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Environmental Status of the Hanford Site for CY-1975

By
Jack J. Fix
Dwayne R. Speer
Peggy J. Blumer

June 1976

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Battelle
Pacific Northwest Laboratories

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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-1970 for 1974.[1] Environmental data from offsite locations are presented in the annual "Environmental Surveillance at Hanford..." series of reports, the latest being BNWL-1979 for 1975.[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-429 for 1974.[3] The present report describes each major monitoring program and evaluates data collected during 1975.

ENVIRONMENTAL STATUS OF THE HANFORD SITE FOR CY-1975

Jack J. Fix, Dwayne R. Speer, Peggy J. Blumer

SUMMARY

Environmental data collected during 1975 showed continued compliance of Hanford operations with applicable State and Federal regulations regarding ambient pollutant levels in the environs. Levels of radioactivity in the atmosphere measured at 21 onsite stations, 17 perimeter stations and 5 distant stations showed no conclusive observable effect from Hanford operations. Levels of radioiodine, tritiated water vapor, ^{90}Sr, plutonium, and gamma-emitting radionuclides were measured during the year. No apparent differences between levels measured at onsite, perimeter, and distant stations were detected.

All analyses of sanitary water obtained from the Columbia River at 100-N, 300 Area, and Richland water plant were less-than detectable with the exception of gross alpha, gross beta, ^{90}Sr, and on one occasion ^{137}Cs. Tritium was measured in river water at Vernita Bridge and Richland. There was no indication that Hanford operations contributed to the observed concentrations.

Radiological analyses of drinking water at FFTF and WPPSS operations showed elevated levels of ^{3}H present due to seepage in the groundwater from the 200 Areas. A person who consumes 1.1 liters of water per working day containing 50,000 pCi/ℓ of ^{3}H and works 5 days per week, 50 weeks per year will incur an annual dose of approximately 1.6 mrem.

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 was apparent. These pollutants were diluted in the river to essentially background levels within a short distance from entry into the river. Watercress collected from the 100-N springs showed elevated levels of several radionuclides.

West Lake, a naturally occurring pond in direct contact with the groundwater, generally had the highest observed levels of gross beta and gross

alpha activity of all surface ponds sampled during 1975. 100-F leach trench had the highest observed levels of ^{90}Sr. No waste is discharged to West Lake and the probable cause of the elevated concentrations 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. Replicate sampling from West Lake during June 1975 indicated an average concentration of about 1100 pCi/ℓ of uranium and <0.3 pCi/ℓ of plutonium. The concentrations observed in Columbia River water are approximately 4 pCi/ℓ and <0.02 pCi/ℓ, respectively. During October 1975, 100-F leach trench was deactivated and will no longer be used.

Consistent with previous results, mice collected at 1301-N trench showed the highest levels of radioactivity per gram of any animal sampled during 1975. Only ^{137}Cs was consistently observed at elevated concentrations in ducks collected from onsite areas compared with ducks collected along the Columbia River. Assuming an individual consumed 500 grams of duck meat containing the highest levels of ^{137}Cs observed during 1975, a 50-year internal dose commitment of 5.9 mrem to the whole body and 6.7 mrem to the bone would be incurred. The majority of the dose would be received during the first year after ingestion.

Analysis of muscle tissue from "road-kill" deer during 1975 did not show any apparent impact from Hanford operations with the exception of detectable ^{60}Co in one deer collected near 100-N. Only naturally occurring ^{40}K was consistently observed. Assuming a person ingested 50 pounds of deer meat containing the 0.05 pCi/g of ^{60}Co observed, a 50-year internal dose commitment of about 0.005 mrem would be incurred.

Surface soil and perennial vegetation samples were collected from 20 different locations during the autumn of 1975 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. From the data collected it is apparent that two of the sampling locations reflect deposition of radioactivity from Hanford operations. These locations are:

1. East of and directly across the road from the 200-W Area shows elevated levels of $^{239-240}Pu$.
2. Directly north of the 300 Area shows elevated levels of U. The location sampled is near the railroad tracks from the 300 Area.

Two other areas are suspected of receiving observable activity from Hanford operations but the data available are insufficient to indicate conclusively that the levels are not due to fallout. These locations are:

1. Directly south of the 1301-N trench, shows possible deposition of ^{60}Co activity. Results for ^{54}Mn in soil, approximately 100-fold greater than other locations, and apparently elevated levels of ^{54}Mn, ^{60}Co, $^{95}ZrNb$, and ^{144}Ce in vegetation further substantiate the conclusion that Hanford origin activity is present.
2. Directly east of the Nuclear Engineering Disposal site shows possible deposition of ^{60}Co.

Several radionuclides, notably ^{54}Mn, ^{60}Co, ^{65}Zn, ^{152}Eu, ^{154}Eu, and ^{155}Eu, observed in Columbia River island and shoreline sediment samples during 1975 are attributed to previous operation of once-through cooling production reactors. During February of 1975, TLDs were deployed along the Columbia River shoreline. The maximum observed reading, at the Hanford railroad tracks entering the river, was about 140 mrad/year. This is twice the background dose rate of about 70 mrad/year. It is likely that there are other areas which have similar elevated dose rates. The radioactivity observed is expected to gradually decline as the radionuclides decay and further dilution occurs.

The greatest external dose observed during 1975 (300 mrad) 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 1975 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.

ENVIRONMENTAL SAMPLE COLLECTION, ANALYSIS, AND EVALUATION

AIR

Air samplers were maintained at onsite, perimeter, and distant locations during 1975 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

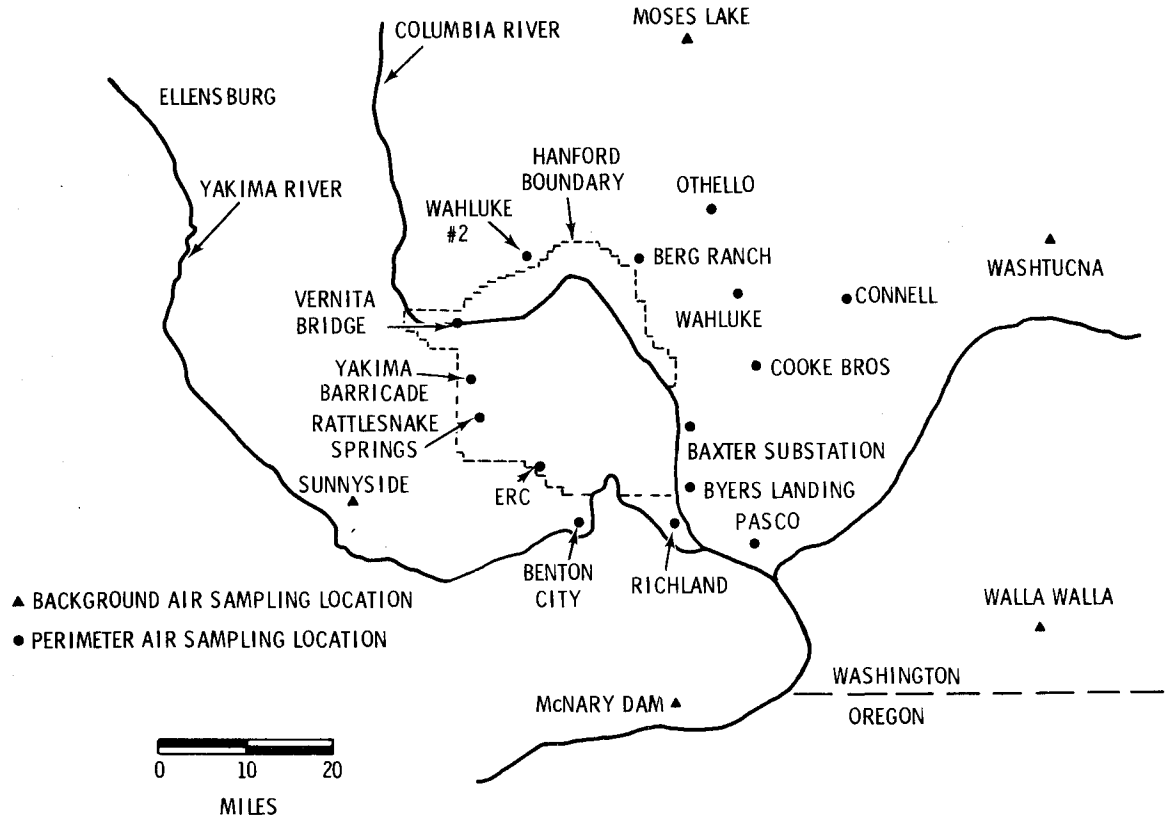


FIGURE 1. Hanford Environmental Air Sampling Locations During 1975

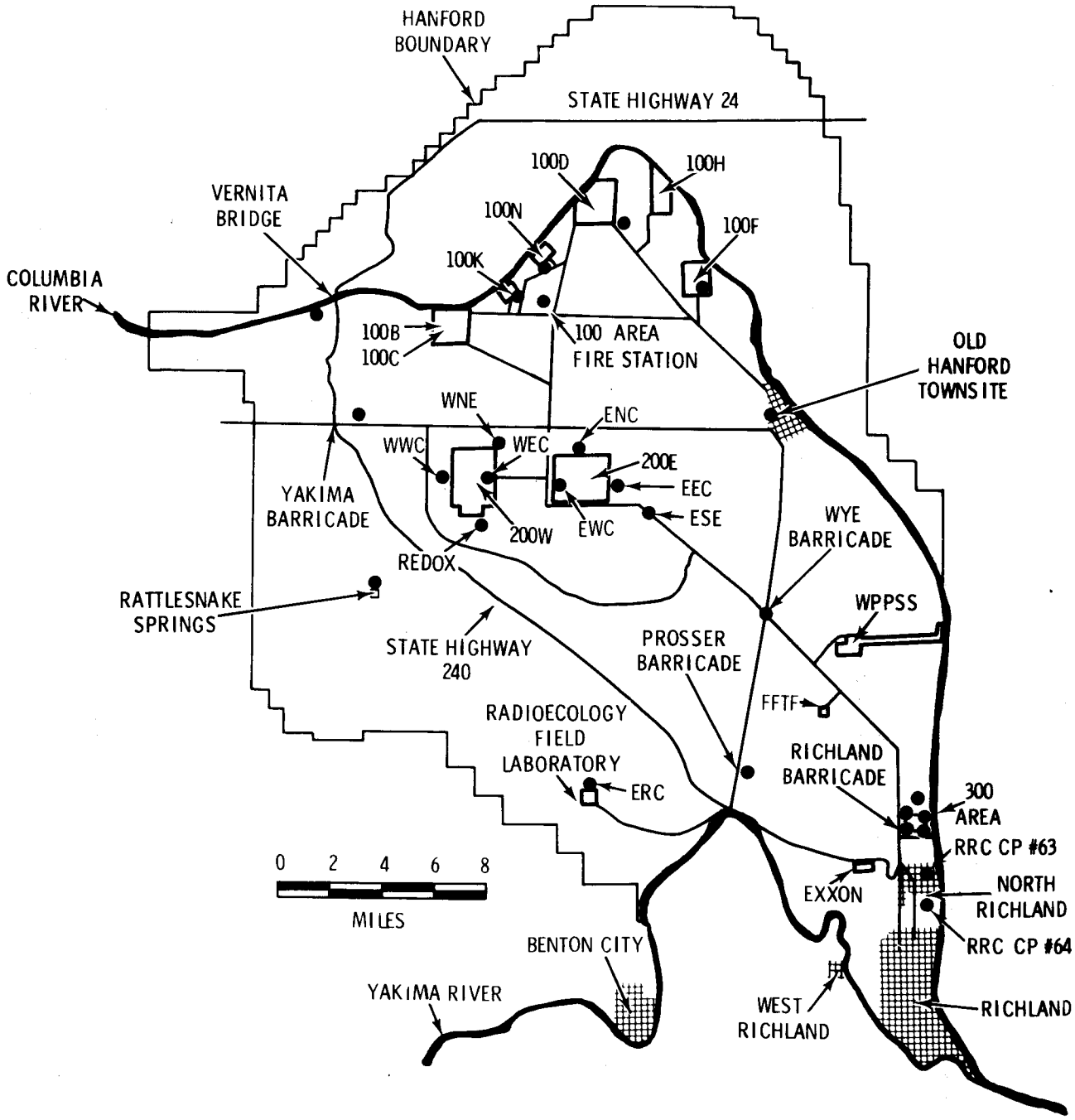


FIGURE 2. Onsite and North Richland Air Sampling Locations During 1975

geographical location and analyzed monthly by gamma spectroscopy and quarterly for ^{90}Sr and plutonium. At a few selected locations, transparent cartridges 25 cm long and 5 cm in diameter containing indicating silica gel were used to collect water vapor in air during biweekly sampling periods for analysis for tritium. An air flow of 70 cm^3/min. passes through the cartridge after the air has passed through the particle filter. Table 1 lists all the air sampling stations, the filter used, status of charcoal or silica gel cartridges, and composite group for each filter.

Figure 3 illustrates the average monthly beta concentrations observed at eastern quadrant stations, which are located in the predominately downwind direction from Hanford operations, compared with the concentrations observed at onsite and distant stations (for the years 1971 through

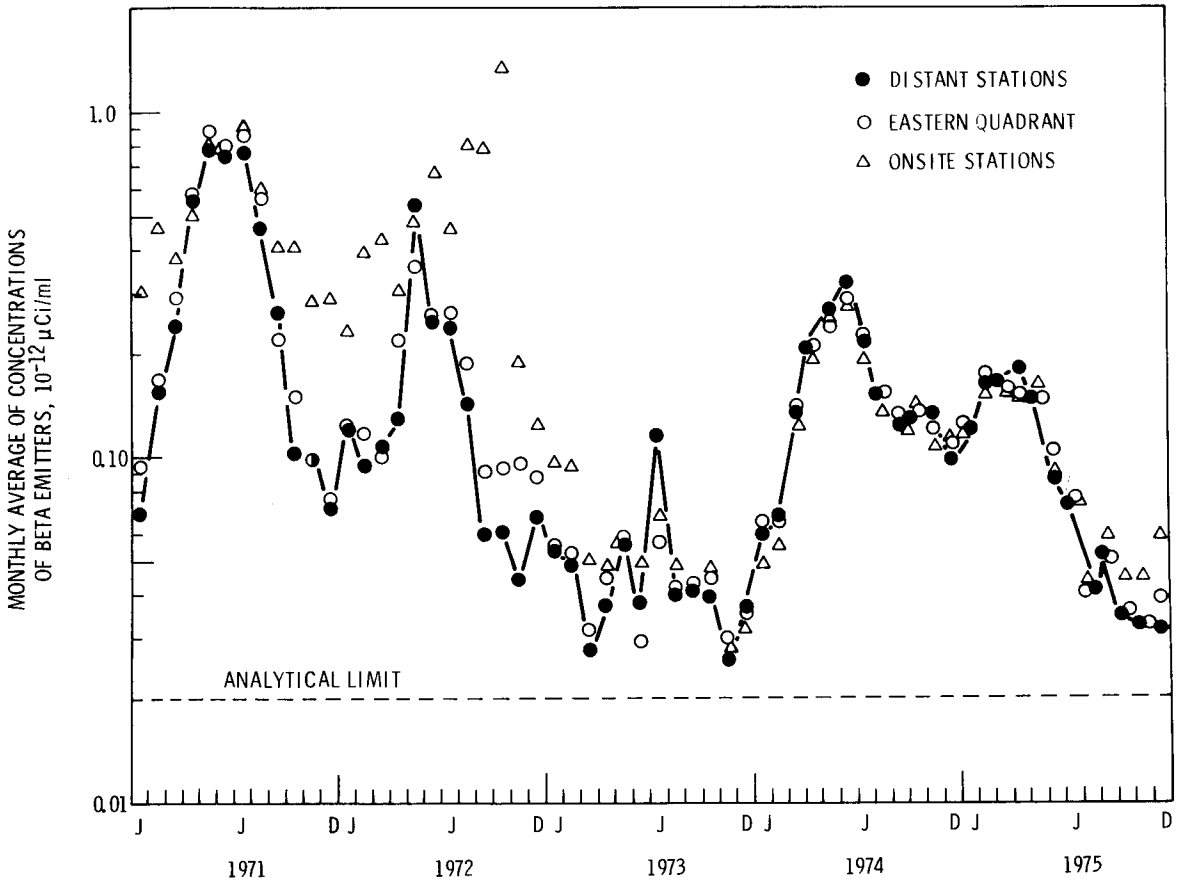


FIGURE 3. Monthly Average Gross Beta Activity in the Atmosphere

TABLE 1. Hanford Air Sampling Network During 1975 Including Location, Filter Used, Frequency of Sample Collection, and Composite Group

Location	Filter Type	Frequency[a]			Composite Group												
					Onsite Area No.					Inner Quadrant					Outer Quadrant		
		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).

1975). The distant stations are sufficiently remote from Hanford operations that observed levels of radiation were assumed due to natural causes or fallout. The gross beta concentration in the atmosphere usually begins to rise each spring following an increased rate of transfer of radiactivity (natural and fallout) from the lower stratosphere to the troposphere. The results of gross beta, gross alpha, and ^{131}I analyses for the different sampling locations are shown in Table 2. The average beta concentration during 1975 observed at onsite, perimeter, and distant stations was 0.9×10^{-13} µCi/ml. The highest observed gross beta concentration, 7.4×10^{-13} µCi/ml, occurred at the 200 WWC station during the period of November 18 through 25, 1975. The reason for the high concentration is not known since subsequent specific radionuclide analyses (Table 3) did not show anything unusual.

Analysis for gross alpha concentrations in the atmosphere during 1975 was done on filters obtained from 12 of the 21 onsite, 4 of the perimeter, and 2 of the distant sampling stations. The results were similar at all locations and the activity observed was primarily due to naturally occurring radioactivity in air.

Analysis for ^{131}I concentrations in the atmosphere was performed on a biweekly interval for 3 of the 21 onsite and 4 of the 17 perimeter sampling stations during 1975. 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 1975 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/m for uncontrolled areas.(4)

During 1975, tritiated water vapor (HTO) was measured at 2 onsite and 3 perimeter sampling stations. An air flow of approximately 1 ft^3/hr was maintained through a transparent 25-cm long, 5-cm diameter cartridge containing indicating silica gel. The biweekly results expressed in terms of specific activity (pCi/ℓ) are shown in Figure 4. There are no apparent

TABLE 2. Radioactivity in Air (1975)

	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	26	0.25	0.03	0.11±0.14								
100-N-WPPSS	47	0.20	0.02	0.09±0.12	47	0.004	*	<0.001	25	*	*	*
100-D	49	0.20	0.01	0.08±0.12								
100-F	25	0.23	0.02	0.10±0.14								
100 Area Fire Station	26	0.22	0.03	0.10±0.11								
Hanford	25	0.29	0.02	0.10±0.16								
200 ENC	50	0.22	0.02	0.09±0.10	49	0.006	*	<0.001				
200 ESE	51	0.21	0.02	0.09±0.10	51	0.007	*	<0.001	25	*	*	*
200 EEC	12	0.18	0.04	0.11±0.09	12	0.002	*					
200 EWC	13	0.16	0.01	0.06±0.07								
200 WNE	14	0.13	0.02	0.06±0.06								
200 WEC	27	0.27	0.02	0.11±0.15	27	0.004	*	<0.001				
200 WWC	52	0.74	0.01	0.11±0.21	50	0.004	*	<0.001				
Redox	50	0.23	0.02	0.09±0.11	50	0.004	*	<0.001				
Wye Barricade	26	0.21	0.03	0.11±0.12	26	0.002	*	<0.001				
300 Pond	14	0.09	0.02	0.05±0.04	13	0.002	0.0005	<0.002				
300 SW Gate	26	0.23	0.02	0.10±0.14					26	*	*	*
300 South Gate	25	0.24	0.02	0.10±0.14	25	0.004	*	<0.001				
3705 Bldg.	51	0.20	0.02	0.08±0.11	50	0.007	*	<0.002				
ACRMS	26	0.22	0.02	0.08±0.09								
Prosser Barricade	26	0.21	0.02	0.10±0.12	26	0.002	*	<0.001				
				0.09±0.04[d]								
Perimeter Stations												
Benton City	26	0.20	0.02	0.10±0.12	26	0.002	*	<0.001	26	*	*	*
ERC	25	0.23	0.02	0.09±0.12								
Rattlesnake Spring	24	0.21	0.02	0.09±0.11								
Yakima Barricade	24	0.22	0.03	0.11±0.13								
Vernita Bridge	26	0.21	0.02	0.10±0.12								
Wahluke #2	25	0.26	0.02	0.10±0.12								
Othello	28	0.22	0.03	0.10±0.13								
Connell	26	0.21	0.02	0.10±0.12								
Berg Ranch	26	0.28	0.01	0.10±0.15	26	0.002	*	<0.001				
Wahluke Wm.	28	0.23	0.03	0.09±0.11								
Cooke Bros.	30	0.21	0.02	0.09±0.11								
Baxter Substation	22	0.16	0.01	0.09±0.09					24	*	*	*
Byers Landing	25	0.22	0.03	0.10±0.12	25	0.003	*	<0.001	25	*	*	*
RRC CP#63	14	0.08	0.03	0.05±0.04								
RRC CP#64	14	0.09	0.02	0.04±0.04								
Richland	25	0.25	0.03	0.09±0.12	25	0.003	*	<0.001	26	*	*	*
Pasco	25	0.21	0.02	0.10±0.13								
				0.09±0.04[d]								
Distant Stations												
Walla Walla	23	0.22	0.03	0.10±0.13	22	0.002	0.0005	0.001				
McNary	26	0.20	0.02	0.09±0.13	25	0.002	0.0005	0.001				
Sunnyside	23	0.20	0.03	0.10±0.12								
Moses Lake	26	0.23	0.02	0.10±0.14								
Washtucna	19	0.20	0.03	0.08±0.12								
				0.09±0.02[d]								

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) Average±2 Sample Standard Deviations.

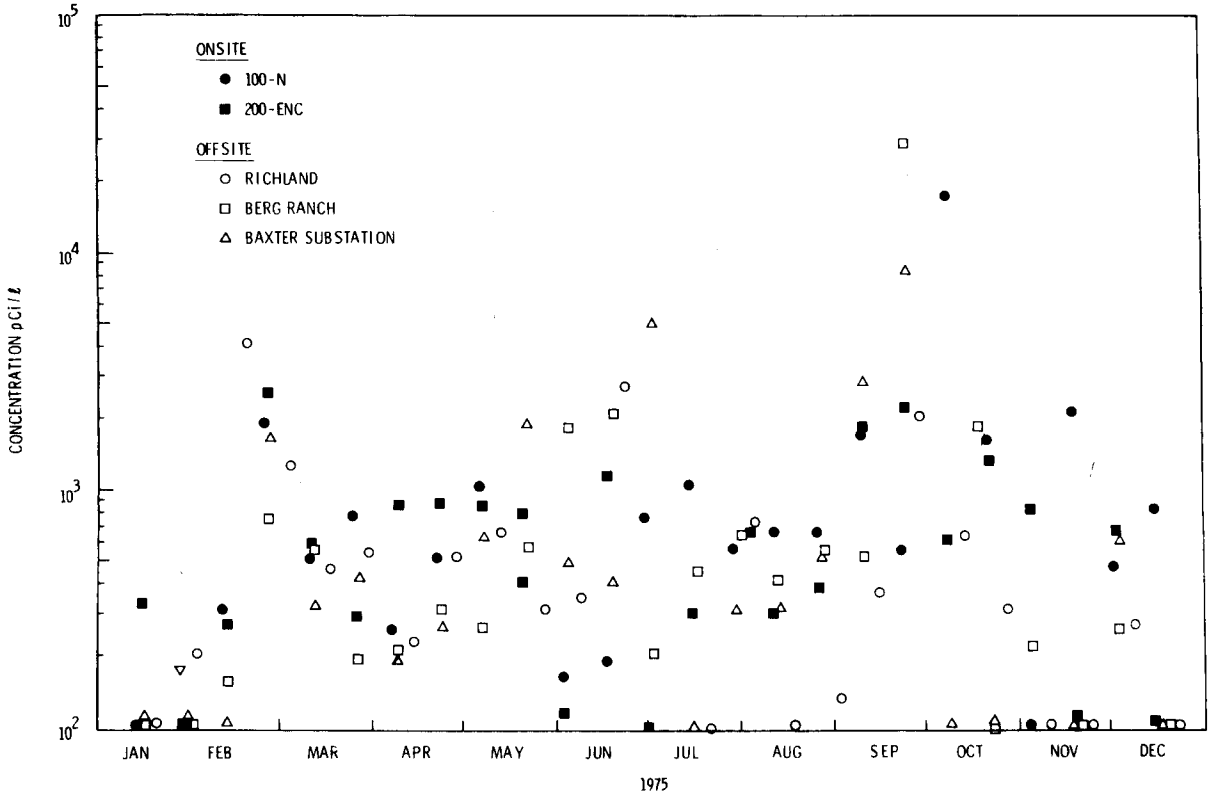


FIGURE 4. Specific Activity of Tritiated Water Vapor During 1975

geographical patterns and the observed concentrations are attributed to fallout. The approximate average air concentration during a two-week sampling period in which 30 ml of water are collected containing 1000 pCi/ℓ of tritium would be 3.2×10^{-12} μCi/cc. The most restrictive ERDA Manual Chapter 0524 guideline for HTO in air is 2×10^{-7} or a factor of about 10^5 greater.

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 5 and 6 are log-normal probability plots of the positive results for ^{106}Ru, ^{144}Ce, and ^{137}Cs, and for ^{90}Sr and Pu, respectively, for all composite groups. None of the data points is grossly different from the other

TABLE 3. Concentrations of Selected Radionuclides on Air Filter Composites - 1975

Units of 10^{-12} µCi/ml

Date	^{7}Be	^{54}Mn	^{60}Co	^{65}Zn	^{90}Sr	$^{95}ZrNb$	^{106}Ru	^{134}Cs	^{137}Cs	$^{144}CePr$	Total Pu
Analytical Limit[a]	0.04	0.002	0.004	0.007	0.0002	0.003	0.06	0.02	0.004	0.04	0.000002
Onsite Area #1											
1/28	*	*	*	*		0.02	0.34	*	*	*	
2/25	*	*	*	*		0.03	*	*	*	*	
3/25	0.15	*	*	*	0.009	0.04	*	*	0.021	*	0.00006
4/29	0.10	*	*	*		0.02	*	*	0.011	*	
5/20	*	*	*	*		0.04	*	*	*	*	
6/24	*	*	*	*	0.003	0.08	0.28	*	*	*	0.00004
7/29	0.06	*	*	*		0.01	0.09	*	*	*	
8/21	*	*	*	*		*	0.12	*	*	*	
9/30	0.06	*	*	*	0.004	*	0.14	*	*	*	0.00003
10/29	*	*	*	*		*	0.09	*	0.006	*	
11/25	*	*	*	*		*	0.11	*	*	*	
12/30	0.04	*	*	*	0.003	*	*	*	0.008	*	0.00001
Annual Average[b]	<0.06	*	*	*	0.005	<0.02	<0.1	*	<0.01	*	0.00004
Onsite Area #2											
3/25					0.004						0.0001
6/24					0.003						0.00003
9/30					0.003						*
12/30					0.009						0.00001
Annual Average[b]					0.005						<0.00004
Onsite Area #3											
1/28	*	*	*	*		0.02	0.20	*	*	*	
2/25	0.05	*	*	*		0.03	*	*	0.005	*	
3/25	0.14	0.01	0.006	*	0.002	0.04	0.05	*	0.010	0.06	0.00009
4/29	0.08	*	*	*		0.02	0.05	*	0.008	0.04	
5/27	0.11	*	*	*		0.03	0.11	*	0.007	*	
6/24	0.06	*	*	*	0.003	0.01	0.15	*	*	*	0.00003
7/29	0.09	*	*	*		0.01	0.09	*	0.003	*	
8/26	*	*	*	*		*	0.14	*	*	*	
9/30	0.05	*	*	*	0.002	*	0.14	*	*	*	0.00002
10/28	*	*	*	*		*	0.10	*	*	*	
11/25	*	*	*	*		*	0.10	*	0.003	*	
12/30	0.04	*	*	*	0.008	0.01	0.04	*	0.009	*	0.000002
Annual Average[b]	<0.07	<0.003	<0.004	*	0.004	<0.02	<0.1	*	<0.01	<0.04	0.00004
Onsite Area #4											
1/28	*	*	*	*		0.03	0.17	*	*	0.03	
2/25	0.02	*	*	*		0.03	*	*	*	0.03	
3/31	0.10	0.006	*	*	0.0007	0.03	0.04	*	0.005	0.06	0.00002
4/28	0.08	0.003	*	*		0.03	0.06	*	0.006	0.05	
5/27	0.08	*	*	*		0.03	0.12	*	0.006	0.04	
6/30	0.04	*	*	*	0.008	0.01	0.13	*	*	0.03	0.00005
7/29	0.07	*	*	*		0.004	0.10	*	*	*	
8/26	*	*	*	*		*	0.15	*	*	*	
9/29	0.06	*	*	*	0.001	*	0.12	*	*	*	0.00001
10/27	0.06	*	*	*		*	0.09	*	*	*	
11/24	*	*	*	*		*	0.11	*	*	*	
12/30	0.04	*	*	*	0.0002	*	0.04	*	*	*	*
Annual Average[b]	<0.06	<0.02	*	*	0.002	<0.01	<0.1	*	<0.004	<0.04	<0.00002
Onsite Area #5											
1/27	*	*	*	*		0.02	0.14	*	*	*	
2/24	*	*	*	*		0.03	*	*	*	0.03	
3/31	0.21	*	*	0.02		0.04	*	*	0.005	0.06	
4/28	0.06	0.003	*	*		0.02	0.09	*	0.005	0.04	
5/27	0.08	*	*	*		0.03	0.14	*	0.004	0.03	
6/30	0.04	*	*	*		0.01	0.11	*	*	0.03	
7/28	0.05	*	*	*		0.004	0.08	*	*	*	
8/25	0.03	*	*	*		*	0.07	*	*	*	
9/29	*	*	*	*	0.001	*	0.20	*	*	*	0.00001
10/27	*	*	*	*		*	0.13	*	*	*	
11/24	*	*	*	*		*	0.07	*	*	*	
12/29	0.03	*	*	*	0.001	*	0.05	*	*	*	*
Annual Average[b]	<0.06	<0.002	*	<0.01	0.001	<0.03	<0.1	*	<0.004	<0.04	<0.00001

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. (contd)

Date	^{7}Be	^{54}Mn	^{60}Co	^{65}Zn	^{90}Sr	$^{95}ZrNb$	^{106}Ru	^{134}Cs	^{137}Cs	$^{144}CePr$	Total Pu
Analytical Limit[a]	0.04	0.002	0.004	0.007	0.0002	0.003	0.06	0.02	0.004	0.04	0.000002
					Inner Southwest Quadrant						
1/22	0.03	*	*	*		0.02	0.09	*	*	*	
2/19	*	*	*	*		0.03	*	*	*	0.03	
3/19	*	0.007	*	*	0.002	0.03	0.16	*	0.003	0.07	0.00001
4/30	0.05	0.003	*	*		0.02	0.09	*	0.005	0.04	
5/28	0.03	*	*	*		0.03	0.20	*	*	0.05	
6/25	0.09	*	*	*	0.002	0.01	0.09	*	*	0.03	0.00001
7/23	0.12	*	*	*		0.005	*	*	*	*	
8/20	*	*	*	*		*	0.15	*	*	*	
9/17	*	*	*	*	0.0008	*	0.23	*	*	*	0.000008
10/29	0.05	*	*	*		*	0.12	*	*	*	
11/26	0.03	*	*	*		*	0.10	*	*	*	
12/23	0.04	*	*	*	0.003	*	*	*	*	*	0.000003
Annual Average[b]	<0.04	<0.0009	*	*	0.002	<0.01	<0.11	*	<0.0006	<0.02	0.000008
					Inner Northwest Quadrant						
1/29	*	*	*	*		0.02	0.12	*	*	*	
2/26	0.06	*	*	*		0.04	*	*	*	0.06	
3/31	0.10	0.01	*	*	0.0004	0.03	0.04	*	0.005	0.06	0.00002
4/30	0.08	0.004	*	*		0.02	0.04	*	0.006	0.03	
5/28	0.15	*	*	*		0.03	0.06	*	0.007	0.04	
6/25	0.07	*	*	*	0.002	0.01	0.13	*	*	*	0.00004
7/30	0.08	*	*	*		0.005	0.10	*	*	*	
8/27	*	*	*	*		*	0.10	*	*	*	
9/29	0.09	*	*	*	0.0007	*	0.11	*	*	*	0.000009
10/29	0.09	*	*	*		*	*	*	*	*	
11/26	*	*	*	*		*	0.08	*	*	*	
12/31	*	*	*	*	0.001	*	0.10	*	*	*	*
Annual Average[b]	<0.06	<0.001	*	*	0.001	<0.01	<0.08	*	<0.001	<0.02	<0.00002
					Inner Northeast Quadrant						
1/31	0.03	*	*	*		0.02	0.09	*	*	0.02	
2/28	0.03	*	*	*		0.04	*	*	*	0.03	
3/28	0.05	*	*	*	0.0003	0.04	0.12	*	0.002	0.05	0.00002
4/25	0.08	0.005	*	*		0.03	0.11	*	0.006	0.05	
5/29	0.07	*	*	*		0.02	0.10	*	0.003	0.04	
6/24	0.03	*	*	*	0.003	0.01	0.20	*	*	0.04	0.00004
7/30	0.12	*	*	*		0.004	*	*	0.002	*	
8/29	0.04	*	*	*		*	0.06	*	*	*	
9/26	0.04	*	*	*	0.0004	*	0.18	*	*	*	0.000007
10/30	0.03	*	*	*		*	0.10	*	*	*	
11/25	0.06	*	*	*		*	0.04	*	*	*	
12/29	0.04	*	*	*	0.0002	*	0.08	*	*	*	*
Annual Average[b]	0.05	<0.0004	*	*	0.001	<0.01	<0.09	*	<0.0009	<0.02	<0.00002
					Inner Southeast Quadrant						
1/20	*	*	*	*		0.02	0.22	*	*	*	
2/18	*	*	0.09	*		0.04	*	*	*	0.05	
3/31	*	*	*	*	0.002	0.03	*	*	0.003	0.05	0.00002
4/28	0.09	0.004	*	*		0.03	0.07	*	0.007	0.07	
5/27	0.04	*	*	*		0.02	0.16	*	0.004	0.03	
6/23	*	*	*	*	*	0.01	0.18	*	*	*	0.00009
7/30	0.06	*	*	*		0.004	0.10	*	*	*	
8/27	0.04	*	*	*		0.001	0.10	*	*	*	
9/29	0.07	*	*	*	0.00008	*	0.11	*	*	*	0.000008
10/31	0.04	*	*	*		*	0.12	*	*	*	
11/24	*	*	*	*		*	0.08	*	*	*	
12/29	0.04	*	*	*	0.0006	*	0.06	*	*	*	0.000006
Annual Average[b]	<0.03	<0.0003	<0.007	*	<0.0007	<0.01	<0.10	*	<0.0009	<0.02	0.00003

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 anlaytical 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. (contd)

Date	^{7}Be	^{54}Mn	^{60}Co	^{65}Zn	^{90}Sr	$^{95}Zr/Nb$	^{106}Ru	^{134}Cs	^{137}Cs	$^{144}CePr$	Total Pu
Analytical Limit(a)	0.04	0.002	0.004	0.007	0.0002	0.003	0.06	0.02	0.004	0.04	0.000002
					Outer Northeast Quadrant						
1/17	*	*	*	*		0.02	0.16	*	*	*	
2/21	*	*	*	*		0.03	*	*	*	*	
3/21	*	0.01	*	*	0.002	0.02	0.11	*	*	0.06	0.00002
4/25	0.10	0.004	*	*		0.02	*	*	0.006	*	
5/23	*	*	*	*		0.03	0.15	*	*	*	
6/20	*	*	*	*	0.003	0.01	0.15	*	*	*	0.0001
7/18	0.14	*	*	*		0.007	*	*	*	*	
8/29	*	*	*	*		*	0.09	*	*	*	
9/26	*	*	*	*	0.001	*	0.19	*	*	*	0.00002
10/24	*	*	*	*		*	0.14	*	*	*	
11/21	*	*	*	*		*	0.18	*	*	*	
12/19	*	*	*	*	0.001	*	*	*	*	*	*
Annual Average(b)	<0.03	<0.001	*	*	0.002	<0.01	<0.11	*	<0.0008	<0.01	<0.00004
					Outer Southeast Quadrant						
1/24	*	*	*	*		0.02	0.19	*	*	*	
2/21	0.03	*	*	*		0.03	*	*	*	0.03	
3/21	*	*	*	*	0.002	0.03	0.20	*	*	*	0.00002
4/19	*	*	*	*		0.03	0.14	*	*	*	
5/30	0.07	*	*	*		0.03	0.16	*	*	*	
6/26	*	*	*	*	0.002	0.02	0.14	*	*	*	0.00004
7/25	0.09	*	*	*		0.005	0.10	*	*	*	
8/22	*	*	*	*		*	0.22	*	*	*	
9/26	0.06	*	*	*	0.0008	*	0.14	*	*	*	0.00002
10/31	*	*	*	*		*	0.15	*	*	*	
11/14	*	*	*	*		*	*	*	*	*	
12/20	0.05	*	*	*	0.001	*	0.05	*	*	*	0.000006
Annual Average(b)	<0.03	*	*	*	0.002	<0.01	<0.13	*	*	<0.005	0.00002
					Outer Western Quadrant						
1/27	*	*	*	*		0.02	0.18	*	*	*	
2/24	*	*	*	*		0.03	*	*	*	*	
3/24	0.18	0.01	*	0.02	0.01	0.03	*	*	0.01	*	0.00002
4/21	0.12	*	*	*		0.03	*	*	*	*	
5/19	*	*	*	*		0.04	*	*	*	*	
6/16	*	*	*	*	0.003	*	0.27	*	*	*	0.00006
7/28	*	*	*	*		*	0.17	*	*	*	
8/27	*	*	*	*		*	*	*	*	*	
9/22	*	*	*	*	0.0005	*	*	*	*	*	0.000005
10/20	*	*	*	*		*	*	*	*	*	
11/17	*	*	*	*		*	*	*	*	*	
12/29	*	*	*	*	0.001	*	*	*	*	*	0.00005
Annual Average(b)	<0.03	<0.001	*	<0.001	0.004	<0.01	<0.09	*	<0.002	*	0.00003

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.

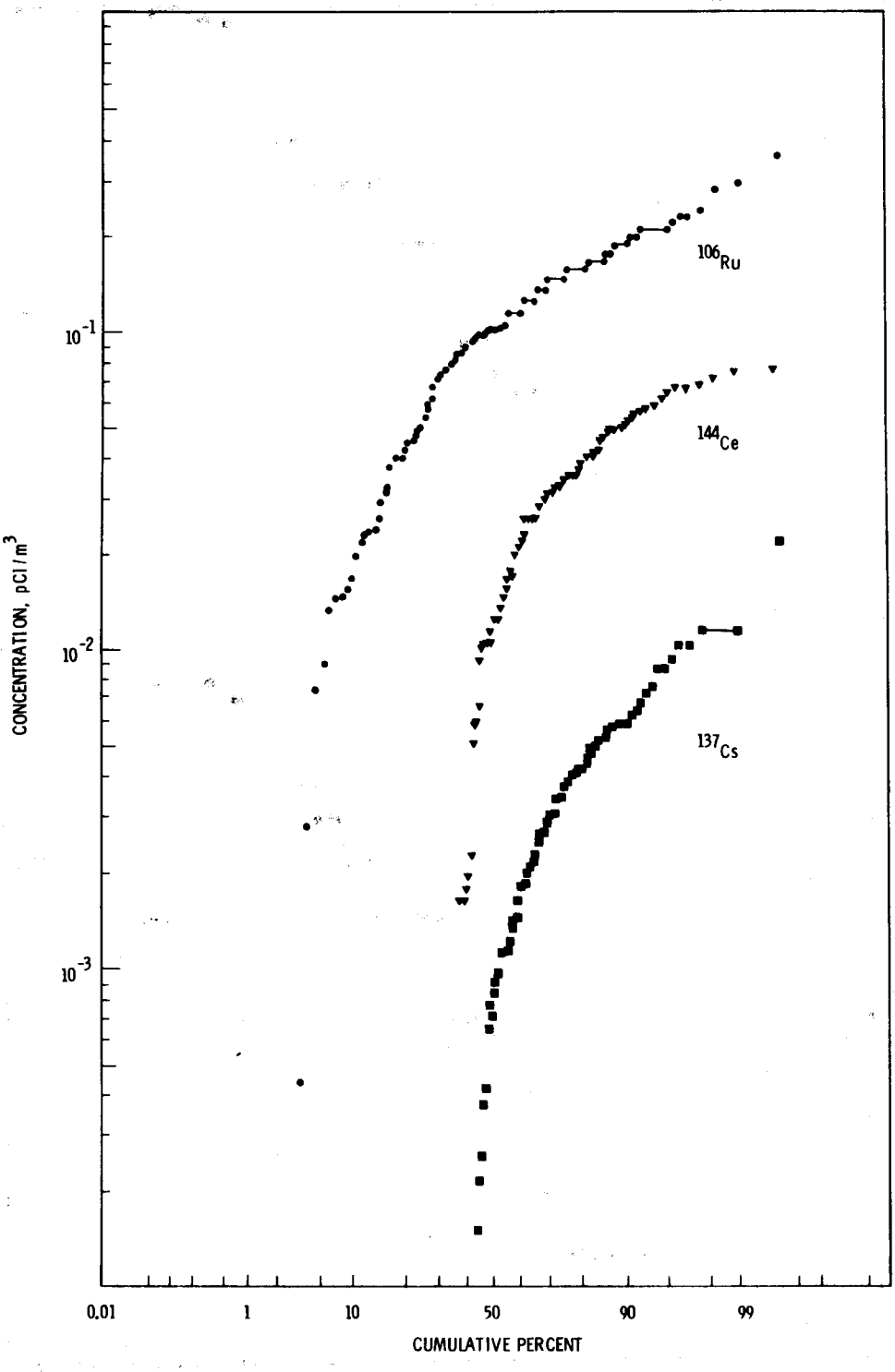


FIGURE 5. Log-Normal Probability Plot of ^{106}Ru, ^{137}Cs, and ^{144}Ce Concentrations in the Atmosphere During 1975

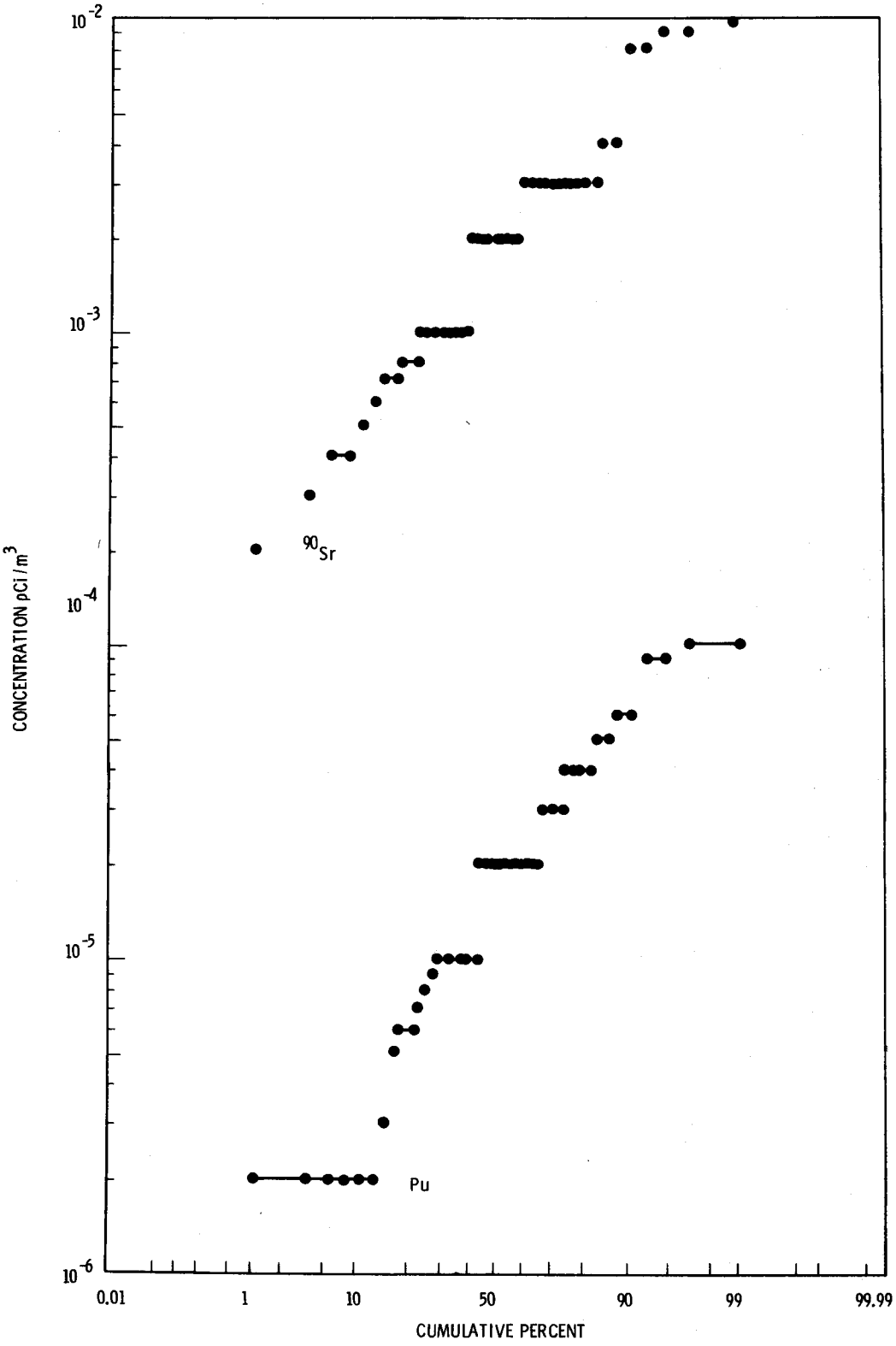


FIGURE 6. Log-Normal Probability Plot of ^{90}Sr and Pu Concentrations in the Atmosphere During 1975

points plotted which leads to the conclusion that there is nothing distinctive or different about any of the results obtained and that all of the observed radioactivity is attributed to worldwide fallout. The maximum Pu concentration was observed in the second quarter composite from the outer northeast quadrant.

In summary, average levels of radionuclides observed at onsite, perimeter, and distant sampling stations were similar, indicating no conclusive observable effect from 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 - 1975

Radionuclide	Maximum Observed[a] Concentration 10^{-12} µCi/ml	ERDAM 0524[b] Standard 10^{-12} µCi/ml	Composite[c] Group
^{7}Be	0.2	40,000	Active Area #5
^{54}Mn	0.01	1,000	Several
^{60}Co	0.09	300	Inner Southeast Quadrant
^{65}Zn	0.02	2,000	Outer Western Quadrant Active Area #1
^{90}Sr	0.01	30	Outer Western Quadrant
$^{95}ZrNb$	0.08	3,000	Active Area #1
^{106}Ru	0.34	200	Active Area #1
^{134}Cs	*	400	
^{137}Cs	0.02	500	Active Area #1
$^{144}CePr$	0.07	200	Inner Southeast Quadrant Inner Southwest Quadrant
Pu-total	$1x10^{-4}$	$6x10^{-2}$[d]	Outer Northeast Quadrant Active Area #2

* less than detectable
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. Fecal coliform measurements were made to clarify the types of coliforms present. The majority of the information has been evaluated and presented in the 1975 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 at Vernita Bridge and Richland, and the annual averages determined during 1975 were both <370 pCi/ℓ.[2] The concentration observed at 100-N was 540±310 pCi/ℓ. 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.

A few operations on the Hanford site obtain drinking water from the groundwater via wells. Among these are the FFTF and WPPSS operations. The annual dose received from ^{3}H present in the water due to seepage in the groundwater from the 200 Areas is approximately 1.6 mrem/year based on an average concentration of 50,000 pCi/ℓ, ingesting 1.1 liters per 8-hour working day, working 5 days per week, and 50 weeks per year. Measurement of tritium at levels 5% of the ERDAM 0524 concentration guide (150,000 pCi/ℓ) in the vicinity of the FFTF site (Well No. 699-18-17) have been made during 1975.

TABLE 5. Radiological Analysis of Drinking Water - 1975

Units of 10^{-9} µCi/ml

Location	Analysis	Analytical Limit	Standards[a]	No. of Samples	Maximum Observed	Minimum Observed	Average[b]
100-N	Beta	2	30	52	11	*	<2
	^{3}H	300	3,000,000	9	860	350	540±310
	^{60}Co	20	30,000	6	*	*	*
	^{65}Zn	40	100,000	6	*	*	*
	^{137}Cs	20	20,000	6	*	*	*
300 Area	Alpha	0.3	30	52	1.2	*	<0.5
	Beta	2	30	52	3	*	<1
	^{60}Co	20	30,000	50	*	*	*
	^{65}Zn	40	100,000	50	*	*	*
	^{137}Cs	20	20,000	50	*	*	*
Richland	Alpha	52	30	52	1.3	*	<0.4
	Beta	2	30	52	3	*	<1
	^{90}Sr	0.08	300	10	0.8	*	<0.4
	^{60}Co	20	30,000	11	*	*	*
	^{65}Zn	40	100,000	11	*	*	*
	^{137}Cs	20	20,000	11	2.6	*	<0.06

* 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.

Drinking water for WPPSS operations is expected to be obtained from the Columbia River during the latter part of 1976.

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. During 1975, the following shoreline areas were sampled:

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

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

300 Area — Depending on the water level of the Columbia River, as many as three different river bank springs can be seen. The first spring (Above 300 Area Spring) is about one 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 was collected from "Above 300 Area Spring" and "300 Area Spring #1" for coliform, fecal coliform, and BOD analyses. Whenever the river level was less than 345' MSL, Mean Sea Level (345' MSL) at the 300 Area forebay, additional samples were 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 first several months of 1975, additional samples from 300 Area Spring #1 and #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 were collected for coliform, fecal coliform, and BOD analyses. Additional samples were collected for NO_3 analysis if the river water level was less than 345' MSL at the 300 Area forebay.

Table 6 lists the results for the samples collected at the 100-N springs during 1975. Several positive results were observed although all were less than ERDA 0524 standards for uncontrolled areas with the exception of two ^{131}I results, as shown in Table 6.

Samples of watercress were collected from different spring locations during 1975 and the results are shown in Table 7. The vegetation is a potential

TABLE 6. Columbia River Water Samples in the Vicinity of the 100-N Area Riverbank Springs - 1975

	Concentration (10^{-9} µCi/ml)											
	^{3}H	^{46}Sc	^{51}Cr	^{54}Mn	^{58}Co	^{60}Co	^{65}Zn	$^{95}ZrNb$	^{106}Ru	^{131}I	^{137}Cs	$^{144}CePr$
Concentration Guide[a]	$3x10^6$	$4x10^4$	$2x10^6$	$1x10^5$	$9x10^4$	$3x10^4$	$1x10^5$	$6x10^4$	$1x10^4$	300	$2x10^4$	$1x10^4$
Analytical Limit	400	25	400	20	30	30	40	20	500	2	30	400
	Analytical Results											
Date												
1/9		*	*	*	*	*	*	*	*	50	*	*
2/14		*	*	*	*	*	*	*	*	*		
3/6		*	*	*	*	*	*	*	*	50	*	*
4/10		*	*	*	*	*	*	*	*	100	*	*
5/8		*	*	*	*	*	*	*	*	100	*	*
6/5		*	*	*	*	*	*	*	*	20	*	*
7/10	25,000	*	*	*	*	110	66	*	*	30	110	*
8/8	32,000	*	*	*	*	*	*	*	*	*	*	*
9/4	14,000	*	580	*	*	120	*	*	4600	270	70	*
10/9	47,000	*	*	74	*	390	*	20	6600	3600	*	8700
11/6	34,000	*	*	*	1000	80	*	*	5400	5200	70	2000
12/5	6,100	*	*	*	*	*	*	*	*	50	*	*

No entry indicates no analysis
* Less than detectable
(a) ERDA Manual Chapter 0524 most restrictive guideline for uncontrolled areas.

TABLE 7. Selected Radionuclides in Watercress Samples from 100-N Riverbank Springs - 1975

	Concentration (pCi/gr Dry Weight)								
	^{40}K	^{60}Co	^{65}Zn	$^{95}ZrNb$	^{106}Ru	^{125}Sb	^{131}I	^{137}Cs	$^{144}CePr$
Analytical Limit[a]	3	0.3	0.5	0.2	3	1	0.4	0.2	2
	Analytical Results								
Date									
7/10	3	2	*	*	51	*	2	0.8	16
8/8	*	2	*	*	7	*	*	0.4	7
9/4		2	*	0.3	11	*	0.4	0.2	19
10/9	4	1	*	0.2	*	1	3.	*	59
11/6	20	9	13	7.7	*	68	226.	*	*
12/5	4	2	*	0.6	6	*		0.8	*

No entry indicates no analysis
* Less than detectable
(a) Approximate detection limit.

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.

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.

TABLE 8. Water Samples from 300 Area Riverbank Springs - 1975

Spring Location[a]	Analysis[b]	Units	Concentration		
			Maximum Observed	Minimum Observed	Average
Above 300 Area	NO_3	ppm	12	<0.5	<2.6
	F^-	ppm	0.2	<0.1	<0.1
	Beta(b)	pCi/ℓ	80	<75	<78
	Alpha	pCi/ℓ	30	<17	<18
	^3H	pCi/ℓ	4000	<500	<1300
300 Area #1	NO_3^-	ppm	33	0.2	14
	F^-	ppm	2.2	0.2	1.0
	Cu	ppb	5.0	0.8	2.0
	U	ppb	160.	1.6	45
300 Area #2	NO_3^-	ppm	46	1.7	16
	F^-	ppm	0.8	0.1	0.5
	Cu	ppb	7.0	1.0	3.7
	U	ppb	36.0	1.1	18
Columbia River (North Richland)	NO_3^-	ppm	1.5	<0.5	
	F^-	ppm	0.2	<0.1	<0.1
	U	ppb	7	<5	<5

(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.

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, 300 Area Spring #1, and North Richland. The results from the spring are the same as measurements obtained at North Richland.

TABLE 9. Columbia River Biological Analyses - 1975[a]

	Coliform			Fecal Coliforms			BOD		
Standard	240			---			---		
Unit	No./100ml			No./100ml			mg/ℓ		
Sample Location	Obs. Max.	Obs. Min.	Annual[b] Average	Obs. Max.	Obs. Min.	Annual Average	Obs. Max.	Obs. Min.	Annual Average
Vernita Bridge	64	12	30±33	26	7	14±17	5	3	4±1
100-F	84	4	31±47	66	6	23±39	6	3	4±2
300-Area Spring[c]	61	9	35±35	62	7	26±32	5	1	4±3
North Richland	56	8	36±35	51	3	27±29	6	2	4±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 - 1975

Date	Coliform N/100 ml	Fecal Coliforms N/100 ml	BOD mg/ℓ	Turbidity JTU *
		300 Area Leaching Trench		
1/21	1.1×10^5	1.4×10^4	7.5	16
2/4	2.0×10^5	1.4×10^4	6.9	20
3/5	4.5×10^5	4.7×10^4	6.4	20
4/29	6.3×10^5	6.1×10^4	6.1	45
5/28	7.2×10^5	5.1×10^4	5.5	39
8/20	5.1×10^5	4.7×10^4	5.4	25
9/16	4.7×10^5	6.6×10^4	5.4	28
11/19	1.4×10^6	5.6×10^4	4.0	31
12/16	4.8×10^5	2.1×10^4	6.5	35
Average	$(5.5 \pm 7.4) \times 10^5$	$(4.2 \pm 4.0) \times 10^4$	6.0±2.0	29±19
		River Shoreline Seepage Area		
1/22	32	32	4.4	1
2/4	33	25	5.5	4
3/5	9	20	4.5	6
4/29	44	18	3.9	6
5/28	25	28	4.5	7
8/20	19	14	3.3	5
9/16	60	62	1.4	2
11/19	61	33	1.8	2
12/16	31	7	2.4	8
Average	35±35	26±32	3.5±2.8	5±5
		North Richland		
Average	36±35	27±29	4.0±1.8	5±6

* 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 1975. 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. Figure 7 shows the location of the major ditches, ponds, and trenches on the Hanford Reservation sampled during 1975.

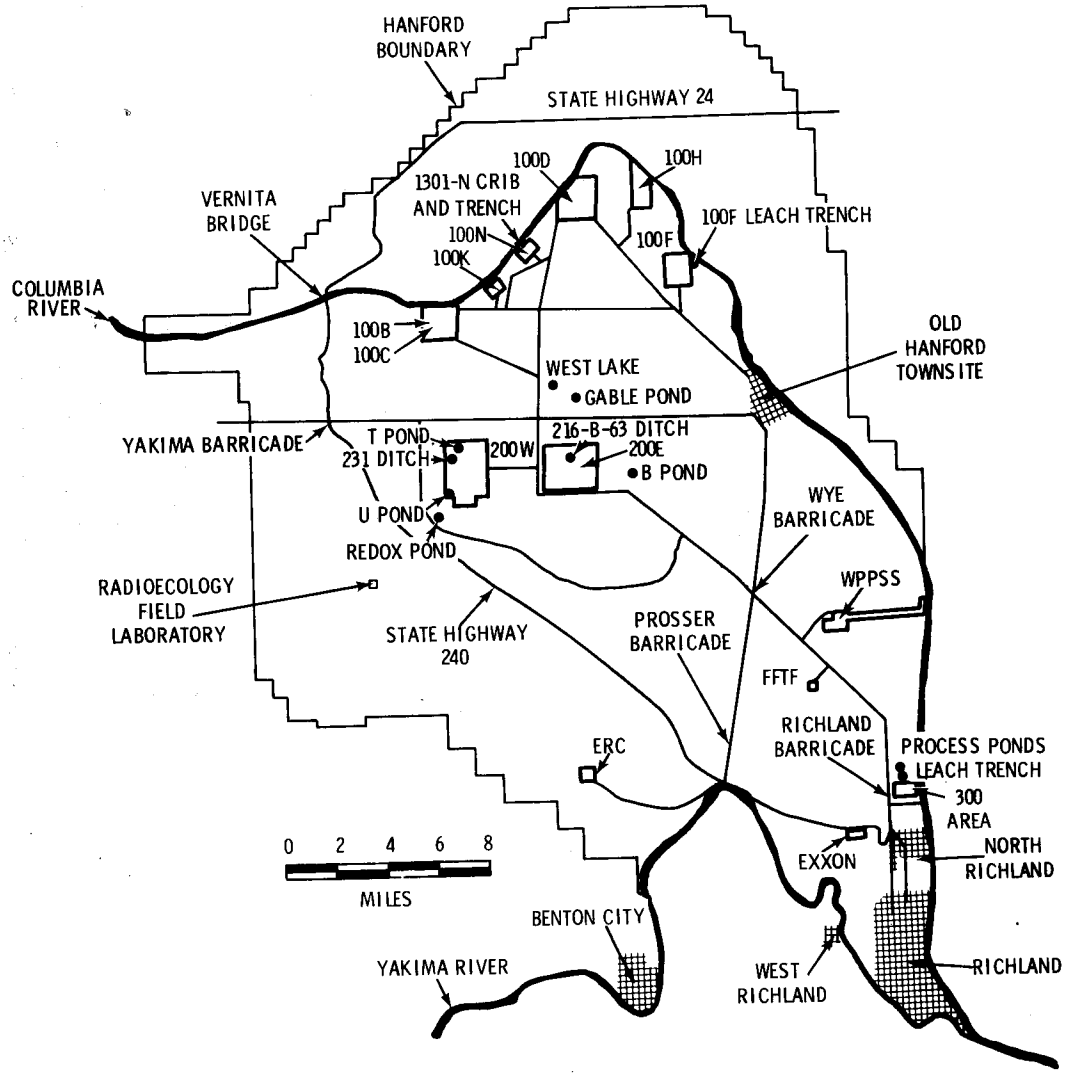


FIGURE 7. Surface Water Areas Sampled During 1975

The results for gross beta, gross alpha, and ^{90}Sr analyses are shown in Figures 8 through 10 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, generally had the highest observed levels of gross beta and gross alpha activity. 100-F leach trench had the highest observed levels of ^{90}Sr.

No waste is discharged to West Lake and a likely cause of the elevated concentrations 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.

Table 11 is a summary of replicate sampling from West Lake during June 1975. The table indicates an average concentration of about 1100 pCi/ℓ of uranium and <0.3 pCi/ℓ of plutonium. The concentrations observed in Columbia River water are approximately 4 pCi/ℓ and <0.02 pCi/ℓ, respectively. During October 1975, 100-F leach trench was deactivated and will no longer be used.

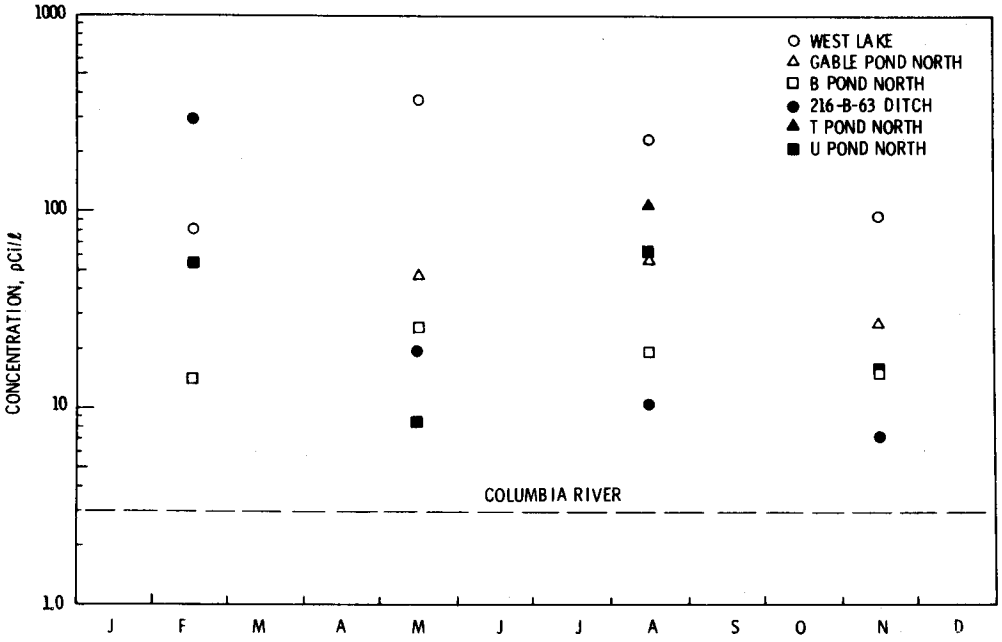


FIGURE 8. Gross Beta Activities Observed in 200 Area Ponds

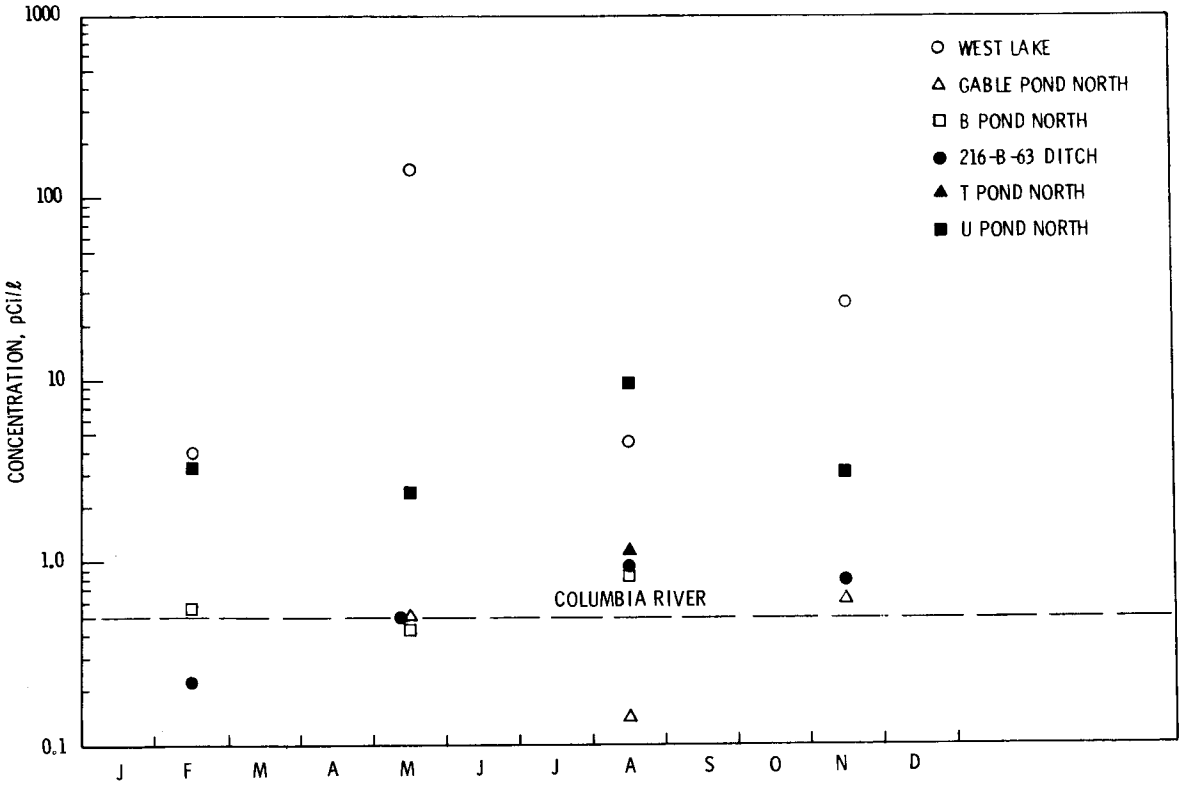


FIGURE 9. Gross Alpha Activities Observed in 200 Area Ponds

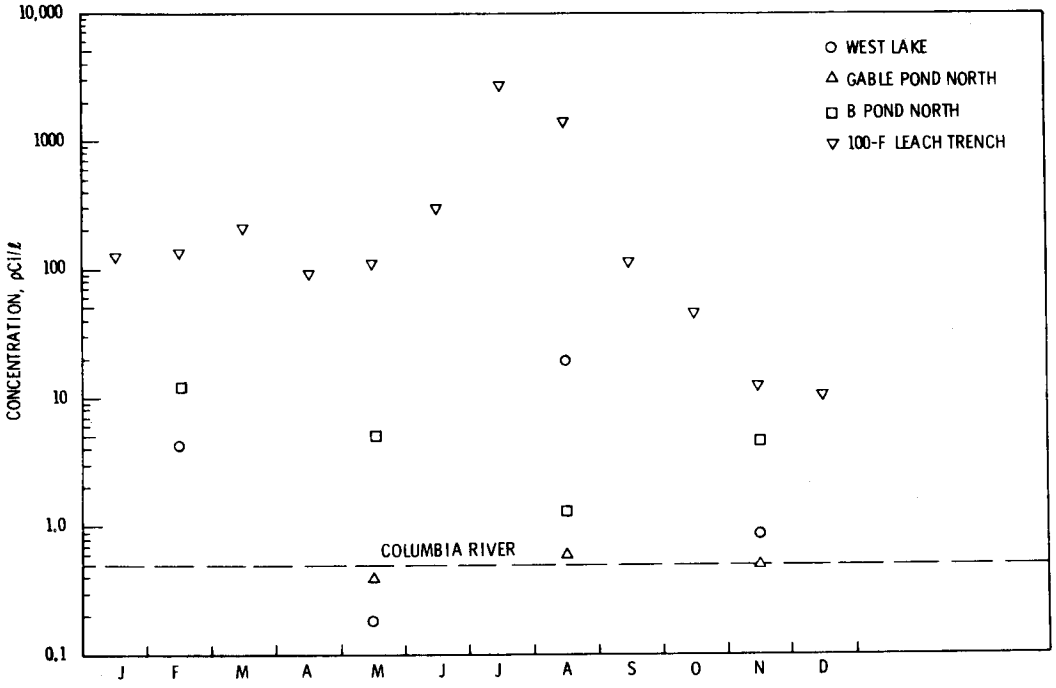


FIGURE 10. Strontium-90 Observed in Selected 100 and 200 Area Ponds

TABLE 11. West Lake Replicate Sampling*

Sample Number	Gross Alpha	Gross Beta	Uranium	Plutonium
	pCi/ℓ	C/Min/mℓ	pCi/ℓ	pCi/ℓ
1	187	206	1010	0.04
2	159	133	959	0.05
3	122	269	448	0.02
4	173	239	1200	0.02
5	241	304	859	<0.004
6	187	365	1420	0.04
7	145	330	1350	0.3
8	109	396	1240	0.02
9	170	178	1110	0.1
10	214	269	1150	<0.008
Aver.±2σ	171±80	269±166	1075±559	<(0.06±0.2)

*Samples obtained from different locations during the same day.

The results of 300 Area process pond sample analyses for gross beta, gross alpha and uranium activity are shown in Figure 11. The gross alpha activity is primarily due to uranium. The levels of uranium observed (100 pCi/ℓ) are approximately 10% of the concentrations observed in West Lake (Table 11) and approximately 25 times the levels observed in Columbia River water (4 pCi/ℓ). The levels of gross beta radioactivity were similar to the other ponds.

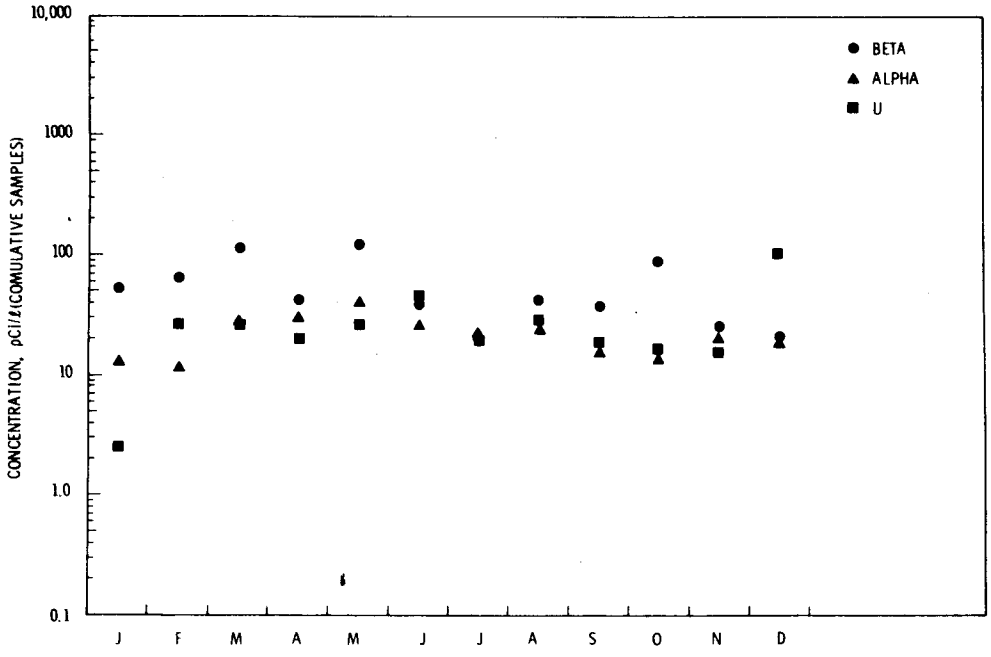


FIGURE 11. Monthly Gross Beta, Gross Alpha, and Uranium Results for 300 Area Discharge to Waste Ponds

The results of gamma spectroscopy analysis of pond water samples are shown in Table 12. Only ^{137}Cs in Gable Mountain pond was detected consistently. ^{137}Cs was also detected in West Lake, B Pond, and U Pond. ^{60}Co was detected in 300 Area pond water on one occasion. All other results were less than detectable.

TABLE 12. Gamma Activity in Waste Water Samples - 1975

Units of 10^{-9} µCi/ml

Location	Date	^{51}Cr	^{60}Co	^{65}Zn	^{137}Cs
Detection Limit[a]		300	30	4	3
West Lake	1/10	*	*	6±4	3±2
	4/4	*	*	*	*
	8/1	*	*	*	*
	11/7	*	*	*	4±2
Gable Pond	1/10	Pond Frozen			
	4/4	*	*	*	63±1
	8/1	*	*	*	35±31
	11/7	*	*	*	59±2
B Pond	1/10	*	*	*	*
	4/4	*	*	*	8±1
	8/1	*	*	*	*
	11/7	*	*	*	4±2
T Pond	1/10	Pond Dry			
	4/4	Pond Dry			
	8/1	*	*	*	*
	11/7	Pond Dry			
U Pond	1/10	*	*	*	42±22
	4/4	*	*	*	*
	8/1	*	*	*	*
	11/7	*	*	*	*
216-B-63 Ditch	1/10	*	*	*	*
	4/4	*	*	*	*
	8/1	*	*	*	*
	11/7	*	*	*	*
331 Pond	1/2	*	*	*	*
300 Pond[b] 1/20	1/27	*	*	*	*
2/18	2/24	*	*	*	*
3/24	3/31	*	102±49	*	*
4/21	4/28	*	*	*	*
5/19	5/27	*	*	*	*
6/23	6/30	*	*	*	*
7/21	7/28	*	*	*	*
8/18	8/25	*	*	*	*
9/22	9/29	*	*	*	*
10/20	10/27	*	*	*	*
11/17	11/24	*	*	*	*
12/22	12/29	*	*	*	*

* Less than detection limit.
(a) Average detection limit calculated from the detection limits reported for each analysis.
(b) Integrated sample dates shown.

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 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 1975. 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, U Pond, and West Lake. Although the data are limited, apparently there are elevated concentrations of uranium in 300 Area pond and in U Pond duck livers, as well as ^{239}Pu in U Pond duck livers.

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 1975 the one analyzed coot had the highest observed maximum concentration of ^{137}Cs. Other duck varieties had levels of ^{137}Cs compared to ducks collected along the Columbia River.

Assuming that an individual consumed 500 grams of meat from the duck containing the highest levels of ^{137}Cs observed during 1975, a 50-year internal dose commitment of 5.9 mrem to the whole body and 6.7 mrem to the bone would be incurred. 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).

TABLE 13. Average Radionuclide Concentrations in Muscle of Gamebirds - 1975

Units of 10^{-6} µCi/gm (wet weight)

Location	Species	No. of Samples	^{40}K Analytical Limit 2.0 Maximum Observed	^{40}K Minimum Observed	^{40}K Average	^{60}Co Analytical Limit 0.2 Maximum Observed	^{60}Co Minimum Observed	^{60}Co Average	^{65}Zn Analytical Limit 0.3 Maximum Observed	^{65}Zn Minimum Observed	^{65}Zn Average
300 Pond	Ducks	2	3.0	2.3	2.6	*	*	*	*	*	*
B Pond	Ducks	4	4.5	2.7	3.7	*	*	*	0.7	*	<0.3
100-F Trench	Ducks	2	2.4	2.3	2.4	*	*	*	*	*	*
West Lake	Ducks	4	6.3	*	<3.9	*	*	*	*	*	*
Gable Pond	Ducks	4	4.8	*	<3.7	*	*	*	*	*	*
U Pond	Ducks	3	3.3	*	<2.8	0.5	*	<0.2	*	*	*
T Pond	Ducks	1			2.6			1.8			*
Columbia River	Ducks	27	4.1	*	<3.2	*	*	*	*	*	*
Columbia River	Geese	17	9.5	0.9	<3.1	*	*	*	*	*	*
100 Areas	Pheasants	16	3.8	*	<2.8	*	*	*	*	*	*

Location	Species	No. of Samples	^{90}Sr Analytical Limit 0.005 Maximum Observed	^{90}Sr Minimum Observed	^{90}Sr Average	^{137}Cs Analytical Limit 0.1 Maximum Observed	^{137}Cs Minimum Observed	^{137}Cs Average
300 Pond	Ducks	2	*	*	*	0.08	*	<0.05
B Pond	Ducks	4	0.02	*	<0.03	17.3	6.6	9.7
100-F Trench	Ducks	2	0.03	0.02	0.02	0.08	*	<0.06
West Lake	Ducks	4	0.03	*	<0.02	25.3	0.4	8.3
Gable Pond	Ducks	4	0.04	*	<0.03	210	*	72
U Pond	Ducks	3	0.04	*	<0.02	59	0.3	25
T Pond	Ducks	1			0.01			47
Columbia River	Ducks	27	0.05	*	<0.008	0.2	*	<0.03
Columbia River	Geese	17				0.2	*	<0.04
100 Areas	Pheasants	16	0.08	*	<0.01	0.1	*	<0.07

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

Samples of muscle liver and bone tissue from "road-kill" deer on the Hanford Reservation were analyzed for radioactivity. The results are shown in Table 16. Only naturally occurring ^{40}K was observed in muscle tissue from each of the deer. ^{60}Co was observed in one deer collected near 100-N. No other radionuclides were observed in muscle tissue. ^{239}Pu concentration in liver samples and ^{90}Sr concentrations in bone are due to either Hanford operations or fallout. The lack of observable quantitites of radionuclides in muscle tissue known to be available on the Hanford site (eg. ^{137}Cs) would indicate that the observed levels of ^{90}Sr and ^{239}Pu are likely due to fallout. The ^{60}Co observed in one deer collected at 100-N is assumed due to Hanford operations. Assuming a person ingested 50 pounds of deer meat containing the 0.05 pCi/g of ^{60}Co observed, a 50-year dose commitment of about 0.005 mrem would be incurred. This is a very small percent (0.001%) of the 500 mrem per year dose guideline set forth in ERDA Manual Chapter 0524.

TABLE 14. Average Concentrations of Selected Radionuclides in the Livers of Waterfowl Samples in the Hanford Environs - 1975

	Units of 10^{-6} µCi/gm (wet weight)	
	U	^{239}Pu
Analytical Limit	0.03	0.0005

Location	No. of Samples	Maximum Observed	Minimum Observed	Average	Maximum Observed	Minimum Observed	Average
300 Pond	2	0.07	0.04	0.06	*	*	*
U Pond	3(a)			0.05	0.06	*	< 0.02
West Lake	2	*	*	*			

*Less than the analytical limit
No entry indicates no analysis was made.
(a) Only one duck analyzed for uranium.

TABLE 15. Selected Radionuclides from Muscle of Waterfowl Samples Taken from Ponds in the Hanford Environs - 1975

Units of 10^{-6} μCi/gm (wet weight)

Duck Variety	^{40}K 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
Mallard	10	3.4	*	<2.6	1.8	*	<0.3
Coot	1			4.8			*
Scaup, Lesser	1		*				*
Green-Winged, Teal	2	6.3	*	<4.7	*	*	*
Blue-Winged, Teal	2	4.0	3.3	3.7	*	*	*
Bufflehead	1			*			*
Barrow's Goldeneye	3	4.5	*	<3.3	*	*	*

	^{65}Zn No. of Samples	^{65}Zn Maximum Observed	^{65}Zn Minimum Observed	^{65}Zn Average	^{90}Sr Maximum Observed	^{90}Sr Minimum Observed	^{90}Sr Average
Mallard	10	*	*	*	0.04	*	<0.01
Coot	1			*			
Scaup, Lesser	1			*			0.04
Green-Winged, Teal	2	*	*	*	*	*	*
Blue-Winged, Teal	2	0.7	*	<0.5	*	*	*
Bufflehead	1			*			0.03
Barrow's Goldeneye	3	*	*	*	0.02	*	0.01

	^{137}Cs No. of Samples	^{137}Cs Maximum Observed	^{137}Cs Minimum Observed	^{137}Cs Average
Mallard	10	59	*	<19.3
Coot	1			210
Scaup, Lesser	1			38
Green-Winged, Teal	2	3.7	0.4	2.1
Blue-Winged, Teal	2	17.3	0.3	8.8
Bufflehead	1			4.1
Barrow's Goldeneye	3	7.5	*	<4.7

TABLE 16. Concentration of Selected Radionuclides in Deer - 1975

Units of 10^{-6} μCi/gm (wet weight)

Location	Date	Tissue	^{40}K	^{60}Co	^{90}Sr	^{137}Cs	^{239}Pu
100-N	1/24	muscle	2.2	0.05	*	*	
		liver					0.0002
	6/19	muscle	2.8	*		*	
	11/19	muscle	1.5	*		*	
		liver					0.0004
		bone			0.007		
Gable Pond	12/22	muscle	2.2	*		*	
		liver					<0.0001
		bone			0.022		

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

Mice and rabbits are collected around sources of drinking water or potential sources of salt on the Hanford Reservation. The results are shown in Tables 17 and 18. 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. The highest observed ^{90}Sr concentrations occurred in samples of bone from rabbits collected in the B-C crib area.

TABLE 17. Concentration of Selected Radionuclides in Rabbits - 1975

Units of 10^{-6} µCi/gm (wet weight)

Location	Date	Tissue	^{40}K	^{60}Co	^{90}Sr	^{137}Cs	^{239}Pu	U
300 Pond	3/4	muscle	2.1	*		*		
		liver					<0.0004	
		bone			0.7			
Redox Pond	3/18	muscle	2.9	*		5.9		
		liver					<0.0004	
		bone			0.06			
Redox Lab	3/24	muscle	1.9	0.4		0.2		
		liver					0.0006	
		bone			3.9			
200 B-C	5/5	muscle	2.3	2.1		1.0		
		liver					0.003	
		bone			300.0			
200 B-C	5/5	muscle	*	3.9		1.2		
		liver					<0.0004	
		bone			250.0			
300 Pond	9/24	muscle	2.8			*		
		liver					<0.0004	<0.0006
		bone			0.02			
200 B-C	11/17	muscle	3.7	*		*		
		liver					<0.0004	
		bone			2.0			

TABLE 18. Concentration of Selected Radionuclides in Mice - 1975

Units of 10^{-6} µCi/gm (wet weight)

Location	Date	^{54}Mn	^{58}Co	^{59}Fe	^{60}Co	^{90}Sr	^{106}Ru	^{131}I	^{134}Cs	^{137}Cs	$^{144}CePr$
N-Trench	2/11	2000	88	1200	360	110	440	210	60	540	1000
	3/4	160	12	200	480	10	30	30	30	250	20
	4/29	4600	270	4600	6200	50	1100	280	110	710	930
B Pond	1/21	*	*	*	*	2	*	*	*	3	*
300 Pond	2/4	*	*	*	*	0.2	*	*	*	*	*
Gable Pond	3/18	*	*	*	*	2.1	*	*	*	7	*
	4/22	*	*	*	*	1.4	*	*	*	5	*
B-C Crib	5/6	*	*	*	*	0.6	*	*	*	*	*
	5/6	*	*	*	*	2.1	*	*	*	*	*
West Lake	3/24	*	*	*	*	0.1	*	*	*	*	*

SOIL AND VEGETATION

Surface soil and perennial vegetation samples were collected from 20 different locations during the autumn of 1975 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 12 and the results listed in Tables 19 and 20. 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.

From the data collected it is apparent that two of the sampling locations reflect deposition of radioactivity from Hanford operations. These locations are:

1. Map location #9, which is east of and directly across the road from the 200 W Area, shows elevated levels of $^{239-240}Pu$.
2. Map location #18, which is directly north of the 300 area, shows elevated levels of U. The location sampled is near the railroad tracks from the 300 Area.

The levels observed may be obtained from Table 19 or a visual inspection of the levels observed may be obtained from Figure 13 in which a log normal probability plot of the individual data points is presented. The uppermost point for both the U and $^{239-240}Pu$ graphs are primarily attributed to Hanford operations.

Two other areas are suspected of receiving observable activity from Hanford operations but the data available are insufficient to indicate conclusively

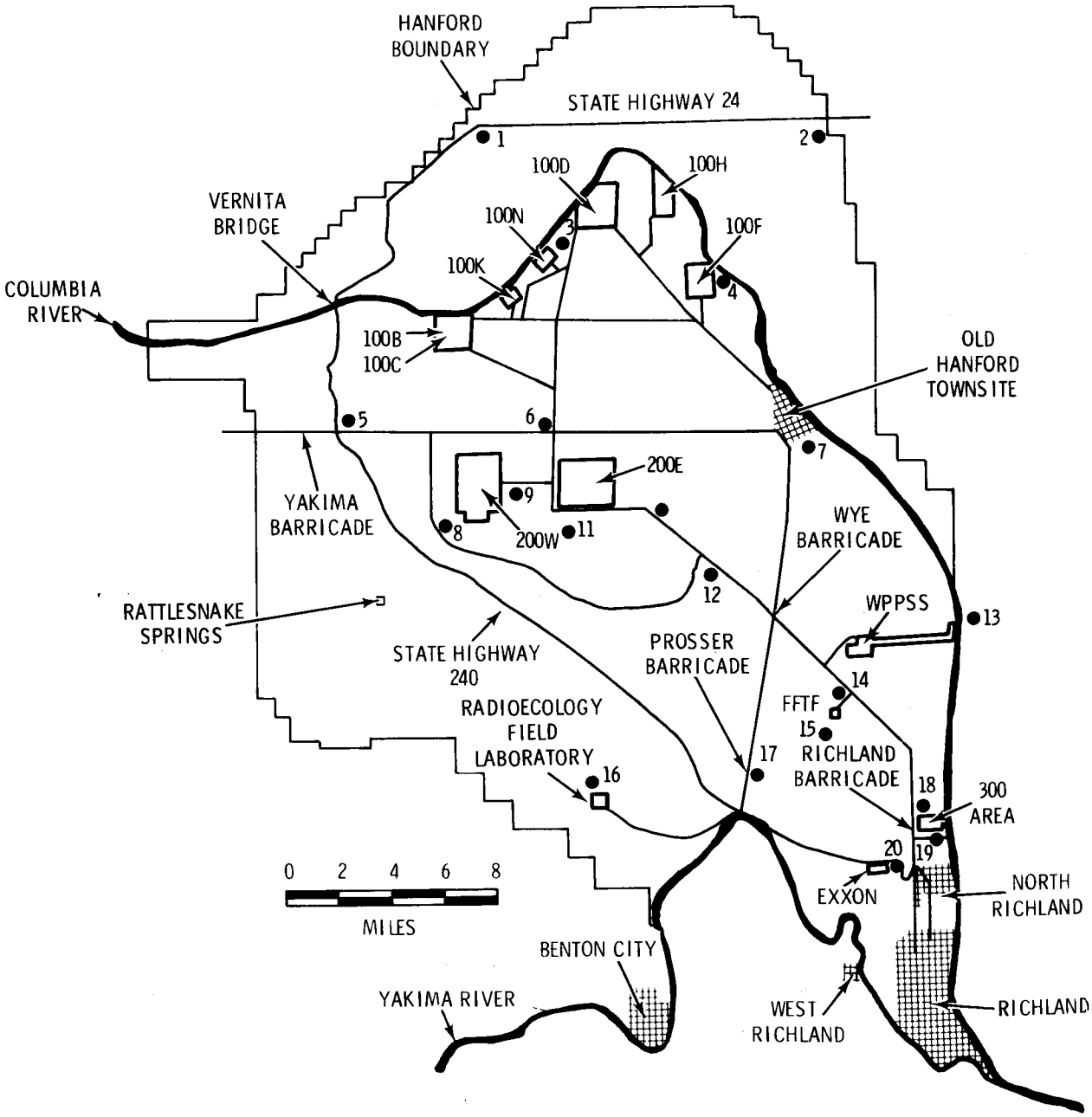


FIGURE 12. Surface Soil and Perennial Vegetation Sampling Locations During 1974

TABLE 19. Concentrations of Radionuclides in Surface Soil - 1975

Units of 10^{-6} µCi/gm (dry weight)

Sample Location	Map Location	Naturally Occurring Radionuclides				Artificially Produced Radionuclides											
		^{40}K	^{224}Ra	^{226}Ra	U-total	^{54}Mn	^{58}Co	^{60}Co	^{65}Zn	^{90}Sr	$^{95}ZrNb$	^{106}Ru	^{134}Cs	^{137}Cs	^{144}Ce	^{238}Pu	$^{239-240}Pu$
Onsite																	
100-N	3	13±2	0.9±0.1	0.6±0.1	0.2±0.03	0.2±0.1	<0.03	2.1±0.2	0.2±0.1	2.11±0.03	<0.4	0.2±0.2	0.5±0.1	1.2±0.1	0.02±0.1	<0.003	0.003±0.001
100-F (CP #58)	4	12±2	0.9±0.1	0.5±0.1	0.3±0.03	<0.03	<0.02	0.06±0.04	<0.06	0.33±0.01	0.2±0.1	<0.2	<0.03	0.9±0.1	0.3±0.2	<0.003	0.016±0.001
Yakima Barricade	5	12±2	0.8±0.1	0.6±0.1	0.3±0.03	<0.02	<0.02	0.1±0.1	0.09±0.07	0.12±0.01	<0.4	0.2±0.2	<0.03	0.1±0.04	0.2±0.1	<0.003	0.005±0.001
CP #59	6	12±2	1.1±0.1	0.7±0.1	0.3±0.03	<0.03	<0.02	<0.02	<0.04	0.28±0.01	0.2±0.1	<0.2	0.04±0.03	2.5±0.2	0.6±0.2	<0.003	0.022±0.001
CP #57	7	12±2	0.8±0.1	0.7±0.1	0.2±0.03	0.04±0.03	<0.02	<0.03	<0.07	0.41±0.01	0.2±0.1	<0.2	<0.03	2.0±0.2	0.4±0.2	<0.003	0.020±0.001
CP #60	8	14±2	0.7±0.1	0.5±0.1	0.3±0.03	0.04±0.03	<0.02	<0.03	<0.04	0.23±0.01	<0.4	0.2±0.2	0.09±0.04	0.4±0.1	0.4±0.1	<0.003	0.008±0.001
CP #2	9	14±2	0.8±0.1	0.5±0.1	0.2±0.3	<0.02	<0.03	<0.02	<0.07	0.29±0.01	0.2±0.1	<0.2	<0.02	3.0±0.2	0.5±0.2	0.005±0.003	0.310±0.001
CP #61	10	7±1	1.0±0.1	0.7±0.1	0.2±0.03	<0.02	<0.03	<0.03	0.2±0.1	0.73±0.01		<0.2	<0.03	1.5±0.2	0.3±0.2	<0.003	0.017±0.001
CP #42	11	12±2	0.9±0.1	0.5±0.1	0.2±0.03	<0.02	<0.03	1.4±0.7	<0.05	0.06±0.01	<0.09	<0.2	<0.02	0.2±0.1	0.2±0.1	<0.003	<0.001
4S & Army Loop Rd	12	14±2	1.0±0.1	0.6±0.1	0.4±0.03	<0.02	<0.02	<0.03	<0.05	0.33±0.01		<0.2	<0.02	0.6±0.1	0.3±0.2	<0.003	0.008±0.001
FFTF	14	13±2	0.7±0.1	0.6±0.1	0.2±0.03	0.04±0.03	<0.02	<0.02	<0.07	0.06±0.01		0.3±0.2	<0.02	<0.03	<0.1	<0.003	<0.001
FFTF	15	12±2	0.8±0.1	0.6±0.1	0.2±0.03	<0.02	<0.03	<0.03	<0.07	0.17±0.01	<0.1	<0.2	<0.02	0.2±0.1	0.4±0.2	<0.003	0.003±0.001
ALE	16	13±2	1.3±0.1	0.8±0.2	0.2±0.03	<0.02	<0.03	<0.02	<0.05	0.47±0.01	0.2±0.1	<0.2	<0.02	1.6±0.7	0.3±0.2	<0.003	0.013±0.001
Prosser Barricade	17	14±2	0.6±0.1	0.5±0.1	0.2±0.03	<0.03	<0.02	<0.02	<0.06	0.18±0.01	<0.6	0.3±0.2	0.05±0.03	0.2±0.1	<0.1	<0.003	<0.001
300 Area	18	13±2	0.5±0.1	0.6±0.1	1.3±0.03	0.04±0.03	<0.03	0.03±0.03	0.12±0.09	0.93±0.02	<0.6	<0.1	0.04±0.03	0.6±0.1	0.2±0.1	<0.003	0.011±0.001
CP #50	19	13±2	0.7±0.1	0.7±0.1	0.2±0.03	<0.02	<0.02	<0.02	0.09±0.08	0.5±0.01	0.4±0.2	<0.2	<0.02	0.06±0.04	0.2±0.1	<0.003	<0.001
Exxon	20	13±2	0.6±0.1	0.4±0.1	0.1±0.03	<0.02	<0.03	<0.03	0.14±0.09	0.56±0.01	<0.5	0.3±0.2	<0.02	0.7±0.1	0.2±0.1	<0.003	0.015±0.001
Avg.±2 sample deviations		12±3.2	0.8±0.4	0.6±0.2	0.3±0.5	<0.04	<0.02	<0.2	<0.09	0.5±1.0	<0.3	<0.2	<0.06	<0.9	<0.3	<0.003	<0.03
Offsite																	
Wahluke #2	1	11±2	0.8±0.1	0.5±0.1	0.2±0.03	0.03±0.03	<0.03	<0.02	0.1±0.1	0.10±0.01	<0.4	<0.1	<0.02	0.3±0.1	0.2±0.1	<0.003	<0.004
Berg Ranch	2	12±2	0.8±0.1	0.7±0.1	0.3±0.03	0.03±0.03	<0.02	<0.02	<0.06	0.18±0.01	<0.4	0.4±0.2	0.03±0.03	0.3±0.1	<0.1	<0.003	<0.008
Ringold	13	12±2	0.8±0.1	0.6±0.1	<0.003	<0.02	0.03±0.03	<0.03	<0.06	0.07±0.01		0.3±0.2	<0.02	0.2±0.1	0.1±0.1	<0.003	0.004±0.001
Average		12	0.8	0.6	<0.2	<0.03	<0.03	<0.02	<0.07	0.1	<0.3	<0.3	<0.02	0.3	<0.1	<0.003	<0.005

TABLE 20. Concentration of Radionuclides in Vegetation - 1975

Units of 10^{-6} μCi/gm (dry weight)

Sample Location	Map Location	Naturally Occurring Radionuclides		Artifically Produced Radionuclides												
		^{40}K	U-total	^{54}Mn	^{58}Co	^{60}Co	^{65}Zn	^{90}Sr	$^{95}ZrNb$	^{106}Ru	^{131}I	^{134}Cs	^{137}Cs	^{144}Ce	^{238}Pu	$^{239-240}Pu$
Onsite																
100-N	3	44±5	<0.05	1.1±0.2	<0.1	3.4±0.4	<0.2	0.01±0.005	1.5±0.6	<0.6	<1.6	<0.1	0.2±0.1	1.4±0.5	<0.003	0.003±0.001
100-F(CP #58)	4	14±2	<0.04	<0.06	<0.1	0.1±0.1	<0.2	0.02±0.004	<0.3	<0.4	<1.1	<0.1	0.1±0.1	0.3±0.3	<0.003	<0.002
Yakima Barricade	5	7±3	<0.07	<0.08	<0.1	<0.1	<0.2	0.01±0.006	<0.5	<0.6	<1.7	<0.1	0.2±0.1	<0.2	<0.003	0.002±0.001
CP #59	6	13±2	<0.03	<0.08	<0.1	<0.1	<0.1	0.03±0.005	<0.5	<0.4	<1.2	<0.1	0.1±0.1	0.4±0.3	<0.003	<0.002
CP #57	7	45±5	<0.06	<0.07	<0.09	<0.2	<0.2	0.04±0.006	<0.8	<0.5	<2.5	<0.1	0.2±0.1	<0.4	<0.003	0.003±0.001
CP #60	8	11±2	<0.04	<0.09	<0.07	<0.07	<0.1	0.04±0.004	<0.6	<0.4	<1.3	<0.1	0.1±0.1	<0.6	<0.003	<0.002
CP #2	9	38±6	<0.05	<0.2	<0.2	<0.3	<0.5	0.02±0.01	<0.9	<1.0	<4.0	<0.2	<0.3	<1.0	<0.003	0.012±0.001
CP #61	10	33±5	<0.05	<0.2	<0.2	0.2±0.2	<0.3	0.02±0.009	<0.8	<0.6	<2.2	<0.1	0.1±0.1	<0.5	<0.003	<0.002
CP #42	11	23±4	<0.05	<0.2	<0.2	2.1±0.3	<0.2	0.01±0.007	<0.4	<0.6	<2.2	<0.1	<0.3	<0.5	<0.003	0.003±0.001
4 S & Army Loop Rd	12	10±2	<0.04	<0.05	<0.1	<0.05	<0.1	0.09±0.005	0.4±0.3	<0.3	<1.2	<0.1	0.4±0.1	<0.5	<0.003	<0.004
FFTF	14	13±2	<0.05	<0.07	<0.1	<0.2	<0.2	0.01±0.005	<0.5	<0.4	<1.5	<0.1	<0.1	<0.3	0.006±0.003	0.004±0.001
FFTF	15	8±2	<0.05	<0.07	<0.1	0.1±0.1	<0.1	0.03±0.01	<0.5	<0.5	<1.9	<0.1	<0.2	<0.9	<0.003	0.002±0.001
ALE	16	4±2	<0.04	<0.09	<0.06	<0.1	<0.1	0.25±0.01	<0.5	<0.3	<1.3	<0.1	<0.1	<0.9	<0.003	0.002±0.001
Prosser Barricade	17	12±2	<0.04	<0.05	<0.07	<0.08	<0.2	0.15±0.01	<0.5	<0.4	<1.8	<0.1	<0.2	<0.6	<0.005	0.002±0.001
300 Area	18	12±2	<0.06	<0.09	<0.06	<0.	<0.1	0.02±0.01	<0.4	<0.3	<2.6	<0.1	<0.1	<0.3	<0.003	<0.002
CP #50	19	40±8	<0.03	<0.2	<0.3	<0.2	<0.5	0.48±0.04	<1.0	<2.0	<7.5	<0.2	<0.2	<2.6	<0.005	<0.002
Exxon	20	11±2	<0.07	<0.1	<0.2	<0.2	<0.2	0.03±0.01	<0.4	<0.5	<3.3	<0.1	<0.1	<0.9	<0.003	0.002±0.001
Avg.±2 Sample Deviations		20±14	<0.05	<0.2	<0.1	<0.4	<0.2	0.08±0.12	<0.6	<0.6	<3.9	<0.1	<0.2	<0.7	<0.003	<0.003
Offsite																
Wahluke #2	1	12±2	0.04±0.03	<0.5	<0.1	<0.05	<0.1	0.02±0.004	<0.3	<0.3	<0.8	<0.04	<0.05	0.3±0.2	<0.003	<0.002
Berg Ranch	2	16±2	<0.03	<0.06	<0.1	<0.07	<0.1	0.01±0.004	<0.3	<0.4	<1.1	<0.05	0.1±0.1	<0.3	<0.003	<0.002
Ringold	13	16±3	<0.03	<0.1	<0.1	<0.2	<0.2	0.02±0.007	<0.4	<0.6	<2.0	<0.08	<0.08	<0.5	<0.005	<0.002
Avg.		15	<0.03	<0.2	<0.1	<0.5	<0.1	0.02	<0.03	<0.4	<1.3	<0.06	<0.08	<0.4	<0.004	<0.002

that the levels are not due to fallout. These locations are:

1. Map location #3, which is directly south of the 1301-N trench, shows possible deposition of ^{60}Co activity. Results for ^{54}Mn in soil, approximately 100-fold greater than other locations, and apparently elevated levels of ^{54}Mn, ^{60}Co, $^{95}ZrNb$, and ^{144}Ce in vegetation further substantiate the conclusion that Hanford origin activity is present.

2. Map location #11, which is directly east of the Nuclear Engineering Disposal site, shows possible deposition of ^{60}Co.

Figure 14 is a lognormal plot of ^{60}Co and ^{90}Sr results for all sampling locations. The ^{90}Sr plot appears to be linear indicating that the observed

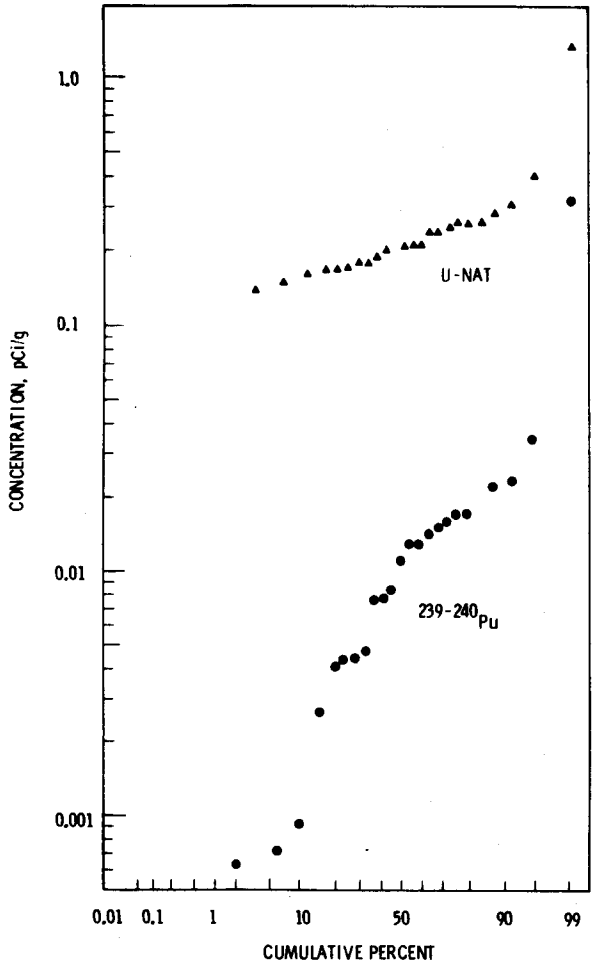


FIGURE 13. Log-Normal Probability Plot of U-Nat and $^{239-240}Pu$ Results During 1975

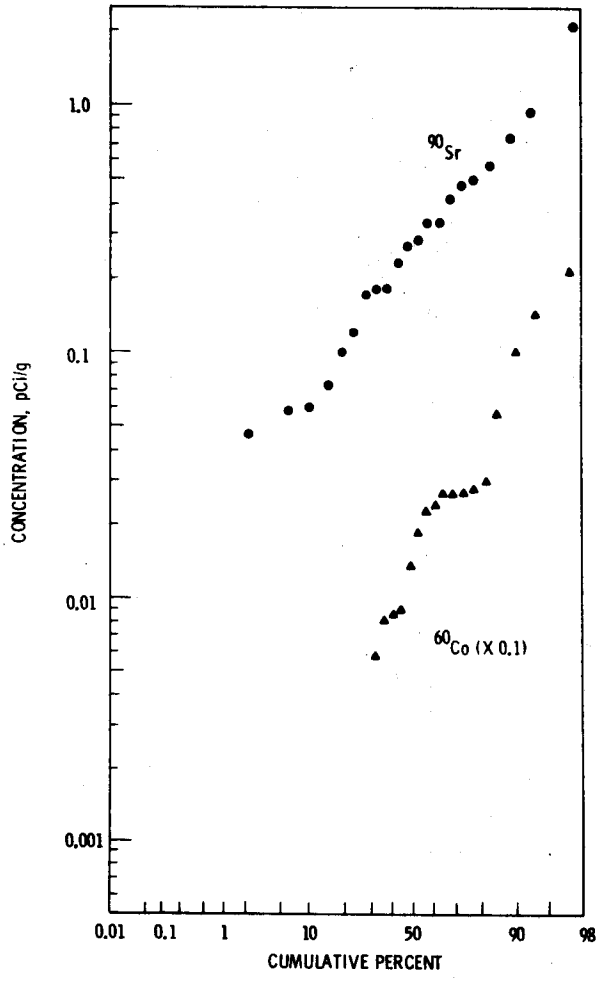


FIGURE 14. Log-Normal Probability Plot of ^{90}Sr and ^{60}Co Results During 1975

concentrations are due to fallout. The uppermost ^{60}Co point was obtained for the 100-N sample. The second highest value plotted was for the sample obtained east of the Nuclear Engineering Site. The results for several background sampling sites were close to the observed ^{60}Co concentrations at 100-N and east of the Nuclear Engineering Site.

COLUMBIA RIVER SEDIMENT

Subsequent to the Aerial Radiological Monitoring System (ARMS) survey along the Columbia River[5] during the spring of 1974 in which elevated levels of ^{60}Co were observed, additional samples of sediment from 21 different island and shoreline locations were taken during the spring of 1975 for spectrometric analysis. These locations are shown in Figure 15 and the results are shown in Table 21 for 17 of the 21 sample locations. Sample 21 in Table 21 represents 5 different samples taken in the same general area. The results of the replicate sampling indicate the amount of variability inherent in the tabled numbers due to the combination of environmental and analytical variability.

Several radionuclides, notably ^{54}Mn, ^{60}Co, ^{65}Zn, ^{152}Eu, ^{154}Eu, ^{155}Eu observed in sediment samples are attributed to previous operation of once-through cooling production reactors. Reference 6 contains aerial photographs of the Columbia River with exposure isopleths of ^{60}Co observed during the aerial survey by EG&G. The sediment sampling locations are also shown on the photographs. There are elevated levels of ^{60}Co due to previous deposition with sediments at many locations generally associated with areas submerged only during high water. The concentrations observed are expected to gradually decline as the radionuclides decay and further dilution occurs.

Table 22 shows the results of profile sediment sampling at the remaining 4 of the 21 sample locations. For each location, 5 separate samples were taken at increments of 0.1", 1-2", 2-4", 4-6", and 6-8". Figures 16 and 17 are plots of the results for ^{60}Co and ^{152}Eu. Apparently, the radionuclide concentrations increase slightly with depth to about 2 inches and then decrease.

TABLE 21. Depth Profile of Radionuclide Concentrations at Selected Columbia River Island and Shoreline Sediment Sampling Locations - 1975

Units of pCi/g (dry weight)

River Mile	Map Location	Naturally Occurring Radionuclides			Artificially Produced Radionuclides												
		^{40}K	^{224}Ra	^{226}Ra	^{54}Mn	^{60}Co	^{65}Zn	^{106}Ru	^{134}Cs	^{137}Cs	^{144}Ce	^{152}Eu	^{154}Eu	^{155}Eu	^{90}Sr	^{238}Pu	$^{239-240}Pu$
Analytical Detection Limit[a]		1.8	0.08	0.12	0.02	0.03	0.04	0.16	0.02	0.07	0.12	0.06	0.16	0.04	0.01	0.003	0.001
371.4	5 - 0-1"	14	7.5	1.1	*	1.0	0.06	*	0.06	1.6	0.5	0.7	0.2	0.05	0.05	*	0.004
	1-2"	14	2.0	0.8	*	0.4	*	*	0.5	0.9	*	0.9	0.2	*			
	2-4"	12	1.4	0.5	*	0.6	*	0.2	*	1.9	0.1	1.2	*	*			
	4-6"	12	2.5	1.0	0.03	0.2	*	0.2	0.06	3.3	0.1	1.0	*	0.07			
	6-8"	12	5.7	1.1	*	0.1	*	*	*	0.6	0.2	0.6	*	*			
367.3	8 - 0-1"	12	2.5	0.9	0.04	3.3	0.05	0.3	0.06	1.7	*	2.8	1.0	*	0.03	*	0.013
	1-2"	12	1.9	0.7	0.05	7.3	0.05	0.2	*	1.5	0.2	2.8	0.6	*			
	2-4"	13	1.8	0.6	*	1.6	*	*	0.08	1.2	*	2.7	0.7	*			
	4-6"	13	2.2	0.9	0.02	0.6	0.05	*	*	0.6	*	1.1	0.5	0.07			
	6-8"	14	1.9	0.6	*	0.08	0.08	*	*	0.05	0.2	0.07	0.3	*			
349.8	12 - 0-1"	12	2.0	0.7	*	1.7	*	*	0.07	1.8	0.1	1.8	0.3	*	0.3	*	<0.1
	1-2"	12	1.5	0.9	0.13	1.5	*	0.2	0.06	0.5	1.0	2.6	6.0	1.6			
	2-4"	12	1.6	0.6	*	1.1	*	*	0.02	1.1	0.1	0.5	0.1	0.06			
	4-6"	13	2.0	0.5	*	0.2	*	*	0.02	0.5	0.2	0.1	*	*			
	6-8"	13	1.1	0.5	*	0.03	0.04	*	*	0.3	*	*	0.1	*			
340.0	17 - 0-1"	16	1.1	0.5	0.04	1.4	*	*	*	0.6	0.2	0.6	*	*	0.1	*	<0.1
	1-2"	14	2.0	1.0	*	2.3	*	*	*	1.5	*	1.3	1.0	*			
	2-4"	12	2.8	1.1	*	2.8	0.07	*	*	2.6	0.2	3.1	0.7	*			
	4-6"	14	1.0	0.6	*	0.8	0.05	*	0.02	1.2	0.2	1.1	0.4	*			
	6-8"	12	1.3	0.6	*	0.2	0.05	*	0.04	0.9	0.2	0.3	*	*			
Averages[b]	0-1"	13.5±3.8	3.3±5.6	0.8±0.5	<0.03	1.9±2	<0.04	<0.2	<0.05	1.4±1.1	<0.2	1.5±2.1	<0.4	<0.05	0.12	0.25	*	<0.05
	1-2"	13.0±2.3	1.9±0.5	0.9±0.3	<0.05	2.9±6.1	<0.04	<0.2	<0.15	1.1±1.0	<0.3	1.9±1.9	2.0<5.4	<0.43				
	2-4"	12.3±1.0	1.9±1.2	0.7±0.5	*	1.5±1.9	<0.04	<0.1	<0.03	1.7±1.4	<0.1	1.9±2.5	<0.4	*				
	4-6"	13.0±1.6	1.9±1.3	0.8±0.5	<0.02	0.5±0.6	<0.04	<0.1	<0.03	1.4±2.6	<0.1	0.8±1.0	<0.3	<0.06				
	6-8"	12.8±1.9	4.0±4.3	0.7±0.5	*	0.1±0.1	<0.05	*	<0.02	0.5±0.7	0.2±0.0	<0.3	<0.1	*				

* Less than the analytical detection limit.

(a) The analytical detection limit listed is the average of individual analytical detection limit for each analyses.

(b) Average and two sample standard deviations shown if radionuclide detected at all locations. Otherwise, a less-than number is calculated from the other results, including less-than values.

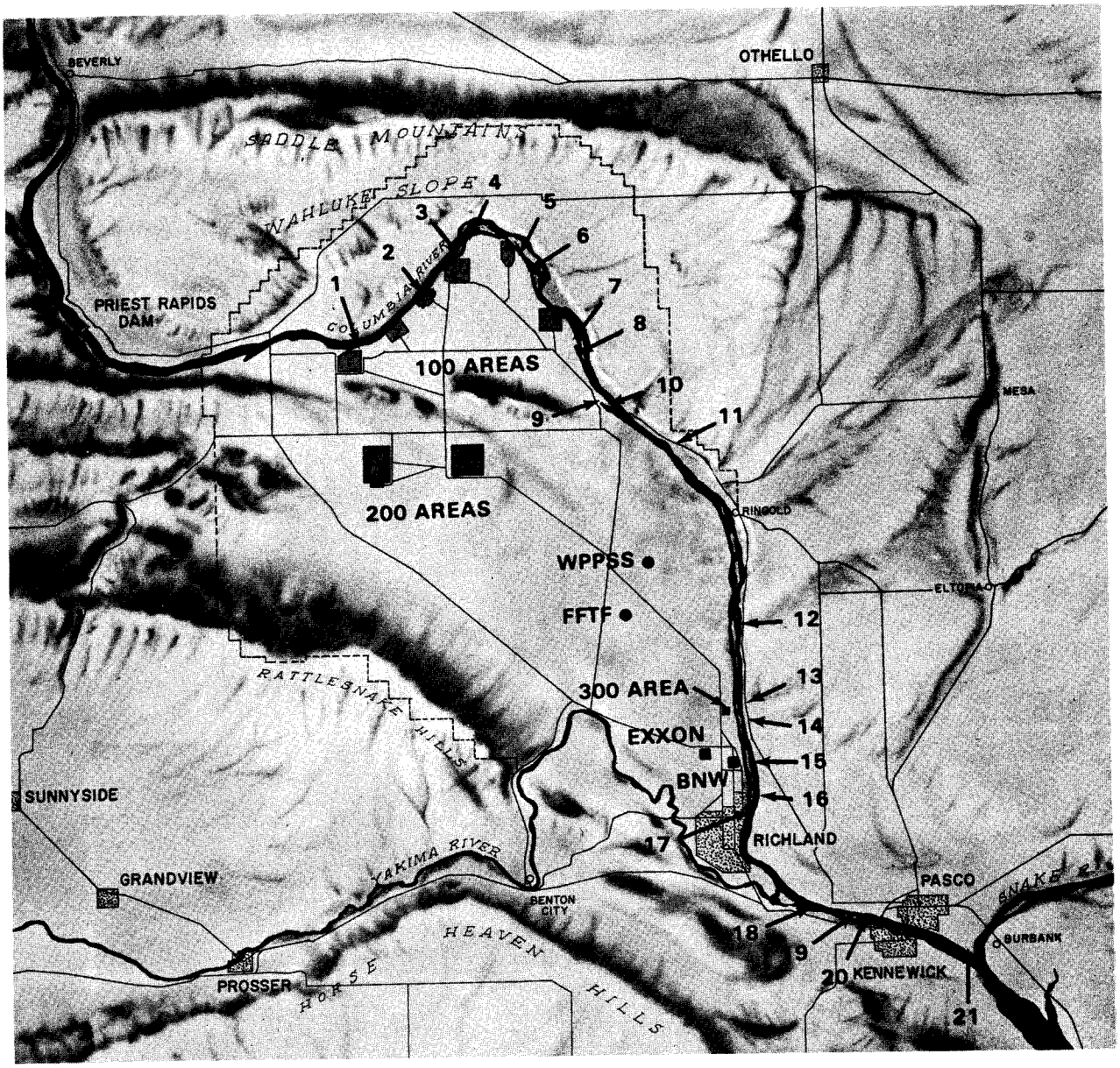


FIGURE 15. Sediment Sampling Locations Along the Columbia River During 1975

TABLE 22. Concentrations of Radionuclides at Columbia River Island and Shoreline Sediment Sampling Locations - 1975

River Mile	Map Location	Naturally Occurring Radionuclides			Artificially Produced Radionuclides									
		^{40}K	^{224}Ra	^{226}Ra	^{54}Mn	^{60}Co	^{65}Zn	^{106}Ru	^{134}Cs	^{137}Cs	^{144}Ce	^{152}Eu	^{154}Eu	^{155}Eu
	Detection Limit[a]	1.8	0.08	0.12	0.02	0.03	0.04	0.16	0.02	0.07	0.12	0.06	0.16	0.04
384.3	1	11	1.3	0.4	*	0.2	*	*	*	0.4	0.1	0.2	0.1	*
379.8	2	11	1.8	0.7	0.05	0.6	0.4	0.15	0.02	0.7	0.4	0.3	0.8	0.3
377.3	3	9	2.9	0.6	*	2.4	*	*	*	0.6	0.6	1.5	0.5	*
376.6	4	11	2.8	0.9	0.2	9.6	0.2	*	0.1	0.8	0.9	0.4	0.6	*
370.6	6	12	1.3	0.4	*	0.06	*	*	0.02	0.07	0.2	*	0.2	*
368.0	7	12	2.1	0.7	*	1.1	*	*	*	1.7	0.2	1.6	0.4	*
363.1	9	13	2.2	0.7	*	1.0	*	*	0.04	1.0	*	0.7	0.1	*
362.6	10	14	1.8	0.6	*	*	0.1	*	0.03	0.2	0.3	*	*	*
359.0	11	14	3.2	0.7	0.04	0.7	0.1	*	0.05	0.4	*	0.3	*	0.1
346.0	13	14	1.5	0.6	0.2	6.2	0.1	0.2	0.02	1.8	*	2.2	0.8	*
344.6	14	11	2.2	0.8	0.07	2.4	0.1	0.3	0.03	0.5	0.4	0.7	0.2	*
342.7	15	12	1.7	0.8	0.02	2.1	*	*	*	0.7	*	0.3	0.4	*
340.3	16	14	1.0	0.4	*	0.6	*	0.7	*	1.0	0.08	0.6	*	*
333.3	18	13	1.1	0.4	0.1	2.5	*	*	*	0.5	0.1	0.6	*	*
332.2	19	13	1.6	0.8	0.06	2.1	*	*	0.05	1.0	0.1	0.9	0.2	*
332.0	20	12	2.8	1.1	0.04	3.2	*	*	*	1.6	0.4	1.9	1.2	*
324.5	Replicates													
	21-1	11	1.9	0.6	0.04	0.6	*	0.1	*	1.2	*	0.6	0.1	*
	21-2	12	1.5	0.5	*	0.2	0.1	*	0.03	0.5	0.08	0.1	*	*
	21-3	14	2.2	0.6	*	0.6	*	*	*	1.2	0.15	0.8	0.2	*
	21-4	11	1.6	0.6	*	0.2	0.1	*	0.02	0.6	0.14	*	0.2	*
	21-5	13	1.3	0.4	*	*	0.1	*	*	0.3	*	0.1	*	*
	Averages[b]	12±3	1.9±1.2	0.6±0.4	<0.05	<1.73	<0.09	<0.12	<0.02	0.8±1.0	<0.23	<0.67	<0.31	<0.05

* Less than the analytical detection limit.

(a) The analytical detection limit listed is the average of individual analytical detection limit for each analyses.

(b) Average and two sample standard deviations shown if radionuclide detected at all locations. Otherwise, a less-than number is calculated from the other results, including less-than values.

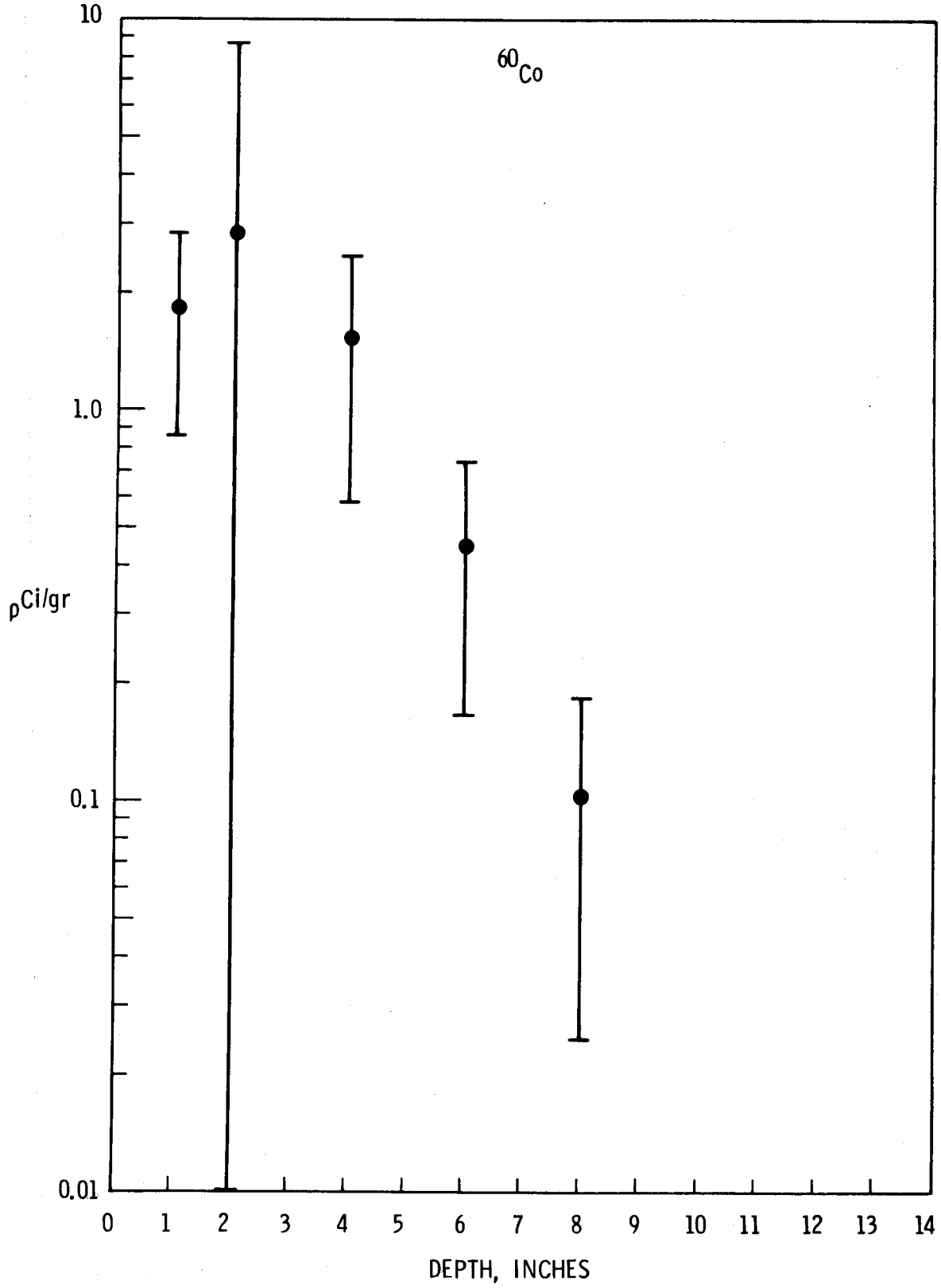


FIGURE 16. Depth Profile of ^{60}Co in Sediment from Columbia River Shoreline, Islands and Slough Areas

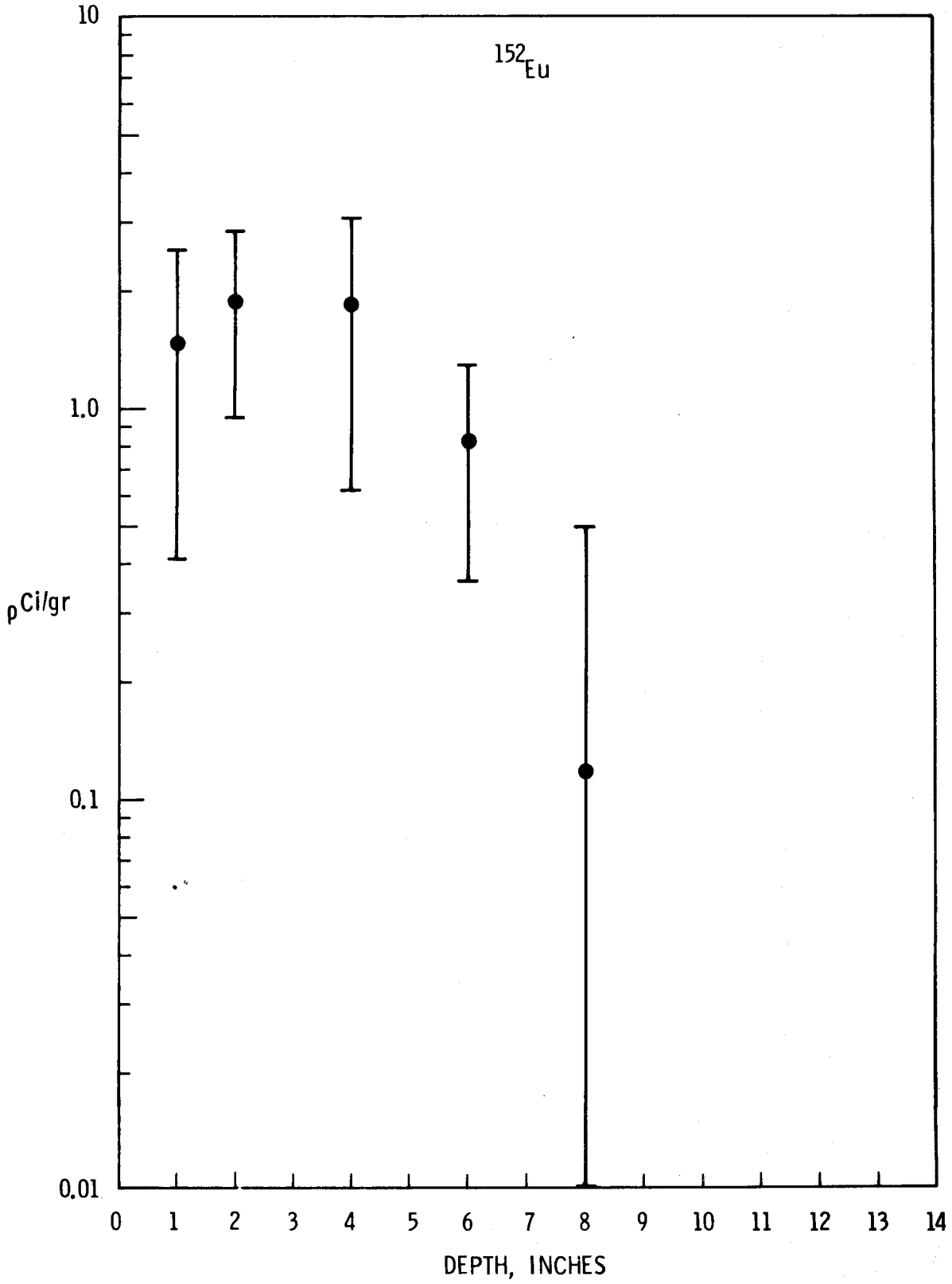


FIGURE 17. Depth Profile of ^{152}Eu in Sediment from Columbia River Shoreline, Islands, and Slough Areas.

EXTERNAL RADIATION

Thermoluminescent dosimeters (TLDs) were used to measure the external dose at several onsite, perimeter, and distant locations. Table 23 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.[7] 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 18 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 elevated doses measured onsite primarily 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.

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 unexpectedly high maximum reading (260) at the 300 Area pond location occurred during a 2-week period in March of 1975 and was due to a railroad car parked at the north end of the 300 Area.

During February of 1975, additional TLDs were deployed along the Columbia River shoreline. The maximum observed reading, at the Hanford railroad tracks entering the river, was about 140 mrad/year. This is twice the background dose rate of about 70 mrad/year. It is likely that there are other areas which have similar elevated dose rates.

TABLE 23. Ambient Radiation Dose - January-December 1975[a]

Location	No. of[b] Measurements	Dose (mrad/yr)[c] Maximum	Minimum	Average
Onsite Stations				
200 ENC	26	350	270	300±40
200 ESE	26	95	73	77±11
200 EWC	26	88	69	77±11
200 EEC	26	106	84	91±11
200 WEC	26	95	77	80±11
Redox	26	102	80	91±11
200 WWC	26	131	99	113±18
200 WNE	26	88	69	77±11
3705 Bldg.	26	84	69	77± 7
ACRMS	26	88	73	80± 7
300 Pond	26	260	77	91±66
300 SW Gate	26	80	66	73± 7
300 South Gate	26	80	58	73± 7
331 Bldg.	13	73	62	66± 7
C.P. #63	13	73	58	66±11
C.P. #64	13	69	55	62±11
C.P. #65	13	80	58	69±11
C.P. #66	12	80	69	73± 7
C.P. #67	13	73	55	62±11
Wahluke C.P. #17	13	91	73	77±11
Wahluke C.P. #18	13	84	66	73±11
Wahluke C.P. #19	13	77	69	73± 4
Wahluke C.P. #20	13	88	69	80±11
Wahluke C.P. #21	13	80	69	80±11
Wahluke C.P. #22	13	80	69	77± 7
Wahluke C.P. #23	13	80	66	73± 7
Wahluke C.P. #24	13	84	69	80±11
Wahluke C.P. #46	13	91	73	80±11
100-K	26	88	69	73±11
WPPSS-100-N	26	110	80	95±18
100-D	13	88	62	77±15
100 Area Fire Station	25	88	69	77± 7
Rt. 10 mi. 1.6	13	77	62	69± 7
FFTF Site	13	80	58	69±11
FFTF North	13	80	62	73±11
FFTF Southeast	13	77	58	69±11
Prosser Barricade	13	88	66	73±11
100-F	26	88	66	77±11
Hanford	13	69	55	66±11
Wye Barricade	13	77	62	69± 7
Rattlesnake Springs	13	77	66	73± 7
ERC	13	88	69	80± 7
Yakima Barricade	13	84	62	77±11
Wahluke #2	13	80	69	77± 7
Shoreline (100-K)	10	80	62	69±11
Shoreline (100-D)	10	73	55	66±11
Locke Island	10	88	69	80±11
White Bluffs	10	84	66	77±11
Shoreline (100-F)	10	77	66	73± 7
Hanford Ferry Landing	9	91	77	84± 7
Hanford RR Tracks	10	157	106	139±29
	Average ± 2 sample standard deviations			82±67
Perimeter Stations				
Pasco	12	80	66	69± 7
Richland	26	77	62	69± 7
Vernita	25	102	77	88±11
Benton City	13	69	51	58± 7
Othello	13	69	51	62±11
Connell	13	69	55	66± 7
Berg Ranch	13	84	73	77± 7
Wahluke Wm	11	77	69	73± 7
Cooke Bros.	13	73	62	69± 7
Ringold	10	91	77	84± 7
Baxter Sub.	13	73	58	66± 7
Byers Landing	13	91	73	77±11
Powerline	10	99	77	91±11
Wooded Island	10	95	77	84±11
	Average ± 2 sample standard deviations			74±20
Distant Stations				
Walla Walla	13	77	66	73± 7
Sunnyside	13	69	58	66± 7
McNary	12	84	66	73± 7
Moses Lake	13	73	58	66± 7
Washtucna	13	73	58	69± 7
	Average ± 2 sample standard deviations			69± 7

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.

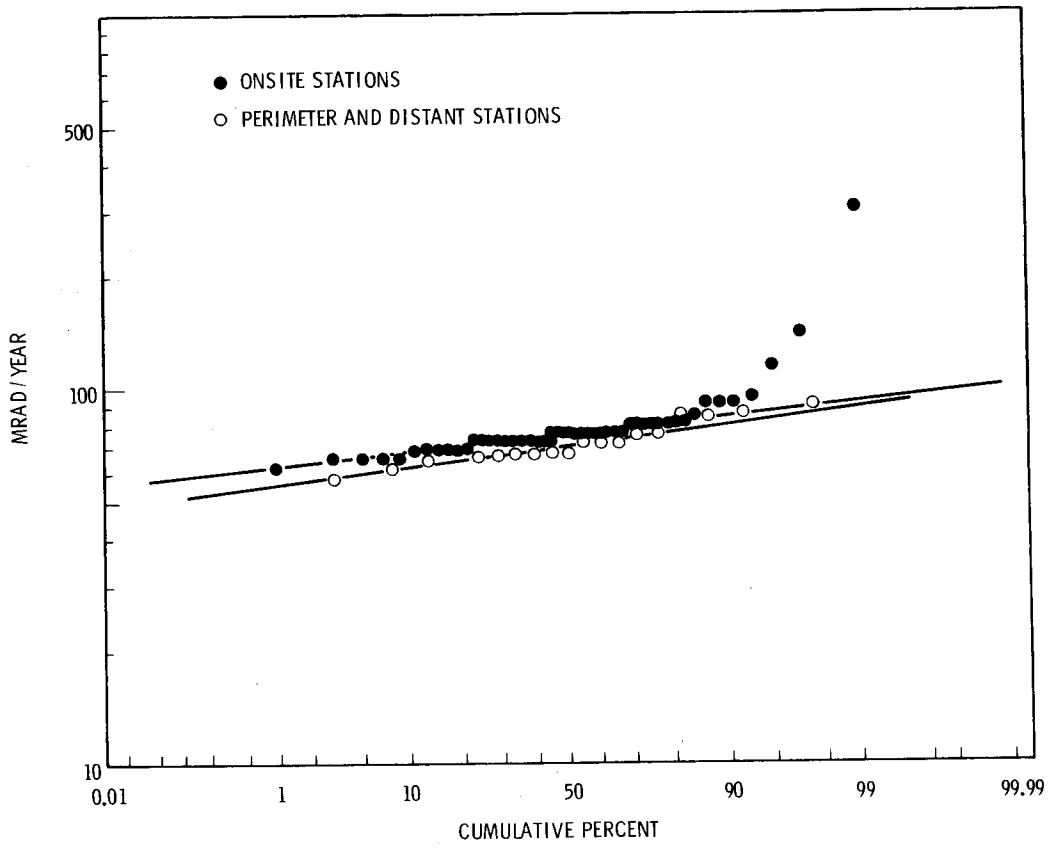


FIGURE 18. Log-Normal Probability Plot of Onsite and Offsite TLD Data During 1975

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 (95 mrem) and a background dose of 70 mrem/yr is 25 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 23 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 at parameter locations away from the Columbia River and distant locations (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.[8] 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.[9] 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 24. An additional dose, approximately 4 mrem/year, must be added to account for the dose, primarily internal, due to fallout radionuclides.[8]

TABLE 24. 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[9]

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.[10] Most traveled roads within the Hanford Reservation were surveyed monthly. During 1975, 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 1975 which required corrective action.

Control Plots

Small areas, called control plots, are located within the Hanford boundaries (Figure 19). These plots, measuring 3.05 m by 3.05 m (10 x 10 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 1975.

Waste Disposal Sites

Active, inactive, and retired waste disposal sites were surveyed during 1975 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

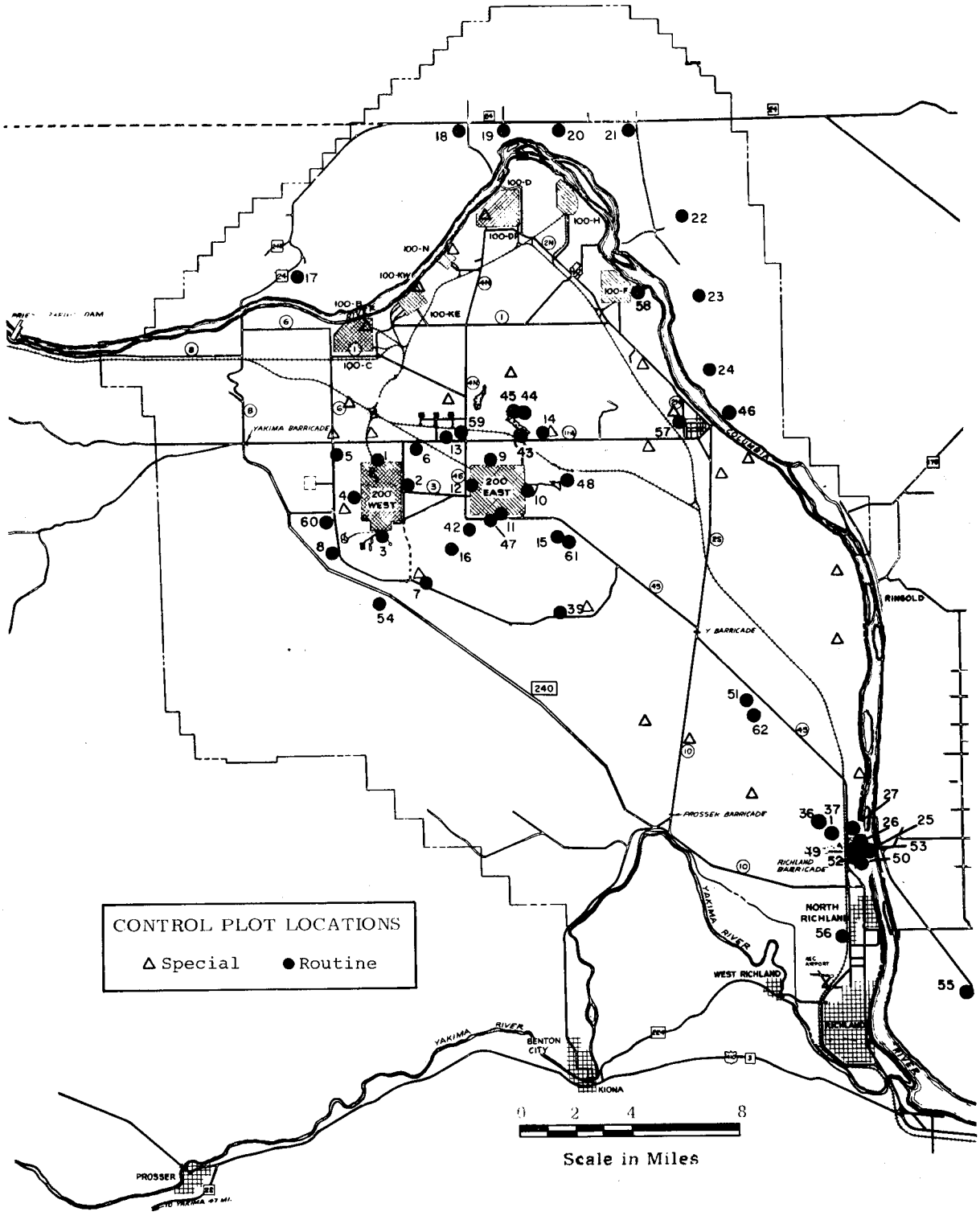


FIGURE 19. Control Plot Locations

from year to year, through routine use a capability for rapid assessment of an emergency situation is maintained. Aerial surveys are conducted at an altitude of 150 meters (500 ft) using a 3-inch by 5-inch NaI (Tl) scintillation crystal detector. During September of 1975, 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

The efforts of several people are necessary to accomplish the collection, analysis, and evaluation of the extensive environmental data acquired each year. Manford Leale is responsible for scheduling the collection and delivery of environmental samples. The laboratories of primarily U. S. Testing Company and Battelle, Pacific Northwest Laboratory perform the analyses. The efforts of Harold Oens, U. S. Testing, and Rip Kirby, Battelle, are particularly appreciated. Emily Porath edited this report and arranged for its typing and subsequent publication. Carolyn Schauls typed the text and most of the tables.

REFERENCES

1. J. R. Raymond, et al., Radiological Status of the Groundwater Beneath the Hanford Project - January-December 1974, BNWL-1970, Battelle, Pacific Northwest Laboratories, Richland, WA, 1976.

2. D. R. Speer, J. J. Fix, and P. J. Blumer, Environmental Surveillance at Hanford for CY-1975, BNWL-1979, Battelle, Pacific Northwest Laboratories, Richland, WA, 1976.

3. J. J. Fix, Environmental Status of the Hanford Reservation for CY-1974, BNWL-B-429, Battelle, Pacific Northwest Laboratories, Richland, WA, 1975.

4. "Standards for Radiation Protection," ERDA Manual, Chapter 0524, with Appendix, U.S. Energy Reserach and Development Administration, Washington, DC, April 1975.

5. W. J. Tipton, An Aerial Radiological Survey of the U.S. Atomic Energy Commission's Hanford Reservation, EG&G, Las Vegas, NV, draft, 1975.

6. J. J. Fix, Association of Long-Lived Radioactivity with Sediment Along the Columbia River Shoreline, Islands, Bottom and Slough Area, BNWL-SA-5484, Battelle, Pacific Northwest Laboratories, Richland, WA, 1976.

7. D. H. Denham, et al., A CaF_2:Dy Thermoluminescent Dosimeter for Environmental Monitoring, BNWL-SA-4191, Battelle, Pacific Northwest Laboratories, Richland, WA, August 1972.

8. D. T. Oakley, Natural Radiation Exposure in the United States, ORP/SID 72-1, Environmental Protection Agency, Washington, DC, June 1972.

9. U.S. Environmental Protection Agency, Estimates of Ionizing Radiation Doses in the United States 1960 - 2000, ORP/CSD 72-1, Rockville, MD, August 1972.

10. L. L. Philipp and E. M. Sheen, Aerial and Ground Gamma Survey Monitors, BNWL-62, Battelle, Pacific Northwest Laboratories, Richland, WA, May 1965.

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

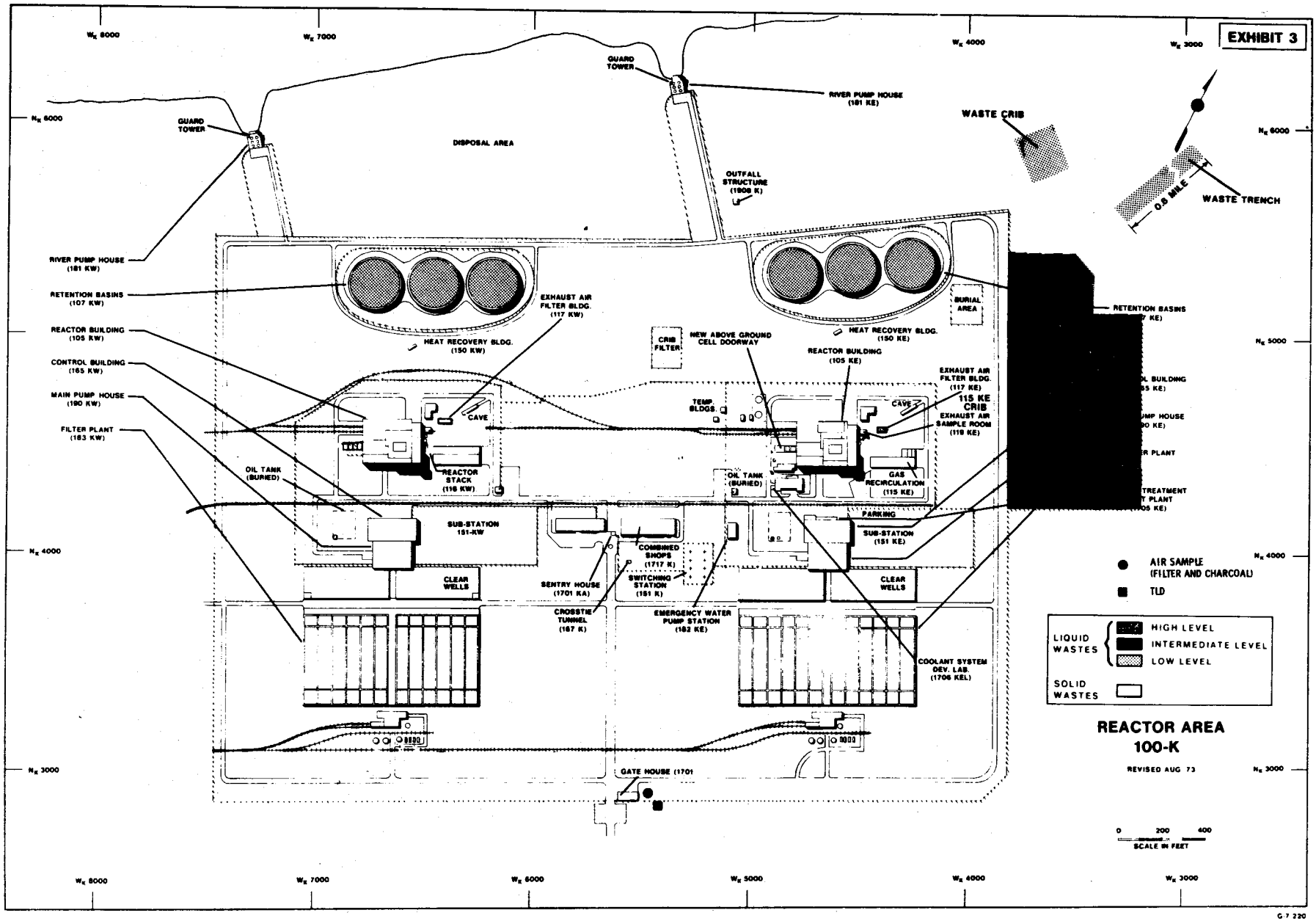
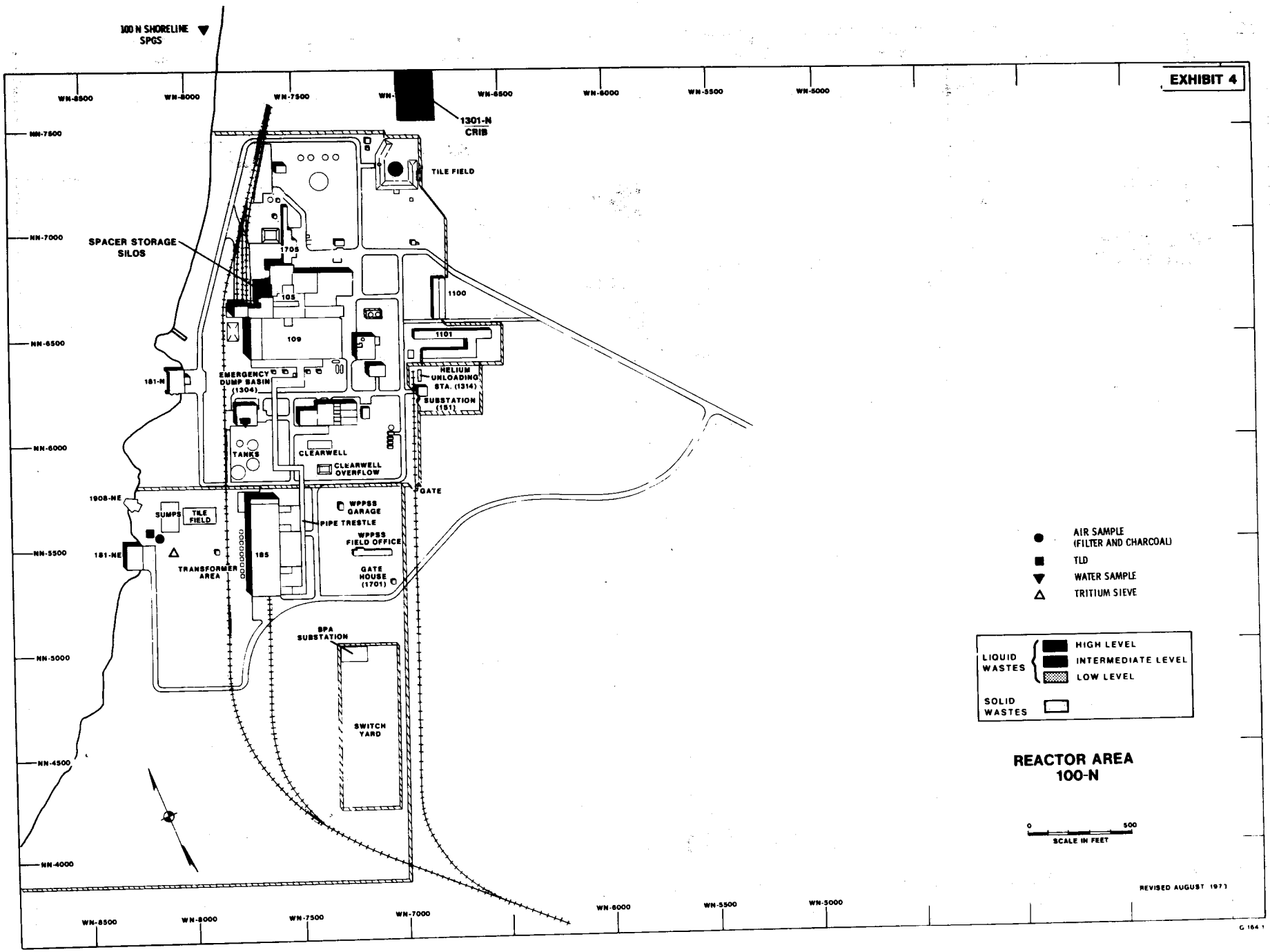


EXHIBIT 3
GUARD TOWER
RIVER PUMP HOUSE (181 KE)
WASTE CRIB
WASTE TRENCH
0.5 MILE
DISPOSAL AREA
OUTFALL STRUCTURE (1908 K)
GUARD TOWER
RIVER PUMP HOUSE (181 KW)
RETENTION BASINS (107 KW)
REACTOR BUILDING (105 KW)
CONTROL BUILDING (165 KW)
MAIN PUMP HOUSE (190 KW)
FILTER PLANT (183 KW)
EXHAUST AIR FILTER BLDG. (117 KW)
HEAT RECOVERY BLDG. (150 KW)
CRIB FILTER
NEW ABOVE GROUND CELL DOORWAY
HEAT RECOVERY BLDG. (150 KE)
REACTOR BUILDING (105 KE)
BURIAL AREA
RETENTION BASINS
EXHAUST AIR FILTER BLDG. (117 KE)
115 KE CRIB
EXHAUST AIR SAMPLE ROOM (119 KE)
TEMP. BLDGS.
CAVE
CAVE
REACTOR STACK (116 KW)
OIL TANK (BURIED)
OIL TANK (BURIED)
GAS RECIRCULATION (115 KE)
PARKING
SUB-STATION 151-KW
SUB-STATION (151 KE)
COMBINED SHOPS (1717 K)
SWITCHING STATION (151 K)
CLEAR WELLS
CLEAR WELLS
SENTRY HOUSE (1701 KA)
CROSSTIE TUNNEL (167 K)
EMERGENCY WATER PUMP STATION (182 KE)
COOLANT SYSTEM DEV. LAB. (1706 KEL)
GATE HOUSE (1701
AIR SAMPLE (FILTER AND CHARCOAL)
TLD
LIQUID WASTES
HIGH LEVEL
INTERMEDIATE LEVEL
LOW LEVEL
SOLID WASTES
REACTOR AREA
100-K
REVISED AUG 73
0 200 400
SCALE IN FEET
G 7 220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100 N SHORELINE
SPGS
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WN-8000
WN-7500
WN-7000
WN-6500
WN-6000
WN-5500
WN-5000
NN-7500
NN-7000
NN-6500
NN-6000
NN-5500
NN-5000
NN-4500
NN-4000
1301-N
CRIB
TILE FIELD
SPACER STORAGE
SILOS
1705
105
109
1100
1101
181-N
EMERGENCY
DUMP BASIN
(1304)
HELIUM
UNLOADING
STA. (1314)
SUBSTATION
(181)
TANKS
CLEARWELL
CLEARWELL
OVERFLOW
GATE
1908-NE
SUMPS
TILE
FIELD
WPPSS
GARAGE
PIPE TRESTLE
WPPSS
FIELD OFFICE
181-NE
TRANSFORMER
AREA
185
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
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SCALE IN FEET
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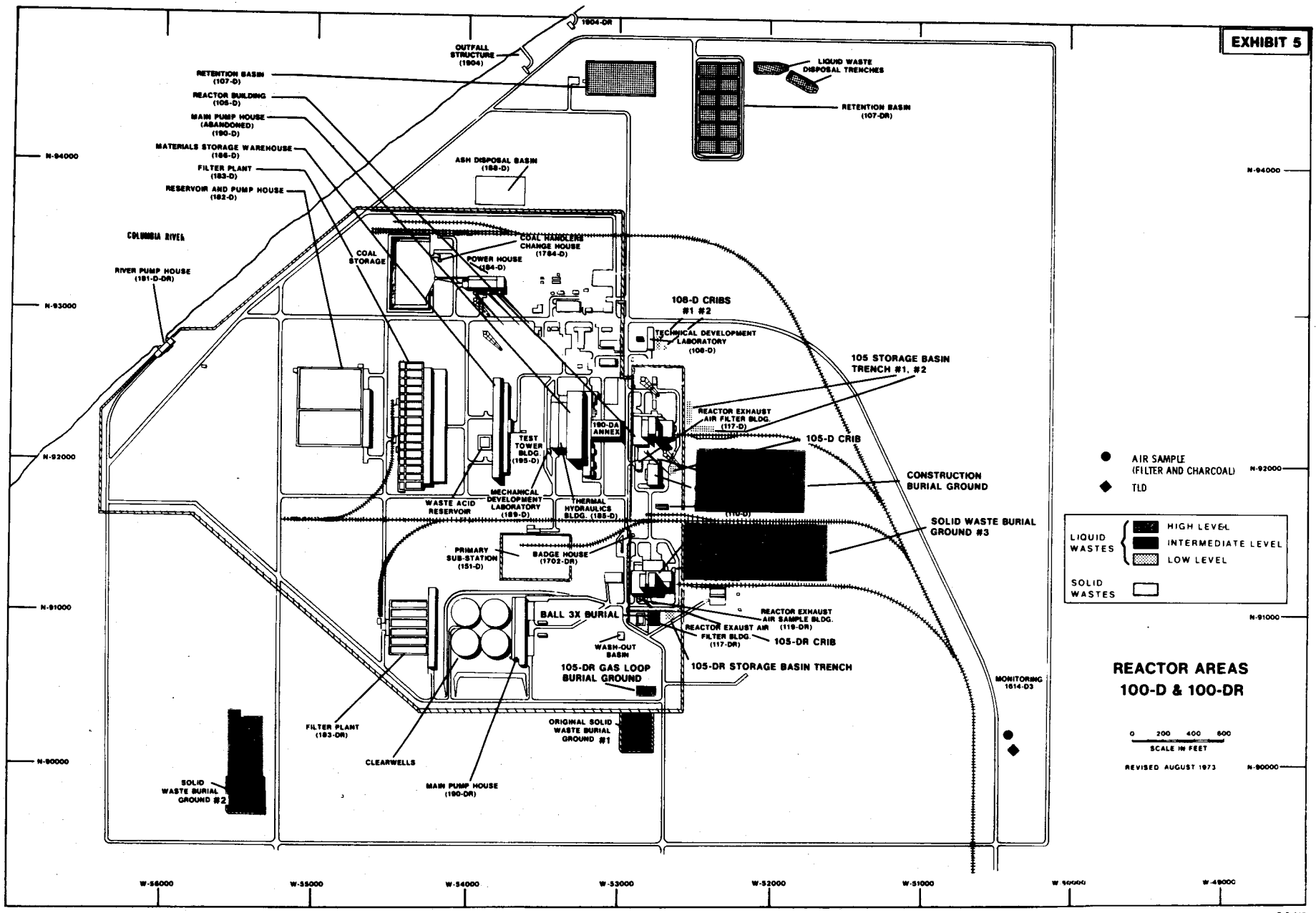
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1904-DR
OUTFALL STRUCTURE (1904)
RETENTION BASIN (107-D)
REACTOR BUILDING (105-D)
MAIN PUMP HOUSE (ABANDONED) (190-D)
MATERIALS STORAGE WAREHOUSE (186-D)
FILTER PLANT (183-D)
RESERVOIR AND PUMP HOUSE (182-D)
COLUMBIA RIVER
RIVER PUMP HOUSE (181-D-DR)
COAL STORAGE
COAL HANDLING CHANGE HOUSE (1784-D)
POWER HOUSE (184-D)
ASH DISPOSAL BASIN (188-D)
LIQUID WASTE DISPOSAL TRENCHES
RETENTION BASIN (107-DR)
108-D CRIBS #1 #2
TECHNICAL DEVELOPMENT LABORATORY (108-D)
105 STORAGE BASIN TRENCH #1, #2
REACTOR EXHAUST AIR FILTER BLDG. (117-D)
190-DA ANNEX
TEST TOWER BLDG. (195-D)
105-D CRIB
CONSTRUCTION BURIAL GROUND
WASTE ACID RESERVOIR
MECHANICAL DEVELOPMENT LABORATORY (189-D)
THERMAL HYDRAULICS BLDG. (185-D)
SOLID WASTE BURIAL GROUND #3
PRIMARY SUB-STATION (151-D)
BADGE HOUSE (1702-DR)
BALL 3X BURIAL
REACTOR EXHAUST AIR SAMPLE BLDG. (119-DR)
REACTOR EXAUST AIR FILTER BLDG. (117-DR)
105-DR CRIB
WASH-OUT BASIN
105-DR GAS LOOP BURIAL GROUND
105-DR STORAGE BASIN TRENCH
MONITORING 1614-03
FILTER PLANT (183-DR)
ORIGINAL SOLID WASTE BURIAL GROUND #1
CLEARWELLS
MAIN PUMP HOUSE (190-DR)
SOLID WASTE BURIAL GROUND #2
N-94000
N-93000
N-92000
N-91000
N-90000
W-56000
W-55000
W-54000
W-53000
W-52000
W-51000
W-50000
W-49000
AIR SAMPLE (FILTER AND CHARCOAL)
TLD
LIQUID WASTES
HIGH LEVEL
INTERMEDIATE LEVEL
LOW LEVEL
SOLID WASTES
REACTOR AREAS
100-D & 100-DR
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SCALE IN FEET
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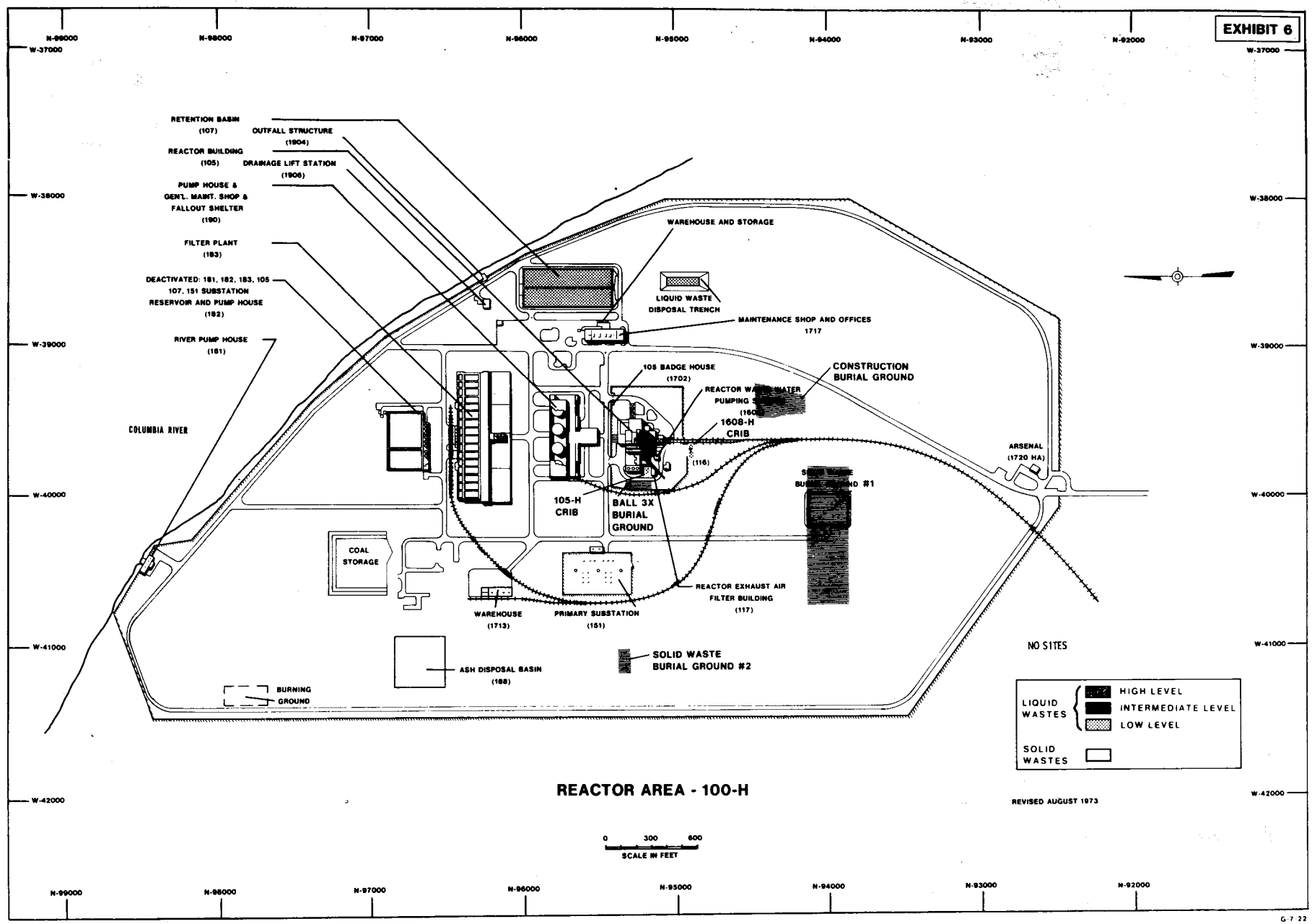
G-7 218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N-94000
N-93000
N-92000
W-37000
W-38000
W-39000
W-40000
W-41000
W-42000
RETENTION BASIN (107)
OUTFALL STRUCTURE (1904)
REACTOR BUILDING (105)
DRAINAGE LIFT STATION (1906)
PUMP HOUSE & GEN'L. MAINT. SHOP & FALLOUT SHELTER (190)
FILTER PLANT (183)
DEACTIVATED: 181, 182, 183, 105 107, 151 SUBSTATION RESERVOIR AND PUMP HOUSE (182)
RIVER PUMP HOUSE (181)
COLUMBIA RIVER
WAREHOUSE AND STORAGE
LIQUID WASTE DISPOSAL TRENCH
MAINTENANCE SHOP AND OFFICES 1717
105 BADGE HOUSE (1702)
CONSTRUCTION BURIAL GROUND
1608-H CRIB
(116)
ARSENAL (1720 HA)
105-H CRIB
BALL 3X BURIAL GROUND
COAL STORAGE
WAREHOUSE (1713)
PRIMARY SUBSTATION (151)
REACTOR EXHAUST AIR FILTER BUILDING (117)
ASH DISPOSAL BASIN (188)
SOLID WASTE BURIAL GROUND #2
BURNING GROUND
NO SITES
LIQUID WASTES
HIGH LEVEL
INTERMEDIATE LEVEL
LOW LEVEL
SOLID WASTES
REACTOR AREA - 100-H
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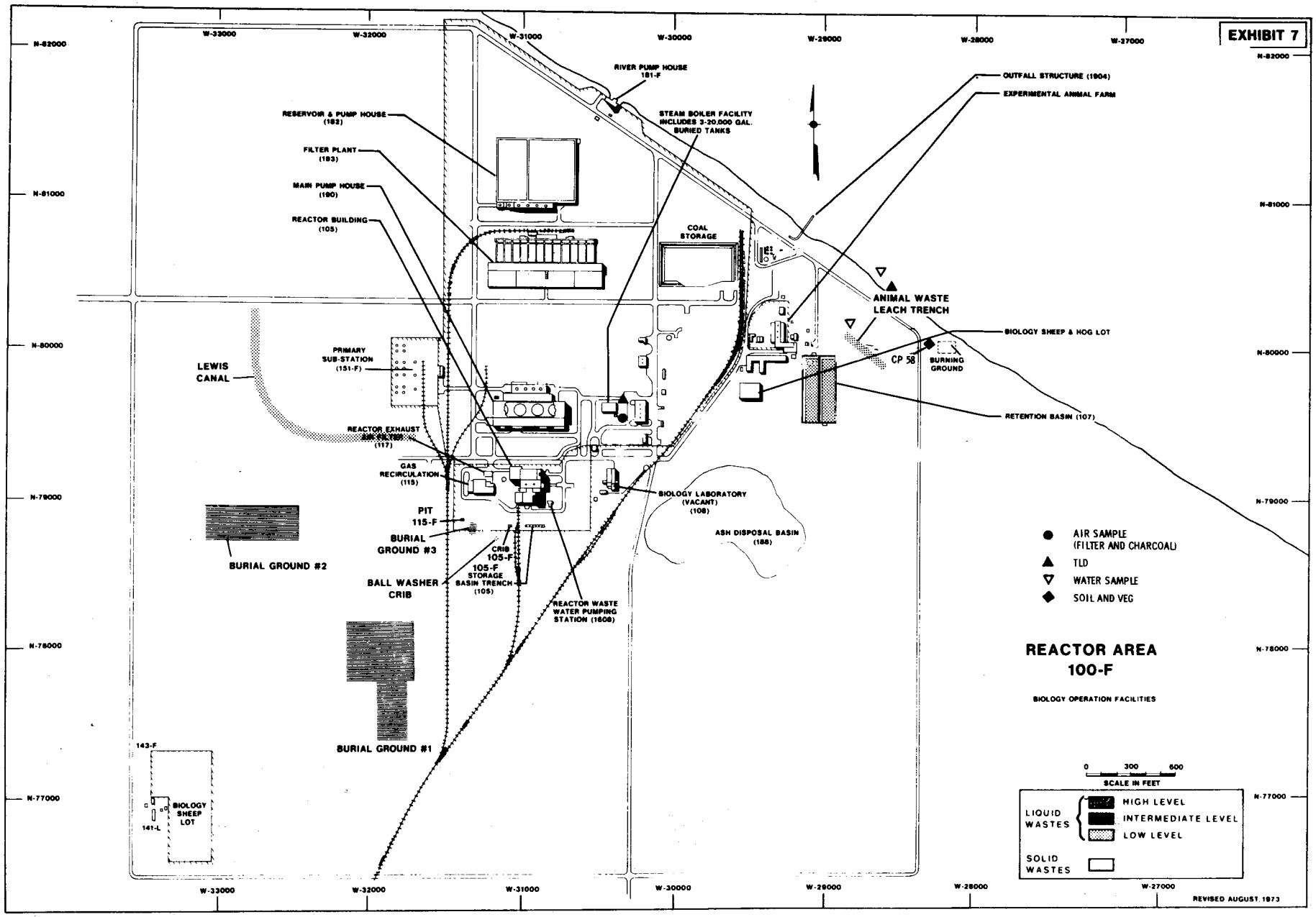
0 300 600
SCALE IN FEET
G-7 22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W-28000
W-27000
N-82000
N-81000
N-80000
N-79000
N-78000
N-77000
RIVER PUMP HOUSE 181-F
OUTFALL STRUCTURE (1904)
EXPERIMENTAL ANIMAL FARM
RESERVOIR & PUMP HOUSE (182)
STEAM BOILER FACILITY INCLUDES 3-20,000 GAL. BURIED TANKS
FILTER PLANT (183)
MAIN PUMP HOUSE (190)
REACTOR BUILDING (105)
COAL STORAGE
ANIMAL WASTE LEACH TRENCH
BIOLOGY SHEEP & HOG LOT
CP 58
BURNING GROUND
LEWIS CANAL
PRIMARY SUB-STATION (151-F)
RETENTION BASIN (107)
REACTOR EXHAUST AIR FILTER (117)
GAS RECIRCULATION (115)
BIOLOGY LABORATORY (VACANT) (108)
PIT 115-F
BURIAL GROUND #3
ASH DISPOSAL BASIN (188)
BURIAL GROUND #2
CRIB 105-F
105-F STORAGE BASIN TRENCH (105)
BALL WASHER CRIB
REACTOR WASTE WATER PUMPING STATION (1608)
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
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INTERMEDIATE LEVEL
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SOLID WASTES
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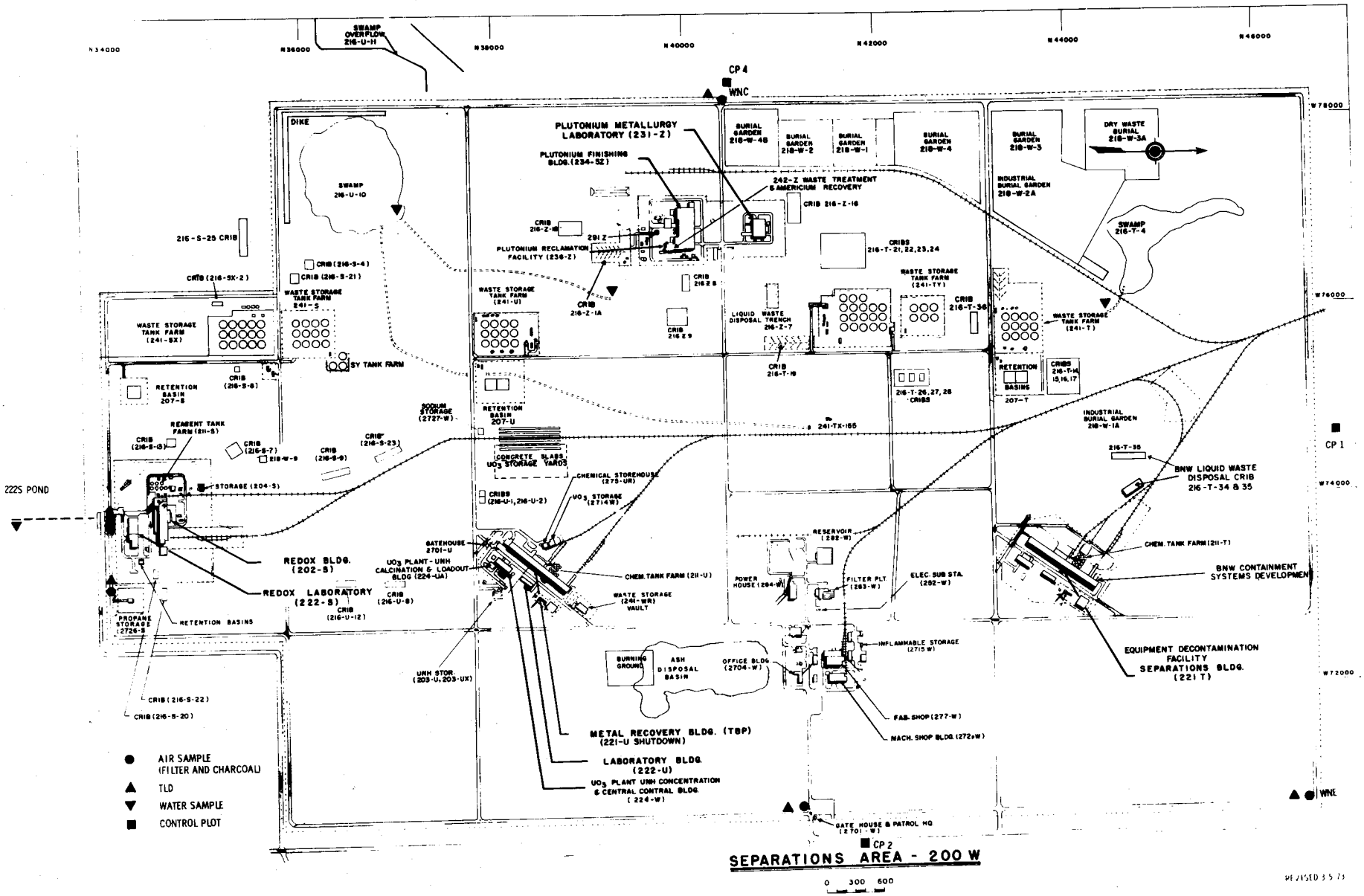
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N38000
N40000
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N46000
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W74000
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SWAMP OVERFLOW 216-U-14
CP 4
WNC
DIKE
PLUTONIUM METALLURGY LABORATORY (231-Z)
PLUTONIUM FINISHING BLDG.(234-5Z)
242-Z WASTE TREATMENT & AMERICIUM RECOVERY
CRIB 216-Z-16
CRIB 216-Z-18
291 Z
PLUTONIUM RECLAMATION FACILITY (236-Z)
CRIB 216-Z-1A
CRIB 216 Z 8
CRIB 216 Z 9
WASTE STORAGE TANK FARM (241-U)
LIQUID WASTE DISPOSAL TRENCH 216-Z-7
CRIB 216-T-19
CRIBS 216-T-21,22,23,24
WASTE STORAGE TANK FARM (241-TY)
CRIB 216-T-36
WASTE STORAGE TANK FARM (241-T)
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CRIBS 216-T-14, 15, 16, 17
216-T-26,27,28 CRIBS
241-TX-155
BURIAL GARDEN 218-W-4B
BURIAL GARDEN 218-W-2
BURIAL GARDEN 218-W-1
BURIAL GARDEN 218-W-4
BURIAL GARDEN 218-W-5
INDUSTRIAL BURIAL GARDEN 218-W-2A
DRY WASTE BURIAL 218-W-3A
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INDUSTRIAL BURIAL GARDEN 218-W-1A
216-T-35
BNW LIQUID WASTE DISPOSAL CRIB 216-T-34 & 35
CP 1
216-S-25 CRIB
CRIB (216-S-4)
CRIB (216-S-21)
CRIB (216-SX-2)
WASTE STORAGE TANK FARM (241-S)
WASTE STORAGE TANK FARM (241-SX)
SY TANK FARM
RETENTION BASIN 207-S
CRIB (216-S-8)
SODIUM STORAGE (272T-W)
REMENT TANK FARM (211-S)
CRIB (216-S-3)
CRIB (216-S-7)
218-W-9
CRIB (216-S-9)
CRIB (216-S-23)
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222S POND
CONCRETE SLABS YARDS
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RETENTION BASIN 207-U
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CRIB (216-U-8)
CRIB (216-U-12)
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RETENTION BASINS
PROPANE STORAGE (272S)
UNH STOR (203-U, 203-UX)
RESERVOIR (282-W)
POWER HOUSE (284-W)
FILTER PLT (283-W)
ELEC. SUB STA. (282-W)
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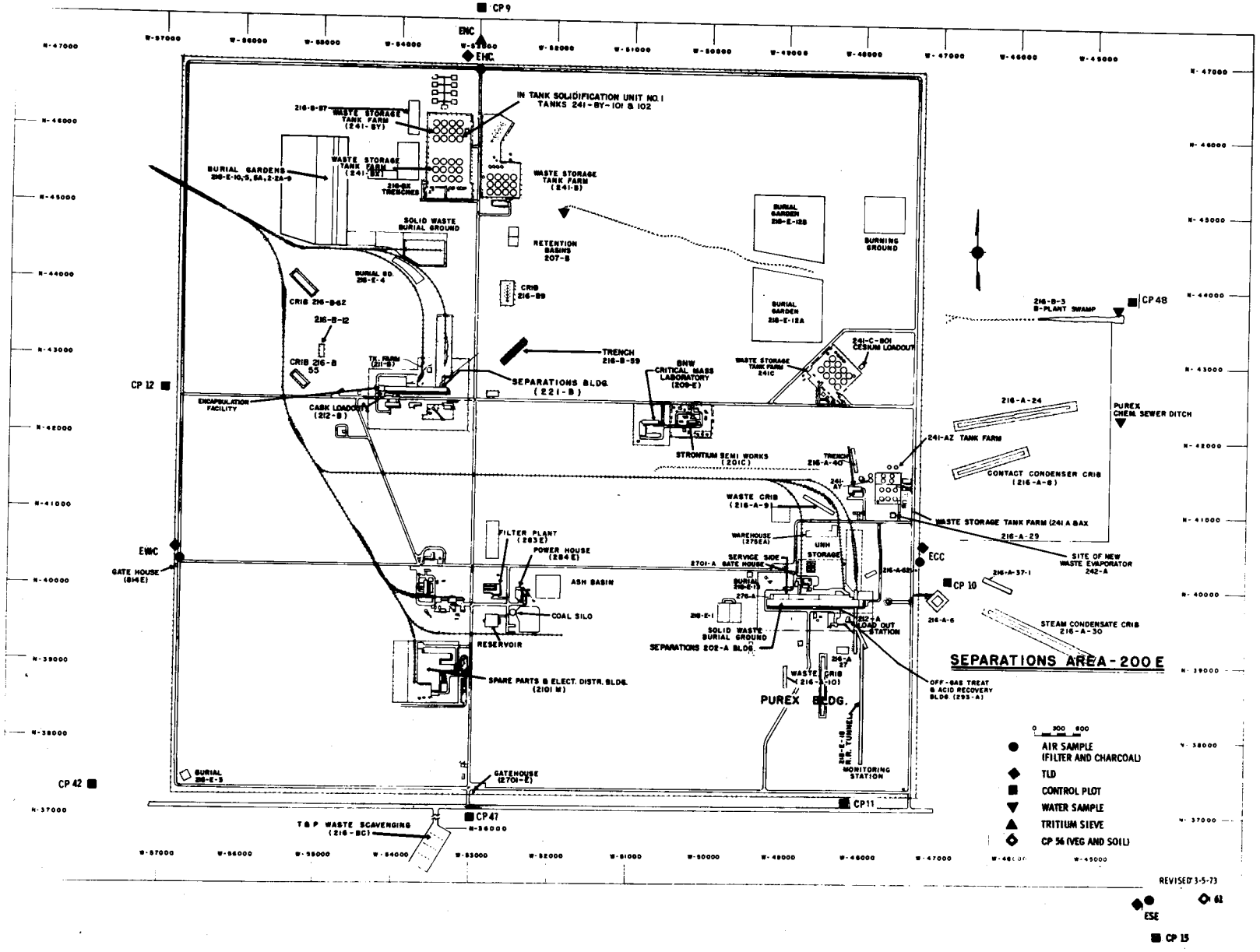
BNW CONTAINMENT SYSTEMS DEVELOPMENT
EQUIPMENT DECONTAMINATION FACILITY
SEPARATIONS BLDG. (221-T)
BURNING GROUND
ASH DISPOSAL BASIN
OFFICE BLDG (270-W)
INFLAMMABLE STORAGE (271S W)
FAB. SHOP (277-W)
MACH. SHOP BLDG. (272-W)
METAL RECOVERY BLDG. (TBP) (221-U SHUTDOWN)
LABORATORY BLDG. (222-U)
UO3 PLANT UNH CONCENTRATION & CENTRAL CONTRAL BLDG. (224-W)
GATE HOUSE & PATROL HQ. (2701-W)
CP 2
WNE
CRIB (216-S-22)
CRIB (216-S-20)
AIR SAMPLE (FILTER AND CHARCOAL)
TLD
WATER SAMPLE
CONTROL PLOT
SEPARATIONS AREA - 200 W
0 300 600
REVISED 3-5-73


SEPARATIONS AREA - 200 E
CP 9
ENC
EHC
IN TANK SOLIDIFICATION UNIT NO. 1
TANKS 241-BY-101 & 102
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WAREHOUSE (275EA)
UNH STORAGE
SERVICE SIDE 270I-A GATE HOUSE
FILTER PLANT (283E)
POWER HOUSE (284 E)
ASH BASIN
COAL SILO
RESERVOIR
EWC
GATE HOUSE (814E)
ECC
CP 10
216-A-37-1
216-A-6
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SOLID WASTE BURIAL GROUND
SEPARATIONS 202-A BLDG.
202-A LOAD OUT STATION
WASTE CRIB (216-A-10)
PUREX BLDG.
OFF-GAS TREAT & ACID RECOVERY BLDG (295-A)
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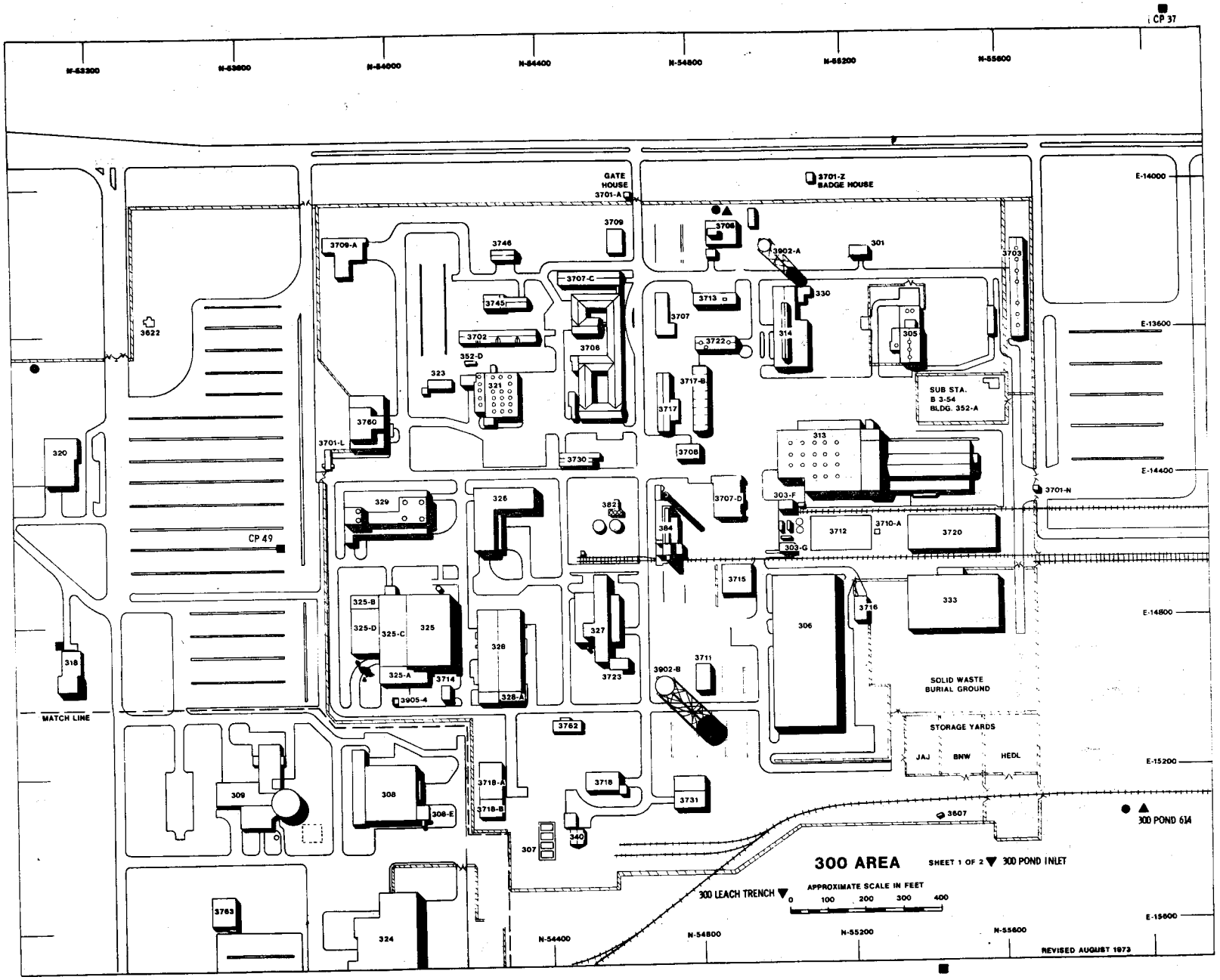
216-E-18 B.R. TUNNEL
MONITORING STATION
BURIAL 218-E-3
GATEHOUSE (270I-E)
CP 42
CP 47
CP 11
T & P WASTE SCAVENGING (216-BC)
0 200 600
AIR SAMPLE (FILTER AND CHARCOAL)
TLD
CONTROL PLOT
WATER SAMPLE
TRITIUM SIEVE
CP 56 (VEG AND SOIL)
REVISED 3-5-73
ESE
CP 15


CP 37
N-53300
N-53800
N-54000
N-54400
N-54800
N-55200
N-55600
E-14000
E-13600
E-14400
E-14800
E-15200
E-15600
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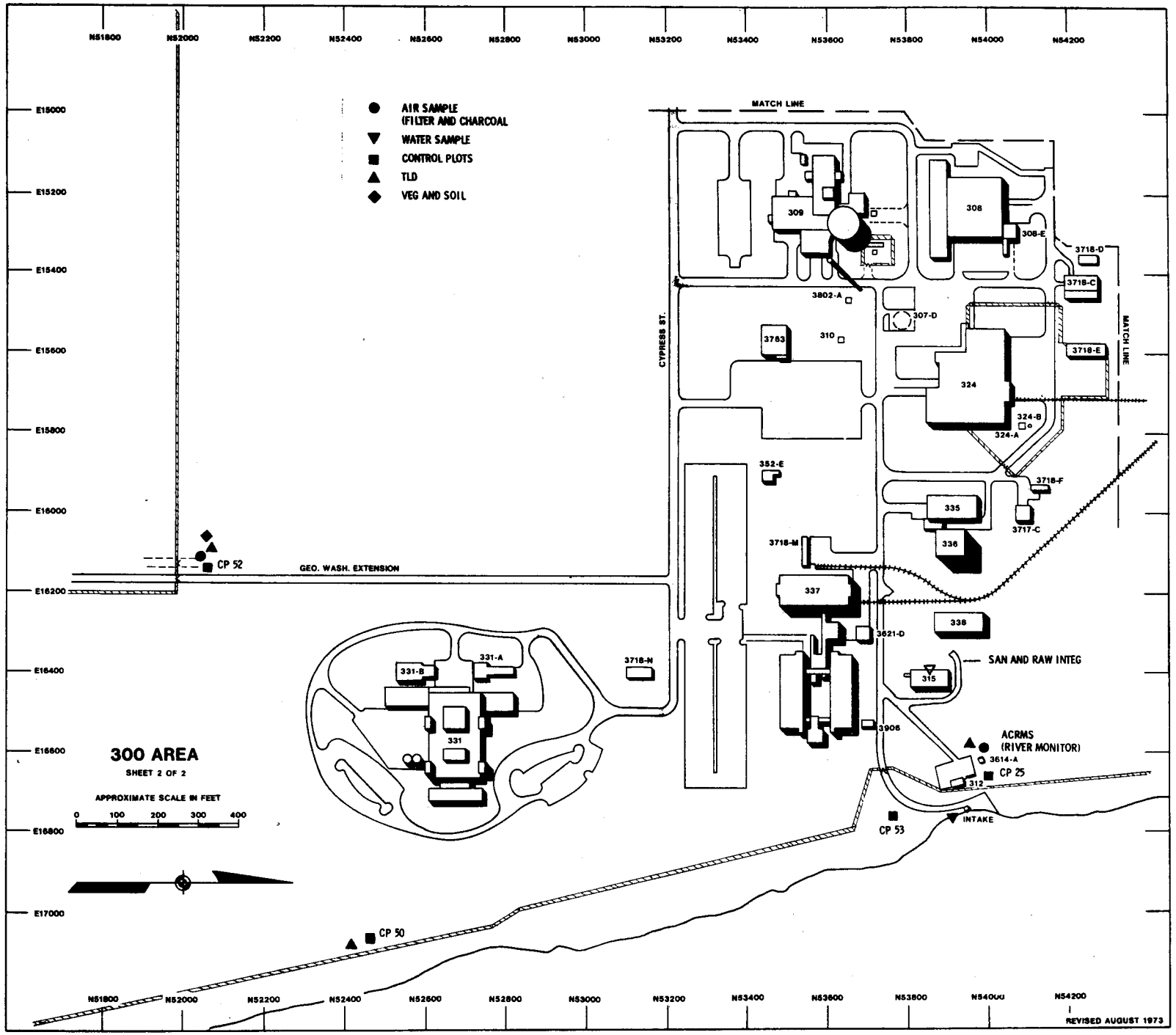
3701-Z BADGE HOUSE
SUB STA. B 3-54 BLDG. 352-A
SOLID WASTE BURIAL GROUND
STORAGE YARDS
JAJ
BNW
HEDL
CP 49
MATCH LINE
300 POND 614
300 POND INLET
300 LEACH TRENCH
300 AREA
SHEET 1 OF 2
APPROXIMATE SCALE IN FEET
0 100 200 300 400
REVISED AUGUST 1973
CONTROL PLOT
AIR SAMPLE (FILTER AND CHARCOAL)
WATER SAMPLE
TLD
SHORELINE SPGS #1


AIR SAMPLE (FILTER AND CHARCOAL)
WATER SAMPLE
CONTROL PLOTS
TLD
VEG AND SOIL
MATCH LINE
CYPRESS ST.
GEO. WASH. EXTENSION
SAN AND RAW INTEG
ACRMS (RIVER MONITOR)
INTAKE
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CP 26
CP 50
CP 52
CP 53
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308
308-E
3718-D
3718-C
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3783
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3718-E
324
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335
3717-C
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338
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N51800
N52000
N52200
N52400
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N52800
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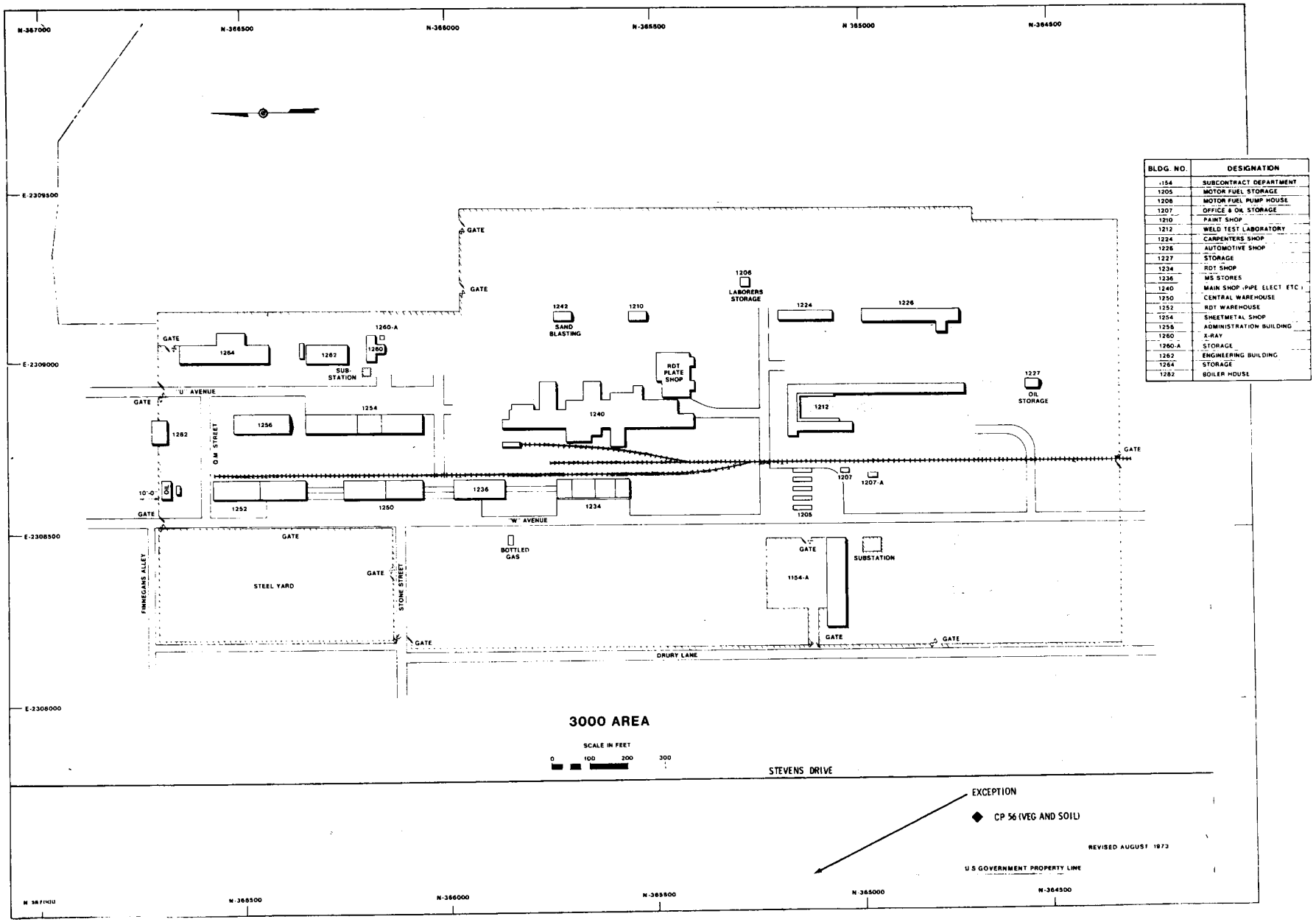
N53600
N53800
N54000
N54200
E15000
E15200
E15400
E15600
E15800
E16000
E16200
E16400
E16600
E16800
E17000
300 AREA
SHEET 2 OF 2
APPROXIMATE SCALE IN FEET
0 100 200 300 400
REVISED AUGUST 1973



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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