1	3.0	3.0	3.0	3.0	4.9
Allard Station						
Shore	5.7	5.0	5.6	5.4	11	10
5' Out	9.8	3.1	3.5	6.0	13	31
100-H Area						
Shore	9.2	3.9	10	7.7	5.1	24
5' Out	8.5	3.1	5.8	6.0	6.6	26
Below 100-F						
Shore	7.5	5.5	5.8	6.5	9.7	9.7
5' Out	9.4	5.7	8.2	8.0	9.8	14
Hanford Ferry						
Shore	4.5	9.5	3.5	5.6	13	13
5' Out	7.9	11	3.6	7.4	11	19
300 Area						
Short	39	6.3	8.4	21	13	180
5' Out	5.0	4.8	280	74	11	840
Byers Landing						
Shore	2.6	3.2	5.5	3.8	3.1	5.5
5' Out						
Richland Dock						
Shore	4.6	7.3	4.9	5.5	6.4	17
5' Out	7.9	7.9	5.5	7.0	14	19
Kennewick Highland Pump Plant						
Shore	3.2	2.6	5.4	3.8	4.4	13
5' Out	6.5	4.6	5.6	5.6	5.5	12
PK Bridge (Pasco)						
Shore	2.4	2.0	4.4	2.6	3.4	5.1
5' Out	5.0	2.7	4.0	4.0	3.2	8.6

TABLE II (contd.)

Beta Particle Emitters - Units of 10^{-5} μc/gram

Location	April Avg.	May Avg.	June Avg.	Quarter Avg.	Last Quarter Avg.	Maximum This Quarter
PK Bridge (Kennewick)						
Shore	2.7	2.7	3.5	2.9	3.6	4.0
5' Out	3.1	4.7	2.6	3.7	5.2	8.1
Sacajawea Park						
5' Out	4.2	6.4	12	7.4	11	16
McNary Dam						
5' Out	2.3	3.0	2.9	2.7	4.3	4.2
Patterson						
5' Out	3.8	3.8	3.4	3.7	3.6	5.2
Snake River Mouth						
5' Out	2.9	3.1	4.4	3.5	3.0	8.8
Yakima River Horn						
Shore	2.3	2.3	4.0	2.9	2.4	6.7
5' Out	2.2	2.5	3.8	2.9	2.3	6.3
Yakima River Prosser						
5' Out	2.2	2.5	4.7	3.1	3.1	7.8

A comparison of the measurements summarized in Table II with the results of similar measurements obtained during the previous quarter shows that the only location at which a significant change occurred was adjacent to the 300 Area. An increase from a previous average of 1.1×10^{-4} μc/g to a value of 7.4×10^{-4} μc/g at this location was largely weighted by the results obtained from one sample which showed a value of 2.8×10^{-3} μc/g. The high measurement was not confirmed by resamples from the same location nor by samples collected from downstream locations during the same week that the high measurement was detected. Deletion of the value of 2.8×10^{-3} μc/g from the over all data would cause the average at the 300 Area location to decrease to 5×10^{-5} μc/g, a value which would be comparable to the average value of 1.1×10^{-4} μc/g observed during the previous quarter.

The majority of mud samples collected from the locations indicated in Table II was also analyzed for the activity density of gross alpha particle emitters. Although eleven of the locations showed average values above the individual sample detection limit of 1×10^{-6} μc/g, only two locations showed an average value which was significantly different from the detection limit. The activity density averaged 1.9×10^{-5} μc/g at the underwater location adjacent to the 300 Area and averaged 1.1×10^{-5} μc/g on the shore at Kennewick. The remaining values ranged from 1×10^{-6} to 2.8×10^{-6} μc/g. Each of the two significant average values was weighted considerably by one high result; one sample from the 300 Area location showed a value of 2.4×10^{-3} μc/g and one sample from the Kennewick location showed a value of 7.3×10^{-5} μc/g. Again deletion of the individual high measurements from the over all data would cause a reduction in the average values to a figure which would be comparable to that measured during the first quarter of 1953.

The activity density of alpha and beta particle emitters in raw water was determined by the analysis of weekly samples collected directly from the raw water river export line where water enters the 183 and 283 buildings in the reactor and separation areas. Table III summarizes the results obtained from the beta measurements during the quarter.

TABLE III

RADIOACTIVE CONTAMINATION IN RAW WATER

RIVER EXPORT LINE

APRIL, MAY, JUNE

1953

Beta Particle Emitters - Units of 10^{-8} μc/cc

Location	April Avg.	May Avg.	June Avg.	Quarter Avg.	Last Quarter Avg.	Maximum This Quarter
183 Bldg. 100-B Area	< 5	< 5	< 5	< 5	< 5	6
183 Bldg. 100-C Area	< 5	< 5	< 5	< 5	< 5	6
183 Bldg. 100-D Area	22	7	7	12	61	41
183 Bldg. 100-DR Area	25	7	10	13	76	35
183 Bldg. 100-H Area	35	17	16	22	120	47
183 Bldg. 100-F Area	42	29	23	32	78	76
283 Bldg. 200-E Area	20	8	6	12	36	29
283 Bldg. 200-W Area	20	< 5	< 5	< 7	76	32

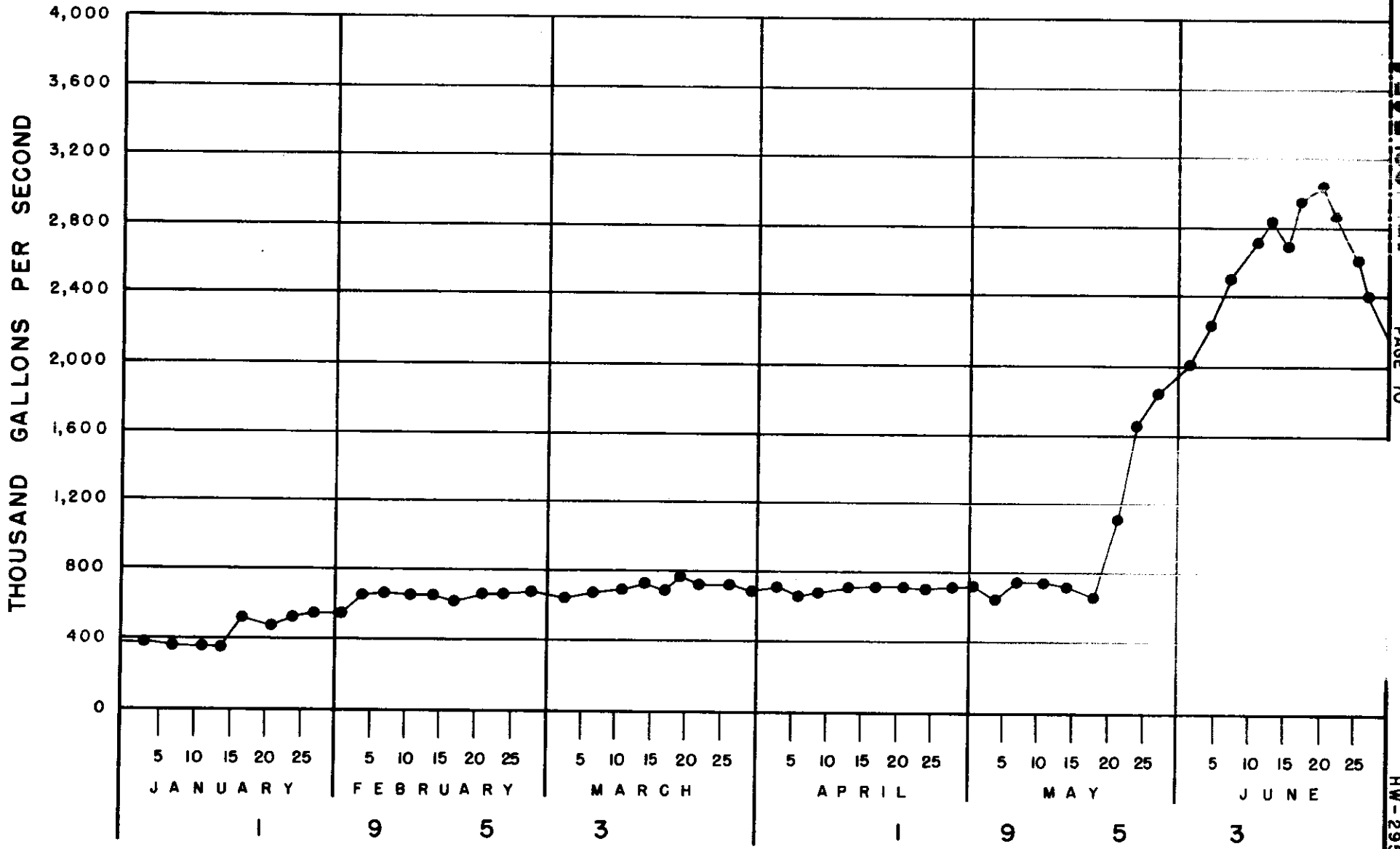
Decreases in average activity density to values on the order of one-third to one-fifth of previous measurements were caused by the progressive increase in the flow rate of the Columbia River during the period (Figure 6). Since this water is pumped directly from the Columbia River, the decrease in activity was expected during this period and in general was on the order of magnitude observed in the seasonal fluctuation during previous years. The average activity density of alpha particle emitters in this same water was less than 5×10^{-9} μc/cc at all areas except 100-B which showed an average of 7×10^{-9} μc/cc. This positive average was caused by three samples which showed values above the detection limit of 5×10^{-9} μc/cc; positive individual measurements were 8×10^{-9} μc/cc, 6×10^{-9} μc/cc, and 7.2×10^{-8} μc/cc. The last measurement was found on May 14, and although it was considerably higher than values normally found for this analysis, there was no related incident with which to associate the increase. A sample collected from this same location during the following week showed a value less than 5×10^{-9} μc/cc.

COLUMBIA RIVER FLOW

APRIL — MAY — JUNE

1953

FIGURE — 6



SECTION VI
RADIOACTIVE CONTAMINATION IN RAIN

Almost 300 rain samples were collected from locations in the Hanford environs during the period April, May, and June, 1953. The bulk of these samples was collected at 27 scattered locations in the immediate environs; approximately 50 samples were collected from remote locations during the latter part of May when significant radioactive particle fallout was measured in the Pacific Northwest. The amount of precipitation occurring during the quarter allowed representative monitoring over the three month period. A summary of rainfall data as measured at the Meteorology Station near the separation areas is presented in Table I; similar data for the previous three years are included for comparison.

TABLE I
PRECIPITATION MEASURED AT METEOROLOGY STATION
APRIL, MAY, JUNE

Units - Inches

Year	April	May	June	Quarterly Total
1950	0.47	0.27	2.92	3.66
1951	0.53	0.43	1.38	2.34
1952	0.13	0.58	1.07	1.78
1953	0.77	0.28	0.55	1.60

A summary of the results obtained from the radiochemical analysis of rain samples collected from environmental locations for the activity density of gross beta particle emitters is presented in Table II.

TABLE II

ACTIVITY DENSITY OF GROSS BETA PARTICLE EMITTERS IN RAIN

APRIL, MAY, JUNE

1953

Location	Number Samples	Units of 10^{-6} µc/cc Maximum	Average
In 200 East Area	27	2100	230
250' East of stack	9	2100	300
2000' East of stack	7	1900	280
750' SE of stack	3	4	2
3500' SE of stack	8	1500	200
In 200 West Area	41	1000	110
1000' E of stack	9	830	95
7000' E of stack	10	150	20
8000' SE of stack	9	1000	190
4900' SE of stack	8	880	110
Redox Area	5	570	140
100 Area Environs	63	1800	68
100-B SE	10	1800	180
100-D SW	11	80	15
100-F SW	7	150	22
Hanford 614	10	19	3
Hanford 101	10	270	29
White Bluffs	9	1500	160
100-H SW	6	380	64
Perimeter Locations	45	4900	310
Richland	9	120	26
Pasco-Kennewick	10	4900	880
Benton City	11	3000	290
Riverland	8	1600	200
North Richland North	7	140	26

TABLE II (contd.)

Location	Number Samples	Units of 10^{-6} µc/cc Maximum	Average
Intermediate Locations	68	99000	2000
Route 4S, Mile 6	8	27	5
300 Area 614	11	99000	9000
200 North 614	8	2800	350
Gable Mountain	5	2	1
Batch Plant	7	550	81
622 Building	19	910	94
Rt. 4S, Mile 17	1		1200
Rt. 2S, Mile 5	1		3600
Rt. 1, Mile 0	1		1700
Rt. 1, Mile 5	1		8100
Rt. 1, Mile 9	1		1100
Rt. 11 A, Mile 15	1		5300
Rt. 11 A, Mile 10	1		5900
Rt. 4S, Mile 0	1		910
Rt. 11A, Mile 5.5	1		520
Rt. 2 No., Mile 10	1		1600

The average and maximum activity density of beta particle emitters measured in rainfall increased significantly during this period. A comparison of results summarized in Table II with the results of similar measurements obtained during the previous quarter and during the same period in 1952 shows that most of the current average values were from 10 to 1,000 times greater than those normally expected. This increase was caused by the high contamination levels in the environs on the morning of May 26 when fallout from the Nevada nuclear explosion tests accompanied an early morning rain (HW-28925). Nearly all maximum values indicated in Table II were measured on May 26. Deletion of these exceptionally high values from the data summarized in Table II would result in decreasing the activity density of beta particle emitters in rainfall to an order of magnitude comparable to that measured during the latter part of 1952 and early

part of 1953. Additional detailed discussion along with estimated iso-activity deposition patterns, resulting from the incident on May 26, may be referred to in an associated publication (HW-28925).

Coincident with the finding of the higher values discussed above, the Regional Survey rain monitoring program was extended to include a wider area over the Pacific Northwest. Rain samples were collected as available from locations in an area bounded by Yakima, Ellensburg, Spokane, Lewiston, and Pendleton. These results are summarized in Table III.

TABLE III

ACTIVITY DENSITY OF GROSS BETA PARTICLE EMITTERS IN RAIN AT OFF-AREA LOCATIONS

MAY 26, 1953

Location	Units of 10^{-6} μc/cc
300 Area to Kennewick	
Mile 0	1800
5	5500
10	4500
15	1300
Benton City to Prosser	
Mile 0	540
5	2500
10	360
Prosser to Patterson	
Mile 5	280
10	1300
15	260
20	1100
Near Patterson	880
Plymouth	14
McNary Dam	21

TABLE III (contd.)

Location	Units of 10^{-6} μc/cc
Western Washington	
Union Gap to Sunnyside, Mile 25	150
Sunnyside North	1000
Sunnyside to Prosser, Mile 5	1200
Prosser	300
Prosser	250
Prosser	640
Union Gap	69
Ellensburg	40
5 Miles East of Vantage	200
Eastern Washington and Northern Oregon	
Ritzville	320
North Sprague	200
West Spokane	8
Ellensburg	20
Pasco to Connell, Mile 5	3700
Lewiston	180
Lewiston (Drainage from Roof)	94
6 Miles West Oregon State Line on US # 395	190
Wallula RR Station	2100
Walla Walla River	510
Junction Highways # 395 and 730	330
5 Miles So. of Junction Highways # 730 and 395	570
Creek Water Cold Creek	86
26 Miles South of Junction on Highways # 730 and 395	82
Pendleton	42
Pendleton to Louden Mile 15	900
Pendleton to Louden Mile 20	430
Creek Water Mile 25 Pendleton to Louden	170
Mile 35 Pendleton to Louden	190
Louden	1100

Although the order of magnitude of the activity density of beta particle emitters in rain at remote locations was comparable to that found in the immediate environs, considerable fluctuation was noted between results which represented adjacent locations. This fluctuation was largely associated with sample availability and with the amount of precipitation at the sampling location. Some of the samples represented water shed from roofs and, in isolated cases, samples were taken from roadside ditches.

A number of the evaporated rain samples were radioautographed according to standard techniques (Section III) to determine the number of radioactive particles collected in rain. Samples which represented rainfall other than that associated with the fallout on May 26 showed concentrations consistent with previous findings with less than 5 particles per weekly sample in all cases; samples collected on May 26 showed significant numbers of radioactive particles with the bulk of the values ranging from 25 to 75 particles per weekly sample. The evaporated samples which were radioautographed represented volumes of water varying from several to 500 ml.

Several mud samples were collected on May 26 at locations where visual examination indicated that considerable amounts of rain had accumulated prior to sample collection. Table IV summarizes the results obtained from the analysis of these samples for the activity density of gross alpha and gross beta particle emitters.

TABLE IV

RADIOACTIVE CONTAMINATION IN MUD

OFF-AREA SURVEY

May 26, 1953

Units of 10^{-6} μc/g

Location	Beta Particle Emitters	Alpha Particle Emitters
20 Miles south of Jct. 730 and 395	1300	0.3
Pendleton	730	0.5
Within 5 Miles radius of Pendleton	160	0.3
Within 35 Miles radius of Pendleton	1200	0.3
Ritzville	7300	

Contamination from beta particle emitters in mud was several hundred times greater than that normally found in the immediate Hanford environs; the activity density from alpha particle emitters in the same material was negligible in all samples and the amounts detected were comparable to that found in the Hanford environs.

SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER SUPPLIES AND TEST WELLS

Nearly 1200 samples were collected from the Hanford environs for purposes of determining the activity density of alpha and beta particle emitters in drinking water supplies and test wells. Selected samples were also analyzed specifically for the activity density of uranium and/or plutonium. Over 1,000 samples represented drinking water sources and the remaining samples represented wells which were not used as sources of drinking water. The volume of the majority of these samples was 500 ml; 11.7 liter samples were collected from locations at which it appeared desirable to increase the sensitivity of the measurement. The smaller samples were used for alpha and beta determinations whereas the larger volumes were used only for the alpha particle measurements.

Table I summarizes the results obtained for locations where the average activity density from alpha particle emitters exceeded the individual sample detection limit of 5×10^{-9} μc/cc during the three month period.

TABLE I

CONTAMINATION FROM ALPHA PARTICLE EMITTERS IN DRINKING WATER

APRIL, MAY, JUNE

1953

500 ml samples

Location	Alpha Particle Emitters			Uranium		
	No. Samples	Units of 10^{-9} μc/cc Max.	Avg.	No. Samples	Units of 10^{-9} μc/cc Max.	Avg.
Richland Well #2	12	55	17	17	6	4
Richland Well #4	62	21	5	50	8	4
Richland Well #12	16	11	5	12	6	4
Richland Well #15	16	80	9	12	5	3
Richland Well #18	16	73	8	16	6	3
Riverland	14	120	10	--	-	..
Benton City Store	14	14	9	14	9	6
Benton City Water Co. Well	13	21	12	12	10	8
Sacajawea Park	14	9	6	14	8	5

Comparison of the results summarized in Table I with the results of similar measurements obtained during the previous quarter and during the same period a year ago shows that the locations at which significant alpha particle emission was detected were nearly all those where it had been detected in the past. The quantities of alpha particle emission measured in wells of the Richland and Benton City areas were on the order of magnitude expected. Again, trace amounts of uranium were found in nearly every sample which showed significant alpha emission. Several samples of water from Benton City drinking water supplies were analyzed for radon; preliminary evaluation of these data confirms earlier measurements (HW-18321) wherein radon was found indicating the presence of uranium in its natural state in the water table below the Richland-Benton City area.

Trace quantities of alpha particle emitters were detected in many individual samples which were collected from locations other than those shown in Table I. In most cases, the activity density was on the order of 10^{-9} μc/cc and except for random instances, subsequent samples did not confirm the magnitude of activity detected in the initial measurement. Table II summarizes all results obtained from the radiochemical analysis of 500 ml samples at all drinking water supplies sampled during the three month period.

TABLE II

SUMMARY OF ALPHA AND BETA PARTICLE EMITTERS MEASURED IN WATER SUPPLIES

APRIL, MAY, JUNE

1953

500 ml Samples

		Alpha Particle Emitters		Beta Particle Emitters	
		Units of 10^{-9} μc/cc		Units of 10^{-8} μc/cc	
Location	Samples	Max.	Avg.	Max.	Avg.
Richland Well #2	12	55	17	5	1
Richland Well #4	62	21	5	51	3
Richland Well #5	14	22	4	9	2
Richland Well #12	16	11	5	17	2
Richland Well #13	13	7	4	9	7
Richland Well #14	15	12	4	17	3
Richland Well #15	16	80	9	8	2
Richland Well #18	16	73	8	6	2
Tract House J-685	12	3	< 2	2	< 1
3000 Area Well A	13	4	< 2	5	1
3000 Area Well B	12	8	2	5	1
3000 Area Well C	12	8	2	18	2
3000 Area Well D	12	7	2	13	3
3000 Area Well E	13	6	< 2	4	< 1
Durand Well #5	10	3	< 2	2	< 1
Columbia Field Well A	13	2	< 2	6	2
Columbia Field Well B	13	9	< 2	2	< 1

[redacted]

TABLE II (contd.)

Location	Samples	Alpha Particle Emitters Units of 10^{-9} µc/cc Max.	Alpha Particle Emitters Units of 10^{-9} µc/cc Avg.	Beta Particle Emitters Units of 10^{-8} µc/cc Max.	Beta Particle Emitters Units of 10^{-8} µc/cc Avg.
Columbia Field Well C	13	< 2	< 2	4	1
Hanford Well #4	12	5	2	42	6
Headgate Well	14	6	< 2	39	6
1100 Area Well #8	15	16	4	5	2
Midway	14	5	< 2	5	< 1
Riverland	14	120	10	7	2
Lower Knob	13	24	4	6	2
Wills Ranch	14	11	< 2	3	1
Pistol Range	14	5	< 2	10	3
White Bluffs Fire Hall	13	11	3	13	6
White Bluffs Telephone Exchange	6	4	2	12	6
Benton City Store	14	14	9	44	5
Benton City Water Co.	13	21	12	5	1
Kiona	13	6	2	9	1
Enterprise	13	3	< 2	4	1
Kennewick Standard Station	13	9	< 2	32	11
Hanford Well #7	15	3	< 2	16	3
100-B Sanitary	14	2	< 2	10	2
100-C Sanitary	14	3	< 2	3	< 1
100-D Sanitary	15	2	< 2	38	9
100-DR Sanitary	14	2	< 2	14	6
100-H Sanitary	14	2	< 2	12	5
100-F Sanitary	14	3	< 2	42	12
100-K Area Well #1	13	4	< 2	11	3
200-E Sanitary	13	2	< 2	12	4
200-W Sanitary	14	5	< 2	25	5
300 Area	12	4	< 2	3	< 1
251 Building	14	2	< 2	10	1
Byers Landing	3	3	2	5	3
Redox Ad. Building	15	15	2	130	12
Sacajawea Park	14	9	6	2	< 1
McNary Dam	12	< 2	< 2	5	1
Patterson	12	7	2	1	< 1
Plymouth	13	3	< 2	6	< 1
Prosser	13	< 2	< 2	9	2
Pasco Improvement Farm	3	6	3	2	1
Pasco Sanitary	14	< 2	< 2	140	34

Drinking water supplies at which the 500 ml samples showed alpha particle emission to be of questionable significance, were also sampled using a larger volume (11.7 liters) to increase the sensitivity of the individual detection limit from 5×10^{-9} μc/cc to 2×10^{-10} μc/cc. Several locations from which past data indicated periodic positive measurements were also sampled on a repetitive basis using the larger volume samples. Table III summarizes the results obtained from these measurements.

TABLE III

ACTIVITY DENSITY FROM ALPHA PARTICLE EMITTERS

MEASURED IN DRINKING WATER

APRIL, MAY, JUNE

1953

11.7 liter samples

Location	Number Samples	Units of 10^{-10} µc/cc Maximum	Average
Richland Well #2	7	36	13
Richland Well #4	9	46	19
Richland Well #5	6	27	15
Richland Well #12	6	29	17
Richland Well #13	6	24	20
Richland Well #14	7	20	15
Richland Well #15	5	35	21
Richland Well #18	6	18	12
Tract House #J-685	7	12	7
Columbia Field Well A	4	10	6
Columbia Field Well B	6	13	8
Columbia Field Well C	6	14	6
1100 Area Well #8	7	16	11
3000 Area Well A	7	11	8
3000 Area Well B	7	10	6
3000 Area Well C	6	10	7
3000 Area Well D	6	20	8
3000 Area Well E	7	13	7
3000 Area Durand #5	7	13	7
Benton City Store	7	63	42
Benton City Water Co.	6	92	53
Kiona	7	14	10
Enterprise Well	6	5	3
Headgate Well	6	9	4
Kennewick Standard Station	6	6	4
Riverland	5	4	3
Midway	7	5	3
Lower Knob	7	3	< 2
Wills Ranch	7	8	4
Hanford Well #4	5	11	9
White Bluffs Fire Hall	7	23	10
Pistol Range	7	62	16
B-Y Well	1	8	8
McGee Well	7	2	< 2
Ford Well	4	4	< 2
251 Building	2	2	< 2
3000 Pond Inlet (Raw Water)	7	14	6
Meeker Well	6	< 2	< 2

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The results summarized in Table III were not indicative of a significant departure from previously measured values.

The activity density of gross beta particle emitters in drinking water was determined by radiochemical analysis of all samples collected from locations shown in Table II. A complete tabulation of average and maximum measurements is presented in Table II. In general, the only drinking water supplies which showed the average activity density from these emitters to exceed 5×10^{-8} μc/cc were those which used the Columbia river as an initial source of water. Significant decreases in the number of wells which showed significant contamination and in the concentrations of active material detected in those wells which showed positive results were associated with increased dilution caused by a rise in the average flow rate of the Columbia river from 547,000 gallons per second during the first three months of 1953 to a current average of 1,311,000 gallons per second. This occurrence is seasonal and the change in the order of magnitude of the beta particle activity measurements is in agreement with the findings during previous years.

Several spot samples collected from remote locations in eastern and western Washington and in northern Oregon were analyzed for the activity density of alpha and beta particle emitters. Radiochemical analyses showed values below the detection limits of those measurements in all samples analyzed.

The results obtained from the radiochemical analysis of various types of samples collected at the Pasco filter plant are summarized in Table IV.

TABLE IV

RADIOACTIVE CONTAMINATION MEASURED AT PASCO FILTER PLANT

APRIL, MAY, JUNE

1953

Type Samples	No. Samples	Activity Density Gross Beta Particle Emitters	
		Maximum	Average
Water Entering Plant from River	14	3.4×10^{-6} μc/cc	2.1×10^{-6} μc/cc
Sand (Surface of sand filter)	12	1.9×10^{-4} μc/gm	7.3×10^{-5} μc/gm
First Backwash Material (liquid)	12	1.6×10^{-6} μc/cc	4.3×10^{-7} μc/cc
First Backwash Material (solid)	12	3.6×10^{-2} μc/gm	1.7×10^{-2} μc/gm
Coal (Surface of coal filter)	11	2.3×10^{-4} μc/gm	1.0×10^{-4} μc/gm
First Backwash Material (liquid)	10	1.3×10^{-6} μc/cc	3.6×10^{-7} μc/cc
First Backwash Material (solid)	10	3.3×10^{-2} μc/gm	1.9×10^{-2} μc/gm
Water Leaving Plant	14	1.4×10^{-6} μc/cc	3.4×10^{-7} μc/cc

General decreases in the activity density of gross beta particle emitters in the samples collected at the filter plant were directly associated with the increased flow rate of the Columbia river during this period (Section V). The average values were approximately one quarter to one half of those measured during the first quarter of 1953; individual measurements show that maximum activity was measured during the early part of April when the flow rate of the Columbia River was the lowest measured during this quarter. Again, the trend in the above data was expected and was consistent with observations found during this same period in 1951 and 1952.

Spot samples of foam-like material collected from the surface of the sand and coal filters showed an average activity density of beta particle emitters on the order of 1.3×10^{-2} μc/g. Maximum measurements obtained from samples taken from the surface of the sand filter showed 2.6×10^{-2} μc/g.

Twenty-seven samples collected from various parts of the filtration process were analyzed for the activity density of alpha particle emitters.

The only sample which showed positive activity was collected from the washings of the first backwash step at the coal filter; the solid portion of these washings showed 9×10^{-6} μc/g.

Spot samples collected from different stages in the filtration process were analyzed specifically for uranium and plutonium. The results from these measurements were below the detection limit of the analyses in all cases.

One hundred fifty samples were collected from various test wells in the environs during the quarter. Table V summarizes the results obtained at locations where the average activity density from alpha or beta particle emitters exceeded the detection limit of the analyses.

TABLE V

SUMMARY OF ALPHA AND BETA PARTICLE EMITTERS

MEASURED IN TEST WELLS

APRIL, MAY, JUNE

1953

500 ml Samples

Location	No. Samples	Alpha Particle Emitters Units of 10^{-9} μc/cc Maximum	Alpha Particle Emitters Units of 10^{-9} μc/cc Average	Beta Particle Emitters Units of 10^{-8} μc/cc Maximum	Beta Particle Emitters Units of 10^{-8} μc/cc Average
300 Area Well #1	14	320	36	13	< 5
300 Area Well #3	27	300	100	88	6
300 Area Well #4	12	600	200	11	< 5
300 North Area Well	4	1200	1000	17	8

In addition to those locations shown in Table V, several of the test wells drilled by Geology during the past several years showed trace beta contamination in individual samples. Since these wells are sampled only once per quarter, the significance of the positive measurements was minimized. The activity density at the nine wells which showed positive measurements ranged from 8×10^{-8} μc/cc to 1.5×10^{-6} μc/cc. Trace alpha particle emission was detected in three of the Geology wells which showed values of 6×10^{-9}, 1.5×10^{-8}, and 5.6×10^{-8} μc/cc.

Test wells which showed significant amounts of uranium were confined to the 300 Area. Average values at 300 Area wells #1, #3, and #4 were 3.2×10^{-8}, 1.1×10^{-7}, and 1.6×10^{-7} μc/cc, respectively. The maximum uranium measurement was obtained at well #4 in a sample which showed 3.8×10^{-7} μc/cc. Two samples from the 300 North Area well showed the activity density of uranium to be 6.3×10^{-7} and 6.9×10^{-7} μc/cc.

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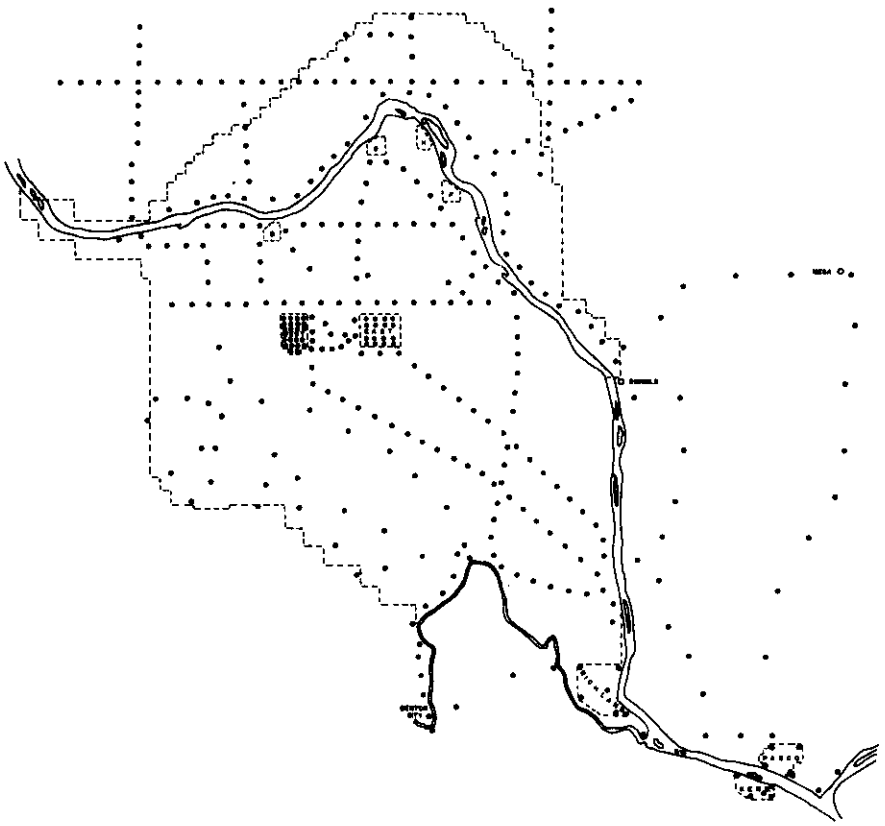
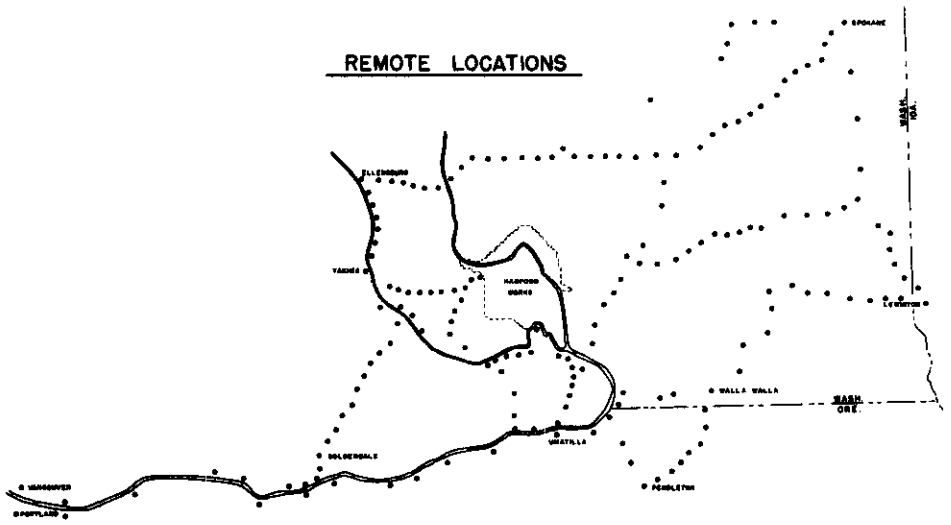
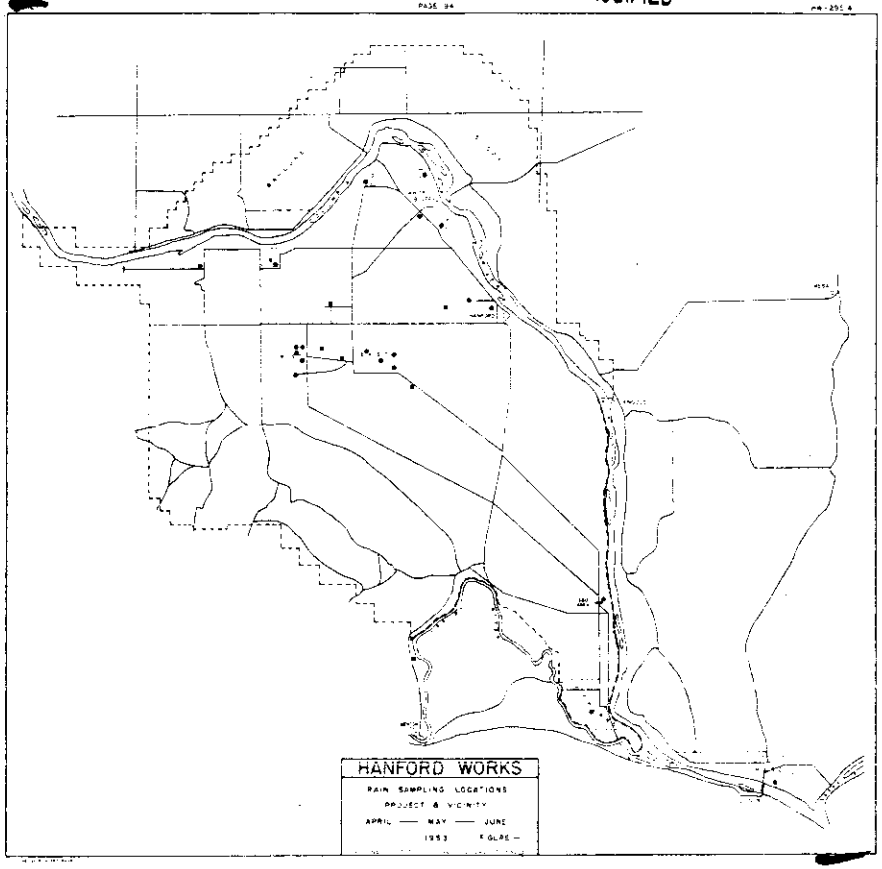
VEGETATION SAMPLING LOCATIONS

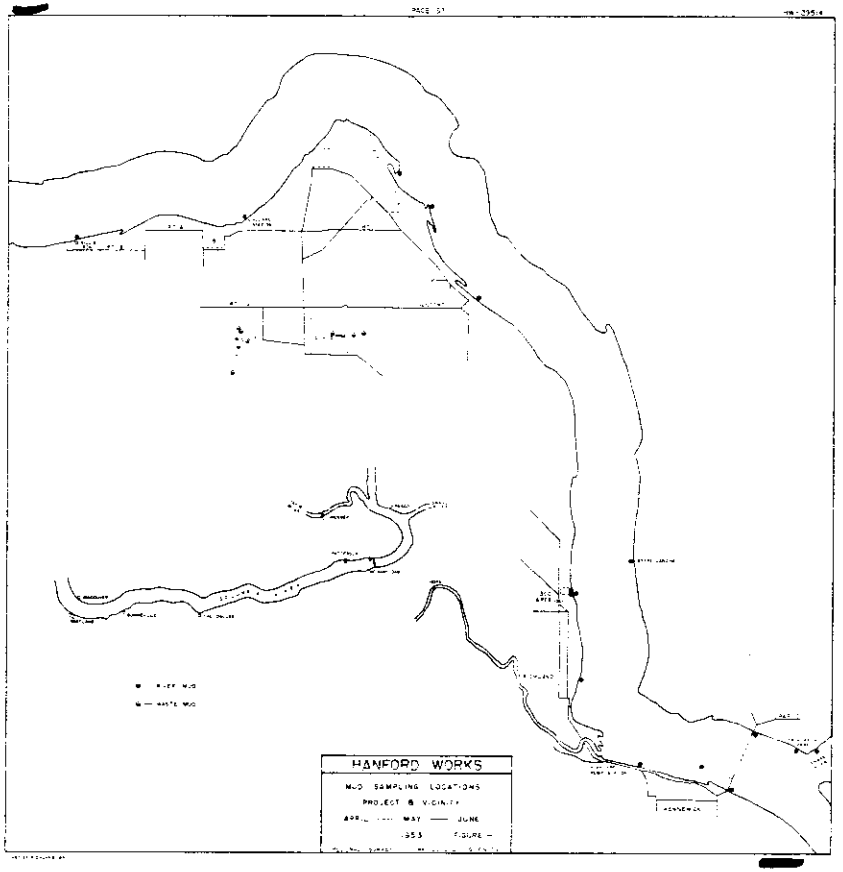
PROJECT AND VICINITY

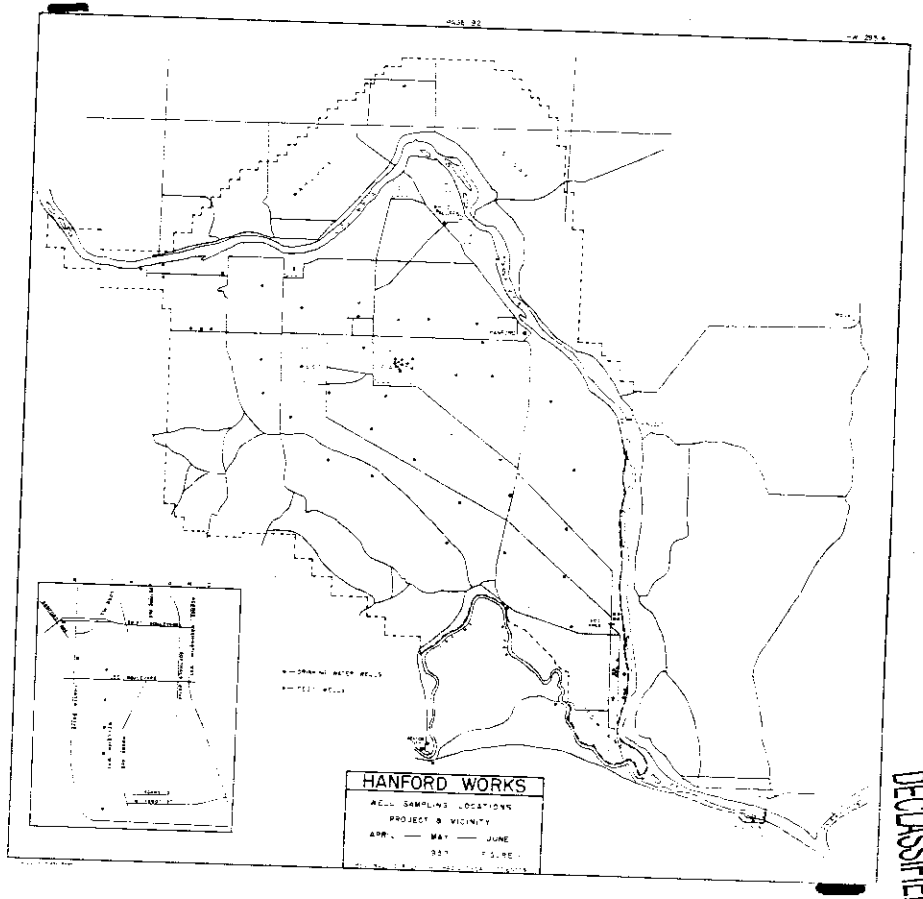


REMOTE LOCATIONS









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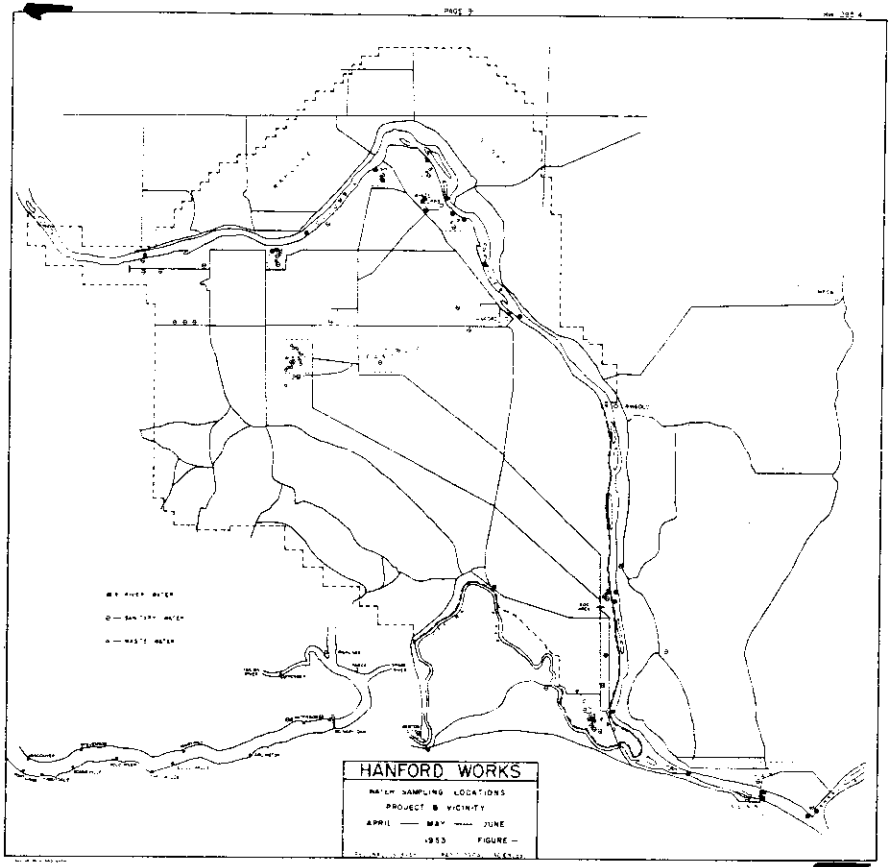

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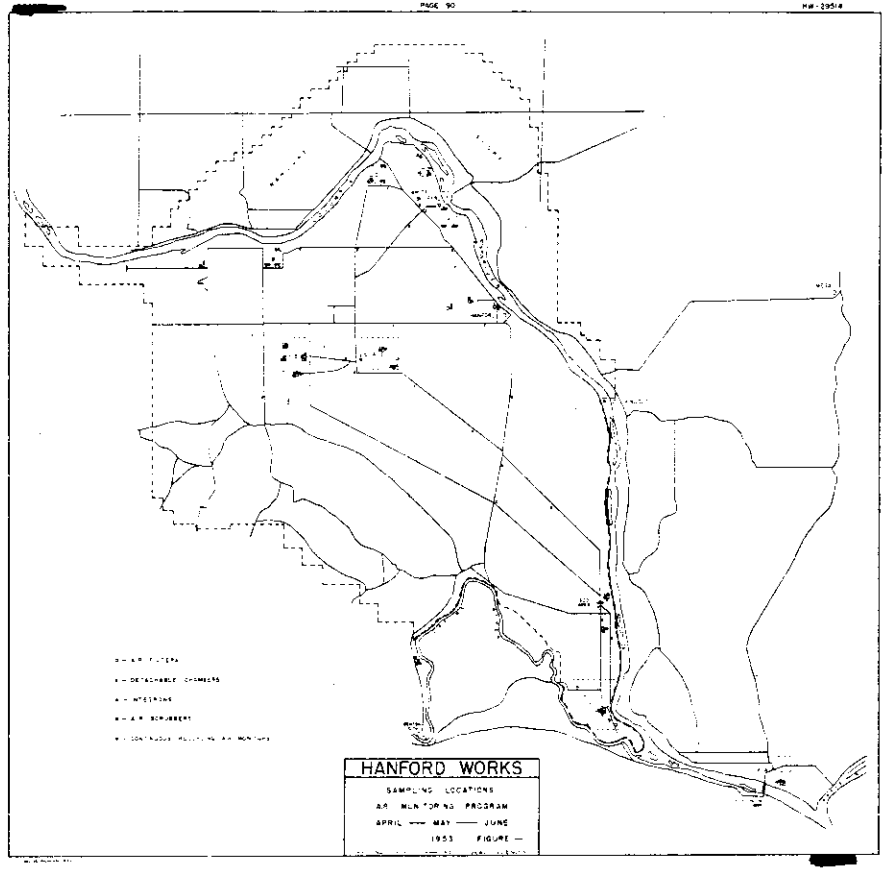

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