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RADIATION SURVEY OF WAHLUKE SLOPE

DECEMBER 1972

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RADIATION SURVEY OF WAHLUKE SLOPE

P. E. Bramson
J. P. Corley

December 1972

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RADIATION SURVEY OF WAHLUKE SLOPE

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INTRODUCTION

In response to the request of AEC-RL, the Environmental Evaluations Section of the Occupational and Environmental Safety Department initiated a radiation survey of the Wahluke Slope area of the Hanford project. Purpose of the study was to provide a basis for decision on release of Wahluke Slope for unrestricted public use. Specifically, the AEC-RL requested information on the levels of contamination and potential dose contribution to the public from the Wahluke Slope control zone lying within the Hanford reservation boundaries beyond a 5.5 mile radius of any reactor on stand-by and N-Reactor.

Previous data⁽¹⁾ for scattered routine environmental monitoring locations have shown no unusual radiological conditions during the last year. An earlier screening survey of Wahluke Slope⁽²⁾ also showed no radiological conditions attributable to Hanford operations except for detectable reactor activation products on land immediately adjacent to the Columbia River.

SUMMARY

Thirty-eight sites (Map 1) were picked on Wahluke Slope primarily by geographical location so as to blanket the entire slope except for the control zone lying within 5.5 miles of N-Reactor and reactors on stand-by status. At each of these sampling sites, surface soil and vegetation samples were obtained for analysis. Contamination, exposure rate, and cumulative dose measurements were made during the months of September and October, 1972, at each site. Contamination surveys of about 60 miles of improved roads (graded or surfaced) in the Wahluke Slope area were performed using a vehicle-mounted road monitor. Groundwater was sampled at nine widely dispersed wells on the slope.

(1) BNWL-1683, "Environmental Surveillance of Hanford for CY-1971," P. E. Bramson and J. P. Corley, August 1972.

(2) Letter, "Measure of Contamination on Wahluke Slope," W. D. Richmond to R. Ritchie, June 12, 1972.

SUMMARY (Continued)

Radionuclide concentrations at the sampling sites on Wahluke Slope are typical of regional fallout except along the Columbia River bank where activation products from Hanford reactor cooling water can be detected. Average measured exposure rate on Wahluke Slope is 0.33 mR/day compared to a calculated value of 0.27 mR/day for cosmic radiation and naturally occurring radionuclides only. Average exposure rate for four sites along the Columbia River was 0.42 mR/day. Survey of more than 60 miles of improved roads on Wahluke Slope with a contamination monitor revealed only nominal background radiation levels. Radionuclide and chemical concentrations in nine Wahluke Slope wells do not appear to be affected by Hanford operations.

SOIL AND VEGETATION

Soil and vegetation samples were analyzed for strontium, plutonium, and gamma-emitting radionuclides. The uranium content of soil was also determined. Tables 1-3 present the radionuclide concentration data for Wahluke Slope soil and vegetation. Average data for 13 sites around the Hanford perimeter which were sampled in 1971 are included for comparison.

Sampling sites 1, 2, 5, and 8 were near the Columbia River bank and downstream of the Hanford reactor locations. Several of the soil samples from these sites were above the average for Co-60 and Zn-65. This confirms the finding of an earlier Wahluke Slope study; i.e., that the Columbia River shoreline immediately adjacent to the slope and down-river from the Hanford reactors shows detectable amounts of activation products from reactor effluent cooling water.

Radionuclide concentrations in soil and vegetation from the remainder of the Wahluke Slope were comparable with the 1971 Hanford perimeter data and most likely reflect the current level of weapons testing fallout contamination. There are no appropriate Concentration Guides with which to compare radionuclide concentrations in soil or desert vegetation.

The plutonium concentrations are typical of general regional levels for arid western states. Other than the higher concentrations along the river, the individual results showed no discernable geographical pattern.

GAMMA EXPOSURE RATES

Exposure rates were initially measured at each of the 38 test sites using a low-level dose rate meter (LLM).⁽³⁾ The results in mR/day are presented in Table 4. A gross contamination count measured with a GM survey instrument did not reveal any additional information. Exposure rates were measured at 3 feet above the ground. The GM survey was at the soil surface. During September and October, Thermoluminescent dosimeters (TLD) were suspended at 3 feet above the soil surface at each of the 38 test locations giving a measure of average exposure rate during this period.

There is some low-level contamination along the Columbia River banks as previously reported.⁽²⁾ Exposure rate measurements at several locations adjacent to the Columbia River appeared to be affected by this localized contamination. Average TLD exposure rate for four of these locations was 0.42 mR/day compared to 0.33 mR/day for the other 34 locations. The LLM exposure rates showed similar average results of 0.45 mR/day and 0.33 mR/day for the same locations.

For comparison, the calculated exposure rate from cosmic radiation and from natural-occurring radionuclides only (K-40, Th-233, and Nat-U), calculated from composited data of 21 soil sample locations on and around the Hanford reservation, is 0.27 mR/day. Exposure contribution from fallout was not considered.

ROAD SURVEY

Over 60 miles of improved (graded or surfaced) roads within the Wahluke Slope area were surveyed with a truck-mounted road monitor. The road monitor consists of a large bioplastic scintillator which is mounted on the truck bumper about 0.6 meter (2 feet) above the road surface. This road monitor has been described in BNWL-62. Radiation levels and variations were similar to those experienced on other off-site roads in the vicinity of Hanford.

(3) Manufactured by Nuclear Enterprises, Limited, Canada.

GROUNDWATER

There are numerous wells on the Wahluke Slope. Some of the wells are being pumped for irrigation or domestic water supply and some have not been pumped for many years. Nine wells shown on the attached map were selected for sampling according to geographical location. Analytical results are presented in Table 5.

Radionuclide and nitrate concentrations in the Wahluke Slope groundwater samples are less than the appropriate Concentration Guides ^(4, 5) for drinking water. The concentrations observed do not appear to be influenced by Hanford operations.

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- (4) U.S. Atomic Energy Commission, "Standards for Radiation Protection," AEC Manual, Chapter 0524, Annex A, Table II, Column 2. November 1968.
 - (5) Recommended Drinking Water Standards. U.S. Public Health Service, Washington, D. C., 1962.

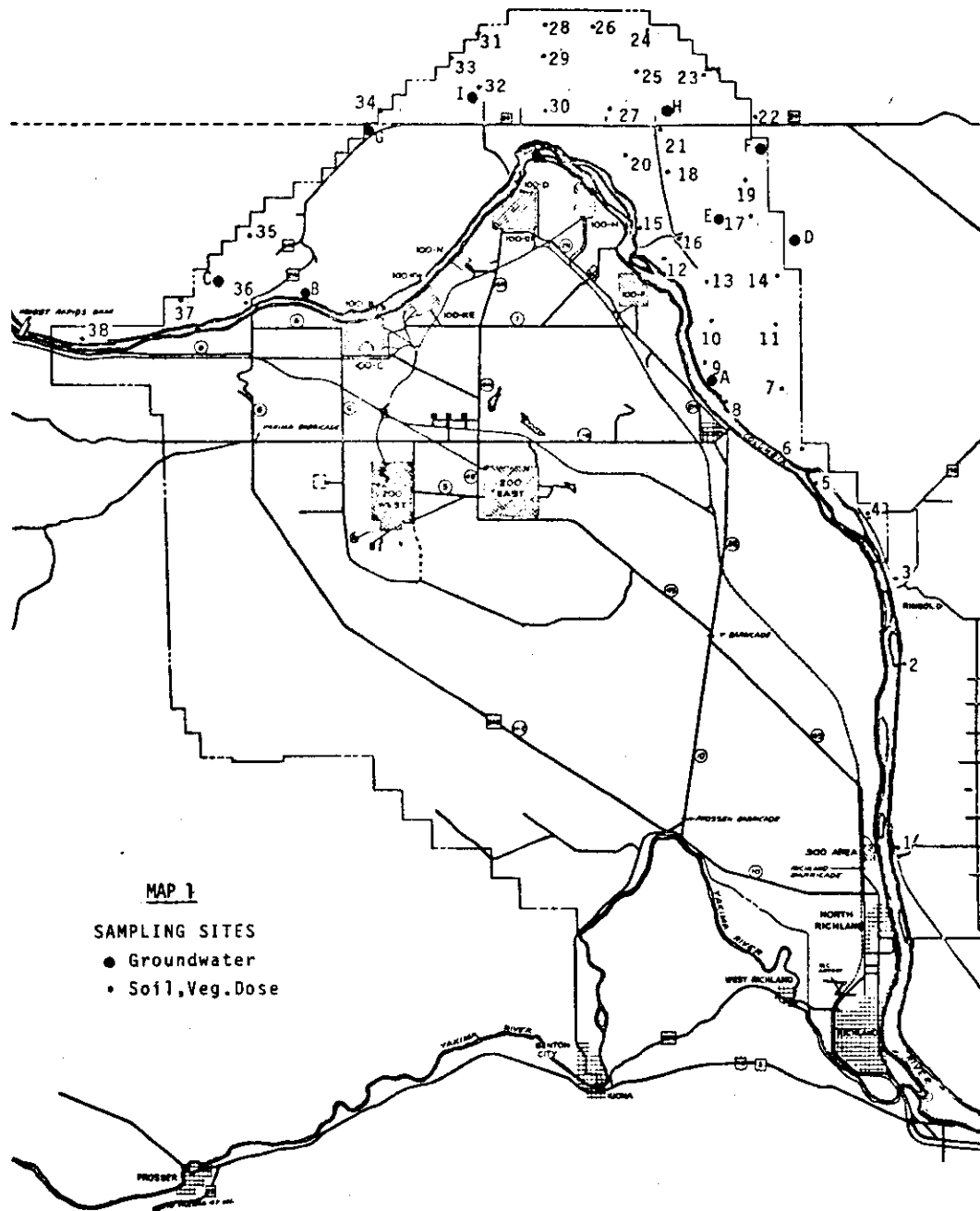


TABLE 1

Soil from Wahluke Slope									
(Units of 10^{-6} μ Ci/gram)									
	⁴⁰ K	⁵⁸ Co	⁶⁰ Co	⁶⁵ Zn	⁹⁵ ZrNb	¹⁰⁶ Ru	¹³⁴ Cs	¹³⁷ Cs	¹⁴⁴ CePr
#1	16.	*0	1.1	.26	.56	*.052	*0	.91	.47
2	15.	.10	1.1	.68	.26	*.12	.20	1.0	1.0
3	18.	*0	*0	*0	.25	*0	.16	.67	.44
4	9.9	.069	*0	*0	.18	*.28	.13	.48	1.3
5	17.	*0	1.7	.25	.70	.81	*0	.72	1.3
6	15.	*.017	.052	*0	.32	*.37	.056	.85	.76
7	11.	.043	*.012	*0	.25	*.29	.033	.38	.82
8	17.	.18	.67	*0	.21	*.35	*0	.30	1.2
9	17.	*0	*0	*0	.39	.44	.058	.88	.82
10	11.	.030	*0	*0	.37	*.36	.010	.89	.66
11	9.8	.055	*0	*0	.19	*.046	.077	.74	.99
12	20.	*0	*0	.36	.013	.57	.071	.14	.68
13	13.	.10	*0	*0	.34	*.094	*.024	.70	.77
14	6.3	*0	*0	*0	.39	*0	.12	.48	.94
15	15.	*0	*0	*0	.39	*.30	*0	.69	1.4
16	11.	*0	.13	.13	.32	*.25	.072	.52	.44
17	9.8	.090	.086	*0	.23	*.24	.088	.48	.94
18	5.1	*0	*.004	*0	.19	*.10	.11	.39	*.083
19	9.2	.014	*.004	*0	.26	*.13	*0	.76	*.27
20	12.	*0	.081	.071	.31	*0	.15	.30	1.1
21	2.1	*0	*0	*0	.54	*0	.047	.33	1.2
22	4.1	*.012	*0	*0	.20	*0	.18	.89	1.7
23	3.9	*.015	*0	*0	.41	*.23	.18	.76	1.2
24	11.	*0	.035	*0	.54	*.32	*0	1.2	1.3
25	12.	*.003	*0	*0	*0	*.082	.096	.039	1.3
26	14.	*0	.078	*0	.32	.11	*.006	.31	.59
27	11.	*.025	*0	*0	.32	.64	*0	.62	*.14
28	14.	*0	*0	*0	.42	*.22	.044	.25	*.038
29	13.	*0	.12	*0	.45	.67	*0	.52	.86
30	13.	.031	.055	*0	.29	*.18	.18	.60	.75
31	13.	*0	*.013	*0	.28	*0	.064	.66	1.3
32	12.	.098	*.004	*0	.32	*0	*0	.30	.39
33	12.	*.014	*0	*.054	.47	.59	.093	.53	.96
34	13.	*0	.037	.22	2.4	*.052	*0	.51	*0
35	14.	*.01	*0	*0	.20	*.28	*0	.58	1.2
36	18.	.12	*0	*0	.22	*.25	.27	.38	.55
37	17.	*0	*.016	*0	.28	*0	*0	.38	.51
38	15.	*0	.044	*0	.95	*.11	*0	.54	1.1
Average	12.	*.027	.141	*.053	.39	.22	.066	.57	.83
Average 13.7 (perimeter)		.017	.026	.046		.415	.033	.63	.387

No entry indicates no specific analysis was performed.

* Less than analytical detection limit.

TABLE 2

Soil from Wahluke Slope

	(10 ⁻⁶ μ Ci/gram)			(μ g/gram)
	⁹⁰ Sr	²³⁸ Pu	²³⁹ Pu	U
#1	.142	*.002	.005	.135
2	.135	*0	.010	.025
3	.246	*.001	.007	.096
4	.257	*.002	.013	.074
5	.049	.003	.009	.084
6	.411	*.001	.008	.141
7	.172	.004	.117	.085
8	.047	*.003	.009	.012
9	.242	*.002	.012	.069
10	.003	*.002	.018	.070
11	.402	*.002	.012	.051
12	.021	*0	.007	.047
13	.316	*.001	.031	.114
14	.281	*0	.006	.132
15	.240	*.001	.008	.113
16	.185	*.002	.018	.210
17	.236	*0	.014	.058
18	.241	.003	.012	.085
19	.233	*0	.010	.089
20	.131	*0	.001	.101
21	.161	*.002	.018	.035
22	.364	*.001	.012	.104
23	.339	*0	.019	.037
24	.441	*.001	.014	.040
25	.153	*.001	.004	.064
26	.129	*.002	.001	.016
27	.267	.003	.011	.087
28	.282	.004	.011	.204
29	.237	*.003	.011	.211
30	.298	*.002	.008	.052
31	.208	*.001	.010	.021
32	.169	*.001	.008	.113
33	.307	*0	.018	.043
34	.341	*0	.017	.030
35	.286	*.001	.027	.216
36	.143	*0	.010	.004
37	.222	*.003	.011	.195
38	.190	*0	.008	.036
Average	.224	.001	.014	.087
Average (perimeter)	.222	.004	.011	

No entry indicates no specific analysis was performed.

* Less than the analytical detection limit.

TABLE 3

Vegetation from Wahluke Slope
(10^{-6} μ Ci/gram)

	^{40}K	^{60}Co	^{90}Sr	$^{95}\text{ZrNb}$	^{103}Ru	^{106}Ru	^{137}Cs	$^{144}\text{CePr}$	^{238}Pu	^{239}Pu
#1	23.	*0	.034	.84	.61	7.4	.55	*.72	*0	.002
2	12.	*0	.041	2.1	.82	2.3	1.2	3.5	*0	.004
3	15.	*0*	.15	1.4	.58	*.53	.43	2.1	*0	.004
4	17.	*0	.046	1.2	.42	2.1	.57	2.5	*.002	.004
5	18.	*0	.055	1.4	.68	4.8	.72	2.4	*0	.001
6	14.	*0	.009	1.9	.45	1.2	.60	3.3	*.001	.006
7	11.	*0	.017	2.3	.70	.94	1.1	4.7	*.002	.030
8	21.	*0	.036	.78	.28	5.0	.31	1.2	*0	.002
9	20.	*0	.32	4.1	1.2	2.1	1.4	5.8	*.001	.008
10	12.	*0	.056	3.5	.69	2.2	2.2	6.7	*.002	.024
11	14.	*0	.008	2.8	.68	*.85	1.1	.79	*.001	.002
12	26.	*0	*0	.50	.48	*1.4	.33	2.4	*.002	.007
13	16.	*0	.064	2.2	.82	.90	.91	3.2	*0	*0
14	15.	*0	.021	2.2	.67	1.2	.64	3.5	*0	.003
15	29.	*0	*0	1.3	.79	*1.1	.43	*1.2	*0	.004
16	13.	*0	.038	1.5	.56	1.8	.69	3.3	*.001	.002
17	13.	*0	.053	2.2	.84	*1.0	.69	4.1	*.002	.008
18	18.	*0	.047	1.7	.66	1.3	.61	2.7	*.003	*0
19	13.	*0	.075	2.0	.66	1.0	.57	3.6	*0	.009
20	12.	*0	.028	2.1	.80	1.2	.49	4.3	*.001	.004
21	14.	*0	.038	1.9	.72	*.75	.35	3.5	*0	*0
22	24.	*0	.074	1.5	.67	1.2	.38	2.0	*0	*0
23	4.6	*0	.12	4.9	1.0	2.5	.72	7.5	*.002	.006
24	42.	*0	.030	.66	.27	*.84	.095	*-.068	*0	.002
25	37.	*0	.022	.69	.30	*.68	.17	*-.067	*0	*0
26	35.	*0	.24	1.0	.48	*.93	.20	1.1	*0	*0
27	9.4	*0	.055	2.0	.64	1.1	.52	4.3	*0	*0
28	14.	*.059	.055	2.8	.85	1.2	.42	5.0	*0	.011
29	11.	*.040	.052	2.9	.88	1.1	.59	5.9	*0	.002
30	34.	*0	.022	.49	.34	*.58	.18	*-.092	*0	*0
31	5.6	*.004	.001	3.2	1.3	1.3	.43	8.0	*.002	.009
32	11.	*.019	.017	2.8	.77	1.4	.45	4.8	*.003	.004
33	19.	*0	.18	.76	.59	*.77	.23	1.3	*.001	*0
34	37.	*0	.029	.49	.28	*.81	.16	*.14	*.002	.004
35	11.	*.007	.070	2.6	.64	1.1	.62	4.7	*.002	.005
36	6.6	*.014	.13	4.1	*-.62	1.5	1.3	*-4.7	*.002	.004
37	8.3	.044	.061	2.8	.47	1.6	.58	4.7	*.002	.006
38	8.6	*0	.071	1.3	.45	1.0	.30	3.1	*.002	*.001
Average	17.		.06	2.0	.62	1.6	.61	3.0	*.001	.005
Average (perimeter)	6.3		.21	1.6	*.81	*.94	.42	3.9	*.001	.004

No entry indicates no specific analysis was performed.

* Less than the analytical detection limit.

TABLE 4

Wahluke Slope Dose Rate and Contamination Data

<u>Location</u>	<u>TLD (mR/day)</u>	<u>LLM (mR/day)</u>
1	.38	.41
2	.34	.36
3	.30	.31
4	.30	.34
5	.52	.53
6	.32	.34
7	.30	.34
8	.42	.48
9	.36	.34
10	.34	.34
11	.33	.31
12	.31	.34
13	.30	.29
14	.30	.31
15	.34	.34
16	.32	.36
17	.28	.36
18	.32	.36
19	.30	.36
20	.28	.31
21	.31	.36
22	.32	.31
23	.31	.29
24	.33	.31
25	.29	.36
26	.29	.29
27	.33	.31
28	.33	.29
29	.34	.29
30	.32	.36
31	.30	.29
32	.30	.31
33	.32	.48
34	.30	.41
35	.30	.38
36	.30	.41
37	.31	.29
38	.28	.24
*Average	.33	.33
Average Riverbank Locations (1,2,5,8)	.42	.45

* Not including sites 1, 2, 5, and 8.

TABLE 5: WAHLUKE SLOPE GROUNDWATER

		Radioactivity (10^{-9} μ Ci/ml)			
		Nitrates (ppm)	Alpha	Beta	Tritium
	Concentration Guide	45	30	10,000	3,000,000
Map I.D.	Well				
A	61-16	*.5	*17	*150	*520
B	76-90	3.3	*17	*150	730
C	79-104	*.5	*17	*150	1100
D	Michaels (a) Line Shack	9.6	*17	*150	*680
E	92-14	*.5	*17	*150	*520
F	105-1	*.5	*17	*150	*520
G	107-79	*.5	*17	*150	*520
H	111-24	*.5	*17	*150	*520
I	114-60	*.5	*17	*150	*760

(a) One mile northeast of Well # 84-E1.

* Less than the analytical detection limit.

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