BNWL-B-429

Environmental Status of the Hanford Reservation for CY-1974

September 1975

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Battelle
Pacific Northwest Laboratories

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FOR CY-1974

By

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Occupational and Environmental Safety Department

September 1975

BATTELLE
Pacific Northwest Laboratories
Richland, Washington 99352

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ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR CY-1974

Jack J. Fix

SUMMARY

Environmental data collected during 1974 showed continued compliance of Hanford operations with all applicable State and Federal regulations. Levels of radioactivity in the atmosphere measured at 19 onsite stations, 17 perimeter stations and 6 distant stations showed no conclusive observable effect from Hanford operations. Possibly, levels of ^{239}Pu measured during the second quarter of 1974 at two sampling stations in the 200 Area were due to Hanford operations. No other apparent differences between levels of radioactivity measured at onsite, perimeter, and distant stations were detected.

Results of analyses of sanitary water samples collected at 100-N, 300 Area, and Richland water plant were all less-than detectable with the exception of gross alpha, gross beta, and ^{90}Sr. Tritium was measured in river water at Vernita Bridge and Richland. There was no indication that Hanford operations contributed to the observed concentrations. Observable influx of radioactivity into the Columbia River from riverbank springs at 100-N and of NO_3, F, and U from riverbank springs at the 300 Area were apparent. These pollutants were rapidly diluted in the river to essentially background levels within a short distance from entry into the river.

West Lake, a naturally occurring pond in direct contact with the groundwater, had the highest observed levels of gross beta, gross alpha, and ^{90}Sr of all the surface water areas sampled with the exception of ^{90}Sr in 100-F leach trench and gross alpha activity in the 300 Area process pond. No waste is discharged to West Lake and the cause of the elevated concentrations is not conclusively known, but a likely explanation is the concentrating effect of continual evaporation of water from the pond. West Lake serves as a basin for a relatively large watershed area. Uranium (accounting for

gross alpha activity), eroded from the soil during the entire history of West Lake's existence, and ^{90}Sr, due to fallout in rainfall, are assumed to have accumulated in the pond. In contrast, the waste discharged to the other ponds has been diluted with river water containing relatively low concentrations of ^{90}Sr and uranium.

Consistent with previous results, mice collected at 1301-N trench showed the highest levels of radioactivity per gram of any animal sampled during 1974. A difference in radioactivity was observed in ducks collected from along the Columbia River and ducks collected from onsite areas. Assuming an individual consumed 500 grams of duck meat containing the highest levels of ^{90}Sr and ^{137}Cs observed during 1974, a 50-year internal dose commitment of 4.8 mrem to the whole body and 5.5 mrem to the bone would be incurred. Greater than 95% of the dose would be due to ^{137}Cs and the majority would be received during the first year after ingestion. Comparable doses would be received from eating 50 pounds of deer meat containing the highest observed levels of ^{137}Cs in muscle tissue. Assuming a concentration of 2 pCi/g, a 50-year internal dose commitment to the whole body and bone of 2.8 and 3.4 mrem, respectively, would be incurred.

Surface soil and perennial vegetation samples collected from 26 different locations on or near the Hanford Reservation did not show any observable effect from Hanford operations. Levels of gamma-emitting radionuclides measured in sediment samples collected from the Columbia River islands were higher than surface soil samples. This apparent increase in radioactivity is likely due to residual amounts of radioactivity present from past once-through-cooling production reactor operation. Additional information is needed to describe the background levels of radioactivity in sediment samples collected upriver of Hanford operations.

The greatest external dose observed during 1974 at the 44 onsite dosimeter locations occurred at the 200-E Area. The cause was nearby waste management activities. The maximum external dose received by Washington Public Power Supply System (WPPSS) personnel working near 100-N was estimated from thermoluminescent dosimeter measurements to be 6 mrem or 1.2% of the dose standard (500 mrem) for non-occupationally exposed individuals.

External background dose from natural radioactivity in the Hanford environs was estimated to be 76 ± 15 mrem during 1974 from thermoluminescent dosimeter measurements. An additional 25 mrem/year is received from ingestion and inhalation of natural radioactivity, primarily ^{40}K. Therefore, the total background dose from natural causes is about 101 mrem/year. For convenience, this dose is assumed to be 100 mrem/year. An additional dose, approximately 4 mrem/year, must be added to account for the dose, primarily internal, due to fallout radionuclides.

Routine radiation surveys of control plots, Hanford roads and railroads, as well as waste disposal sites showed no conditions which required expedient corrective action.

INTRODUCTION

The environmental surveillance and evaluations program conducted by Battelle, Pacific Northwest Laboratory (also referred to as Battelle-Northwest or BNW) under contract to the U. S. Energy Research and Development Administration (ERDA) provides measurement and interpretation of Hanford operations radiological impact upon its environs, both onsite and offsite. In compliance with appropriate regulations, radiation exposures to population groups due to Hanford operations are evaluated. Also, contributions to environmental radioactivity due to fallout from nuclear detonations in the atmosphere and naturally occurring radioactivity are evaluated and used to determine the relative significance of the radiological impact attributable to Hanford operations.

The program is designed so that all significant potential pathways are evaluated, including particularly, those resulting in direct exposure to the public and those wherein environmental reconcentration is likely to occur. Summaries of the data and interpretations are published in a series of annual reports. Groundwater data and evaluations are reported in the series, "Radiological status of the Groundwater Beneath Hanford Project for...," the latest issue being BNWL-1860 for 1973.(1) Environmental data from offsite locations are presented in the annual "Environmental Surveillance at Hanford..." series of reports, the latest being BNWL-1910 for 1974.(2) Environmental data from locations within the plant boundaries are presented in the annual "Environmental Status of the Hanford Reservation for..." report series, the previous report being BNWL-B-336 for 1973.(3) The present report describes each major monitoring program and evaluates data collected during 1974.

ENVIRONMENTAL SAMPLE COLLECTION, ANALYSIS, AND EVALUATION

AIR

Air samplers were maintained at onsite, perimeter, and distant locations during 1974 as shown in Figures 1 and 2. Specific locations of samplers around operating areas are shown in Appendix A. Each air sampler maintains a flow of 2.5 m^3/hr through a particle filter (either Hollingsworth and Vose Company HV-70 or Gelman Acropor, AN-800) and generally a 15-cm long, 5-cm diameter charcoal cartridge. The filters were collected either weekly (AN-800) or biweekly (HV-70) and analyzed for gross beta and alpha activity after waiting a minimum of 7 days to allow the short-lived radon and thoron daughters to decay. The filters were composited into groups according to

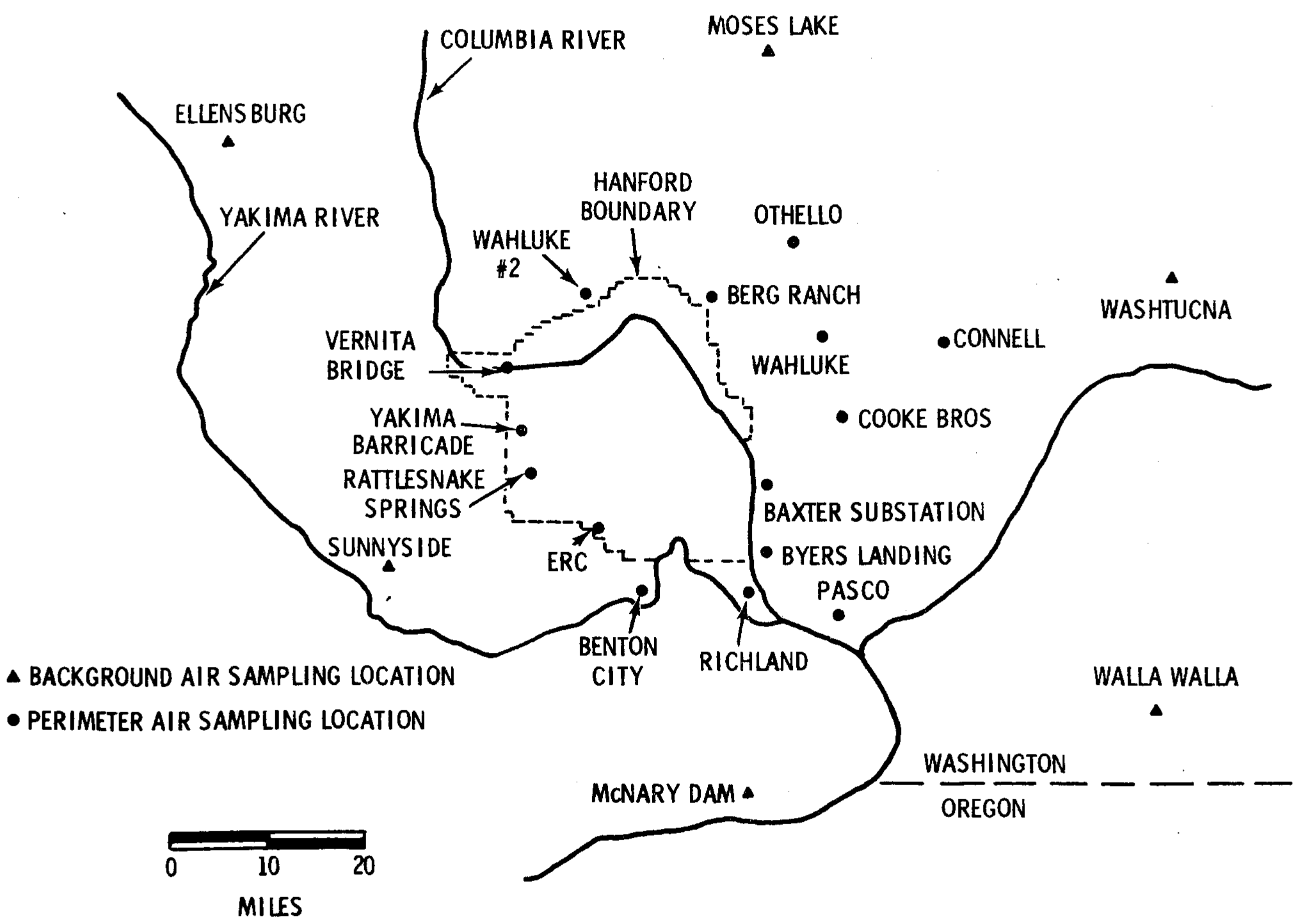

FIGURE 1. Hanford Environmental Air Sampling Locations During 1974

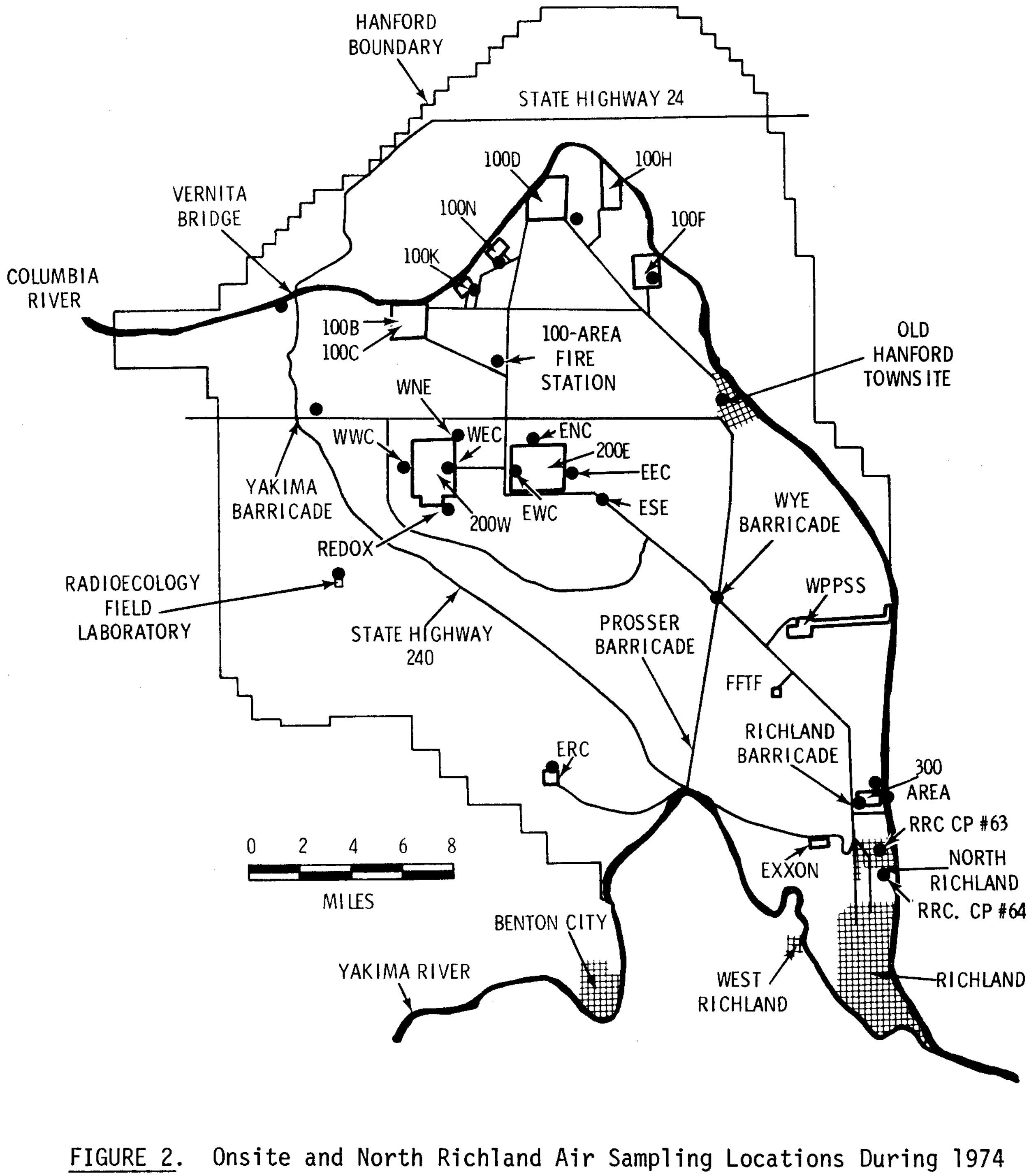

FIGURE 2. Onsite and North Richland Air Sampling Locations During 1974

geographical location and analyzed monthly by gamma spectroscopy and quarterly for ^{90}Sr and plutonium. At a few selected locations, silica gel cartridges were used to collect water vapor in the air for analysis for tritium. Table 1 lists all the air sampling stations, the filter used, status of charcoal or silica gel cartridges, and composite group for each filter.

The results of gross beta, gross alpha, and ^{131}I analyses for the different sampling locations are shown in Table 2. The distant stations are sufficiently remote from Hanford operations that observed levels of radiation were assumed due to natural causes or fallout. During 1974, airborne beta concentrations followed the typical annual cycle with a midsummer maximum and a midwinter minimum. Figure 3 illustrates these annual cycles for the years 1971 through 1974 in which the average monthly beta concentrations observed at eastern quadrant stations, which are located in the predominately downwind direction from Hanford operations, are compared with the concentrations observed at onsite and distant stations. The gross beta concentration in the atmosphere usually begins to rise each spring following an increased rate of transfer of radioactivity (natural and fallout) from the lower stratosphere to the troposphere. The average beta concentration during 1974 observed at onsite and perimeter stations was 1.7×10^{-13} µCi/ml, compared to 1.6×10^{-13} µCi/ml observed at all distant stations. The highest observed gross beta concentration, 9.7×10^{-13} µCi/ml, occurred at Richland on June 25, 1974. During this time, daily samples were being collected to detect an expected increase in fallout radioactivity following a nuclear detonation in the atmosphere by the Peoples Republic of China on June 17, 1974. The observed increases coincided with the usual midsummer maximum (Figure 3) and were only a small addition to the normal background due to natural radioactivity and fallout from previous nuclear detonations in the atmosphere.

The highest observed gross alpha concentration during 1974 occurred at Benton City (4.0×10^{-14} µCi/ml) on June 26, 1974, during the period of daily air sample collection. This increase was apparently due to the nuclear detonation in the atmosphere by the Peoples Republic of China.

TABLE 1. Hanford Air Sampling Network During 1974 Including Location, Filter Used, Frequency of Sample Collection, and Composite Group

		Frequency[a]			Composite Group												
					Active Area No.					Inner Quadrant					Outer Quadrant		
Location	Filter Type	Filter	Charcoal	Silica Gel	1	2	3	4	5	NE	E	SE	SW	NW	NE	SE	W
Onsite																	
200 ENC	AN-800	W	M (NRA)	BW	*												
200 ESE	AN-800	W	BW			*											
200 EWC	AN-800	W (BNW)															
200 EEC	AN-800	W (BNW)															
200 WEC	HV-70	BW	M (NRA)				*										
Redox	AN-800	W	M (NRA)				*										
200 WWC	AN-800	W	M (NRA)				*										
200 WNE	AN-800	W (BNW)															
3705 Bldg.	AN-800	W	M (NRA)					*									
ACRMS	HV-70	BW						*									
300 Pond	AN-800	W (BNW)	M (NRA)														
300 SW Gate	HV-70	BW	BW					*									
300 South Gate	HV-70	BW	M (NRA)					*									
Prosser Barr.	HV-70	BW	M (NRA)										*				
100-K	HV-70	BW	M (NRA)						*								
100-N	AN-800	W	BW	BW					*								
100-D	AN-800	W	M (NRA)						*								
100-F	HV-70	BW	M (NRA)								*						
100 Fire Stn.	HV-70	BW	M (NRA)						*								
Hanford	HV-70	BW	M (NRA)								*						
Wye Barr.	HV-70	BW	M (NRA)								*						
Rattlesnake Springs	HV-70	BW	M (NRA)										*				
ERC	HV-70	BW	M (NRA)										*				
Yakima Barr.	HV-70	BW	M (NRA)											*			
Wahluke #2	HV-70	BW	M (NRA)											*			
Perimeter																	
Pasco	HV-70	BW	M (NRA)									*					
Richland	HV-70	BW	BW	BW								*					
Benton City	HV-70	BW	BW										*				
Vernita	HV-70	BW	M (NRA)											*			
Berg Ranch	HV-70	BW	M (NRA)	BW						*							
Wahluke Wm.	HV-70	BW	M (NRA)							*							
Cooke Bros.	HV-70	BW	M (NRA)							*							
Baxter Sub.	HV-70	BW	BW	BW								*					
Byers Landing	HV-70	BW	BW									*					
Othello	HV-70	BW	M (NRA)							*							
Connell	HV-70	BW	M (NRA)							*							
C.P. #63	HV-70	BW (BNW)	M (NRA)														
C.P. #64	HV-70	BW (BNW)	M (NRA)														
Distant																	
Walla Walla	HV-70	BW	M (NRA)													*	
McNary	HV-70	BW	M (NRA)													*	
Sunnyside	HV-70	BW	M (NRA)														*
Moses Lake	HV-70	BW	M (NRA)												*		
Washtucna	HV-70	BW	M (NRA)												*		

a. Frequency of sample collection: W-weekly, BW-biweekly, M-monthly. All analyses by U.S. Testing except for analyses by BNW (indicated in table) or NRA (not routinely analyzed).

TABLE 2. Radioactivity in Air - 1974

	Concentration (10^{-12} μCi/ml)[a]												
	Gross Beta				Gross Alpha[b]				^{131}I				
Analytical Limit	0.01				0.0004				0.07				
Concentration Guide[c]	100.				0.02				100.				
Location	**No. of Samples**	**Max.**	**Min.**	**Average**	**No. of Samples**	**Max.**	**Min.**	**Average**	**No. of Samples**	**Max.**	**Min.**	**Avg.**	
Onsite Stations													
100-K	47	0.33	0.02	0.15±0.16									
100-N-WPPSS	51	0.45	0.03	0.13±0.16	52	0.007	*	<0.002	28	*	*	*	
100-D	46	0.46	0.01	0.14±0.18									
100-F	45	0.68	0.01	0.15±0.23									
100 Area Fire Station	27	0.39	0.02	0.19±0.18									
200 ENC	51	0.34	0.03	0.14±0.14	51	0.005	*	<0.001					
200 ESE	51	0.34	0.01	0.14±0.15	52	0.004	*	<0.002	46	*	*	*	
200 EEC(d)	43	0.58	0.04	0.23±0.26	43	0.026	<0.01	<0.004					
200 EWC(d)	44	0.54	0.04	0.22±0.26	44	0.007	<0.003	<0.004					
200 WNE(d)	43	0.53	0.05	0.24±0.24	43	0.026	<0.003	<0.004					
200 WEC	48	0.48	0.01	0.15±0.17	48	0.006	*	<0.002					
200 WWC	52	0.35	0.02	0.14±0.18	52	0.005	*	<0.002					
Redox	52	0.34	0.02	0.15±0.17	52	0.008	*	<0.002					
300 Pond(d)	44	0.56	0.04	0.19±0.24	44	0.010	<0.003	<0.004					
300 S.W. gate	23	0.34	0.04	0.17±0.15									
3705 Bldg.	52	0.34	0.01	0.14±0.17	52	0.008	*	<0.003	42	*	*	*	
A.C.R.M.S.	48	0.28	0.01	0.12±0.14					43	*	*	*	
Hanford	26	0.34	0.02	0.17±0.18									
Wye Barricade	26	0.38	0.04	0.18±0.19	24	0.002	*	<0.001					
				0.17±0.07(e)									
Perimeter Stations													
Baxter Substation	25	0.35	0.03	0.16±0.19					24	*	*	*	
Benton City	37	0.56	0.03	0.21±0.26	37	0.04	*	<0.002	27	*	*	*	
Berg Ranch	24	0.33	0.04	0.19±0.16	23	0.004	<0.001	<0.002					
Byers Landing	36	0.48	0.04	0.21±0.24	36	0.02	*	<0.002	27	*	*	*	
Connell	24	0.33	0.03	0.14±0.18									
Cooke Bros.	27	0.31	0.03	0.13±0.16					26	*	*	*	
ERC	27	0.36	0.04	0.17±0.20									
Othello	27	0.33	0.04	0.14±0.18									
Pasco	27	0.40	0.04	0.18±0.20									
Rattlesnake Springs	27	0.35	0.05	0.17±0.18									
Richland	35	0.97	0.04	0.21±0.36	37	0.004	*	<0.002	27	*	*	*	
Vernita Bridge	27	0.33	0.03	0.17±0.18									
Wahluke	26	0.36	0.01	0.16±0.18									
Wahluke #2	25	0.34	0.02	0.16±0.16									
Yakima Barricade	25	0.36	0.03	0.17±0.20									
RRC CP#63(d)	17	0.42	0.02	0.16±0.20	17	0.003	<0.001	<0.002					
RRC CP#64(d)	20	0.37	0.05	0.16±0.16	20	0.003	<0.001	<0.002					
				0.17±0.05(e)									
Distant Stations													
Ellensberg	16	0.28	0.04	0.15±0.13									
McNary Dam	26	0.43	0.06	0.16±0.18	25	0.005	*	<0.002					
Moses Lake	26	0.29	0.03	0.16±0.15									
Sunnyside	26	0.34	0.03	0.15±0.16									
Walla Walla	22	0.48	0.04	0.18±0.25	22	0.003	*	<0.001					
Washtucna	21	0.41	0.06	0.17±0.22									
				0.16±0.02(e)									

No entry indicates no analysis.

* Less than detectable.

a. 1 pCi/m^3 = 10^{-12} μCi/ml. Average ±2 sample standard deviations shown if all analyses had positive results. Otherwise, a less-than number is calculated from all results, including less-than values.

b. Gross alpha activity does not include any significant contribution due to naturally occurring radon and short-lived daughters in the air. The filters are held 7 days before analysis to allow radioactive decay of these radionuclides.

c. ERDAM-0524 standards only apply to concentrations of radioactivity in excess of that due to naturally occurring or fallout radioactivity.

d. Analyzed by BNW rather than by U.S. Testing Company.

e. Average ±2 Sample Standard Deviations.

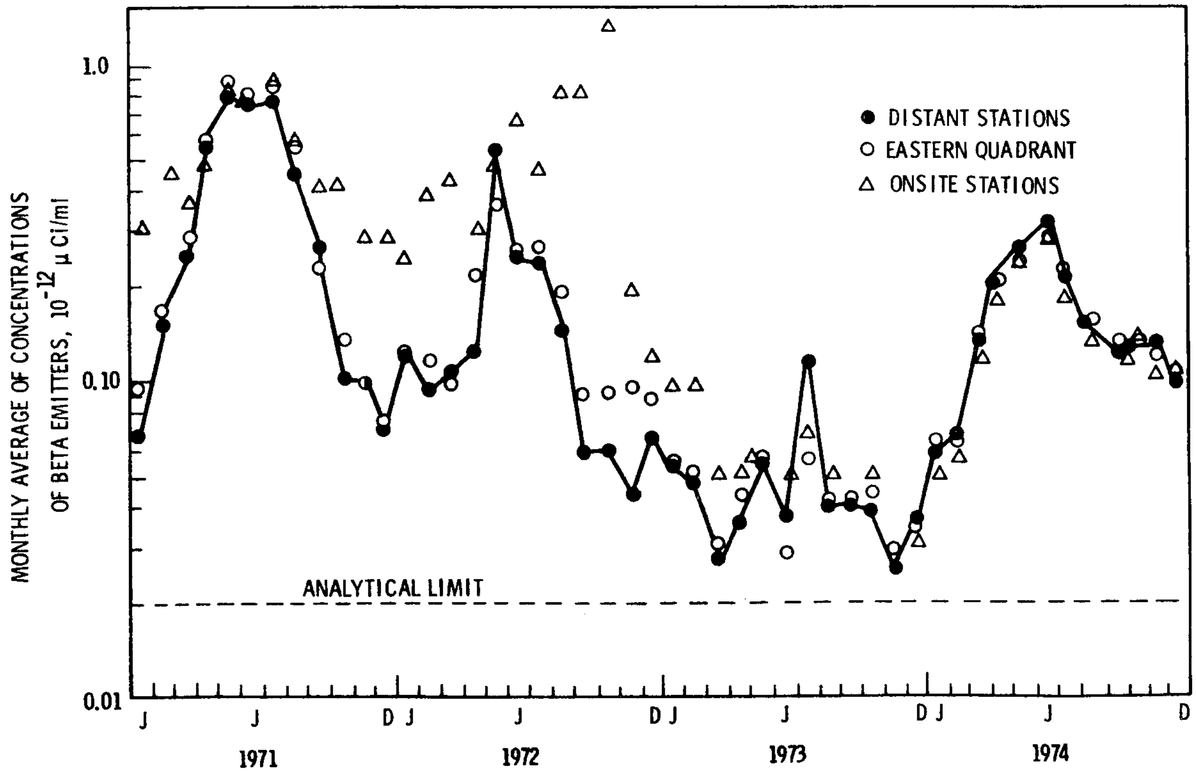

FIGURE 3. Monthly Average Gross Beta Activity in the Atmosphere

The highest observed concentrations during 1974 at onsite stations, 2.6×10^{-14} μCi/ml, occurred at stations 200 EEC and 200 WNE during the period of August 20th through the 27th. The reason for the increase is not known. The results for all other stations for the same time period were approximately 2×10^{-15} μCi/ml or a factor of ten lower.

Analysis for ^{131}I concentrations in the atmosphere were performed on a biweekly interval for 4 of the 19 onsite and 5 of the 15 perimeter sampling stations during 1974. Although charcoal cartridges were located at all perimeter and distant sampling stations and most onsite locations (Table 1), the majority were not analyzed but provided available samples for analysis if there had been any indication that iodine was present in the atmosphere. The charcoal for all stations was changed monthly. All ^{131}I analyses during 1974 were less than the detection limit of 0.07×10^{-12} μCi/ml, or less than 0.07% of the ERDA Manual Chapter 0524 standard of 1×10^{-10} μCi/ml for uncontrolled areas.[4]

Results of specific radionuclide analyses are shown in Table 3 for each monthly or quarterly analysis. Beryllium-7 is a naturally occurring radionuclide formed by the interaction of cosmic rays with oxygen and nitrogen in the upper atmosphere. The other radionuclides are fission or activation products and result from either fallout or Hanford operations. Figures 4 and 5 are log-normal probability plots of the positive results for ^{106}Ru, ^{144}Ce, and ^{137}Cs, and for ^{90}Sr and ^{239}Pu, respectively, for all composite groups. Nothing distinctive about the data is apparent from the figures except that the data are not distributed log normally. The maximum ^{239}Pu concentrations were observed in the 2nd quarter composites from Active Area #1 and #2. Only one air sampling station is included in each of these composites: 200 ENC in Active Area #1 and 200 ESE in Active Area #2. The observed concentrations, 5×10^{-16} and 2×10^{-16} μCi/ml, were about a factor of 10 greater than the annual average of 2×10^{-17} μCi/ml.

TABLE 3. Concentrations of Selected Radionuclides on Air Filter Composites - 1974

Units of 10^{-12} μCi/ml of Air (Continuous Samples)

Date	^{7}Be	^{54}Mn	^{60}Co	^{65}Zn	^{90}Sr	$^{95}ZrNb$	^{106}Ru	^{131}I	^{137}Cs	$^{140}BaLa$	$^{144}CePr$	Total Pu
Analytical Limit(a)	0.03	0.002	0.003	0.006	0.0002	0.002	0.04	0.12	0.003	0.15	0.03	0.000002
					Active Area #1							
1/29	0.12	*	*	*		0.03	*	*	0.04	*	*	
2/26	*	*	*	*		0.01	*	*	0.02	*	*	
3/26	0.12	0.01	*	*	*	0.05	*	*	0.01	*	0.09	0.00002
4/30	0.16	*	*	*		0.08	0.10	*	0.02	*	0.18	
5/28	*	0.009	*	*		0.06	0.23	*	0.008	*	0.12	
6/25	*	0.008	*	*	0.004	0.05	0.23	*	0.009	*	0.19	0.0002
7/23	0.13	*	*	*		0.03	*	*	*	*	*	
8/27	0.19	0.03	*	*		*	*	*	0.02	*	*	
9/24	0.15	*	*	*	0.005	0.02	*	*	0.01	*	*	0.00004
10/29	*	*	*	*		0.01	0.19	*	0.01	*	*	
11/26	*	*	*	*		0.007	*	*	*	*	*	
12/31	*	*	*	*	0.002	0.03	0.16	*	*	*	*	0.00002
Annual Average(b)	<0.08	<0.005	*	*	<0.003	<0.03	<0.08	*	<0.01	*	<0.06	0.00007
					Active Area #2							
3/26					0.002							*
6/25					0.004							0.0005
9/24					0.006							0.00008
12/31					0.003							0.00001
Annual Average(b)					0.004							0.0001

No entry indicates no analysis was made.
* Indicates result was less than the analytical limit.
a. The analytical limit shown is the average of the individual analytical limits for all samples.
b. The annual average has been calculated from the result reported for each analysis including "less-than analytical limit" values.

TABLE 3. (continued)

Date	^{7}Be	^{54}Mn	^{60}Co	^{65}Zn	^{90}Sr	$^{95}ZrNb$	^{106}Ru	^{131}I	^{137}Cs	$^{140}BaLa$	$^{144}CePr$	Total Pu
Analytical Limit[a]	0.03	0.002	0.003	0.006	0.0002	0.002	0.04	0.12	0.003	0.15	0.03	0.000002
Active Area #3												
1/29	0.14	0.004	*	0.01		0.009	*	*	0.005	*	*	
2/26	*	0.004	*	*		0.01	0.10	*	0.003	*	*	
3/26	0.009	0.008	*	*	0.001	0.05	0.17	*	0.02	*	0.04	0.000009
4/30	0.08	*	*	*		*	0.17	*	0.02	*	0.13	
5/28	*	0.01	*	*		0.07	0.26	*	0.02	*	0.14	
6/25	*	0.01	0.009	*	0.004	0.05	0.33	*	0.007	*	0.12	0.00001
7/30	0.14	*	*	0.008		0.03	*	*	0.01	*	0.10	
8/27	*	*	*	*		0.008	0.05	*	0.003	*	*	
9/24	0.14	0.003	*	*	0.005	0.02	0.04	*	0.02	*	0.06	0.00004
10/29	0.10	*	*	*		0.03	0.10	*	0.003	*	0.03	
11/26	*	*	*	*		0.008	0.12	*	*	*	*	
12/31	0.04	0.004	*	*	0.002	0.02	0.05	*	0.009	*	*	0.00002
Annual Average[b]	<0.06	<0.004	<0.009	*	0.003	<0.03	<0.11	*	<0.009	*	<0.05	0.00002
Active Area #4												
1/29	*	*	*	*		0.005	0.08	*	*	*	*	
2/26	*	0.004	0.01	*		0.01	0.18	*	*	*	*	
3/26	0.02	0.01	*	*	0.0006	0.03	0.15	*	*	*	0.04	0.00002
4/30	0.12	*	*	0.007		0.05	*	*	0.007	*	0.10	
5/28	*	0.04	*	*		*	0.24	*	0.02	*	*	
6/28	*	0.02	0.01	*	0.003	0.05	0.41	*	0.006	*	0.15	0.00007
7/30	0.17	0.009	*	0.005		0.03	*	*	0.008	*	0.10	
8/27	0.18	0.007	*	0.006	0.002	0.02	*	*	0.007	*	0.08	
9/30	0.04	*	*	*	0.004	0.01	0.20	*	*	*	0.03	0.00004
10/29	0.10	*	*	*		0.02	0.09	*	0.002	*	0.03	
11/25	*	*	*	*		0.03	0.16	*	*	*	*	
12/31	0.02	0.005	*	*	0.0007	0.02	0.10	*	*	*	0.02	0.00002
Annual Average[b]	<0.05	<0.008	<0.002	*	<0.002	<0.02	<0.14	*	<0.003	*	<0.04	0.00004
Active Area #5												
1/28	0.07	0.003	*	*		0.005	*	*	*	*	*	
2/25	*	0.003	*	*		0.02	0.11	*	*	*	*	
3/25	0.03	*	*	*		0.05	0.16	*	*	*	0.04	
4/29	0.08	*	*	*		0.07	0.14	*	0.008	*	0.12	
5/28	*	0.01	*	*		0.06	0.21	*	0.007	*	0.12	
6/24	*	0.02	0.009	*		0.06	0.40	*	0.006	*	0.16	
7/29	0.08	0.008	*	*		0.03	0.12	*	0.006	*	0.10	
8/26	0.17	0.006	0.002	0.006		0.02	*	*	0.006	*	0.07	
9/30	0.06	*	*	*		0.02	0.17	*	*	*	0.04	
10/28	0.10	*	*	*		0.04	0.15	*	0.002	*	0.02	
11/25	0.04	*	*	*		0.04	0.05	*	*	*	*	
12/30	0.03	0.006	*	*		0.02	0.09	*	*	*	0.02	
Annual Average[b]	<0.06	<0.005	<0.001	*		0.03	<0.13	*	<0.003	*	<0.06	
Inner Northeast Quadrant												
1/31	0.06	0.003	*	*		0.006	*	*	*	*	*	
2/28	*	0.004	*	*		0.01	0.11	*	*	*	*	
3/29	0.06	0.01	*	*	0.0006	0.04	0.12	*	0.002	*	0.05	0.00002
4/26	*	*	*	*		0.05	0.19	*	0.005	*	0.09	
5/23	*	0.02	*	*		0.05	0.18	*	0.005	*	0.11	
6/21	*	0.02	*	0.02	0.0005	0.06	*	*	0.01	0.33	0.18	0.000001
7/31	0.17	0.01	*	*		0.03	*	*	0.008	*	0.11	
8/30	0.15	0.004	*	0.004		0.02	*	*	0.005	*	0.07	
9/27	0.11	0.01	*	*	0.0002	0.05	0.06	*	0.004	*	0.04	0.000004
10/25	0.07	*	*	*		0.03	0.19	*	*	*	*	
11/22	*	*	*	*		0.04	0.12	*	*	*	*	
12/26	0.05	0.005	*	*	0.0005	0.02	0.08	*	*	*	0.02	0.00005
Annual Average[b]	<0.06	<0.007	*	*	0.0004	0.03	<0.09	*	<0.003	<0.03	<0.06	0.00002

No entry indicates no analysis was made.
* Indicates result was less than analytical limit.
a. The analytical limit shown is the average of the individual analytical limits for all samples.
b. The annual average has been calculated from the result reported for each analysis including "less-than analytical limit" values.

TABLE 3. (continued)

Date	^{7}Be	^{54}Mn	^{60}Co	^{65}Zn	^{90}Sr	^{95}ZrNb	^{106}Ru	^{131}I	^{137}Cs	^{140}BaLa	^{144}CePr	Total Pu
Analytical Limit(a)	0.03	0.002	0.003	0.006	0.0002	0.002	0.04	0.12	0.003	0.15	0.03	0.000002
					Inner Eastern Quadrant							
1/30	0.05	0.002	*	*		0.008	*	*	*	*	*	
2/27	*	0.003	0.01	*		0.02	0.21	*	*	*	*	
3/27	0.07	0.01	*	*	0.0009	0.04	0.11	*	0.003	*	0.04	0.00001
4/29	0.07	*	*	*		0.05	0.13	*	0.006	*	0.10	
5/29	0.20	0.02	*	0.02		0.06	*	*	0.01	*	0.14	
6/26	*	0.02	0.004	*	0.003	0.06	0.37	*	0.008	*	0.16	0.00002
7/31	0.17	*	0.001	0.01		0.04	*	*	0.007	*	0.14	
8/28	0.19	0.01	*	0.007		0.02	*	*	0.008	*	0.09	
9/30	0.12	0.002	*	*	0.005	0.02	0.05	*	0.004	*	0.05	0.00004
10/30	0.08	*	*	*		0.02	0.22	*	*	*	*	
11/27	0.08	*	*	*		0.03	*	*	*	*	*	
12/30	*	0.006	*	*	0.001	0.02	0.13	*	*	*	*	0.00001
Annual Average(b)	<0.08	<0.005	<0.002	*	0.002	0.03	<0.10	*	<0.004	*		0.00002
					Inner Southeast Quadrant							
1/21	0.07	0.003	*	*		0.007	*	*	*	*	*	
2/19	*	0.006	0.009	*		0.001	0.22	*	*	*	*	
3/18	*	0.005	*	*	0.0004	0.03	0.10	*	*	*	*	0.00002
4/29	0.04	*	*	*		0.05	0.13	*	0.004	*	0.08	
5/28	*	0.02	*	*		0.04	0.27	*	0.005	*	0.11	
6/28	*	0.008	*	*	0.003	0.04	0.28	*	0.006	*	0.13	0.00004
7/22	0.31	*	*	*		0.04	*	*	0.008	*	0.10	
8/19	0.27	0.01	0.004	0.01		0.03	*	*	0.01	*	0.13	
9/30	0.04	*	*	*	0.005	0.02	0.23	*	*	*	0.04	0.00006
10/28	0.13	*	*	*		0.01	0.10	*	*	*	*	
11/25	*	*	*	*		0.05	0.12	*	*	*	*	
12/23	0.11	*	*	*	0.001	0.05	*	*	*	*	0.04	0.00001
Annual Average(b)	<0.08	<0.002	<0.002	*	0.002	0.03	<0.12	*	<0.002	*	<0.06	0.00003
					Inner Southwest Quadrant							
1/23	0.04	*	*	*		0.01	0.08	*	*	*	*	
2/20	*	0.006	0.01	*		*	0.25	*	*	*	*	
3/20	0.01	0.008	*	*	0.0005	0.03	0.13	*	*	*	*	0.00002
4/17	*	*	*	*		0.04	0.19	*	0.003	*	0.08	
5/29	0.06	0.02	*	*		0.06	0.18	*	0.008	*	0.14	
6/28	*	0.01	0.01	*	0.002	0.06	0.41	*	0.008	*	0.15	0.00003
7/24	0.18	*	*	0.01		0.03	*	*	0.007	*	0.12	
8/22	0.21	0.006	*	0.009		0.03	*	*	0.007	*	0.10	
9/18	0.04	*	*	*	0.002	0.02	0.22	*	*	*	0.05	0.00001
10/30	0.07	*	*	*		0.01	0.20	*	*	*	*	
11/27	*	*	*	*		0.01	0.13	*	*	*	*	
12/26	0.09	0.001	*	*	0.001	0.02	*	*	*	*	0.03	0.00003
Annual Average(b)	<0.06	<0.005	<0.002	*	0.001	0.03	<0.15	*	<0.003	*	<0.06	0.00002
					Inner Northwest Quadrant							
1/30	0.09	0.002	*	0.005		0.008	*	*	*	*	*	
2/27	*	0.005	*	*		0.01	0.12	*	*	*	*	
3/28	*	0.007	*	*	0.0003	0.02	0.12	*	*	*	*	0.00002
4/29	*	*	*	*		0.04	0.17	*	0.003	*	0.08	
5/29	0.06	0.01	*	*		0.05	0.14	*	0.007	*	0.12	
6/26	*	0.05	*	*	0.003	*	0.30	*	0.02	*	0.17	0.00004
7/31	0.18	0.01	*	0.01		0.03	*	*	0.009	*	0.13	
8/28	0.06	*	*	*		0.02	0.21	*	*	*	0.06	
9/25	*	*	*	*	*	0.02	0.24	*	*	*	0.04	0.000003
10/30	0.05	*	*	*		0.03	0.20	*	*	*	*	
11/27	0.04	*	*	*		0.07	0.07	*	*	*	*	
12/26	*	0.009	*	*	0.001	0.03	0.12	*	*	*	*	*
Annual Average(b)	<0.05	<0.008	*	*	<0.001	<0.02	<0.14	*	<0.003	*	<0.05	0.00002

No entry indicates no analysis was made.
* Indicates result was less than analytical limit.
a. The analytical limit shown is the average of the individual analytical limits for all samples.
b. The annual average has been calculated from the result reported for each analysis including "less-than analytical limit" values.

TABLE 3. (continued)

Date	^{7}Be	^{54}Mn	^{60}Co	^{65}Zn	^{90}Sr	^{95}ZrNb	^{106}Ru	^{131}I	^{137}Cs	^{140}BaLa	^{144}CePr	Total Pu
Analytical Limit[a]	0.03	0.002	0.003	0.006	0.0002	0.002	0.04	0.12	0.003	0.15	0.03	0.000002
						Outer Northeast Quadrant						
1/18	0.08	*	*	*		0.006	*	*	*	*	*	
2/15	*	0.004	*	*		0.009	0.11	*	*	*	*	
3/26	0.005	0.006	*	*	0.0004	0.02	0.09	*	*	*	*	0.00001
4/15	*	*	*	*		0.04	0.18	*	*	*	0.07	
5/24	*	0.02	*	*		0.06	0.23	*	0.007	*	0.14	
6/21	*	0.02	*	*	0.003	0.05	0.21	*	0.009	0.27	0.15	0.00005
7/23	*	*	*	*		0.03	*	*	*	*	0.09	
8/24	0.21	0.007	0.004	0.007		0.02	*	*	0.009	*	0.12	
9/13	0.16	0.007	*	*	0.0006	0.02	*	*	0.007	*	*	0.00005
10/25	0.05	*	*	*		0.03	0.20	*	*	*	*	
11/27	*	*	*	*		0.01	0.18	*	*	*	*	
12/20	0.11	*	*	*	0.001	0.02	*	*	*	*	*	0.00004
Annual Average[b]	<0.009	<0.005	*	*	0.001	0.03	<0.10	*	<0.003	<0.02	<0.05	0.00004
						Outer Southeast Quadrant						
1/25	0.06	0.004	*	*		0.008	*	*	*	*	*	
2/22	*	0.006	*	*		0.01	0.15	*	*	*	*	
3/22	*	0.006	*	*	0.0007	0.03	0.07	*	*	*	*	0.00002
4/19	*	*	*	*		0.08	0.29	*	*	*	0.18	
5/31	0.18	*	0.003	*		0.08	*	*	0.008	*	*	
6/28	*	0.005	*	*	0.003	0.07	0.29	*	0.01	*	0.19	0.00005
7/26	0.22	*	*	*		0.04	*	*	0.005	*	0.12	
8/23	0.20	*	*	*		0.03	*	*	*	*	0.12	
9/20	0.03	*	*	*	0.006	0.02	0.17	*	*	*	0.06	0.00002
10/25	0.07	*	*	*		0.03	0.28	*	*	*	*	
11/22	0.05	*	*	*		0.08	0.08	*	*	*	0.28	
12/27	*	0.007	*	*	0.0006	0.02	0.19	*	*	*	*	0.00001
Annual Average[b]	<0.07	<0.002	<0.0004	*	0.002	0.04	<0.13	*	<0.002	*	<0.08	0.00002
						Outer Western Quadrant						
1/28	0.08	*	*	*		0.005	*	*	*	*	*	
2/25	*	*	*	*		0.01	0.15	*	*	*	*	
3/25	*	0.01	*	*	0.0006	0.04	0.13	*	*	*	*	0.000009
4/22	*	*	*	*		0.04	0.19	*	*	*	0.06	
5/20	*	0.02	*	*		0.05	0.18	*	0.007	*	*	
6/17	*	0.009	*	*	0.003	0.06	0.20	*	0.007	*	0.14	0.000002
7/29	0.16	*	*	0.008		0.03	*	*	0.007	*	0.11	
8/26	0.20	0.007	*	*		0.02	*	*	0.009	*	0.09	
9/13	*	*	*	*	0.007	0.02	0.19	*	*	*	*	*
10/23	0.10	*	*	*		0.01	0.14	*	0.003	*	0.03	
11/18	*	*	*	*		0.009	*	*	*	*	*	
12/16	0.22	0.006	*	*	0.001	0.02	*	*	*	*	*	0.00002
Annual Average[b]	<0.06	<0.005	*	*	0.003	0.02	<0.10	*	<0.003	*	<0.04	<0.00002

No entry indicates no analysis was made.
* Indicates result was less than analytical limit.
a. The analytical limit shown is the average of the individual analytical limits for all samples.
b. The annual average has been calculated from the result reported for each analysis including "less-than analytical limit" values.

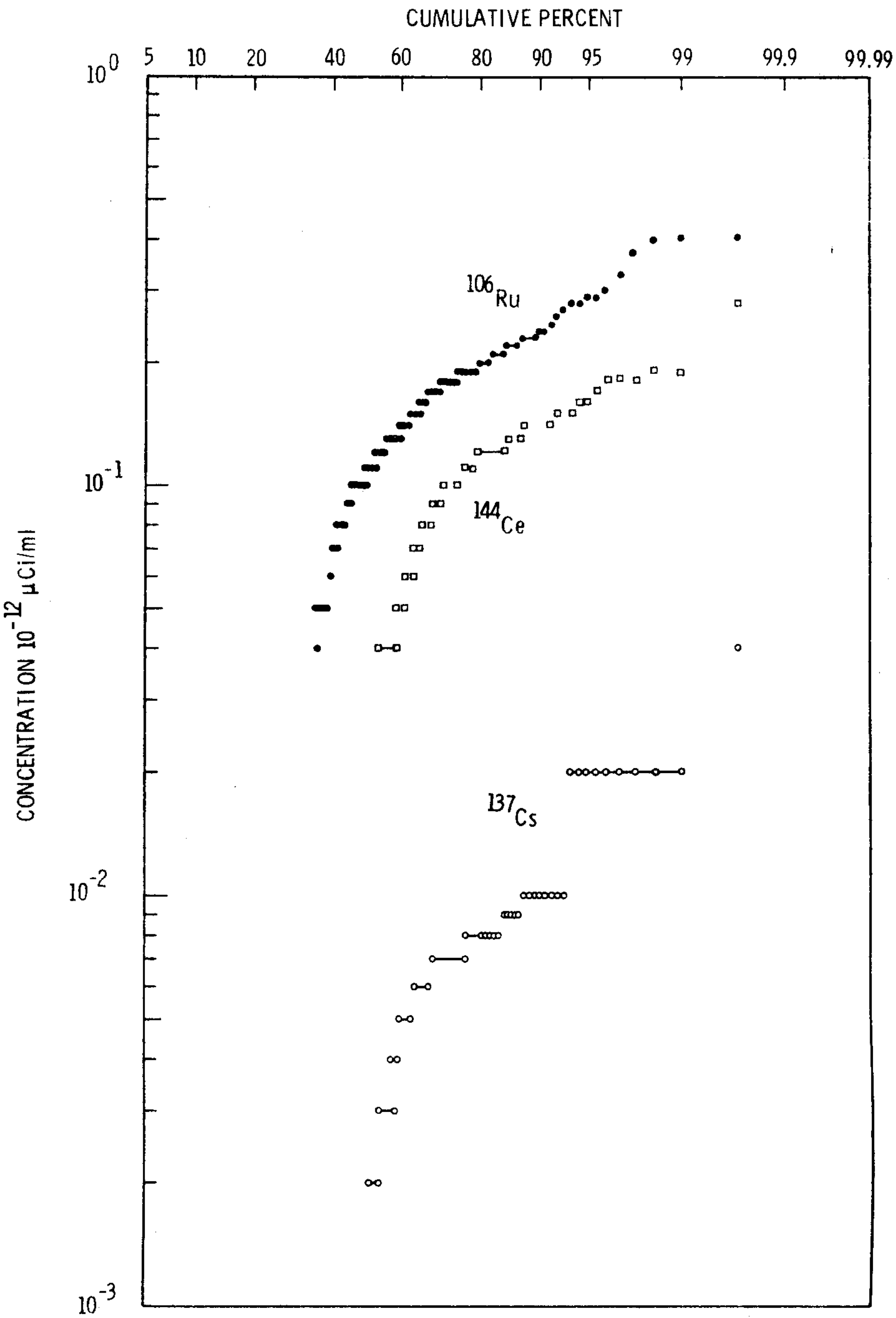

FIGURE 4. Log-Normal Probability Plot of ^{106}Ru, ^{137}Cs, and ^{144}Ce Concentrations in the Atmosphere During 1974.

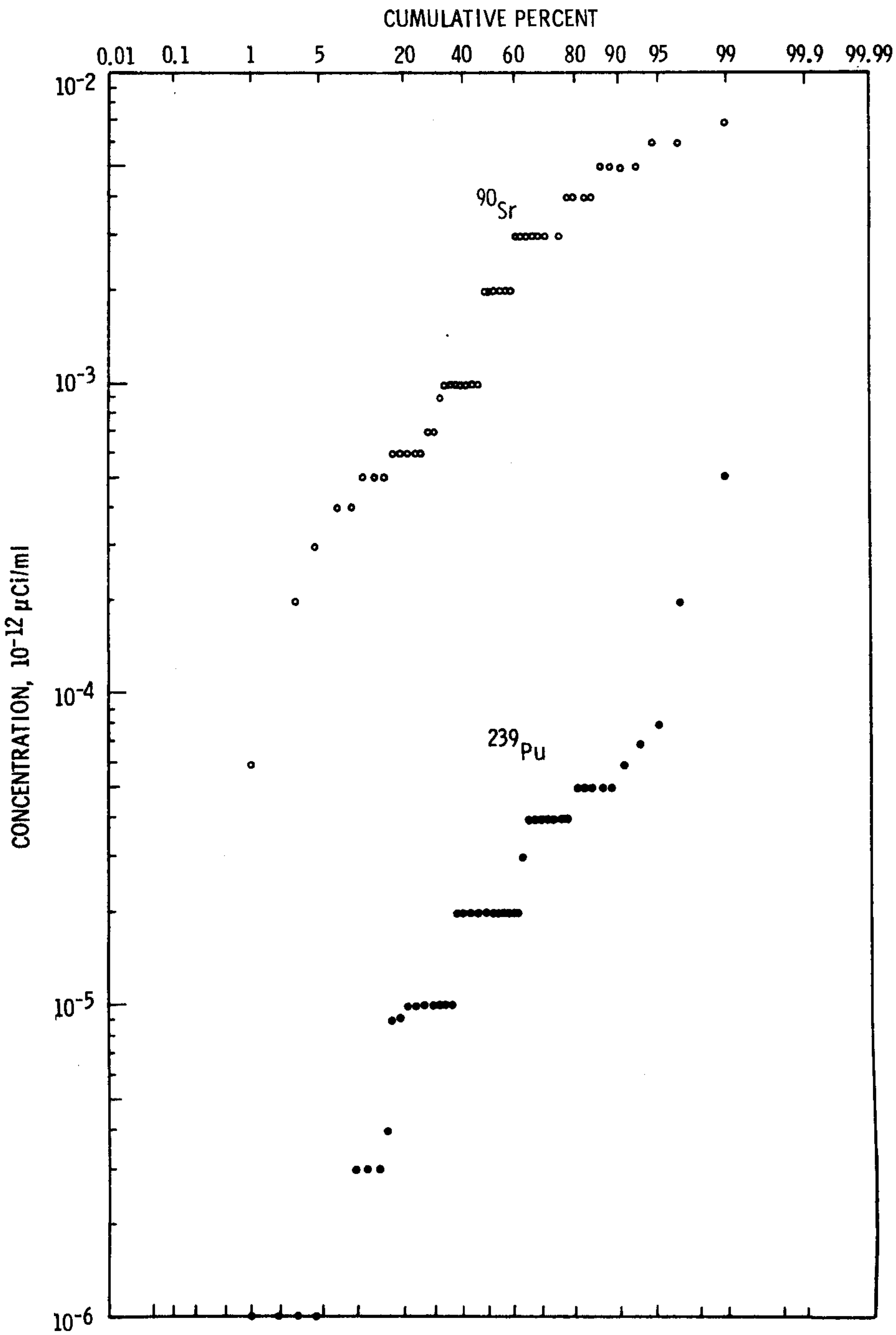

FIGURE 5. Log-Normal Probability Plot of ^{90}Sr and ^{239}Pu Concentrations in the Atmosphere During 1974.

In summary, average levels of radionuclides observed at onsite, perimeter, and distant sampling stations were similar, indicating no conclusive observable effect from Hanford operations. Possibly, levels of ^{239}Pu measured in the 200 Area were due to Hanford operations. In Table 4 the maximum observed concentrations for any composite group are compared to ERDA Manual Chapter 0524 concentration guides for uncontrolled areas although the observed levels are likely attributable to causes other than Hanford operations. In all cases, the observed values are much lower than the concentration guides.

TABLE 4. Maximum Concentration of Specific Radionuclides Observed in Air - 1974

Radionuclide	Maximum Observed[a] Concentration 10^{-12} µCi/ml	ERDAM 0524[b] Standard 10^{-12} µCi/ml	Composite[c] Group
^{7}Be	0.3	40,000	Inner Northeast Quadrant
^{54}Mn	0.04	1,000	Active Area #4
^{60}Co	0.01	300	Active Area #4
^{65}Zn	0.02	2,000	Inner Eastern Quadrant Inner Northeast Quadrant
^{90}Sr	0.007	30	Outer Western Quadrant
$^{95}ZrNb$	0.08	3,000	Active Area #1 Outer Southeast Quadrant
^{103}Ru	0.02	3,000	Inner Northeast Quadrant
^{106}Ru	0.41	200	Active Area #4
^{134}Cs	0.04	400	Inner Southeast Quadrant
^{137}Cs	0.04	500	Active Area #1
$^{140}BaLa$	0.33	1,000	Inner Northeast Quadrant
^{141}Ce	0.04	5,000	Active Area #4
$^{144}CePr$	0.28	200	Outer Southeast Quadrant
Pu-total	5×10^{-4}	6×10^{-2}[d]	Active Area #2

a. 1 fCi/l = 10^{-12} µCi/ml
b. Concentration Guides for uncontrolled areas shown.
c. In some cases the maximum concentration was observed in more than one composite group.
d. Concentration guide for ^{239}Pu.

COLUMBIA RIVER

Samples of Columbia River water were obtained at Vernita Bridge, 100-B, 100-N springs, Hanford powerline, 300 Area forebay, and Richland sanitary water forebay for radiological, chemical, physical, and/or biological analyses. Additionally, samples from the vicinity of the 300 Area riverbank springs and 100-F shoreline were analyzed for coliform organisms and BOD. Enterococci measurements were made to clarify the types of coliforms present. The majority of the information has been evaluated and presented in the 1974 Environmental Surveillance Report.(2) Data representing the analysis of samples collected from onsite sanitary water and Columbia River shoreline locations are discussed herein.

Sanitary Water

Cumulative sampling (30 ml every 30 minutes) of sanitary water for radiological analyses was conducted at 100-N, 300 Area, and Richland, The results of these analyses are shown in Table 5. The gross alpha count is an approximation of the naturally occurring uranium in the river. Tritium concentrations were measured in raw river water, and the annual averages determined during 1974 at Vernita Bridge and Richland were <330- and <480- pCi/l, respectively.(2) These values are very much less than the ERDA 0524 concentration guide(4) of 3×10^6 pCi/l, and the source of the tritium is primarily fallout. Other radionuclides were generally less-than detectable although ^{90}Sr, attributed to fallout, was detected in most samples collected at Richland.

Columbia River Shoreline

Several riverbank springs are observable along the Columbia River at 100-N and the 300 Area resulting from either waste water discharge to nearby trenches (1301-N) or ponds (300 Area) or, in the case of one spring above the 300 Area and above the Port of Benton, to the surfacing of groundwater flow as it enters the Columbia River. Currently, the following shoreline areas are sampled routinely:

100-N A series of springs between 100-N and 100-D result from seepage from the 1301-N trench. Approximately 2.5 million gallons of water flow into the trench per day and subsequently

TABLE 5. Radiological Analysis of Drinking Water - 1974

Units of 10^{-9} μCi/ml

Radiological	Analytical Limit	Standards[a]	300 Area No. of Samples	300 Area Maximum Observed	300 Area Minimum Observed	300 Area Average[b]	100-N No. of Samples	100-N Maximum Observed	100-N Minimum Observed	100-N Average[b]
Alpha	0.3	30	51	1.5	*	<0.52				
Beta	0.005	2,000,000	51	*	*	*	51	0.006	*	<0.003
^{46}Sc	25.	40,000	51	*	*	*				
^{51}Cr	350.	2,000,000	51	*	*	*				
^{60}Co	20.	30,000	51	*	*	*				
^{65}Zn	40.	100,000	51	*	*	*				
^{90}Sr	0.08	300								
^{137}Cs	20.	20,000	51	*	*	*				

Radiological	Analytical Limit	Standards[a]	Richland No. of Samples	Richland Maximum Observed	Richland Minimum Observed	Richland Average[b]
Alpha	0.3	30	52	0.9	*	<0.5
Beta	0.005	2,000,000	52	*	*	*
^{46}Sc	25.	40,000	52	*	*	*
^{51}Cr	350.	2,000,000	52	*	*	*
^{60}Co	20.	30,000	52	*	*	*
^{65}Zn	40.	100,000	52	*	*	*
^{90}Sr	0.08	300	10	0.6	*	0.3
^{137}Cs	20.	20,000	52	*	*	*

* Less than analytical limit.
No entry indicates no analysis was made.

a. Radiological standards obtained from ERDAM-0524 and apply only to concentrations in excess of natural or fallout activity.

b. Average ±2 sample standard deviations shown if all analyses were positive. Otherwise, a less-than number was calculated from all results, including less-than numbers.

to the river. A monthly grab sample for ^{3}H, ^{131}I, and gamma spectroscopy analyses is collected at the river bank opposite the 1301-N trench.

100-F   100-F leach trench receives animal waste from experiments being conducted in the 100-F area. A monthly grab sample of river water is collected from along the 100-F shoreline directly across and slightly down river from the trench. Analyses for coliforms, enterococci, and BOD are performed.

300 Area — Depending on the water level of the Columbia River, as many as 3 different riverbank springs can be seen. The first spring (Above 300 Area Spring) is about 1 mile above the 300 Area and results from the surfacing of groundwater flow as it enters the Columbia River. The other two springs (300 Area Spring #1 and #2) are directly adjacent to and are caused by seepage from the 300 Area sanitary leach trenches and 300 Area process ponds. Each month, a grab sample is collected from "Above 300 Area Spring" and "300 Area Spring #1" for coliform, enterococci, and BOD analyses. Whenever the river level is less than 345 feet above Mean Sea Level (345' MSL) at the 300 Area forebay, additional samples are collected at "Above 300 Area Spring," "300 Area Spring #1," and occasionally at "300 Area Spring #2" twice a week for NO_3 analysis. Whenever the water level is greater than 345' MSL, no additional samples are collected. During the latter part of 1974, additional samples from 300 Area Spring #1 #2 were collected for U, F, NO_3, and Cu analyses.

Port of Benton — An additional riverbank spring is located upstream of the Port of Benton dock in North Richland. Each month, samples are collected for coliform, enterococci, and BOD analyses. Additional samples are collected for NO_3 analysis if the river water level is less than 345' MSL at the 300 Area forebay.

Table 6 lists the results for the samples collected at the 100-N springs during 1974. Several positive results were observed although all were less than ERDA 0524 standards for uncontrolled areas, as shown in Table 6.

Samples of watercress were collected from two different spring locations during 1974 and the results are shown in Table 7. The vegetation is a potential means of accumulating radionuclides present in the spring water and providing transport of the radionuclides to deer, gamebirds, and potentially to man. Several short-lived radionuclides were observed. Additional data are necessary to provide a more complete description of the levels of radioactivity in vegetation along the riverbank springs.

TABLE 6. Columbia River Water Samples in the Vicinity of the 100-N Area Riverbank Springs - 1974

Concentration Guide[a]	Concentration (10^{-9} μCi/ml)										
	3×10^6	4×10^4	2×10^6	1×10^5	3×10^4	1×10^5	6×10^4	1×10^4	300	2×10^4	1×10^4
Date	^{3}H	^{46}Sc	^{51}Cr	^{54}Mn	^{60}Co	^{65}Zn	$^{95}ZrNb$	^{106}Ru	^{131}I	^{137}Cs	$^{144}CePr$
1-21	2600										
4-15	845										
7-12		<39	<380		<32	<54					
8-23		<41			42	<55		633			
9-30		<24	<280	<14	<19		<12	<300	<34	<22	501
10-10	12,300										
11-14				732	<32	278	273	<430		<29	680
12-5		<24	<290		<19	<39				<22	

No entry indicates no analysis was made.
a. Concentration guides from ERDAM-0524 for uncontrolled areas.

TABLE 7. Selected Radionuclides in Watercress Samples from 100-N Riverbank Springs - 1974

Sample	Concentration (ρCi/ℓ)					
	^{60}Co	^{95}Zr	^{99}Mo	^{103}Ru	^{106}Ru	^{131}I
#1	8.3	5.4	57.2	0.3	2.4	208
#2	0.4	0.04	*	*	*	0.4

Table 8 lists the results for samples collected from the 300 Area riverbank springs and 300 Area forebay. There is definite influx of F , U, and NO_3 into the Columbia River although sufficient dilution occurs before reaching the 300 Area forebay to reduce the levels to background concentrations. With the removal of the process ponds from service during the early part of 1975, in lieu of two recently dug trenches further from the river, the observed levels in the riverbank springs are expected to decrease.

The results of biological analyses of water samples collected at Vernita Bridge, 100-F shoreline, 300 Area Spring #1, and Port of Benton Spring in North Richland are shown in Table 9. Table 10 shows the difference in results for biological measurements of samples collected from the 300 Area leach trench and 300 Area Spring #1.

TABLE 8. Water Samples from 300 Area Riverbank Springs - 1974

Spring Location[a]	Analysis[b]	Concentration Maximum Observed	Concentration Minimum Observed	Average
Above 300 Area	NO_3	12.	<0.5	<2.8
	F^-	0.2	<0.1	<0.1
	Beta[b]	<80	<75	<76
	Alpha	<17	<17	<17
	^3H	1300	<430	<884
	U			<0.005
300 Area #1	NO_3^-	180	<2	<34
	F^-	2.1	0.5	1.5
	Cu	3.	<1.	<1.4
	U	11.	2.2	7.8
	pH	8.0	7.9	8.0
300 Area #2	NO_3^-	46	24	37
	F^-	1.7	1.0	1.4
	Cu	2.	<1.	<1.3
	U	8.	6.	7.
	pH			7.9

(a) Several riverbank springs can be observed along the Hanford reach of the Columbia River depending on the river water level. The first spring sampled is about 1 mile above the 300 Area. The springs listed 2nd and 3rd are directly east of the 300 Area process ponds and sanitary land trench. Spring #2 is observable only during periods of low river flow.

(b) The analyses for springs #1 and #2 were performed by HEDL

TABLE 9. Columbia River Biological Analyses - 1974[a]

	Coliform			Enterococci			BOD		
Standard		240			---			---	
Unit		No./100ml			No./100ml			mg/ℓ	
Sample Location	Obs. Max.	Obs. Min.	Annual Average[b]	Obs. Max.	Obs. Min.	Annual Average	Obs. Max.	Obs. Min.	Annual Average
Vernita Bridge	120	9	43±72	64	3	29±40	4	1	3±2
100-F	100	6	44±66	130	6	43±76	5	1	3±2
300-Area Spring[c]	110	11	51±71	76	8	37±48	5	1	3±2
North Richland	150	4	54±74	194	4	61±98	5	1	3±2

a. Analytical results for monthly grab samples.
b. Average ± 2 sample standard deviations shown.
c. Spring located approximately 1 mile above the 300 Area process ponds.

TABLE 10. Biological Measurements of Samples Collected from the 300 Area Leaching Trench and Associated River Shoreline Seepage Area - 1974

Date	Coliform N/100 ml	Enterococci N/100 ml	BOD mg/ℓ	Turbidity JTU *
		300 Area Leaching Trench		
1/10	1.3×10^6	2.7×10^5	1.2	31
2/13	6.4×10^5	7.2×10^4	4.5	35
3/5	1.0×10^6	2.4×10^4	4.0	31
4/3	1.2×10^6	2.2×10^4	6.5	35
4/30	9.4×10^5	5.5×10^4	4.1	19
6/26	5.8×10^5	7.6×10^4	3.5	32
7/9	1.2×10^6	1.4×10^5	2.8	28
8/6	5.4×10^6	1.3×10^5	3.6	14
9/3	1.4×10^6	1.5×10^5	2.9	18
10/7	1.5×10^6	1.2×10^5	3.2	28
11/12	5.6×10^5	4.1×10^4	5.2	17
12/10	6.8×10^5	5.1×10^5	7.0	18
Average	$(1.4 \pm 2.6) \times 10^6$	$(1.3 \pm 2.7) \times 10^5$	4.0±3.2	26±15.
		River Shoreline Seepage Area		
1/10	11	8	3.0	2
2/13	26	23	2.5	31
3/5	36	29	2.3	14
4/3	26	20	4.9	16
4/30	12	10	3.2	11
6/26	70	68	3.3	10
7/9	110	72	1.2	4
8/6	23	30	2.7	1
9/3	98	76	1.2	5
10/7	51	54	1.9	3
11/12	99	28	2.2	0
12/10	52	30	4.6	0
Average	51±71	37±48	2.8±2.3	8.1±18
		North Richland		
Average	54±74	61±98	2.8±2.1	10±21

*Jackson Turbidity Units

DITCHES, PONDS, AND TRENCHES

Surface water areas on the Hanford Reservation resulting from the disposal of process water were sampled routinely during 1974. Grab samples were collected and analyzed for gross beta, gross alpha, and gamma-emitting radionuclides. In some cases, specific analyses for ^{90}Sr, uranium, and plutonium were done. Chemical analyses were done for 300 Area pond and sanitary leach trench samples. Figure 6 shows the location of the major ditches, ponds, and trenches on the Hanford Reservation sampled during 1974.

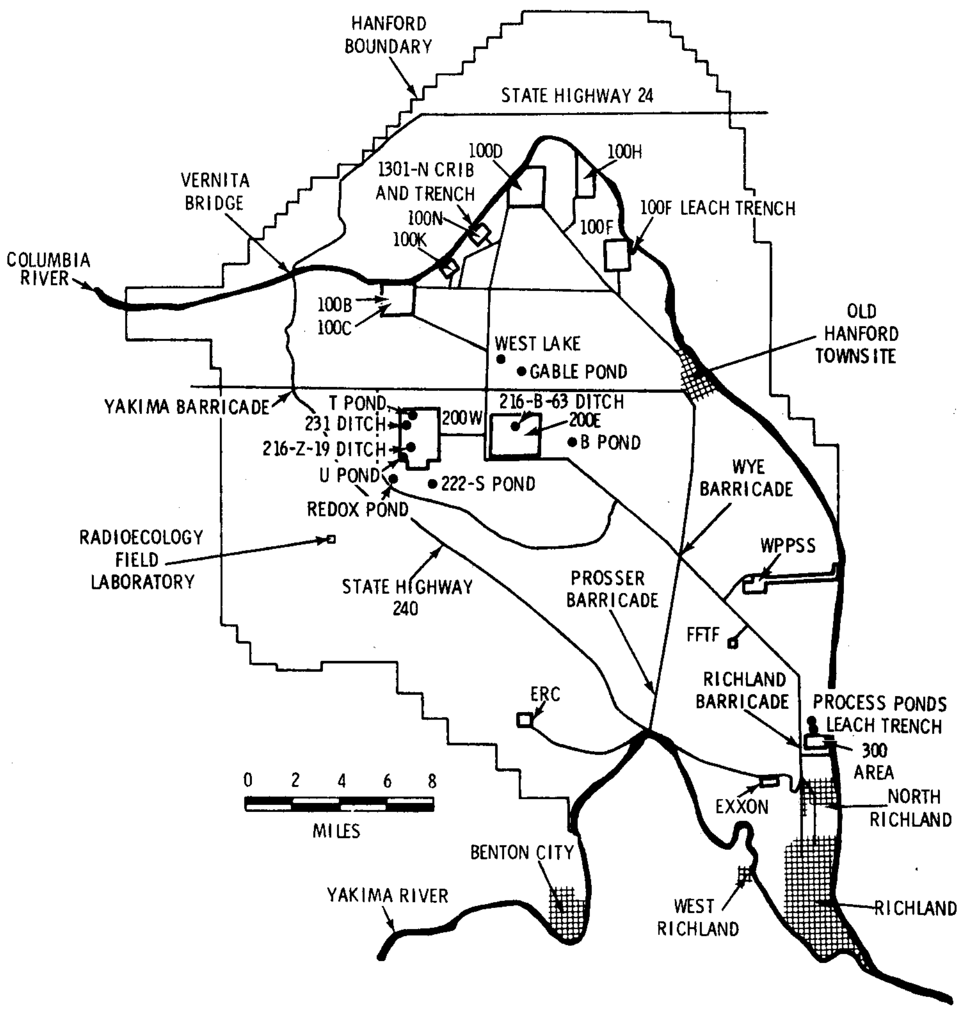

FIGURE 6. Surface Water Areas Sampled During 1974

The results for gross beta, gross alpha, and ^{90}Sr analyses are shown in Figures 7 through 9 for all 200 Area and vicinity surface water areas and the 100-F leach trench. West Lake, a naturally occurring pond in direct contact with the groundwater, had the highest observed levels of gross beta, gross alpha, and ^{90}Sr, with the exception of ^{90}Sr levels in 100-F leach trench. No waste is discharged to West Lake and the cause of the elevated concentrations is not conclusively known but a likely explanation is the concentrating effect of continual evaporation of water from the pond. West Lake serves as a basin for a relatively large watershed area. Uranium (accounting for gross alpha activity), eroded from the soil during the entire history of West Lake's existence, and ^{90}Sr, due to fallout in rainwater, are assumed to have accumulated in the pond. In contrast, the waste discharged to the other ponds has been diluted with river water containing relatively low concentrations of ^{90}Sr and uranium.

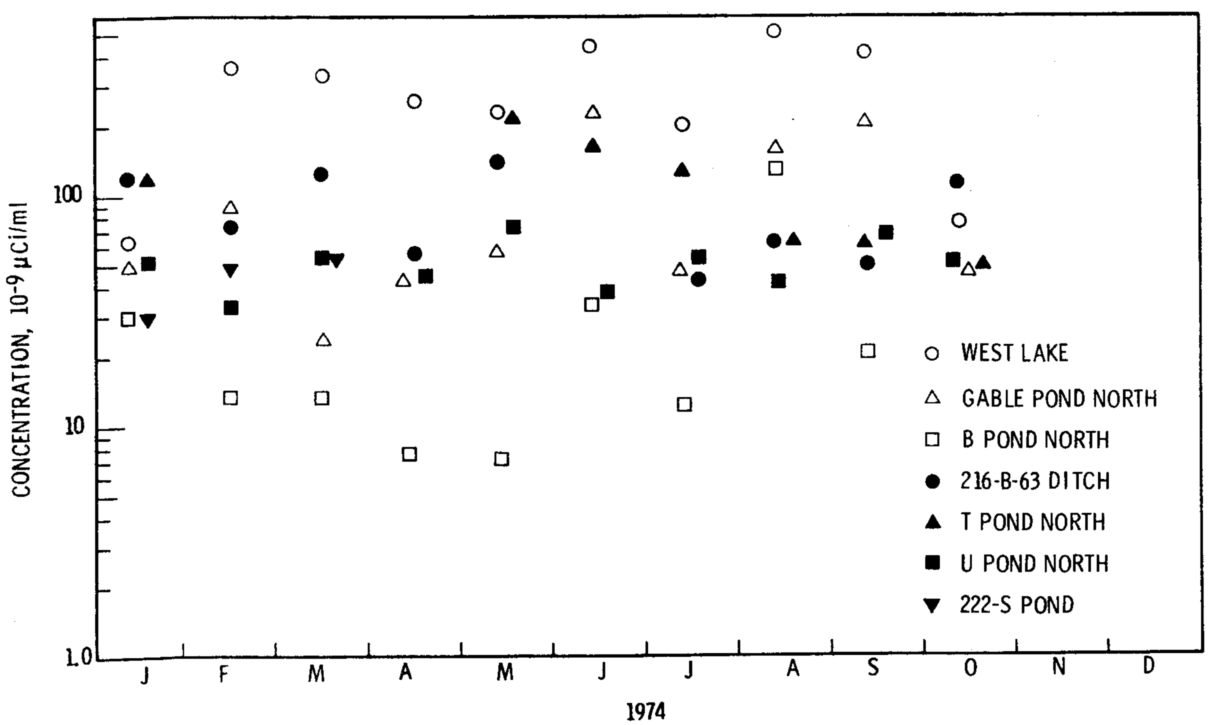

FIGURE 7. Gross Beta Activities Observed in 100 and 200 Area Process Ponds

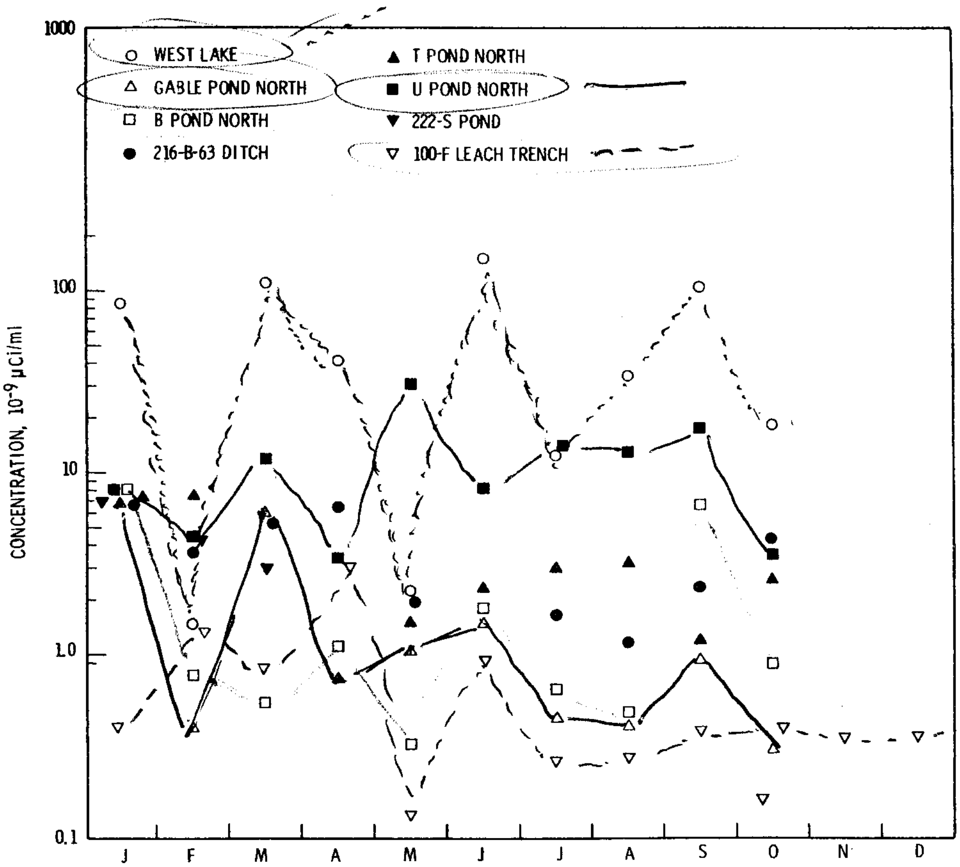

FIGURE 8. Gross Alpha Activities Observed in 200 Area and 100-F Process Ponds

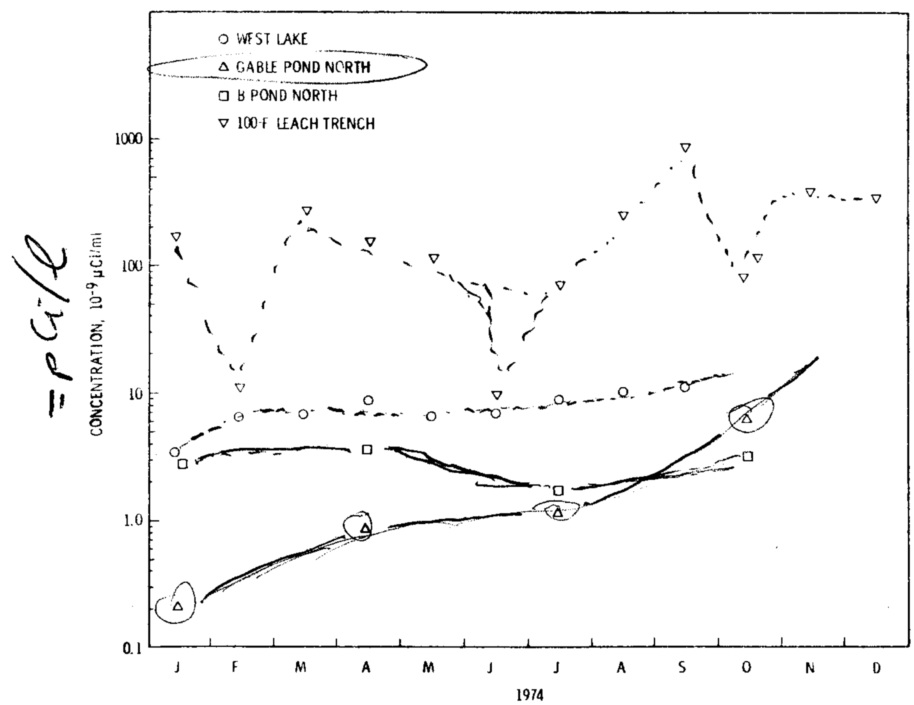

FIGURE 9. Strontium-90 Observed in Selected 100 and 200 Area Process Ponds

The 300 Area process ponds contained the highest observed gross alpha activity of all surface water areas on the Hanford Reservation, as shown in Figure 10 in which weekly results of gross alpha and beta analyses, as well as monthly uranium analyses, are plotted. The gross alpha activity is primarily due to uranium. The levels of gross beta radioactivity were similar to the other ponds.

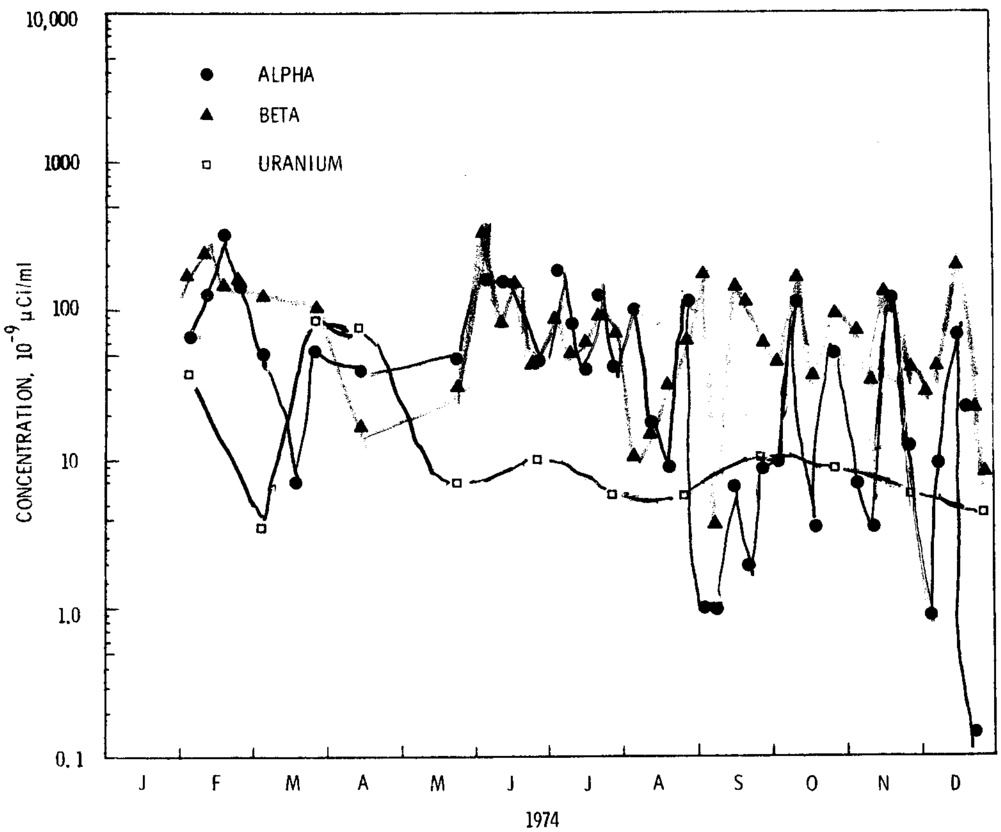

FIGURE 10. Radiochemical Analysis of 300 Area Pond Samples

The results of gamma spectroscopy analysis of pond water samples are shown in Table 11. Only ^{137}Cs in Gable Mountain pond was detected consistently at levels greater than approximately twice the detection limit. ^{60}Co was detected in 300 Area pond water and ^{51}Cr was reported on two occasions but at levels very near the detection limit. All other results were less-than detectable.

TABLE 11. Gamma Activity in Waste Water Samples - 1974

Units of 10^{-9} $\mu Ci/ml$

		Date	^{51}Cr	^{60}Co	^{65}Zn	^{137}Cs
Detection Limit[a]			330	32	55	11
Location						
West Lake		1/18	*	*	*	*
		4/5	*	*	*	*
		7/12	*	*	*	*
		10/11	*	*	*	*
Gable Pond		1/18	*	*	*	*
		4/5	340	*	*	34
		7/12	*	*	*	15
		10/11	*	*	*	43
B Pond		1/18	*	*	*	16
		4/5	350	*	*	*
		7/12	*	*	*	*
		10/11	*	*	*	*
T Pond		1/11	*	*	*	*
		7/12	*	*	*	*
		10/11	*	*	*	*
S Pond		1/11	*	*	*	*
U Pond		1/18	*	*	*	*
		4/5	*	*	*	*
		7/12	*	*	*	*
		10/11	*	*	*	*
216-B-63 Ditch		1/11	*	*	*	*
		4/5	*	*	*	*
		7/12	*	*	*	*
		10/11	*	*	*	*
331 Pond		1/2	*	*	*	*
300 Pond[b]	1/28	2/4	*	*	*	*
	2/4	3/4	*	68	*	*
	3/4	4/8	*	36	*	*
	6/3	7/1	*	*	*	*
	7/1	7/29	*	*	*	*
	7/29	8/26	*	*	*	*
	8/26	9/30	*	*	*	*
	9/30	10/28	*	*	*	*
	10/28	11/25	*	*	*	*
	11/25	12/30	*	*	*	*

*Less than detection limit.

(a) Average detection limit calculated from the detection limits reported for each analysis.

(b) Integrated sample dates shown.

Results of chemical analyses of 300 Area pond and sanitary leach trench samples, as reported by HEDL, are shown in Table 12. In the preceding section (Riverbank Springs) it was noted that influx of F , NO_3, and U were observed along the 300 Area riverbank springs. The levels were diluted to background concentrations before reaching the 300 Area sanitary water forebay.

WILDLIFE

Selected wildlife were collected throughout the Hanford environs as an indicator of radionuclide availability and potential transfer through the food chain. Although the Hanford Reservation south of the Columbia River is not open to hunting, several of the wildlife species collected are game animals and, as such, are potentially subject to hunting during any time spent offsite. Table 13 shows the results of gamma spectroscopy and ^{90}Sr analyses of about 500 gram samples of muscle tissue taken from gamebirds collected during 1974. Ducks were collected from each of the larger trenches or ponds on the Hanford Reservation and along the Columbia River. Cesium-137 was present in the highest concentration and is primarily attributable to Hanford operations.

Table 14 shows the concentrations of uranium and ^{239}Pu observed in liver tissue from ducks collected in 300 Area pond, 100-F trench, and U Pond. Although the data are limited, apparently the elevated concentrations of uranium in the 300 Area pond and ^{239}Pu in U Pond are concentrated in the livers of resident ducks, possibly from ingestion of vegetation growing in the ponds.

In Table 15 the observed levels of selected radionuclides in ducks are classified according to the variety of duck. Apparently, coots are inclined to nest on the ponds whereas the mallards migrate from location to location. During 1974 coots had the highest observed maximum and average concentration of ^{137}Cs. Other duck varieties, including mallards and pintails, had comparable maximum observed levels of ^{137}CS.

TABLE 12. Chemical Analyses of 300 Area Process Water - 1974[a]

Units of ppm

Off Date[b]	Cd	Cl	Cr^{+6}	Cu	F	Fe	NO_3	Pb	SO_4	Zn	Al
300 Area Process Pond (Integrated Samples)											
2/4	*	19	0.18	0.81	1.1	0.06	60	*	39	0.03	
3/4	*	52	*	16.	2.3	0.64	85	*	74	0.04	
3/25	*	6.9	0.23	2.8	0.90	0.58	70	0.05	43	*	
4/8	*	5.3	0.0008	2.2	0.04	0.46	58	0.01	28	0.12	
6/3	*	4.4	0.0048	0.13	0.68	0.09	56	0.006	78	0.01	
7/1	*	3.0	0.008	0.25	0.58	0.05	40	0.02	57	*	
7/29	*	6.0	0.01	0.20	1.3	0.10	24	0.01	23	*	
9/3	0.007	5.0	0.01	0.15	0.72	0.13	70	0.02	22	*	
10/8	*	3.5	*	0.02	*	0.20	25	0.002	23	*	
11/4	0.003	2.5	0.01	0.09	3.4	0.11	72	0.009	24	0.04	
12/2	0.002	2.6	0.004	0.22	0.48	0.08	28	0.007	21	0.02	
12/30	0.004	3.2	0.002	1.4	0.50	0.09	26	1.8	20	0.04	
Average[c]	<0.01	9.4±28	<0.04	2.0±9.0	<1.0	0.22±0.43	51±43	<0.16	35±41	<0.03	
Sanitary Sewage (Grab Samples)											
1/21	*	4.4	*	*	0.13	0.04	1.4	*	22	0.10	0.11
2/19	0.001	6.4	0.002	0.02	0.23	0.18	1.3	*	22	0.16	0.22
3/18	0.001	5.0	0.004	0.04	0.19	0.22	1.7	0.005	28	0.004	0.20
4/15	0.008	6.7	0.01	0.005	0.15	0.19	10	0.01	27	0.03	0.60
5/13	*	4.0	0.006	0.01	0.01	0.13	1.0	0.001	22	0.006	0.003
6/24	*	9.0	0.005	0.01	0.12	0.22	3.0	0.001	22	0.01	
7/22	*	28	0.03	0.02	0.10	0.33	11	0.002	23	0.001	
8/19	*	2.8	*	0.006	0.10	0.20	1.0	0.26	14	0.001	
9/16	0.002	8.0	*	0.001	0.14	0.14	22	0.004	18	0.01	
10/23	0.002	2.0	0.003	0.01	0.07	0.20	1.2	0.07	13	0.001	
11/18	0.01	12	0.001	0.01	0.12	0.06	0.94	0.03	27	0.003	
Average	<0.003	8.0±14	<0.006	<0.01	0.12±0.12	0.17±0.16	5.0±13.	<0.04	22±9.9	0.03±0.10	

a. Analyses performed by HEDL.
b. Date of sample collection tabled. Inclusive dates for integrated sample collection would be from the previous date to the off date.
c. Annual average ±2 sample standard deviations shown if all analyses were positive. Otherwise, a less-than number was calculated from the results, including less-than values.

TABLE 13. Average Radionuclide Concentrations in Muscle of Gamebirds - 1974

Units of 10^{-6} μCi/gm (wet weight)

Location	Species	No. of Samples	^{40}K Maximum Observed	^{40}K Minimum Observed	^{40}K Average	^{60}Co Maximum Observed	^{60}Co Minimum Observed	^{60}Co Average	^{65}Zn Maximum Observed	^{65}Zn Minimum Observed	^{65}Zn Average
Analytical Limit											
300 Pond	Ducks	2	2.3	2.3	2.3±0.003	*	*	*	*	*	*
B Pond	Ducks	3	4.0	*	<3.4	0.10	*	<0.11	*	*	*
100-F Trench	Ducks	2	3.5	*	<3.0	0.29	*	<0.17	*	*	*
West Lake	Ducks	3	2.6	1.6	1.9±1.2	*	*	*	0.27	*	<0.11
Gable Pond	Ducks	5	6.2	*	<3.3	0.43	*	<0.08	*	*	*
U Pond	Ducks	3	3.4	2.5	3.0±0.88	*	*	*	*	*	*
Redox Pond	Ducks	1			1.5			*			*
Columbia River	Ducks	33	3.4	*	<2.2	0.12	*	<0.01	*	*	*
Columbia River	Geese	14	3.4	2.2	2.8±0.79	0.17	*	<0.04	0.19	*	<0.02
100 Areas	Pheasants	15	3.6	*	<2.8	*	*	*	*	*	*

Location	Species	No. of Samples	^{90}Sr Maximum Observed	^{90}Sr Minimum Observed	^{90}Sr Average	^{137}Cs Maximum Observed	^{137}Cs Minimum Observed	^{137}Cs Average
Analytical Limit								
300 Pond	Ducks	2	*	*	*	*	*	*
B Pond	Ducks	3	*	*	*	4.6	4.5	4.6±0.13
100-F Trench	Ducks	2	0.08	0.01	0.05±0.10	*	*	*
West Lake	Ducks	3	*	*	*	5.6	1.9	4.0±3.8
Gable Pond	Ducks	5	0.30	*	<0.06	170	10.	66 ±130
U Pond	Ducks	3	0.02	*	<0.007	43	8.5	29 ±36
Redox Pond	Ducks	1			0.0007			120
Columbia River	Ducks	33	0.009	*	<0.003	0.07	*	0.01
Columbia River	Geese	14				0.21	*	<0.04
100 Areas	Pheasants	15	*	*	*	*	*	*

* Less than the analytical limit.
No entry indicates no analysis was made.

TABLE 14. Average Concentrations of Selected Radionuclides in the Livers of Waterfowl Samples in the Hanford Environs - 1974

Units of 10^{-6} μCi/gm (wet weight)

Analytical Limit		U			^{239}Pu		
Location	No. of Samples	Maximum Observed	Minimum Observed	Average	Maximum Observed	Minimum Observed	Average
300 Pond	1			0.68			*
100-F Trench	2				*	*	*
U Pond	3				0.22	0.003	0.12±0.22

* Less than the analytical limit.
No entry indicates no analysis was made.

TABLE 15. Selected Radionuclides from Muscle of Waterfowl Samples Taken from Ponds in the Hanford Environs - 1974

Units of 10^{-6} μCi/gm (wet weight) = pCi/gm

		^{40}K			^{60}Co			^{65}Zn		
Duck Variety	Samples	Max. Obs.	Max. Obs.	Average	Max. Obs.	Min. Obs.	Average	Max. Obs.	Min. Obs.	Average
Mallard	10	3.5	*	2.4	0.29	*	<0.04	0.27	*	*
Coot	4	6.2	*	4.5	*	*	*	*	*	*
Gadwall	1			1.9			0.10			*
Scaup, Lesser	1			1.6			*			*
Pintail	1			3.9			*			*
Grn Winged Teal	1			*			0.43			*
Shoveler	1			3.0			*			*

		^{90}Sr			^{137}Cs		
Duck Variety	Samples	Max. Obs.	Min. Obs.	Average	Max. Obs.	Min. Obs.	Average
Mallard	10	0.08	*	<0.01	121	*	<24.
Coot	4	0.02	*	<0.01	174	4.6	55±160
Gadwall	1			*			4.5
Scaup, Lesser	1			*			1.9
Pintail	1			*			75.
Grn Winged Teal	1			0.30			10.
Shoveler	1			*			8.5

* Less than the analytical limit.
No entry indicates no analysis was made.

Conservatively assuming that an individual consumed 500 grams of duck meat containing the highest levels of ^{90}Sr and ^{137}Cs observed during 1974, a 50-year internal dose commitment of 4.8 mrem to the whole body and 5.5 mrem to the bone would be incurred. Greater than 95% of the dose would be due to ^{137}Cs so that the majority of the dose would be received during the first year after ingestion (^{137}Cs biological half-times; Body, 70 days; Bone, 140 days).

Samples of muscle and liver tissue from "road-kill" deer on the Hanford Reservation were analyzed for radioactivity. The results are shown in Table 16. The observed radioactivity is assumed to be due to Hanford operations, probably through the drinking of water from one of the ponds. Assuming an individual consumed 50 pounds of deer meat containing 2 pCi/g of ^{137}Cs, a 50-year internal dose of 2.8 mrem to the whole body and 3.4 mrem to the bone would be incurred.

TABLE 16. Concentration of Several Radionuclides in Deer - 1974

Units of 10^{-6} μCi/gm (wet weight)

Location	Date	Tissue	^{40}K	^{65}Zn	^{90}Sr	$^{95}ZrNb$	^{137}Cs	^{239}Pu
100-H	1/11	Muscle	2.3	*	*	*	*	
		Liver						0.0004
Gable Pond	11/21	Muscle	2.2	*	*	0.32	1.8	
		Liver						0.0002
Rt 11A Mi8	12/17	Muscle	2.2	*	*	*	1.1	
		Liver						0.0001

* Less than the analytical limit.
No entry indicates no analysis was made.

Small mammals, such as mice or rabbits, are collected around sources of drinking water or potential sources of salt on the Hanford Reservation. The results are shown in Table 17. The highest levels observed were in mice collected from around the 1301-N trench. The mesh of the screening over the trench is sufficiently large that mice can pass through easily. Rabbits were collected from the B-C Crib burial ground. The highest observed ^{90}Sr concentration occurred in samples of bone.

TABLE 17. Concentration of Selected Radionuclides in Small Animals - 1974

Units of 10^{-6} µCi/gm

Date	Location	^{40}K	^{51}Cr	^{54}Mn	^{58}Co	^{59}Fe	^{60}Co	^{65}Zn	^{90}Sr	^{95}Nb	^{95}Zr	^{99}Mo
Mice												
6/11	200-W U Plant	*	*	*	*	*	*	*	8.0	*	*	*
10/24	200-E Purex Chem Sewer	*	*	*	*	*	*	*	0.91	*	*	*
11/5	100-N Trench	17	*	400	*	99	390	68	54.	73	94	93
11/12	U Pond	*	*	*	*	*	0.4	1.1	4.1	*	*	*
12/17	100-N Trench	*	*	3,800	*	5,800	3,400	*	20	*	*	*
12/31	100-N Trench	*	3,900	2,400	1,500	32,000	30,000	*	89	12,000	23,000	*
12/31	U Pond	*	*	*	*	*	*	*	0.97	*	*	*

Date	Location	^{103}Ru	^{106}Ru	^{131}I	^{134}Cs	^{137}Cs	^{140}BaLa	^{141}Ce	^{144}CePr	^{239}Np	^{239}Pu	U
Mice												
6/11	200-W U Plant	*	*	*	*	13.	*	*	*	*	0.25	0.77
10/24	200-E Purex Chem Sewer	*	*	*	*	*	*	*	*	*	*	
11/5	100-N Trench	56	40	54	80	860	*	110	70	980		
11/12	U Pond	*	*	*	*	160	*	*	*	*	0.11	0.01
12/17	100-N Trench	*	*	1,400	*	940	23,000	*	15,000	*		
12/31	100-N Trench	2,900	5,000	6,000	880	1,700	790	4,100	6,400	*		
12/31	U Pond	*	*	*	*	2.9	*	*	*	*		

Date	Location	^{40}K	^{60}Co	^{65}Zn	^{90}Sr	^{137}Cs	^{239}Pu
Rabbits							
2/25	B/C Crib (Muscle)	3.1	*	*		1.9	
	(Bone)				220		
2/25	B/C Crib (Muscle	2.6	0.09	*		5.5	
	(Bone)				220		
2/25	B/C Crib (Muscle)	2.7	*	*		2.0	
	(Bone)				78		
4/11	B/C Crib (Muscle)	3.5	*	*		0.48	
	(Bone)				0.14		
	(Liver)						*
8/29	B/C Crib (Muscle)	2.3	*	*		*	
	(Bone)				0.47		
	(Liver)						*

* Less than the analytical limit.
No entry indicates no analysis was made.

SOIL AND VEGETATION

Surface soil and perennial vegetation samples were collected from 26 different locations during the autumn of 1974 for the purpose of measuring the levels of radioactivity due to fallout and natural causes as well as to assess any potential buildup of radioactivity from Hanford operations. These locations are shown in Figure 11 and the results listed in Tables 18 and 19. Each soil sample represents the composite of five "plugs" of soil from an approximate 10 m^2 area. Each plug was approximately 2.5 centimeters (1 inch) in depth and 10 centimeters (4 inches) in diameter. The vegetation samples were collected in the immediate vicinity of each soil sampling location and consisted of perennial vegetation, primarily the new growth from rabbitbrush plants. Both sets of samples were analyzed for gamma-emitting radionuclides using a lithium drifted germanium detector, for plutonium nuclides using alpha spectroscopy, and for ^{90}Sr and uranium by specific analysis.

Figure 12 is a log-normal probability plot of the ^{239}Pu results for both soil and vegetation. A W-test[3] of the soil data indicates that the data follow a log-normal distribution with a confidence of 68% (normal distribution .02%). The apparent straight line characteristic of the data in Figure 12 indicates that all of the data represent the same population. Therefore, for the locations sampled, the levels of ^{239}Pu in both soil and vegetation apparently result from fallout ^{239}Pu; contributions from Hanford operations have not detectibly increased these levels.

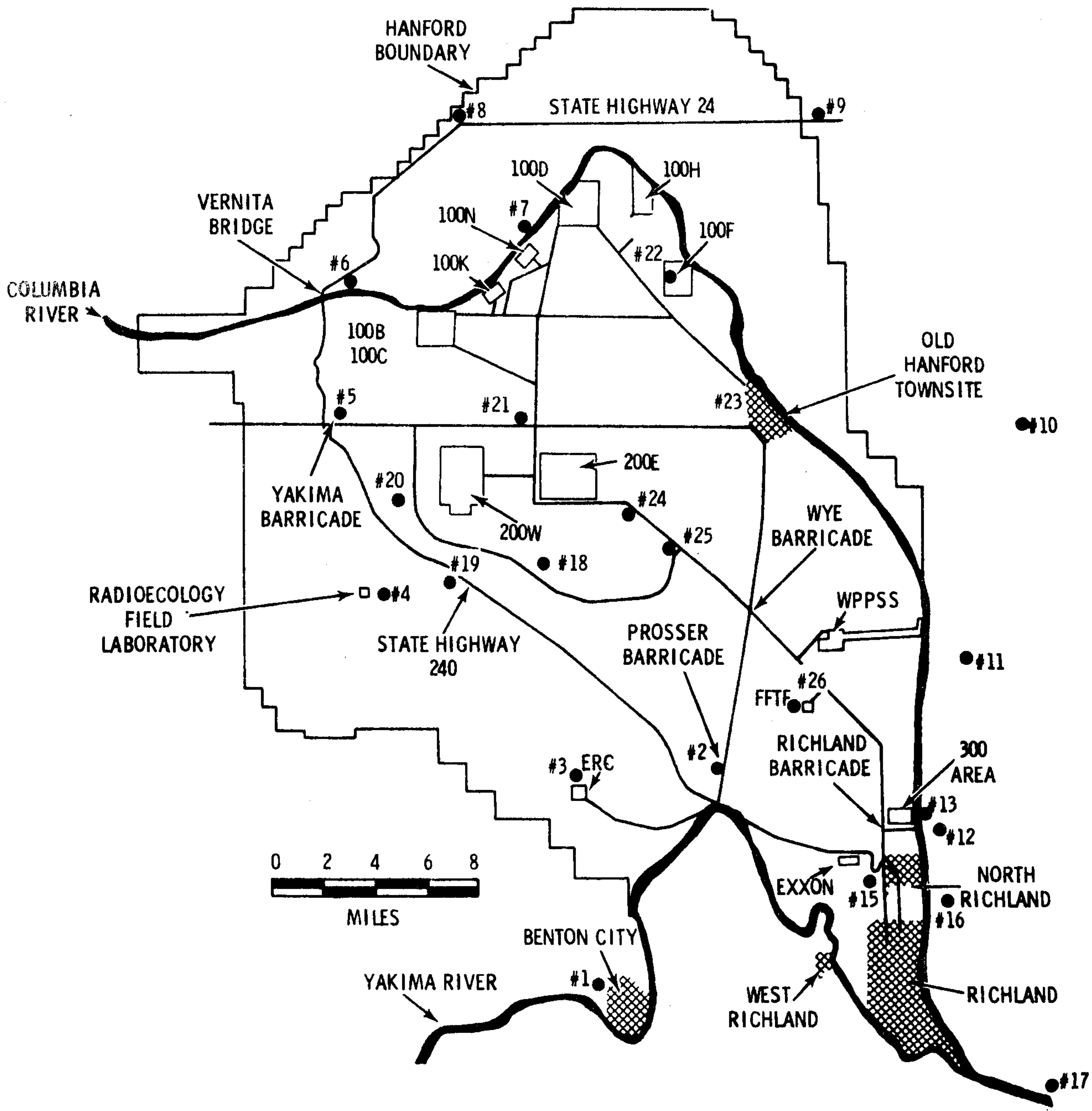

FIGURE 11. Surface Soil and Perennial Vegetation Sampling Locations During 1974

TABLE 18. Concentration of Radionuclides in Vegetation - 1974

Units of 10^{-6} μCi/gm (dry weight)

Sample Location	Map Location	Naturally Occurring Radionuclides		Artificially Produced Radionuclides											
		K-40	U-total	Co-58	Co-60	Zn-65	Sr-90	ZrNb-95	RuRh-106	I-131	Cs-137	BaLa-140	CePr-144	Pu-238	Pu-239,240
Onsite															
Prosser Barricade	2	9.0	*	*	*	0.80	0.04	0.28	*	*	0.18	14.	*	*	*
ERC	3	13.	0.12	*	*	0.98	0.02	0.14	*	*	0.13	14.	*	0.003	0.001
Radioecology Field Lab	4	9.0	*	*	*	0.52	0.05	0.28	*	*	0.16	11.	0.58	*	0.003
Yakima Barricade	5	8.5	*	0.67	*	0.36	0.05	1.1	*	*	0.09	7.7	*	*	0.002
300 Area South Gate	14	11.	0.21	*	*	0.63	0.17	0.52	*	*	0.4	10.	2.2	*	0.005
C P #40	18	8.3	*	*	*	0.51	0.03	0.24	*	*	0.12	11.	*	*	0.002
C P #54	19	9.7	*	*	*	0.45	0.06	0.18	*	*	0.11	9.7	*	*	0.002
C P #60	20	11.	0.05	*	*	0.96	0.03	0.11	*	*	0.13	17.	*	*	*
C P #59	21	18.	0.06	*	*	1.4	0.08	0.40	*	*	0.62	16.	*	*	0.002
C P #58	22	6.4	*	*	*	0.60	0.06	0.30	*	*	0.18	12.	1.0	*	*
Hanford Shoreline	23	5.7	0.01	*	*	0.17	0.02	0.14	*	*	0.09	3.9	0.95	0.001	0.009
C P #61	24	11.	*	*	*	0.98	0.03	0.46	*	*	0.52	13.	0.69	*	0.002
4 S & Army Loop Rd	25	12.	*	*	*	0.94	0.26	1.4	*	*	0.32	13.	0.85	*	0.002
FFTF	26	13.	*	*	*	0.86	0.06	0.29	*	*	0.17	12.	*	*	0.002
Avr.±2 sample deviations		10±6.2	<0.04	*	*	0.73±0.64	0.07±0.13	0.42±0.75	*	*	0.23±0.34	12±6.7	<0.34	<0.0004	<0.002
Offsite															
Benton City	1	10.	0.19	*	*	0.63	0.06	0.78	*	*	0.10	7.9	*	*	0.002
Vernita	6	11.	*	*	*	0.77	0.06	1.3	*	*	0.24	14.	1.2	*	0.001
Wahluke Slope	7	9.6	0.05	*	*	0.76	0.03	0.37	*	*	0.12	15.	0.98	*	*
Wahluke #2	8	11.	0.08	*	*	0.80	0.13	0.30	*	*	0.15	17.	*	*	0.001
Berg Ranch	9	11.	0.16	*	*	0.84	0.06	0.22	*	*	0.12	15.	*	*	0.003
Cooke Bros.	10	20.	0.23	*	*	1.8	0.04	0.13	*	*	0.12	29.	2.3	*	*
Baxter Substation	11	18.	0.34	*	*	1.3	0.14	0.14	*	*	0.10	20.	*	*	0.002
Byers Landing	12	10.	7.2	*	*	0.79	0.02	0.30	*	*	0.19	11.	0.52	*	0.002
Byers Pumphouse	13	11.	*	*	*	1.0	0.02	4.0	*	*	0.46	15.	*	*	0.001
North Richland	15	8.4	0.09	*	*	0.43	0.07	0.26	*	*	0.13	8.8	0.51	*	0.004
Island #340	16	4.7	0.32	*	*	*	0.12	0.31	1.3	*	0.15	3.6	1.0	0.002	0.02
Riverview	17	10.	0.22	*	*	0.45	0.06	0.32	*	*	0.14	9.7	0.41	*	0.002
Avr.±2 sample deviations		11±8.1	<0.74	*	*	<0.80	0.07±0.08	0.70±2.2	*	*	0.17±0.20	14±13	<0.38	<0.0004	<0.003

* Less than detection limit.
a. Average ±2 sample standard deviations shown if radionuclide detected at all locations. Otherwise, a less-than number is calculated from the positive results.

TABLE 19. Concentrations of Radionuclides in Surface Soil - 1974

Units of 10^{-6} μCi/gm (dry weight)

Sample Location	Map Location	Naturally Occurring Radionuclides				Artificially Produced Radionuclides											
		K-40	Ra-224	Ra-226	U-total	Co-58	Co-60	Zn-65	Sr-90	Zr-95	NB-95	RuRh-106	Cs-134	Cs-137	CePr-144	Pu-238	Pu-239-240
Onsite																	
Prosser Barricade	2	14	0.9	0.5	0.1	*	0.04	0.2	0.48	0.2	0.1	0.7	0.06	0.9	*	*	0.010
ERC	3	13	1.0	0.7	0.7	0.02	*	0.2	0.02	0.3	*	0.4	0.05	0.1	0.13	*	0.002
Radioecology Field Lab	4	12	0.7	0.5	0.3	*	*	0.1	0.34	0.1	*	0.5	0.06	1.0	0.32	*	0.018
Yakima Barricade	5	14	0.8	0.7	0.1	*	*	*	0.01	0.1	*	0.5	*	0.1	0.62	*	0.003
300 Area South Gate	14	14	0.5	0.6	0.7	0.03	0.05	0.3	0.12	*	*	0.6	*	1.5	0.25	*	0.022
C. P. #40	18	17	0.6	0.6	0.2	0.03	*	0.2	0.01	*	0.1	0.6	0.04	0.2	*	*	0.005
C. P. #54	19	12	0.7	0.5	0.2	*	*	*	0.05	0.2	*	0.7	*	0.4	0.39	*	0.013
C. P. #60	20	11	0.6	0.5	0.3	*	*	0.2	0.31	0.2	*	0.6	*	0.5	0.24	*	0.028
C. P. #59	21	14	0.9	0.8	0.1	*	0.03	0.2	0.76	0.2	*	0.6	0.06	2.9	0.37	*	0.050
C. P. #58	22	13	0.8	0.6	0.3	*	0.05	0.2	0.32	0.2	*	0.6	*	0.6	0.31	*	0.014
Hanford Shoreline	23	16	1.1	0.8	0.4	*	0.05	*	0.15	*	*	0.6	*	2.1	0.55	*	0.006
C. P. #61	24	11	0.7	0.6	0.1	0.04	*	0.3	0.10	*	*	0.7	*	1.5	*	*	0.017
4S. & Army Loop Rd	25	15	0.7	0.4	0.4	*	0.07	*	0.09	*	*	0.6	*	0.7	*	*	*
FFTF	26	12	1.0	0.5	0.9	*	0.06	0.3	0.02	*	*	0.9	*	0.1	0.23	*	0.003
Avr.±2 sample deviations		13±4	0.8±0.4	0.6±0.2	0.3±0.5	<0.02	<0.03	<0.02	0.2±0.4	<0.1	<0.1	0.6±0.2	<0.03	0.9±1.7	<0.25	*	<0.014
Offsite																	
Benton City	1	13	1.4	0.8	0.3	*	*	0.2	0.78	*	*	0.74	*	1.7	*	*	0.037
Vernita	6	18	0.8	0.5	0.1	*	*	*	0.03	0.2	*	0.7	*	0.1	0.33	*	0.004
Wahluke Slope	7	14	0.7	0.5	0.2	*	*	*	0.03	*	*	0.6	0.04	0.1	0.19	*	0.004
Wahluke #2	8	13	5.9	0.9	0.1	*	*	0.1	0.02	0.2	*	0.9	*	0.2	*	*	0.013
Berg Ranch	9	13	1.4	0.7	0.1	*	*	0.2	0.05	0.3	*	0.4	0.12	0.5	0.11	*	0.007
Cooke Bros.	10	13	0.6	0.6	0.4	*	*	0.2	0.06	*	*	0.5	*	0.1	0.44	*	0.003
Baxter Substation	11	16	0.7	0.5	0.4	0.04	*	0.2	0.06	0.3	*	0.5	0.05	0.3	0.34	0.01	0.004
Byers Landing	12	12	1.0	0.5	0.4	*	*	0.4	0.25	0.1	*	0.5	0.06	0.7	0.20	*	0.006
Byers Pumphouse	13	12	0.9	0.5	0.6	*	0.07	0.2	0.38	0.2	0.1	0.7	*	1.9	0.44	*	0.023
North Richland	15	14	0.9	0.7	0.3	0.03	*	0.2	0.26	*	*	1.0	*	0.5	0.16	*	0.007
Island #340	16	12	0.8	0.8	0.4	*	2.37	0.2	0.08	0.3	0.2	0.6	0.04	0.9	0.17	*	0.043
Riverview	17	13	0.6	0.3	0.4	*	0.04	0.3	0.04	0.1	*	0.4	0.06	0.1	*	*	0.002
Avr.±2 sample deviations		14±3.6	1.3±2.9	0.6±0.3	0.3±0.3	<0.02	<0.21	<0.5	0.17±0.45	<0.2	<0.1	0.6±0.4	<0.04	0.8±1.4	<0.20	<0.002	0.013±0.028

* Less than detection limit.
a. Average ±2 sample standard deviations shown if radionuclide detected at all locations. Otherwise, a less-than number is calculated from the positive results.

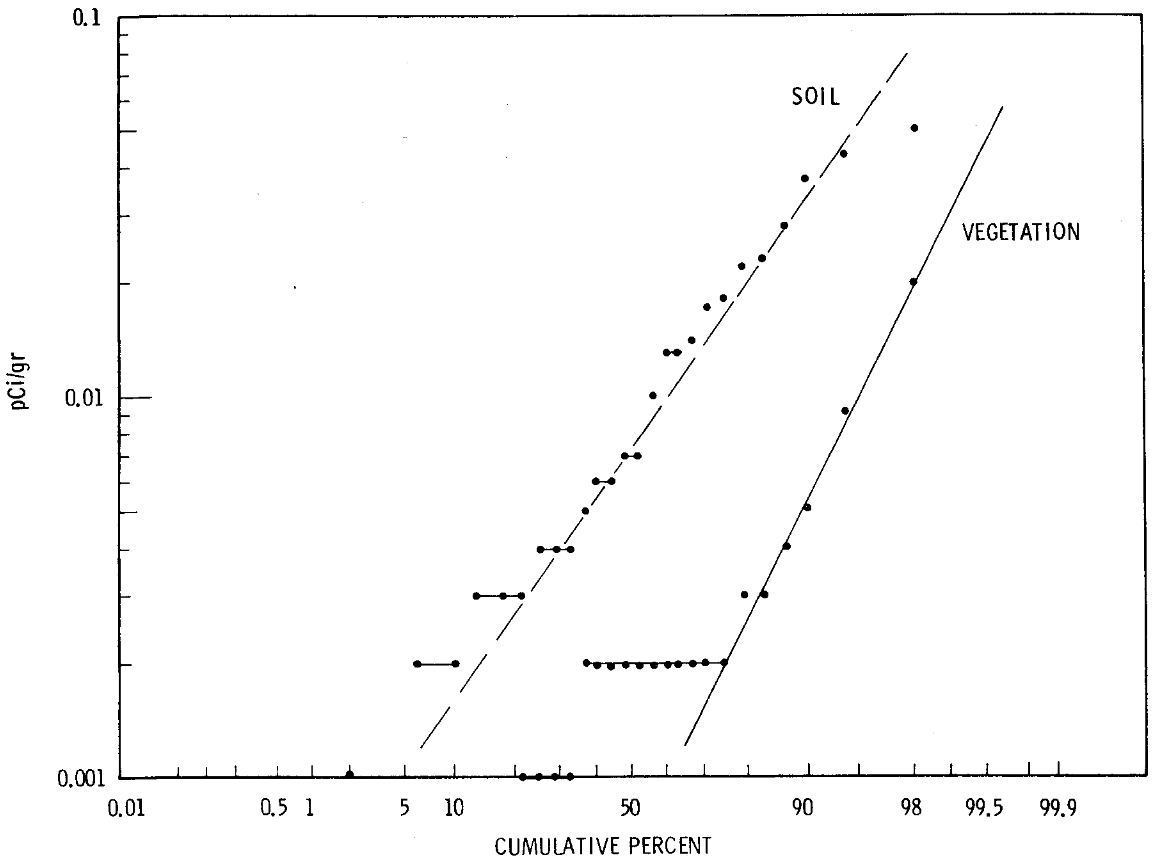

FIGURE 12. Log-Normal Probability Plot of ^{239}Pu Concentration in Soil and Perennial Vegetation Samples During 1974.

COLUMBIA RIVER SEDIMENT

Subsequent to the ARMS survey along the Columbia River [5] during the spring of 1974 in which elevated levels of ^{60}Co were observed, samples of sediment on the islands were taken for spectrometric analysis. The results are shown in Table 20. A comparison of the average concentrations of the different radionuclides observed on the islands with the concentrations observed in surface soil reveals that the island samples were higher for all radionuclides, including naturally occurring radionuclides. Additional sediment samples collected during the spring of 1975 will allow a better description of the extent and magnitude of the elevated levels as compared to background levels.

TABLE 20. Island Soil Samples - 1974

Units of 10^{-6} μCi/gm (dry weight)

Sample Location[a]	Naturally Occurring Radionuclides			Artificially Produced Radionuclides							
	K-40	Ra-224	Ra-226	Mn-54	Cr-51	Co-60	Zn-65	RuRh-106	Cs-137	Eu-152	Eu-154
Island #348	16.	0.7	0.7	0.3	0.5	10.	3.0	2.9	3.6	6.7	1.5
Island #345	18.	3.5	1.2	0.5	*	11.	0.7	3.4	2.6	5.1	1.5
Island #344	16.	2.1	0.8	0.3	0.2	6.	1.3	1.7	2.7	6.7	1.0
Island #342	18.	6.1	1.0	0.2	*	3.	0.4	1.1	1.8	2.6	0.6
Island #341	16.	4.1	1.0	0.4	*	6.	1.4	2.0	1.9	2.9	0.6
Island #340	19.	4.4	0.7	0.3	*	7.	2.4	2.3	2.4	4.3	2.1
Island #333	18.	4.3	0.6	0.3	*	1.	0.6	1.5	1.1	1.1	0.3
Island #332	19.	5.0	0.6	0.2	0.1	4.	1.1	1.6	1.4	1.7	0.7
Maximum	19.	6.1	1.2	0.5	0.5	11.	3.0	3.4	3.6	6.7	2.1
Minimum	16.	0.7	0.6	0.2	*	1	0.4	1.1	1.1	1.1	0.3
Average ± 2 sample standard deviations[b]	18±3	3.8±3.4	0.8±0.4	0.3±0.2	<0.3	6±7	1.4±1.8	2.1±1.5	2.2±1.6	3.9±4.3	1.0±1.2

* Less than detectable.
a. River mile of island used as identification.
b. Average ± 2 sample standard deviations shown if radionuclide detected at all locations. Otherwise, a less-than number is shown.

EXTERNAL RADIATION

Thermoluminescent dosimeters (TLDs) were used to measure the external dose at several onsite, perimeter, and distant locations. Table 21 shows the results of these measurements. The dosimeter employed consisted of 3 chips of CaF_2:Dy (Harshaw TLD-200) encased in an opaque plastic capsule lined with 0.010" of tantalum and 0.002" of lead to flatten the lower energy response.(6) The dosimeters were mounted approximately one meter above ground level and changed either biweekly or monthly.

The external dose measured at any location is affected by several parameters, including the height of the dosimeter, elevation, and the amount of natural, fallout, and potentially Hanford origin radioactivity in the underlying soil. The variability in measured dose from the different locations was expected primarily because of the spatial dependence of natural radioactivity in soil. Figure 13 is a log-normal probability plot of the annual average dose for each location divided into two groups: onsite and offsite stations. Both groups represent straight line plots although the elevated doses measured around the 200 Areas do not lie on the line, as expected. According to the straight line plot for perimeter and distant stations, contributions from Hanford operations at perimeter stations were indiscernible from the variability in background dose measured at the distant stations.

TABLE 21. Ambient Radiation Dose - January-December 1974[a]

Location	No. of[b] Measurements	Dose (mrad/yr)[c] Maximum	Minimum	Average
Onsite Stations				
200 ENC	27	370	270	330±55
200 ESE	27	88	69	80± 9
200 EWC	27	88	69	77±11
200 EEC	27	100	84	95±10
200 WEC	27	130	69	84±25
Redox	27	110	73	95±18
200 WWC	27	130	106	120±18
200 WNE	27	91	69	80±11
3705 Bldg.	27	88	55	77±14
ACRMS	27	98	69	84±14
300 Pond	27	95	69	88±15
300 SW Gate	27	84	69	77± 8
300 South Gate	27	80	58	73±10
331 Bldg.	13	73	58	69± 9
C.P. #63	13	88	69	77±10
C.P. #64	14	73	58	66±10
C.P. #65	14	77	62	69± 9
C.P. #66	14	80	62	73±10
C.P. #67	14	84	55	65±14
Wahluke C.P. #17	14	88	69	79±11
Wahluke C.P. #18	14	84	69	76±10
Wahluke C.P. #19	14	84	66	74±10
Wahluke C.P. #20	14	88	69	79±12
Wahluke C.P. #21	14	84	69	76± 9
Wahluke C.P. #22	14	91	66	77±15
Wahluke C.P. #23	14	84	66	75±12
Wahluke C.P. #24	14	88	69	79±13
Wahluke C.P. #46	14	88	51	79±21
100-K	26	88	58	75±12
WPPSS-100-N	26	124	77	96±22
100-D	13	88	66	76±13
100 Area Fire Station	15	91	62	72±14
Rt. 10 mi. 1.6	13	77	58	69±11
FFTF Site	14	77	58	71± 9
FFTF North	14	80	66	73±10
FFTF Southeast	14	77	58	70± 9
Prosser Barricade	13	84	66	74±11
100-F	26	102	58	79±16
Hanford	13	77	58	66±11
Wye Barricade	13	80	66	71±10
Rattlesnake Springs	13	80	66	72±11
ERC	13	88	69	80±11
Yakima Barricade	13	88	69	78±11
Wahluke #2	13	84	66	78±12
Average ± 2 sample standard deviations				83±78
Perimeter Stations				
Eltopia	11	69	55	62± 9
Pasco	14	80	66	73± 9
Richland	27	80	55	66±14
Vernita	15	116	69	84±22
Benton City	13	66	55	62± 9
Othello	14	73	55	62± 9
Connell	14	73	55	66±11
Berg Ranch	14	95	69	80±15
Wahluke Wm	14	84	66	77±12
Cooke Bros.	14	77	55	69±13
Ringold	11	69	55	62±17
Baxter Sub.	13	77	44	66±18
Byers Landing	14	88	69	77±11
Average ± 2 sample standard deviations				70±15
Distant Stations				
Ellensburg	10	66	44	51±13
Walla Walla	13	80	62	73±10
Sunnyside	14	69	55	66± 9
McNary	14	80	62	73±11
Moses Lake	14	73	58	66± 7
Washtucna	14	84	58	69±13
Average ± 2 sample standard deviations				66±16

a. Total background dose from external irradiation would include an additional dose from the neutron component of cosmic radiation. At the Hanford elevation, this additional dose is estimated from EPA publication ORP/SID 72-1 to be 6 mrem/year.

b. Dosimeters are generally deployed on a 2-week or 4-week interval. This practice results in approximately 13 or 26 separate measurements at each location. There is some variability because of scheduling and year-to-year overlap.

c. Monthly or biweekly measurements converted to equivalent annual dose. Average ±2 sample standard deviations calculated for each location.

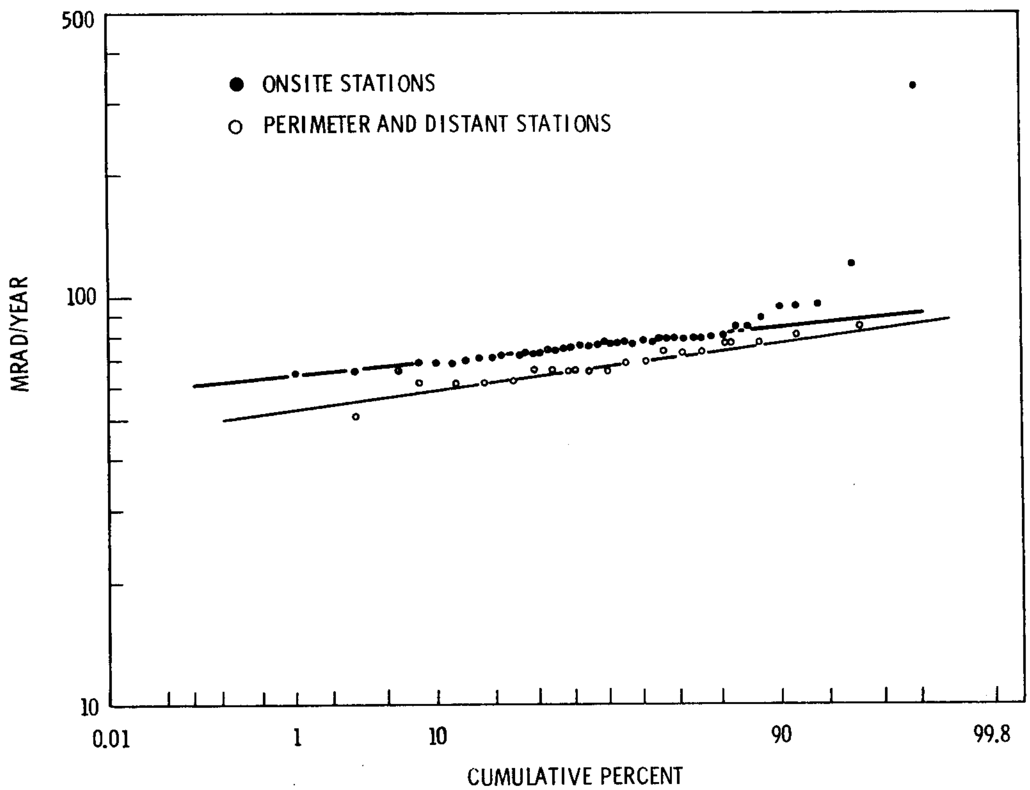

FIGURE 13. Log-Normal Probability Plot of Onsite and Offsite TLD Data During 1974

Specific locations of TLDs stationed around each facility area (100-N, 200-E, etc.) are shown in Appendix A. In general, all dosimeters are located on the perimeter of each area. The dosimeter located at 100-N is used to estimate the potential dose received by WPPSS personnel. The annual difference between the dose recorded at the 100-N station (96 mrem) and a background dose of 70 mrem/yr is 26 mrem based on continuous occupancy. Assuming a 40-hour work week for 50 weeks per year reduces this dose to approximately 6 mrem/yr or 1.2% of the Radiation Protection Guide (500 mrem) for nonoccupationally exposed individuals.

From the information in Table 21 the external background dose from natural radioactivity received by the population in the Hanford environs can be estimated. The average measured dose and 95% confidence interval were about 70±15 mrem/year (1 mrem equals 1 mrad in this case). To this number, an additional 6 mrem/year must be added to account for the neutron component of cosmic radiation.[7] Thus an estimate of the total (external plus internal) background dose must include the approximate 25 mrem/year received from radioactivity, primarily ^{40}K, in human bodies.[8] Therefore, the average total background dose received from natural radioactivity in the Hanford environs is approximately 100±15 mrem/year. A realistic breakdown of the doses due to different sources of natural background radiation is shown in Table 22. An additional dose, approximately 4 mrem/year, must be added to account for the dose, primarily internal, due to fallout radionuclides.[8]

TABLE 22. Background Dose Received in the Hanford Environs from Natural Causes

		millirem/year	
External Irradiation:			75
Terrestrial		33	
Cosmic:	ionizing component	36	
	Neutron component	6	
Internal Irradiation:[a]			25
^{40}K		17	
^{14}C		1	
^{210}Po		3	
^{222}Rn		3	
Other (^{3}H, ^{87}Rb)		1	
TOTAL			100

(a) Adopted from U. S. Environmental Protection Agency Publication ORP/CSD 72-1[8]

RADIATION SURVEYS

Hanford Roads Survey

Hanford roads were routinely surveyed with a bioplastic scintillation detector attached to the front end of a truck and positioned about 0.6 meters (2 ft.) above the road surface. This road monitor has been described in BNWL-62.[9] Most traveled roads within the Hanford Reservation were surveyed monthly. During 1974, no conditions were detected which required corrective action.

Railroad Survey

All Hanford railroad tracks outside area fences were surveyed semi-annually with the previously described road survey detector attached to a railroad maintenance car. No conditions were detected in 1974 which required corrective action.

Control Plots

Small areas, called control plots, are located within the Hanford boundaries (Figure 14). These plots, measuring 3.05 m by 3.05 m (10x10 ft) were surveyed monthly or semi-monthly with a GM survey meter for deposited radioactive material. In addition, 22 special control plots located near test wells were surveyed on a semi-annual basis. All control plots showed only background measurements for 1974.

Waste Disposal Sites

Active, inactive, and retired waste disposal sites were surveyed during 1974 and inspected for general physical condition and evidence of disturbance. The sites were generally in good order, with the most recurring problem being housekeeping--primarily vegetation growing inside the waste sites. Radiation levels were noted during each survey and, if unusual, reported to responsible contractor representatives for corrective action.

Aerial Surveys

Aerial surveys can be used to detect contamination which is spread over a large land area. Although Hanford aerial surveys have been only comparative from year to year, through routine use a capability for rapid assessment of an emergency situation is maintained. Aerial surveys are conducted at an

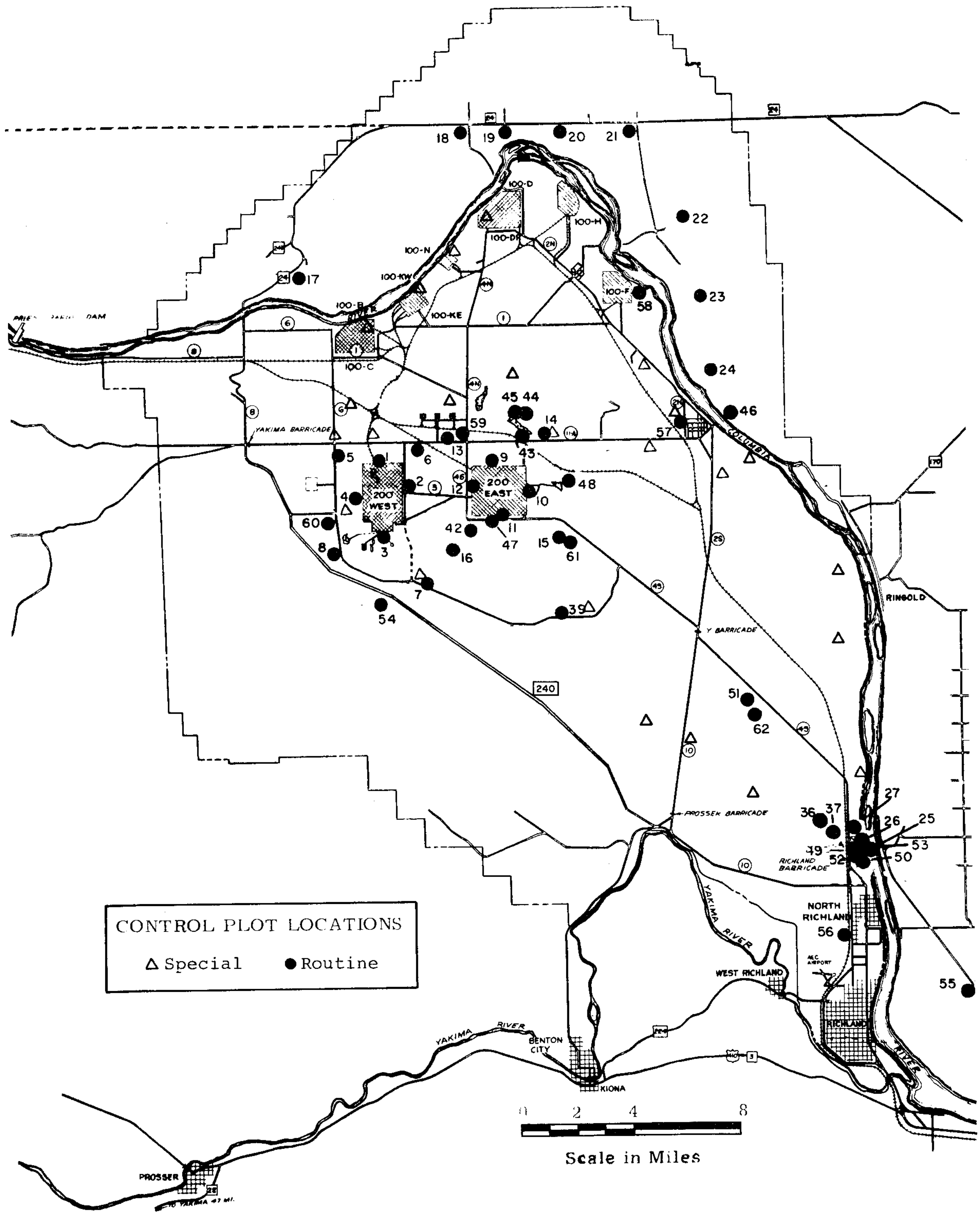

FIGURE 14. Control Plot Locations

altitude of 150 meters (500 ft) using a 3-inch by 5-inch NaI (Tl) scintillation crystal detector. During October of 1974, three flight patterns were flown:

1) the perimeter of the Hanford Reservation
2) the Columbia River from Vernita Bridge to Plymouth
3) a pattern parallel to the perimeter of the Hanford Reservation but 15 to 20 air miles distant.

No significant differences from previous measurements were observed.

ACKNOWLEDGMENT

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APPENDIX A

SPECIFIC SAMPLING LOCATIONS AROUND HANFORD FACILITIES

100-K
100-N
100-D
100-H
100-F
200-W
200-E
300 Area
300 Area
3000 Area

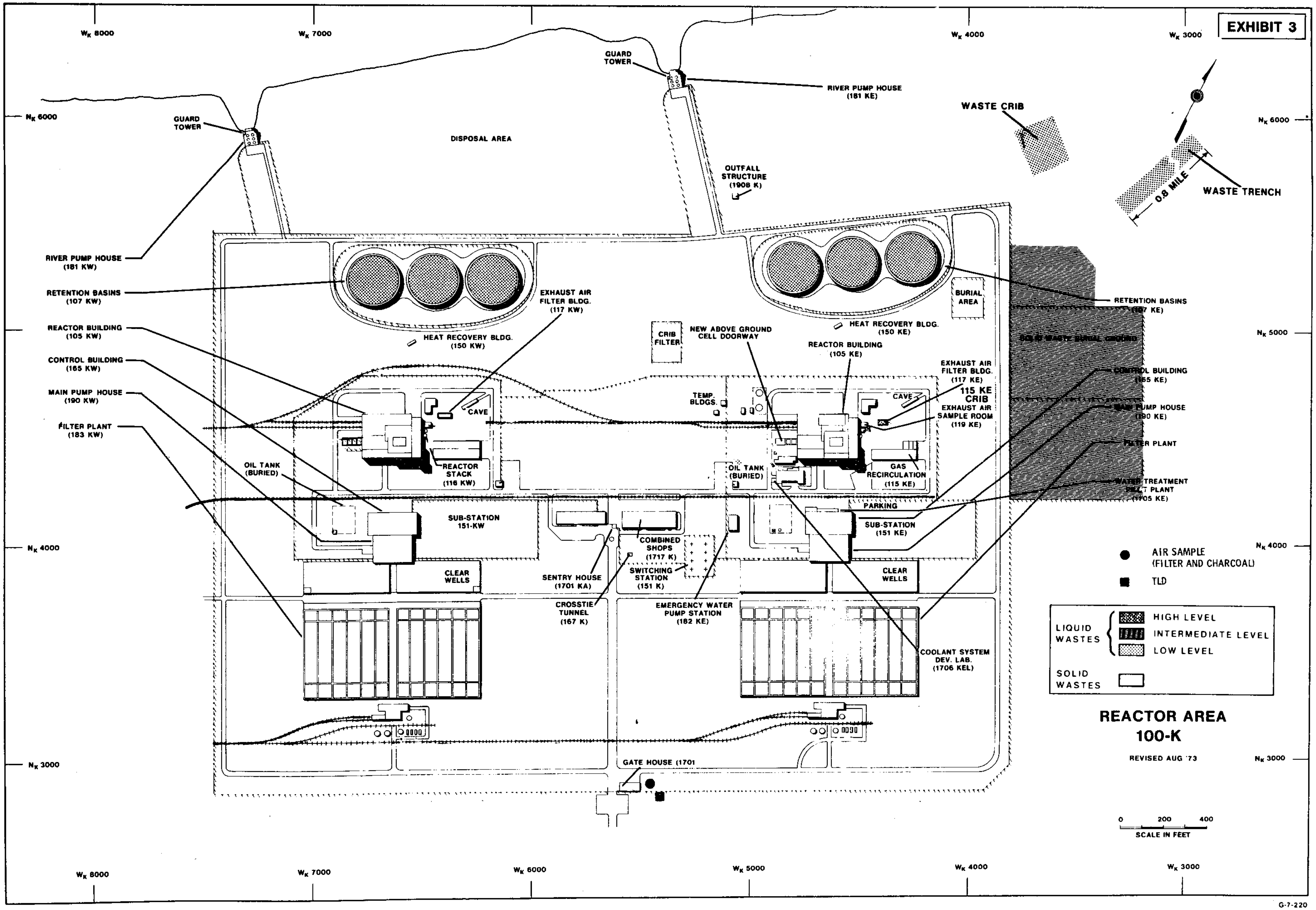


EXHIBIT 3
REACTOR AREA
100-K
REVISED AUG '73
AIR SAMPLE (FILTER AND CHARCOAL)
TLD
LIQUID WASTES
HIGH LEVEL
INTERMEDIATE LEVEL
LOW LEVEL
SOLID WASTES
0 200 400
SCALE IN FEET
WASTE CRIB
WASTE TRENCH
0.8 MILE
GUARD TOWER
RIVER PUMP HOUSE (181 KE)
DISPOSAL AREA
OUTFALL STRUCTURE (1908 K)
RIVER PUMP HOUSE (181 KW)
RETENTION BASINS (107 KW)
REACTOR BUILDING (105 KW)
CONTROL BUILDING (165 KW)
MAIN PUMP HOUSE (190 KW)
FILTER PLANT (183 KW)
EXHAUST AIR FILTER BLDG. (117 KW)
HEAT RECOVERY BLDG. (150 KW)
CAVE
REACTOR STACK (116 KW)
OIL TANK (BURIED)
SUB-STATION 151-KW
CLEAR WELLS
CRIB FILTER
NEW ABOVE GROUND CELL DOORWAY
TEMP. BLDGS.
SENTRY HOUSE (1701 KA)
COMBINED SHOPS (1717 K)
SWITCHING STATION (151 K)
CROSSTIE TUNNEL (167 K)
EMERGENCY WATER PUMP STATION (182 KE)
GATE HOUSE (1701
RETENTION BASINS (107 KE)
BURIAL AREA
HEAT RECOVERY BLDG. (150 KE)
REACTOR BUILDING (105 KE)
EXHAUST AIR FILTER BLDG. (117 KE)
115 KE CRIB
EXHAUST AIR SAMPLE ROOM (119 KE)
GAS RECIRCULATION (115 KE)
PARKING
SUB-STATION (151 KE)
CLEAR WELLS
COOLANT SYSTEM DEV. LAB. (1706 KEL)
SOLID WASTE BURIAL GROUND
CONTROL BUILDING (165 KE)
MAIN PUMP HOUSE (190 KE)
FILTER PLANT
WATER TREATMENT PILOT PLANT (1705 KE)
W_K 8000
W_K 7000
W_K 6000
W_K 5000
W_K 4000
W_K 3000
N_K 6000
N_K 5000
N_K 4000
N_K 3000
G-7-220

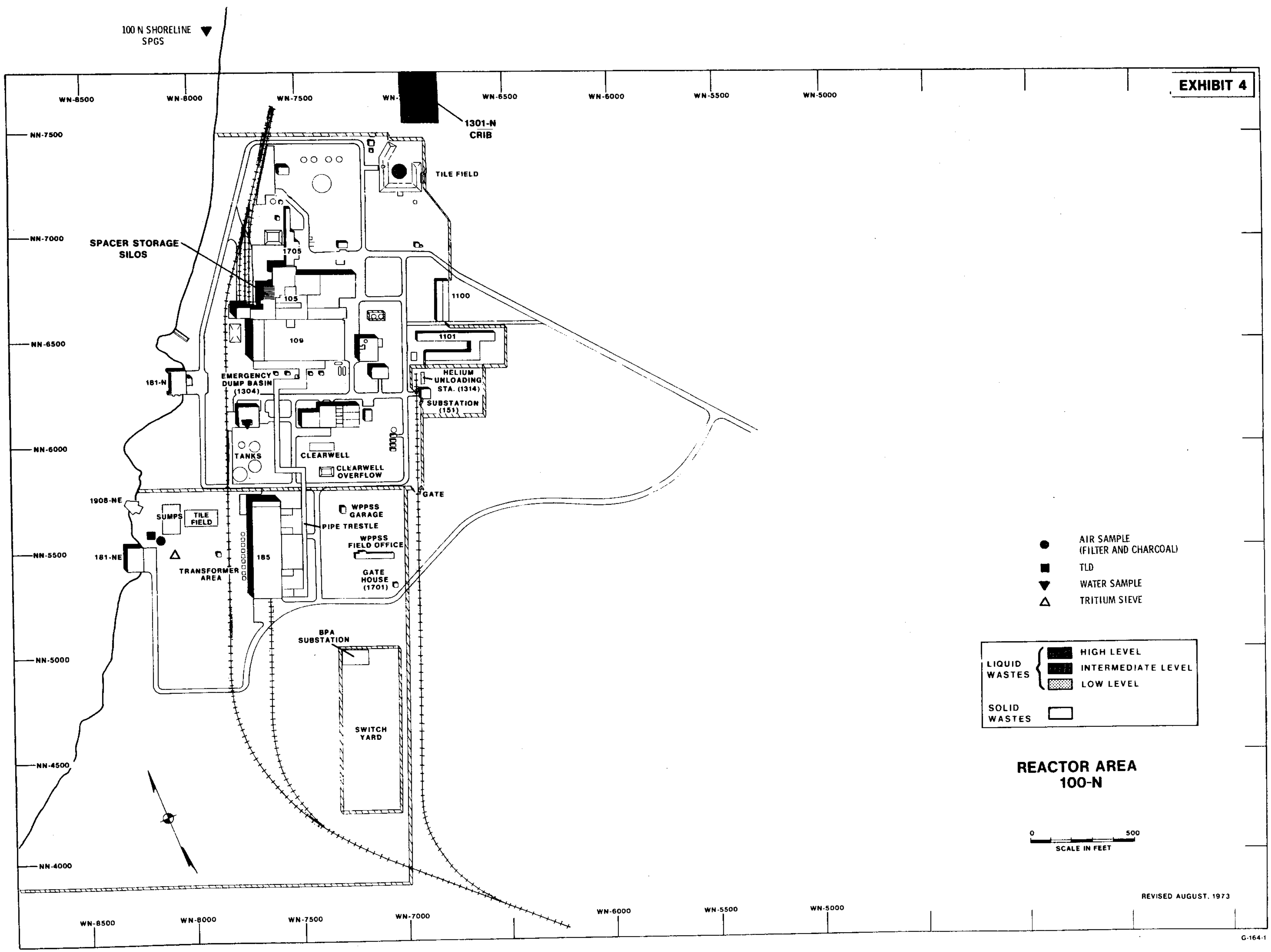
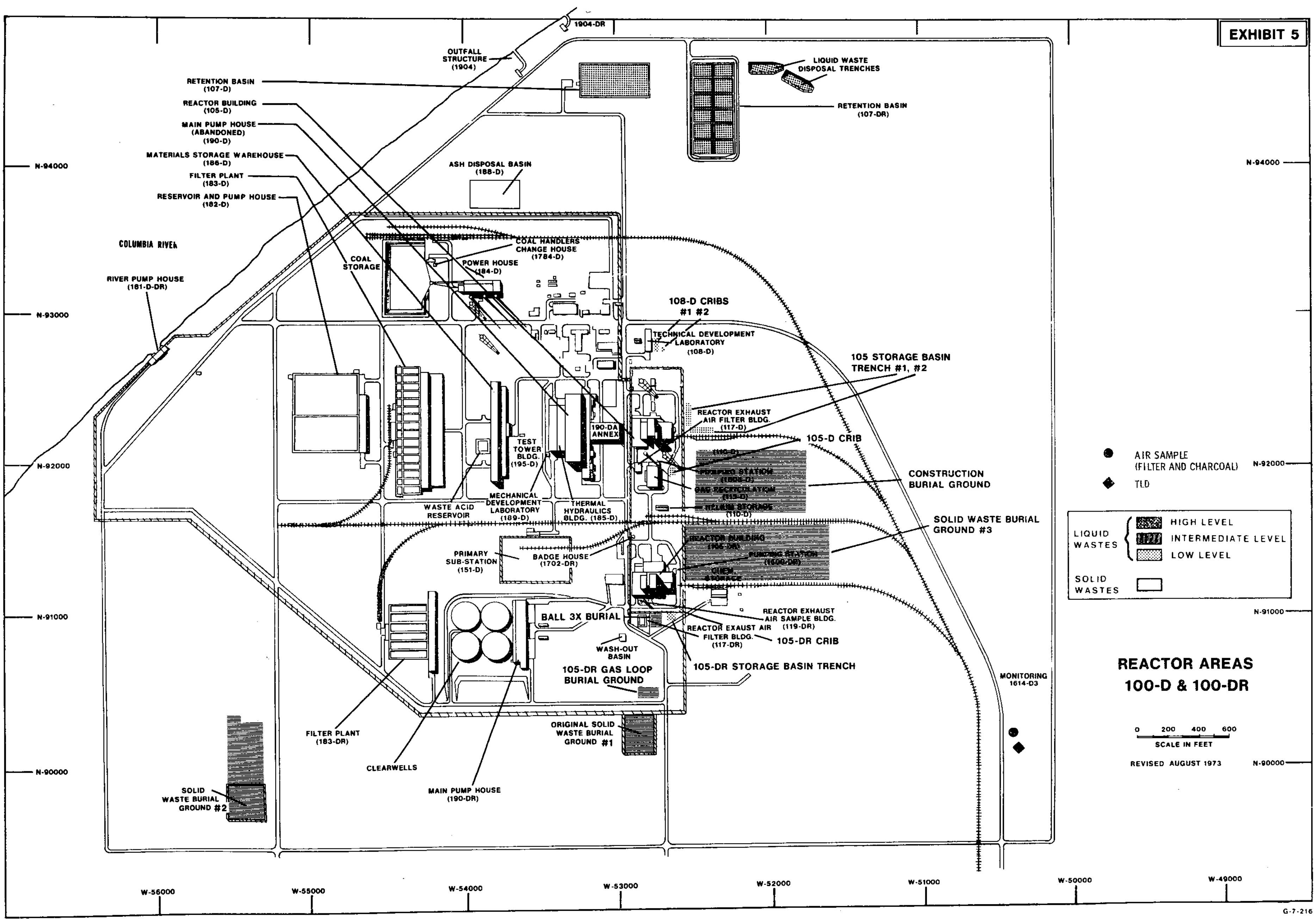


EXHIBIT 4
100 N SHORELINE SPGS
1301-N CRIB
TILE FIELD
SPACER STORAGE SILOS
1705
105
1100
109
1101
181-N
EMERGENCY DUMP BASIN (1304)
HELIUM UNLOADING STA. (1314)
SUBSTATION (151)
TANKS
CLEARWELL
CLEARWELL OVERFLOW
GATE
1908-NE
SUMPS
TILE FIELD
WPPSS GARAGE
PIPE TRESTLE
WPPSS FIELD OFFICE
181-NE
185
TRANSFORMER AREA
GATE HOUSE (1701)
BPA SUBSTATION
SWITCH YARD
AIR SAMPLE (FILTER AND CHARCOAL)
TLD
WATER SAMPLE
TRITIUM SIEVE
LIQUID WASTES
HIGH LEVEL
INTERMEDIATE LEVEL
LOW LEVEL
SOLID WASTES
REACTOR AREA 100-N
0
500
SCALE IN FEET
REVISED AUGUST, 1973
G-164-1
WN-8500
WN-8000
WN-7500
WN-6500
WN-6000
WN-5500
WN-5000
WN-7000
NN-7500
NN-7000
NN-6500
NN-6000
NN-5500
NN-5000
NN-4500
NN-4000

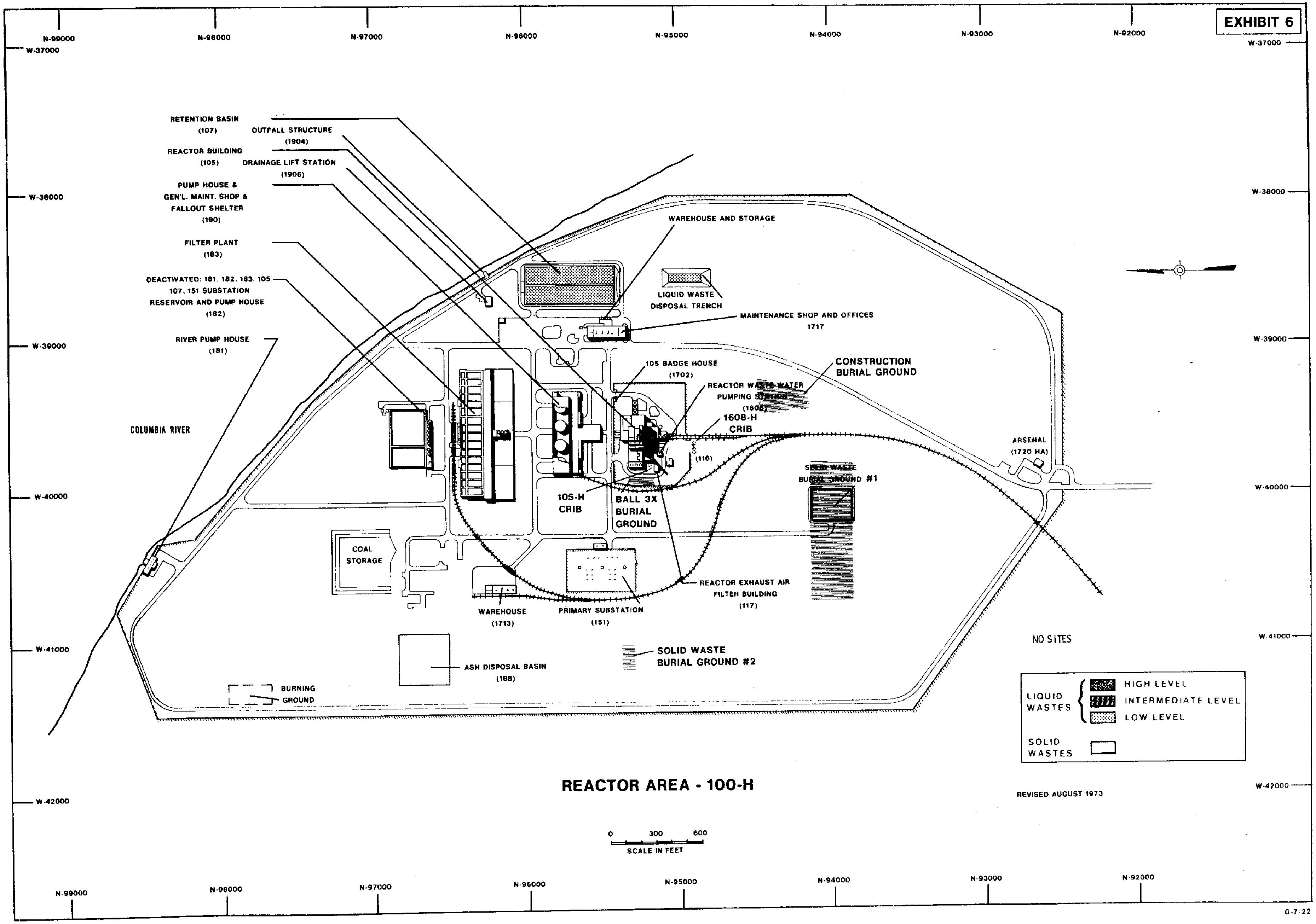
EXHIBIT 5



REACTOR AREAS
100-D & 100-DR

G-7-216

EXHIBIT 6



REACTOR AREA - 100-H

REVISED AUGUST 1973

G-7-22

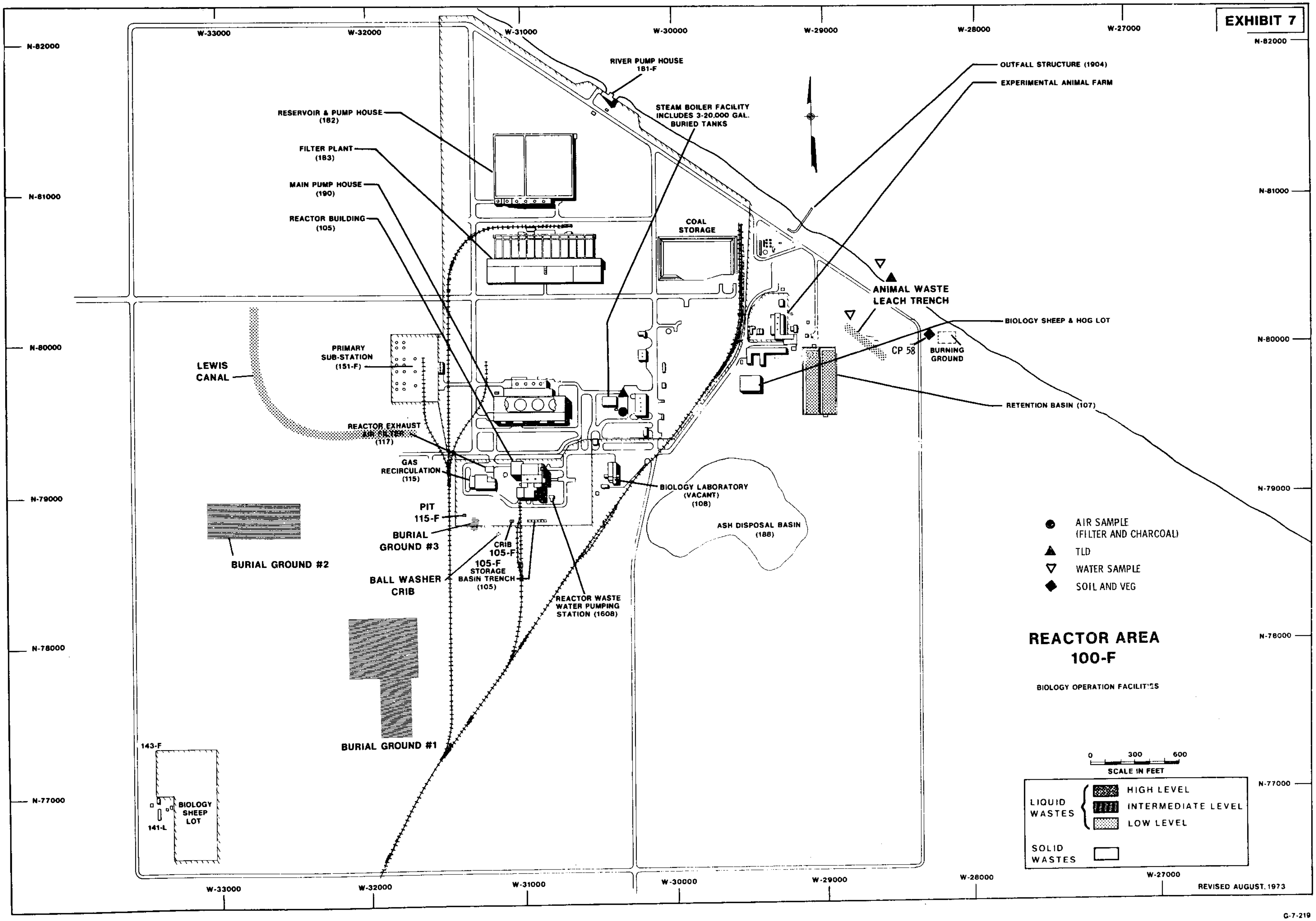
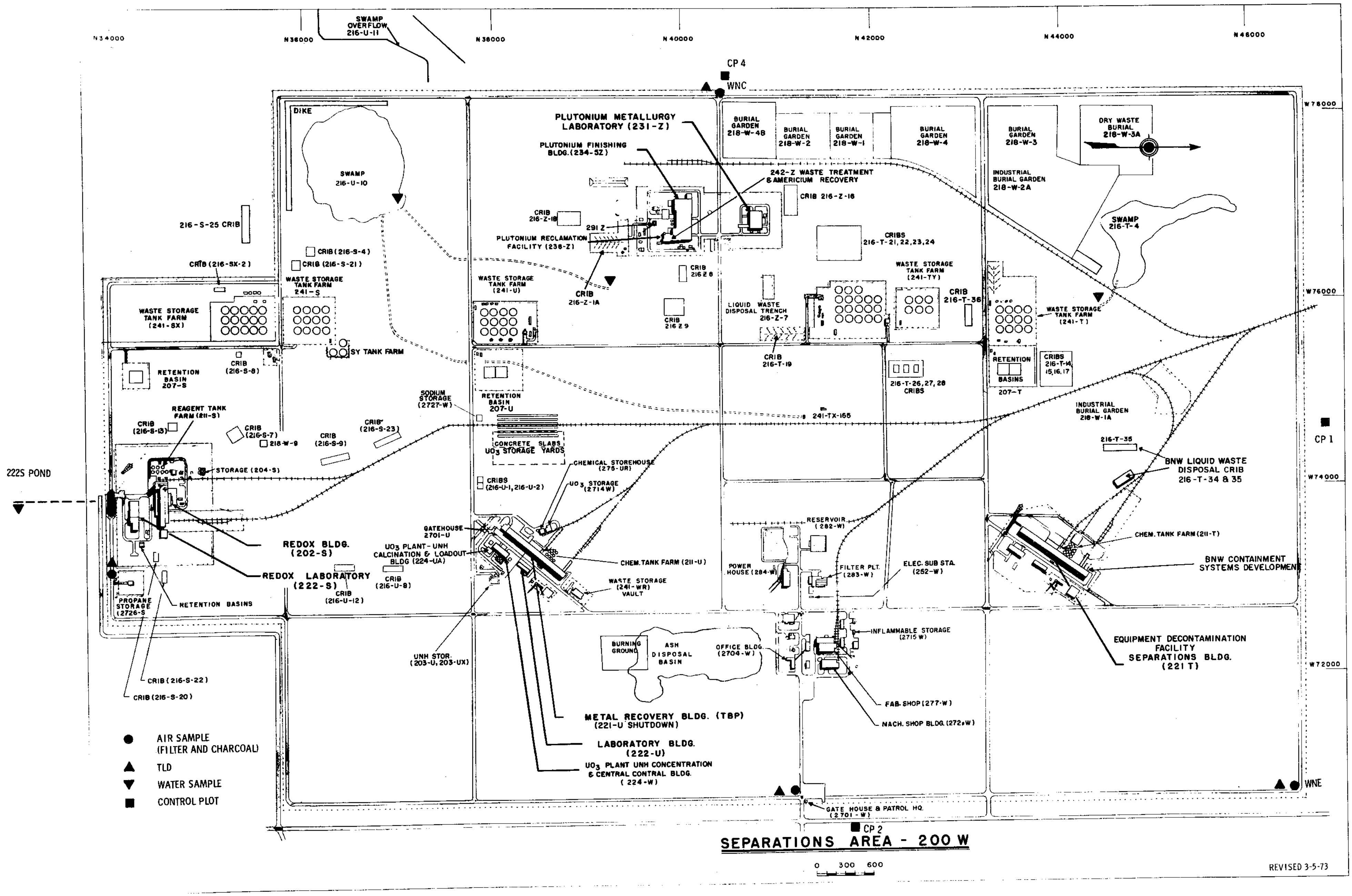
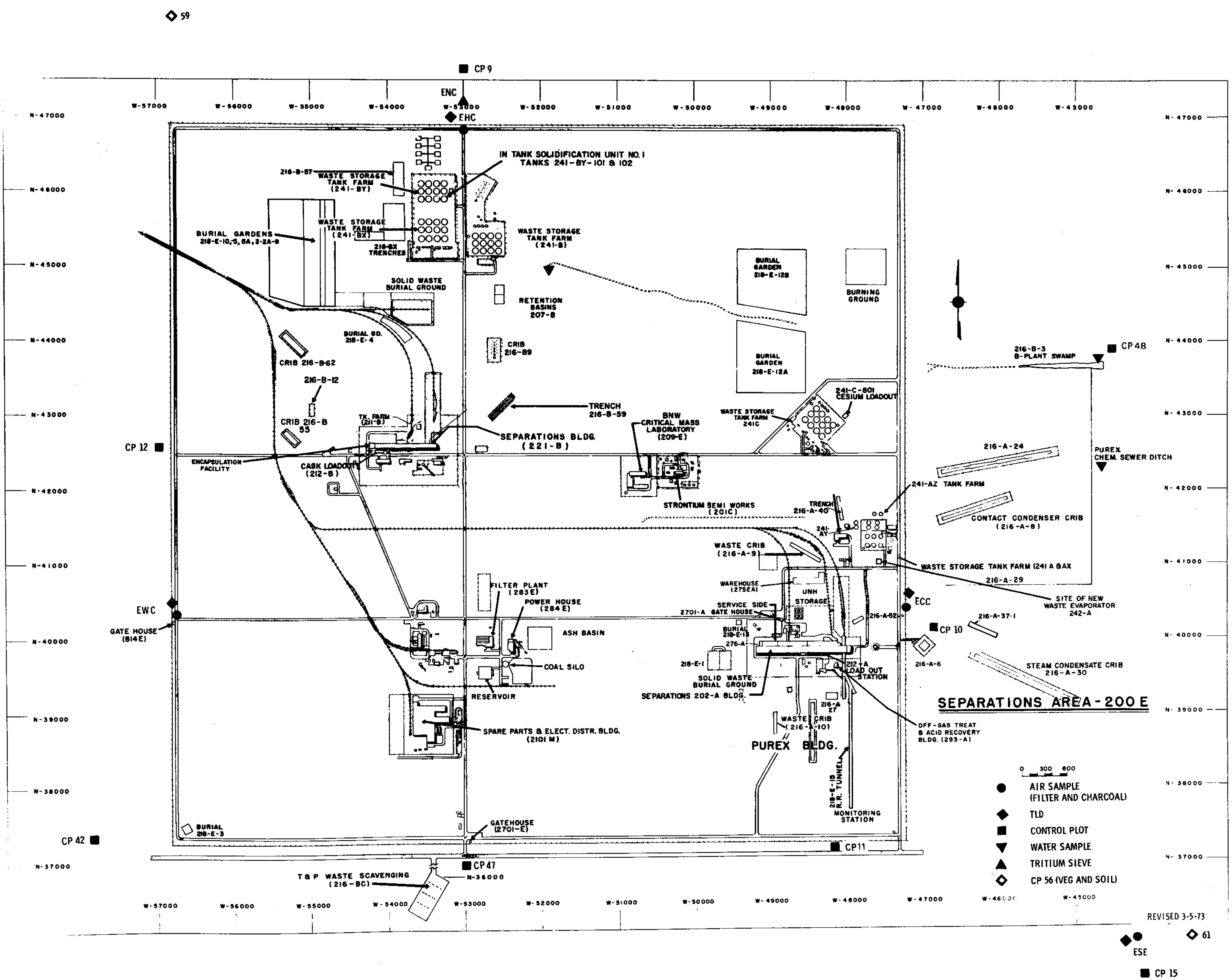
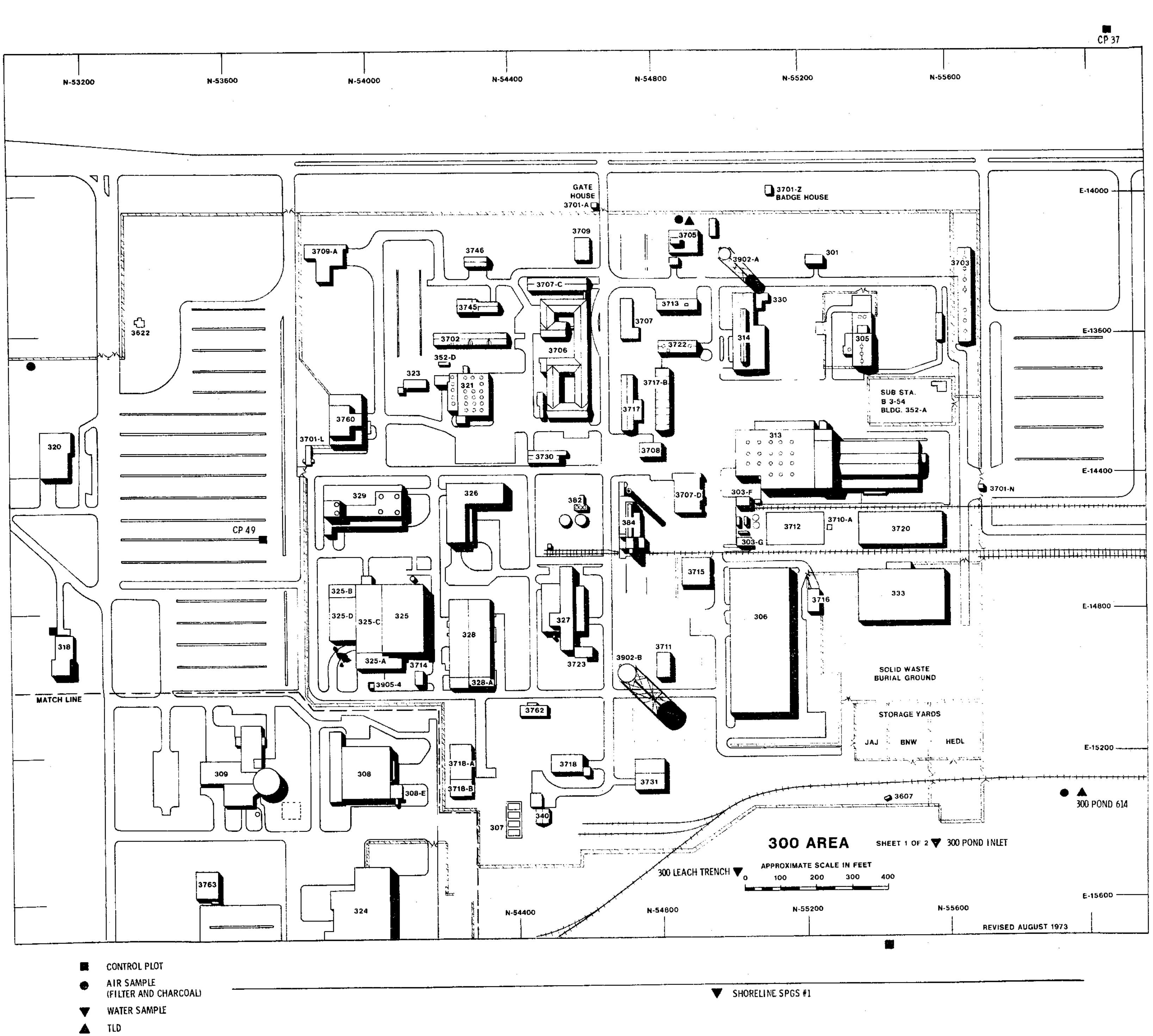


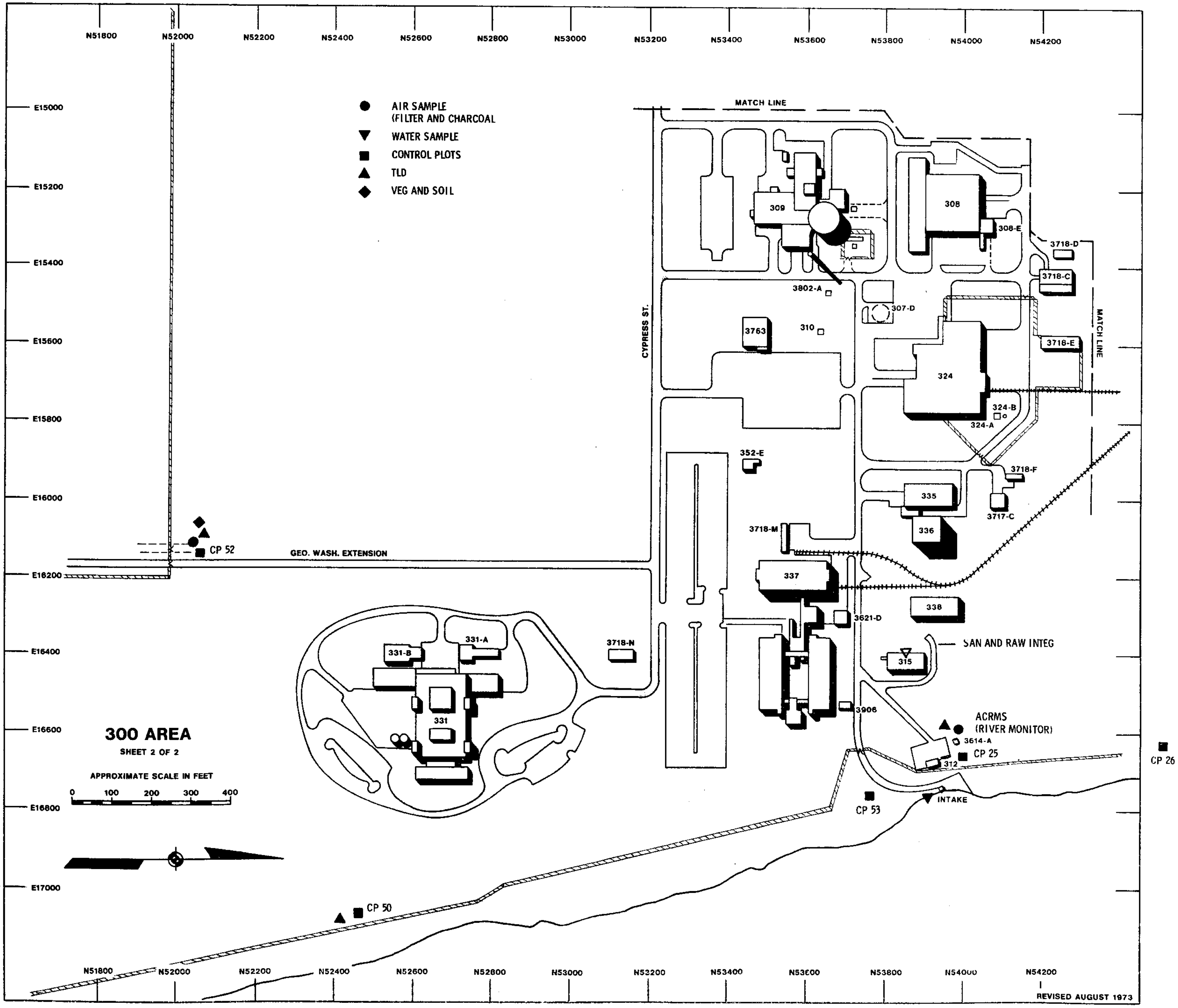
EXHIBIT 7
RIVER PUMP HOUSE 181-F
STEAM BOILER FACILITY INCLUDES 3-20,000 GAL. BURIED TANKS
RESERVOIR & PUMP HOUSE (182)
FILTER PLANT (183)
MAIN PUMP HOUSE (190)
REACTOR BUILDING (105)
COAL STORAGE
OUTFALL STRUCTURE (1904)
EXPERIMENTAL ANIMAL FARM
ANIMAL WASTE LEACH TRENCH
BIOLOGY SHEEP & HOG LOT
CP 58
BURNING GROUND
RETENTION BASIN (107)
PRIMARY SUB-STATION (151-F)
LEWIS CANAL
REACTOR EXHAUST AIR FILTER (117)
GAS RECIRCULATION (115)
PIT 115-F
BURIAL GROUND #3
BURIAL GROUND #2
CRIB 105-F
105-F STORAGE BASIN TRENCH (105)
BALL WASHER CRIB
REACTOR WASTE WATER PUMPING STATION (1608)
BIOLOGY LABORATORY (VACANT) (108)
ASH DISPOSAL BASIN (188)
BURIAL GROUND #1
143-F
BIOLOGY SHEEP LOT
141-L
AIR SAMPLE (FILTER AND CHARCOAL)
TLD
WATER SAMPLE
SOIL AND VEG
REACTOR AREA
100-F
BIOLOGY OPERATION FACILITIES
0 300 600
SCALE IN FEET
LIQUID WASTES
HIGH LEVEL
INTERMEDIATE LEVEL
LOW LEVEL
SOLID WASTES
N-82000
N-81000
N-80000
N-79000
N-78000
N-77000
W-33000
W-32000
W-31000
W-30000
W-29000
W-28000
W-27000
REVISED AUGUST, 1973
G-7-219



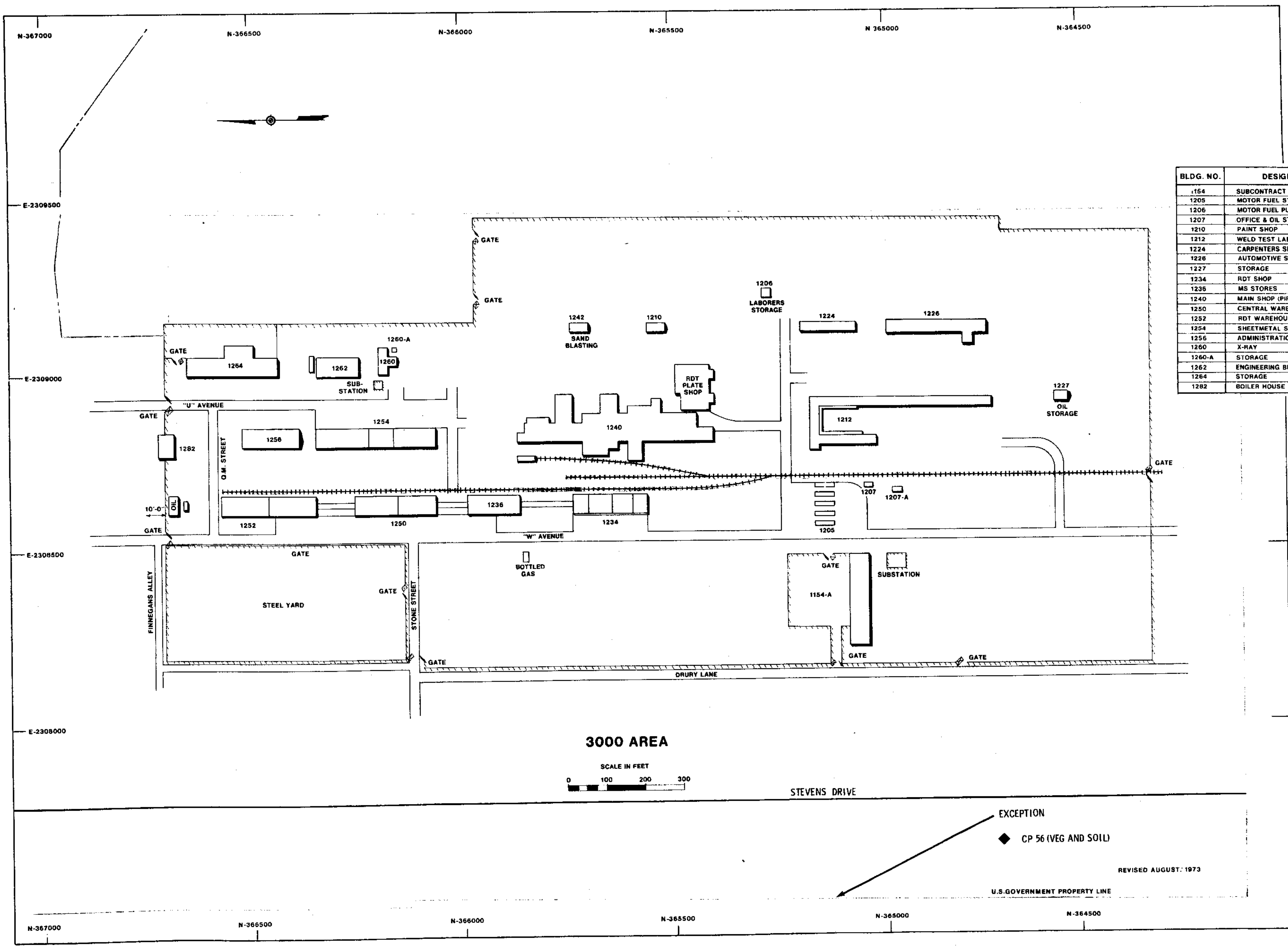
SEPARATIONS AREA - 200 W


SEPARATIONS AREA - 200 E
CP 9
ENC
EHC
CP 12
EWC
GATE HOUSE (814E)
CP 42
CP 47
CP 11
CP 10
CP 48
ECC
ESE
CP 15
59
61
IN TANK SOLIDIFICATION UNIT NO. I TANKS 241-BY-101 & 102
216-B-57
WASTE STORAGE TANK FARM (241-BY)
WASTE STORAGE TANK FARM (241-BX)
216-BX TRENCHES
BURIAL GARDENS 218-E-10,-5,5A,2-2A-9
WASTE STORAGE TANK FARM (241-B)
SOLID WASTE BURIAL GROUND
RETENTION BASINS 207-B
BURIAL GD. 218-E-4
CRIB 216-B62
216-B-12
CRIB 216-B 55
CRIB 216-B9
TK. FARM (211-B)
TRENCH 216-B-59
SEPARATIONS BLDG. (221-B)
ENCAPSULATION FACILITY
CASK LOADOUT (212-B)
BURIAL GARDEN 218-E-12B
BURIAL GARDEN 218-E-12A
BURNING GROUND
216-B-3 B-PLANT SWAMP
241-C-801 CESIUM LOADOUT
WASTE STORAGE TANK FARM 241C
BNW CRITICAL MASS LABORATORY (209-E)
STRONTIUM SEMI WORKS (201C)
216-A-24
PUREX CHEM. SEWER DITCH
241-AZ TANK FARM
CONTACT CONDENSER CRIB (216-A-8)
TRENCH 216-A-40
241-AY
WASTE CRIB (216-A-9)
WASTE STORAGE TANK FARM (241 A &AX
216-A-29
SITE OF NEW WASTE EVAPORATOR 242-A
WAREHOUSE (275EA)
UNH STORAGE
SERVICE SIDE
2701-A GATE HOUSE
BURIAL 218-E-13
276-A
216-A-52
216-A-37-1
216-A-6
218-E-1
SOLID WASTE BURIAL GROUND
SEPARATIONS 202-A BLDG.
212-A LOAD OUT STATION
STEAM CONDENSATE CRIB 216-A-30
216-A 27
WASTE CRIB (216-A-10)
PUREX BLDG.
OFF-GAS TREAT & ACID RECOVERY BLDG. (293-A)
218-E-15 R.R. TUNNEL
MONITORING STATION
FILTER PLANT (283E)
POWER HOUSE (284E)
ASH BASIN
COAL SILO
RESERVOIR
SPARE PARTS & ELECT. DISTR. BLDG. (2101 M)
GATEHOUSE (2701-E)
BURIAL 218-E-3
T & P WASTE SCAVENGING (216-BC)
N-36000
W-57000
W-56000
W-55000
W-54000
W-53000
W-52000
W-51000
W-50000
W-49000
W-48000
W-47000
W-46000
W-45000
N-47000
N-46000
N-45000
N-44000
N-43000
N-42000
N-41000
N-40000
N-39000
N-38000
N-37000
0 300 600
AIR SAMPLE (FILTER AND CHARCOAL)
TLD
CONTROL PLOT
WATER SAMPLE
TRITIUM SIEVE
CP 56 (VEG AND SOIL)
REVISED 3-5-73


300 AREA
SHEET 1 OF 2
APPROXIMATE SCALE IN FEET
0 100 200 300 400
REVISED AUGUST 1973
CP 37
CP 49
N-53200
N-53600
N-54000
N-54400
N-54800
N-55200
N-55600
E-14000
E-13600
E-14400
E-14800
E-15200
E-15600
GATE HOUSE 3701-A
3701-Z BADGE HOUSE
3709
3709-A
3746
3745
3702
352-D
323
321
3760
3701-L
3707-C
3706
3730
3705
3902-A
301
3703
330
3713
3707
3722
314
305
SUB STA. B 3-54 BLDG. 352-A
3717-B
3717
3708
313
303-F
3707-D
3701-N
3712
3710-A
3720
303-G
382
384
3715
333
3716
306
3711
3902-B
329
326
325-B
325-D
325-C
325
325-A
3714
3905-4
328
328-A
327
3723
3622
320
318
MATCH LINE
309
308
308-E
3718-A
3718-B
3762
3718
3731
3607
340
307
3763
324
SOLID WASTE BURIAL GROUND
STORAGE YARDS
JAJ
BNW
HEDL
300 POND 614
300 POND INLET
300 LEACH TRENCH
SHORELINE SPGS #1
CONTROL PLOT
AIR SAMPLE (FILTER AND CHARCOAL)
WATER SAMPLE
TLD



AIR SAMPLE
(FILTER AND CHARCOAL
WATER SAMPLE
CONTROL PLOTS
TLD
VEG AND SOIL
MATCH LINE
309
308
308-E
3718-D
3718-C
3802-A
307-D
310
3763
CYPRESS ST.
324
3718-E
324-B
324-A
352-E
3718-F
335
3717-C
3718-M
336
CP 52
GEO. WASH. EXTENSION
337
338
3621-D
SAN AND RAW INTEG
3718-N
331-A
331-B
315
331
3906
ACRMS
(RIVER MONITOR)
3614-A
CP 25
312
CP 26
INTAKE
CP 53
CP 50
300 AREA
SHEET 2 OF 2
APPROXIMATE SCALE IN FEET
0 100 200 300 400
N51800 N52000 N52200 N52400 N52600 N52800 N53000 N53200 N53400 N53600 N53800 N54000 N54200
E15000 E15200 E15400 E15600 E15800 E16000 E16200 E16400 E16600 E16800 E17000
REVISED AUGUST 1973



BLDG. NO.	DESIGNATION
1154	SUBCONTRACT DEPARTMENT
1205	MOTOR FUEL STORAGE
1206	MOTOR FUEL PUMP HOUSE
1207	OFFICE & OIL STORAGE
1210	PAINT SHOP
1212	WELD TEST LABORATORY
1224	CARPENTERS SHOP
1226	AUTOMOTIVE SHOP
1227	STORAGE
1234	RDT SHOP
1236	MS STORES
1240	MAIN SHOP (PIPE, ELECT, ETC.)
1250	CENTRAL WAREHOUSE
1252	RDT WAREHOUSE
1254	SHEETMETAL SHOP
1256	ADMINISTRATION BUILDING
1260	X-RAY
1260-A	STORAGE
1262	ENGINEERING BUILDING
1264	STORAGE
1282	BOILER HOUSE

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