



Appendix B

Additional Monitoring Results for 2001

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This appendix contains additional information on 2001 monitoring results, supplementing the data

summarized in the main body of the report. More detailed information is available in PNNL-13910, APP. 1.

Table B.1. Radionuclide Concentrations in Columbia River Water at Priest Rapids Dam, 2001 Compared to Previous 5 Years

Radionuclide ^(a)	No. of Samples	2001 Concentration, ^(b) pCi/L		No. of Samples	1996-2000 Concentration, ^(b) pCi/L		Ambient Surface Water Quality Standard, pCi/L	
		Maximum	Average		Maximum	Average		
Composite System								
Tritium	12	66 ± 8.8	37 ± 22	58	200 ± 22	36 ± 48	20,000 ^(c)	
Alpha (gross)	12	1.7 ± 1.1	0.53 ± 0.84	60	5.6 ± 3.1	0.54 ± 1.5	15 ^(d,e)	
Beta (gross)	12	2.1 ± 1.7 ^(f)	0.47 ± 1.8	60	7.7 ± 2.2	0.90 ± 3.4	50 ^(d,e)	
Strontium-90	12	0.092 ± 0.035	0.073 ± 0.027	60	0.13 ± 0.062	0.078 ± 0.036	8 ^(d,e)	
Technetium-99	12	0.26 ± 0.27 ^(f)	-0.0011 ± 0.24	60	1.6 ± 0.69	0.034 ± 0.50	900 ^(c)	
Iodine-129	4	0.000019 ± 0.0000025	0.0000064 ± 0.000017	20	0.000022 ± 0.0000021	0.0000095 ± 0.000012	1 ^(c)	
Uranium-234	12	0.26 ± 0.058	0.24 ± 0.038	60	0.42 ± 0.087	0.25 ± 0.098	-- ^(g)	
Uranium-235	12	0.014 ± 0.011	0.0070 ± 0.0074	60	0.025 ± 0.016	0.0072 ± 0.013	--	
Uranium-238	12	0.22 ± 0.053	0.18 ± 0.056	60	0.38 ± 0.080	0.20 ± 0.094	--	
Uranium (total)	12	0.47 ± 0.076	0.42 ± 0.082	60	0.81 ± 0.18	0.45 ± 0.19	--	
Continuous System								
Cobalt-60	P	12	0.0013 ± 0.00062 ^(f)	0.00046 ± 0.00020 ^(f)	37	0.0013 ± 0.0016 ^(f)	0.00016 ± 0.00094	100 ^(c)
	D	12	0.0040 ± 0.0028 ^(f)	0.0013 ± 0.0029 ^(f)	37	0.0065 ± 0.0057	0.00073 ± 0.0041	
Cesium-137	P	12	0.0032 ± 0.0013	0.00086 ± 0.0017	37	0.0031 ± 0.0016 ^(f)	0.00093 ± 0.0016	200 ^(c)
	D	12	0.0034 ± 0.0021 ^(f)	0.00075 ± 0.0022 ^(f)	37	0.24 ± 5.0 ^(f)	0.0075 ± 0.079	
Europium-155	P	12	0.0012 ± 0.0016 ^(f)	-0.00018 ± 0.0012 ^(f)	37	0.0032 ± 0.0044 ^(f)	0.00041 ± 0.0023	600 ^(c)
	D	12	0.0044 ± 0.0040	0.00099 ± 0.0030 ^(f)	37	0.012 ± 0.014 ^(f)	0.0014 ± 0.0082	
Plutonium-239/240	P	4	0.00018 ± 0.000069	0.000068 ± 0.00015	21	0.00028 ± 0.00010	0.000049 ± 0.00012	--
	D	4	0.000055 ± 0.000072 ^(f)	0.000035 ± 0.000048	21	0.000072 ± 0.000082 ^(f)	0.000020 ± 0.000023	

(a) Radionuclides measured using the continuous system show the particulate (P) and dissolved (D) fractions separately. Other radionuclides are based on unfiltered samples collected by the composite system (see Section 4.2).

(b) Maximum values are ± total propagated analytical uncertainty (2 sigma). Averages are ±2 standard deviations of the calculated mean. To convert to international metric system units, multiply pCi/L by 0.037 to obtain Bq/L.

(c) WAC 173-201A-050 and EPA-570/9-76-003.

(d) WAC 246-290.

(e) 40 CFR 141.

(f) Less than the detection limit.

(g) Dashes indicate no concentration guides available.

Table B.2. Radionuclide Concentrations in Columbia River Water at the Richland Pumphouse, 2001 Compared to Previous 5 Years

Radionuclide ^(a)	No. of Samples	2001 Concentration, ^(b) pCi/L		No. of Samples	1996-2000 Concentration, ^(b) pCi/L		Ambient Surface Water Quality Standard, pCi/L	
		Maximum	Average		Maximum	Average		
Composite System								
Tritium	12	130 ± 14	81 ± 49	58	150 ± 18	69 ± 49	20,000 ^(c)	
Alpha (gross)	12	1.4 ± 1.0	0.58 ± 0.84	60	2.2 ± 1.1	0.55 ± 0.86	15 ^(c,d)	
Beta (gross)	12	1.9 ± 1.7 ^(e)	0.68 ± 1.6	60	6.6 ± 2.5	0.90 ± 0.34	50 ^(c,d)	
Strontium-90	12	0.094 ± 0.039	0.065 ± 0.037	60	0.30 ± 0.081	0.079 ± 0.071	8 ^(c,d)	
Technetium-99	12	0.12 ± 0.19 ^(e)	0.024 ± 0.14	60	0.53 ± 0.52	0.041 ± 0.30	900 ^(f)	
Iodine-129	4	0.00019 ± 0.000021	0.00012 ± 0.00010	19	0.00016 ± 0.000013	0.00010 ± 0.000086	1 ^(f)	
Uranium-234	12	0.32 ± 0.072	0.28 ± 0.056	60	0.40 ± 0.075	0.27 ± 0.10	-- ^(g)	
Uranium-235	12	0.016 ± 0.022 ^(e)	0.0093 ± 0.0073	60	0.024 ± 0.015	0.0089 ± 0.012	--	
Uranium-238	12	0.30 ± 0.066	0.22 ± 0.069	60	0.30 ± 0.060	0.22 ± 0.075	--	
Uranium (total)	12	0.63 ± 0.095	0.52 ± 0.060	60	0.70 ± 0.14	0.49 ± 0.16	--	
Continuous System								
Cobalt-60	P	12	0.0015 ± 0.0008 ^(e)	0.00048 ± 0.0010 ^(e)	36	0.0016 ± 0.001 ^(e)	0.00016 ± 0.0010	100 ^(f)
	D	12	0.0025 ± 0.0018 ^(e)	0.00079 ± 0.0017 ^(e)	36	0.0048 ± 0.0037 ^(e)	0.00067 ± 0.0031	
Cesium-137	P	12	0.0013 ± 0.00068 ^(e)	-0.000048 ± 0.0022 ^(e)	36	0.0037 ± 0.0015	0.0010 ± 0.0017	200 ^(f)
	D	12	0.0022 ± 0.0019 ^(e)	0.00088 ± 0.0018 ^(e)	36	0.0071 ± 0.0052 ^(e)	0.0012 ± 0.0031	
Europium-155	P	12	0.0020 ± 0.0015 ^(e)	0.00035 ± 0.0017 ^(e)	36	0.0029 ± 0.017 ^(e)	0.00027 ± 0.0026	600 ^(f)
	D	12	0.0030 ± 0.0041 ^(e)	0.00093 ± 0.0030 ^(e)	36	0.0077 ± 0.013 ^(e)	0.00076 ± 0.0077	
Plutonium-239/240	P	4	0.000073 ± 0.000043	0.000033 ± 0.000058	20	0.00017 ± 0.000087	0.000043 ± 0.000088	--
	D	4	0.00015 ± 0.000070	0.000052 ± 0.00013	20	0.00016 ± 0.000091	0.000038 ± 0.000080	

(a) Radionuclides measured using the continuous system show the particulate (P) and dissolved (D) fractions separately. Other radionuclides are based on unfiltered samples collected by the composite system (see Section 4.2).

(b) Maximum values are ± total propagated analytical uncertainty (2 sigma). Averages are ±2 standard error of the calculated mean. To convert to international metric system units, multiply pCi/L by 0.037 to obtain Bq/L.

(c) 40 CFR 141.

(d) WAC 246-290.

(e) Less than the detection limit.

(f) WAC 173-201A-050 and EPA-570/9-76-003.

(g) Dashes indicate no concentration guides available.

Table B.3. Radionuclide Concentrations Measured in Columbia River Water along Transects of the Hanford Reach, 2001

<u>Transect/Radionuclide</u>	<u>No. of Samples</u>	<u>Concentration,^(a) pCi/L</u>		
		<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>
Vernita Bridge (HRM 0.3)^(b)				
Tritium	16	80 ± 10	18 ± 5.5	39 ± 40
Strontium-90	16	0.11 ± 0.15 ^(c)	0.053 ± 0.030	0.071 ± 0.030
Uranium (total)	16	0.59 ± 0.12	0.38 ± 0.069	0.45 ± 0.10
100-N Area (HRM 9.5)				
Tritium	7	110 ± 13	23 ± 5.9	53 ± 78
Strontium-90	7	0.14 ± 0.048	0.046 ± 0.029	0.083 ± 0.076
Uranium (total)	7	0.53 ± 0.089	0.39 ± 0.069	0.44 ± 0.092
100-F Area (HRM 19)				
Tritium	6	36 ± 6.8	34 ± 6.6	34 ± 2.0
Strontium-90	6	0.076 ± 0.033	0.041 ± 0.028	0.062 ± 0.022
Uranium (total)	6	0.44 ± 0.078	0.37 ± 0.068	0.41 ± 0.064
Hanford Town Site (HRM 28.7)				
Tritium	6	820 ± 73	36 ± 6.7	210 ± 630
Strontium-90	6	0.069 ± 0.032	0.040 ± 0.028	0.057 ± 0.019
Uranium (total)	6	0.49 ± 0.096	0.38 ± 0.069	0.43 ± 0.094
300 Area (HRM 43.1)				
Tritium	6	49 ± 8.2	30 ± 6.2	36 ± 15
Strontium-90	6	0.074 ± 0.039	0.054 ± 0.031	0.064 ± 0.0016
Uranium (total)	6	1.8 ± 0.25	0.41 ± 0.072	0.66 ± 1.1
Richland Pumphouse (HRM 46.4)				
Tritium	30	130 ± 14	23 ± 5.8	56 ± 57
Strontium-90	26	0.084 ± 0.035	0.053 ± 0.033	0.068 ± 0.016
Uranium (total)	26	0.91 ± 0.14	0.39 ± 0.087	0.51 ± 0.10

(a) Maximum and minimum values are ± total propagated analytical uncertainty. Mean values are ±2 standard error of the mean. To convert to international metric system units, multiply pCi/L by 0.037 to obtain Bq/L.

(b) HRM = Hanford River Mile (e.g., Vernita Bridge crossing is Mile 0, the Richland Pumphouse is Mile 46.4).

(c) Below detection limit.

Table B.4. Radionuclide Concentrations Measured in Columbia River Water at Near-Shore Locations in the Hanford Reach, 2001

<u>Near-Shore/Radionuclide</u>	<u>No. of Samples</u>	<u>Concentration,^(a) pCi/L</u>		
		<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>
Vernita Bridge (HRM 0.3)^(b)				
Tritium	4	70 ± 9.3	28 ± 6.2	41 ± 39
Strontium-90	4	0.11 ± 0.15 ^(c)	0.055 ± 0.029	0.074 ± 0.050
Uranium (total)	4	0.59 ± 0.12	0.38 ± 0.072	0.48 ± 0.094
100-N Area (HRM 8.4 to 9.8)				
Tritium	6	130 ± 14	62 ± 8.7	99 ± 58
Strontium-90	6	0.28 ± 0.079	0.066 ± 0.032	0.15 ± 0.16
Uranium (total)	6	0.44 ± 0.079	0.32 ± 0.068	0.40 ± 0.096
100-F Area (HRM 18-23)				
Tritium	3	37 ± 8.3	34 ± 6.6	35 ± 3.2
Strontium-90	3	0.072 ± 0.032	0.055 ± 0.031	0.064 ± 0.016
Uranium (total)	3	0.48 ± 0.082	0.37 ± 0.068	0.42 ± 0.10
Hanford Town Site (HRM 26 to 30)				
Tritium	5	5,100 ± 440	40 ± 7.0	1,500 ± 4,200
Strontium-90	5	0.077 ± 0.033	0.040 ± 0.028	0.064 ± 0.028
Uranium (total)	5	0.61 ± 0.099	0.42 ± 0.075	0.48 ± 0.16
300 Area (HRM 41.5 to 43.1)				
Tritium	5	550 ± 50	43 ± 7.2	180 ± 420
Strontium-90	5	0.082 ± 0.037	0.059 ± 0.032	0.072 ± 0.017
Uranium (total)	5	0.66 ± 0.10	0.44 ± 0.074	0.49 ± 0.18
Richland Pumphouse (HRM 43.5 to 46.4)				
Tritium	23	130 ± 14	28 ± 6.4	66 ± 52
Strontium-90	22	0.12 ± 0.044	0.041 ± 0.028	0.071 ± 0.030
Uranium (total)	22	0.58 ± 0.098	0.39 ± 0.072	0.48 ± 0.094

(a) Maximum and minimum values are ± total propagated analytical uncertainty. Mean values are ±2 standard deviations. To convert to international metric system units, multiply pCi/L by 0.037 to obtain Bq/L.

(b) HRM = Hanford River Mile (e.g., Vernita Bridge crossing is Mile 0, the Richland Pumphouse is Mile 46.4).

(c) Below detection limit.

Table B.5. Selected U.S. Geological Survey Columbia River Water Quality Data,^(a) 2001

Analysis	Units	Vernita Bridge (upstream)				Richland Pumpouse (downstream)				Washington Ambient Surface Water Quality Standard ^(b)
		No. of Samples	Median	Maximum	Minimum	No. of Samples	Median	Maximum	Minimum	
Temperature	°C	4	11	19	6.6	5	8.5	19	4.5	20 (maximum)
Dissolved oxygen	mg/L	4	11	13	9.4	5	11	12	8.9	8 (minimum)
Turbidity	NTU ^(c)	4	2.2	3.0	1.3	4	1.8	4.1	0.90	5 + background
pH	pH units	4	8.1	8.5	8.0	5	8.1	8.3	7.9	6.5 - 8.5
Sulfate, dissolved	mg/L	4	9.0	11	8.4	5	9.3	12	9.1	-- ^(d)
Dissolved solids, 180°C (356°F)	mg/L	4	85	97	80	5	79	97	75	--
Specific conductance	µS/cm	4	142	158	134	5	143	161	139	--
Total hardness, as CaCO ₃	mg/L	4	63	71	59	5	65	74	61	--
Alkalinity	mg/L	4	57	63	53	5	60	64	52	--
Phosphorus, total	mg/L	4	<0.06	<0.06	<0.06	5	<0.06	<0.06	<0.06	--
Chromium, dissolved	µg/L	4	<0.8	<0.8	<0.8	5	<0.8	<0.8	<0.8	--
Dissolved organic carbon	mg/L	4	1.3	2.4	1.1	4	1.4	1.7	1.1	--
Iron, dissolved	µg/L	4	<10	<10	<10	5	<10	<10	<10	--
Ammonia, dissolved, as N	mg/L	4	<0.40	<0.41	<0.40	5	<0.40	<0.41	<0.40	--
Nitrite + nitrate, dissolved, as N	mg/L	4	0.098	0.15	0.046	5	0.11	0.16	0.073	--

(a) Provisional data from U.S. Geological Survey National Stream Quality Accounting Network (NASQAN), subject to revision.

(b) From WAC 173-201A.

(c) NTU = Nephelometric turbidity units.

(d) Dashes indicate no standard available.

Table B.6. Concentrations ($\mu\text{g/L}$) of Dissolved Metals in Columbia River Transect and Near-Shore Water Samples, 2001

Location	Metal	No. of Samples	Maximum	Minimum	Average	$\pm 2\text{SD}^{(a)}$
Vernita Bridge	Antimony	16	0.24	0.16	0.20	0.050
	Arsenic	16	0.75	0.51	0.61	0.14
	Beryllium	16	0.018	0.008	0.0090	0.0051
	Cadmium	16	0.056	0.0088	0.022	0.31
	Chromium	16	0.68	0.016	0.26	0.43
	Copper	16	0.68	0.45	0.57	0.13
	Lead	16	0.032	0.0035	0.017	0.019
	Mercury	16	0.00055	0.00034	0.00042	0.00014
	Nickel	16	0.62	0.17	0.30	0.34
	Selenium	16	0.28	0.11	0.14	0.099
	Silver	16	0.017	0.0012	0.0054	0.010
	Thallium	16	0.028	0.018	0.024	0.0072
	Zinc	16	2.3	0.89	1.3	0.71
100-N Area	Antimony	11	0.26	0.20	0.23	0.027
	Arsenic	11	0.74	0.63	0.70	0.065
	Beryllium	11	0.008	0.008	0.008	0
	Cadmium	11	0.015	0.0076	0.012	0.0048
	Chromium	11	0.78	0.057	0.43	0.34
	Copper	11	0.60	0.53	0.57	0.043
	Lead	11	0.044	0.0099	0.022	0.020
	Mercury	0				
	Nickel	11	0.31	0.16	0.25	0.11
	Selenium	11	0.27	0.16	0.22	0.077
	Silver	11	0.0084	0.0012	0.0040	0.0051
	Thallium	11	0.040	0.034	0.036	0.0044
	Zinc	11	4.6	1.2	1.9	2.7
100-F Area	Antimony	7	0.25	0.21	0.23	0.025
	Arsenic	7	0.77	0.66	0.73	0.086
	Beryllium	7	0.008	0.008	0.008	0
	Cadmium	7	0.016	0.011	0.013	0.0035
	Chromium	7	0.89	0.26	0.50	0.42
	Copper	7	0.69	0.60	0.65	0.062
	Lead	7	0.088	0.024	0.055	0.048
	Mercury	0				
	Nickel	7	0.71	0.23	0.33	0.35
	Selenium	7	0.27	0.12	0.20	0.10
	Silver	7	0.025	0.0012	0.0081	0.017
	Thallium	0				
	Zinc	7	30	1.2	5.5	21
Hanford Town Site	Antimony	12	0.25	0.20	0.22	0.038
	Arsenic	12	0.91	0.66	0.72	0.14
	Beryllium	12	0.008	0.008	0.008	0
	Cadmium	12	0.017	0.0056	0.010	0.0062
	Chromium	12	0.55	0.31	0.43	0.15
	Copper	12	0.66	0.54	0.58	0.072
	Lead	12	0.086	0.0023	0.026	0.050
	Mercury	12	0.00092	0.00038	0.00053	0.00031
	Nickel	12	0.44	0.21	0.29	0.14
	Selenium	12	0.32	0.15	0.20	0.10
	Silver	12	0.013	0.0012	0.0044	0.0082
	Thallium	0				
	Zinc	12	17	1.0	3.7	10

Table B.6. (contd)

Location	Metal	No. of Samples	Maximum	Minimum	Average	±2SD^(a)
300 Area	Antimony	12	0.22	0.21	0.22	0.0087
	Arsenic	12	0.88	0.65	0.73	0.14
	Beryllium	12	0.008	0.008	0.008	0
	Cadmium	12	0.022	0.0084	0.013	0.0077
	Chromium	12	0.48	0.21	0.34	0.15
	Copper	12	0.68	0.55	0.60	0.092
	Lead	12	0.16	0.0056	0.032	0.088
	Mercury	0				
	Nickel	12	0.29	0.18	0.24	0.060
	Selenium	12	0.80	0.16	0.29	0.47
	Silver	12	0.0012	0.0012	0.0012	0
	Thallium	0				
Zinc	12	2.4	1.2	1.5	0.66	
Richland Pumphouse	Antimony	43	0.26	0.16	0.20	0.048
	Arsenic	43	1.1	0.49	0.63	0.23
	Beryllium	43	0.017	0.008	0.0084	0.0033
	Cadmium	43	0.069	0.0064	0.024	0.034
	Chromium	43	0.67	0.016	0.17	0.32
	Copper	43	0.71	0.44	0.55	0.15
	Lead	43	0.83	0.0021	0.044	0.26
	Mercury	43	0.00067	0.00022	0.00046	0.00018
	Nickel	43	3.2	0.12	0.30	0.93
	Selenium	43	0.31	0.11	0.14	0.10
	Silver	43	0.029	0.0012	0.0050	0.010
	Thallium	43	0.028	0.017	0.022	0.0057
Zinc	43	5.1	0.82	1.4	1.7	

SD = Standard deviation.

Table B.7. Radionuclide Concentrations in Sediment from the Columbia River and from Columbia River Riverbank Springs, 2001 Compared to Previous 5 Years

Location	Radionuclide	2001			1996-2000		
		No. of Samples	Concentration, pCi/g ^(a)		No. of Samples	Concentration, pCi/g ^(a)	
			Median ^(b)	Maximum ^(c)		Median ^(b)	Maximum ^(c)
River Sediment (2001 TOC Value)^(d)							
100-F Slough (2,030 mg/kg)	Cobalt-60	1		0.0068 ± 0.021 ^(e)	5	0.023	0.033 ± 0.011
	Cesium-137	1		0.16 ± 0.045	5	0.32	0.47 ± 0.053
	Europium-155	1		0.069 ± 0.062 ^(e)	5	0.033	0.061 ± 0.033 ^(e)
	Plutonium-239/240	1		0.0020 ± 0.00054	5	0.0020	0.0024 ± 0.00072
	Strontium-90	1		-0.010 ± 0.018 ^(e)	5	0.0032	0.0062 ± 0.0047
	Uranium-234	1		0.13 ± 0.032	3	0.16	0.31 ± 0.062
	Uranium-235	1		0.0023 ± 0.0036 ^(e)	5	0.0058	0.064 ± 0.068 ^(e)
Uranium-238	1		0.12 ± 0.030	5	0.29	1.4 ± 0.41	
Hanford Slough (1,130 mg/kg)	Cobalt-60	1		0.026 ± 0.026 ^(e)	5	0.011	0.27 ± 0.046
	Cesium-137	1		0.027 ± 0.026 ^(e)	5	0.16	0.59 ± 0.068
	Europium-155	1		0.059 ± 0.064 ^(e)	5	0.067	0.083 ± 0.045
	Plutonium-239/240	1		0.00040 ± 0.00023	5	0.0030	0.0076 ± 0.0014
	Strontium-90	1		0.0021 ± 0.02 ^(e)	5	0.043	0.016 ± 0.009
	Uranium-234	1		0.12 ± 0.030	3	0.38	0.37 ± 0.072
	Uranium-235	1		0.0046 ± 0.0045	5	0.012	0.16 ± 0.15
Uranium-238	1		0.13 ± 0.031	5	0.34	1.7 ± 0.66	
McNary Dam (4,460 - 13,500 mg/kg)	Cobalt-60	6	0.036 ^(e)	0.12 ± 0.042 ^(e)	22	0.031	0.075 ± 0.030
	Cesium-137	6	0.42	1.1 ± 0.15	22	0.36	0.81 ± 0.090
	Europium-155	6	0.082 ^(e)	0.13 ± 0.066 ^(e)	22	0.054	0.091 ± 0.042 ^(e)
	Plutonium-239/240	6	0.0085	0.032 ± 0.0048	22	0.077	0.013 ± 0.0019
	Strontium-90	6	0.0073	0.043 ± 0.028	22	0.023	0.048 ± 0.011
	Uranium-234	6	0.80	0.87 ± 0.17	14	0.72	0.86 ± 0.11
	Uranium-235	6	0.021	0.032 ± 0.012	22	0.024	0.21 ± 0.10 ^(e)
Uranium-238	6	0.62	0.65 ± 0.13	22	0.63	2.3 ± 0.81	
Priest Rapids Dam (10,300 - 14,100 mg/kg)	Cobalt-60	2	0.00052 ^(e)	0.0034 ± 0.028 ^(e)	21	0.0022 ^(e)	0.042 ± 0.041 ^(e)
	Cesium-137	2	0.47	0.50 ± 0.090	21	0.34	0.67 ± 0.077
	Europium-155	2	0.025 ^(e)	0.044 ± 0.065 ^(e)	21	0.051	0.082 ± 0.088 ^(e)
	Plutonium-239/240	2	0.0096	0.0096 ± 0.0015	21	0.0086	0.017 ± 0.0030
	Strontium-90	2	0.0087 ^(e)	0.022 ± 0.023 ^(e)	21	0.013	0.028 ± 0.028 ^(e)
	Uranium-234	2	0.64	0.82 ± 0.15	14	0.51	0.83 ± 0.14
	Uranium-235	2	0.027	0.037 ± 0.013	14	0.018	0.17 ± 0.16
Uranium-238	2	0.53	0.60 ± 0.12	21	0.65	1.5 ± 0.56	



Table B.7. (contd)

Location	Radionuclide	2001			1996-2000		
		No. of Samples	Concentration, pCi/g ^(a)		No. of Samples	Concentration, pCi/g ^(a)	
			Median ^(b)	Maximum ^(c)		Median ^(b)	Maximum ^(c)
Richland (4,170 mg/kg)	Cobalt-60	1		0.032 ± 0.023 ^(e)	5	0.020	0.039 ± 0.019
	Cesium-137	1		0.24 ± 0.049	5	0.23	0.24 ± 0.033
	Europium-155	1		0.035 ± 0.056 ^(e)	5	0.030 ^(e)	0.062 ± 0.032 ^(e)
	Plutonium-239/240	1		0.0016 ± 0.00049	5	0.0020	0.0034 ± 0.00073
	Strontium-90	1		-0.0073 ± 0.023 ^(e)	5	0.0043	0.0063 ± 0.0041
	Uranium-234	1		0.16 ± 0.044	3	0.24	0.25 ± 0.053
	Uranium-235	1		0.011 ± 0.0094	5	0.014	0.068 ± 0.13
	Uranium-238	1		0.12 ± 0.034	5	0.24	2.1 ± 0.54
White Bluffs Slough (16,500 mg/kg)	Cobalt-60	1		0.051 ± 0.031 ^(e)	5	0.061	0.20 ± 0.031
	Cesium-137	1		0.58 ± 0.098	5	0.53	0.60 ± 0.067
	Europium-155	1		0.053 ± 0.075 ^(e)	5	0.052	0.10 ± 0.034 ^(e)
	Plutonium-239/240	1		0.0044 ± 0.0010	5	0.0049	0.0058 ± 0.0011
	Strontium-90	1		-0.014 ± 0.017	5	0.0050	0.010 ± 0.0057
	Uranium-234	1		0.47 ± 0.093	3	0.30	0.69 ± 0.13
	Uranium-235	1		0.013 ± 0.0070	5	0.0087	0.14 ± 0.14 ^(e)
	Uranium-238	1		0.38 ± 0.075	5	0.59	1.9 ± 0.52
Riverbank Spring Sediment							
100-B Spring	Cobalt-60	1		0.022 ± 0.013 ^(e)	5	0.010	0.051 ± 0.024 ^(e)
	Cesium-137	1		0.075 ± 0.019	5	0.079	0.14 ± 0.026
	Europium-155	1		0.088 ± 0.036	5	0.074 ^(e)	0.11 ± 0.072 ^(e)
	Strontium-90	1		0.0030 ± 0.025 ^(e)	5	0.0020 ^(e)	0.0041 ± 0.0083 ^(e)
	Uranium-234	1		0.48 ± 0.097	3	0.26	0.49 ± 0.087
	Uranium-235	1		0.014 ± 0.0089	5	0.029	0.20 ± 0.10 ^(e)
	Uranium-238	1		0.41 ± 0.085	5	0.40	1.2 ± 0.38
100-F Spring	Cobalt-60	1		0.016 ± 0.011 ^(e)	5	0.021	0.044 ± 0.024 ^(e)
	Cesium-137	1		0.14 ± 0.023	5	0.14	0.32 ± 0.040
	Europium-155	1		0.070 ± 0.031 ^(e)	5	0.030 ^(e)	0.055 ± 0.031 ^(e)
	Strontium-90	1		0.0018 ± 0.025 ^(e)	5	0.0087	0.013 ± 0.032 ^(e)
	Uranium-234	1		0.70 ± 0.14	4	0.43	0.69 ± 0.078
	Uranium-235	1		0.060 ± 0.019	6	0.036	0.16 ± 0.076
	Uranium-238	1		0.65 ± 0.13	6	0.56	1.4 ± 0.54

Table B.7. (contd)

Location	Radionuclide	2001			1996-2000		
		No. of Samples	Concentration, pCi/g ^(a)		No. of Samples	Concentration, pCi/g ^(a)	
			Median ^(b)	Maximum ^(c)		Median ^(b)	Maximum ^(c)
100-K Spring	Cobalt-60	0			1		0.015 ± 0.021 ^(e)
	Cesium-137	0			1		0.19 ± 0.046
	Europium-155	0			1		0.039 ± 0.047
	Strontium-90	0			1		0.0085 ± 0.0048
	Uranium-234	0			0		
	Uranium-235	0			1		0.14 ± 0.065 ^(e)
	Uranium-238	0			1		0.82 ± 0.24
300 Area Spring	Cobalt-60	1		0.00067 ± 0.0089 ^(e)	6	0.012 ^(e)	0.020 ± 0.010 ^(e)
	Cesium-137	1		0.038 ± 0.013	6	0.11	0.27 ± 0.035
	Europium-155	1		0.064 ± 0.027 ^(e)	6	0.038 ^(e)	0.086 ± 0.035 ^(e)
	Uranium-234	3	1.8	2.7 ± 0.49	4	2.8	3.9 ± 0.60
	Uranium-235	3	0.076	0.10 ± 0.026	6	0.11	0.19 ± 0.11 ^(e)
	Uranium-238	3	1.8	2.4 ± 0.44	6	2.1	3.7 ± 0.57
Hanford Spring	Cobalt-60	0			6	0.054	0.067 ± 0.026
	Cesium-137	0			6	0.21	0.25 ± 0.058
	Europium-155	0			6	0.067 ^(e)	0.10 ± 0.053 ^(e)
	Uranium-234	0			4	0.58	0.75 ± 0.13
	Uranium-235	0			6	0.018	0.025 ± 0.077 ^(e)
	Uranium-238	0			6	0.53	1.6 ± 0.56

(a) To convert to international metric system units, multiply pCi/g by 0.037 to obtain Bq/g.

(b) Median values are not provided when only one sample analyzed.

(c) Values are ± total propagated analytical uncertainty.

(d) TOC = Total organic content.

(e) Below detection limit.

Table B.8. Median Metal Concentrations (mg/kg dry wt.) in Columbia River Sediment, 2001

<u>Metal</u>	(n=2) Priest Rapids Dam	(n=3) Hanford Reach^(a)	(n=2) McNary Dam	(n=6) Riverbank Springs^(b)
Antimony	0.63	0.55	0.83	0.58
Arsenic	5.9	4.4	8.7	4.0
Beryllium	1.5	1.3	1.6	1.3
Cadmium	2.6	0.60	1.9	0.57
Chromium	72	59	70	77
Copper	26	22	34	16
Lead	37	23	57	18
Mercury	0.069	0.0045	0.060	0.00090
Nickel	29	17	26	18
Selenium	0.93	0.46	0.47	0.35
Silver	0.34	0.30	0.36	0.13
Thallium	0.75	0.60	0.78	0.56
Zinc	310	220	300	150

(a) 100-F Slough, Hanford Slough, and Richland.

(b) 100-B Area, 100-F Area, and 300 Area.

Table B.9. Radionuclide Concentrations Measured in Water from Riverbank Springs, 2001 Compared to Previous 5 Years

Location/Radionuclide	2001			1996-2000			Washington State Ambient Surface Water Quality Standard, ^(b) pCi/L
	No. of Samples	Concentration, ^(a) pCi/L		No. of Samples	Concentration, ^(a) pCi/L		
		Maximum	Median		Maximum	Median	
100-B Area							
Alpha (gross)	4	9.4 ± 3.8	3.9	6	2.0 ± 1.4	1.7	15
Beta (gross)	4	24 ± 4.5	7.2	6	15 ± 3.1	7.4	50
Strontium-90	4	0.070 ± 0.28 ^(c)	0.019 ^(c)	6	4.5 ± 1.0	0.031	8
Technetium-99	2	5.9 ± 0.50	4.0	4	18 ± 2.3	7.9	900 ^(d)
Tritium	4	8,000 ± 690	6,300	6	24,000 ± 1,800	13,000	20,000
100-D Area							
Alpha (gross)	2	1.6 ± 1.8 ^(c)	0.71 ^(c)	7	0.98 ± 1.4 ^(c)	0.50	15
Beta (gross)	2	14 ± 3.0	8.8	7	14 ± 3.6	2.9	50
Strontium-90	1	0.55 ± 0.17	0.55	7	5.3 ± 1.2	1.4	8
Tritium	2	9,400 ± 1,000	7,300	7	4,800 ± 450	360	20,000
100-F Area							
Alpha (gross)	4	5.2 ± 2.9	4.4	5	41 ± 18	4.0	15
Beta (gross)	4	10 ± 2.6	8.3	5	65 ± 11	7.8	50
Strontium-90	4	0.27 ± 0.43 ^(c)	-0.023 ^(c)	5	0.094 ± 0.057	0.013	8
Tritium	4	1,500 ± 320	1,400	5	1,800 ± 240	1,100	20,000
Uranium (total)	2	5.2 ± 0.70	4.8	5	9.2 ± 0.79	4.6	-- ^(e)
100-H Area							
Alpha (gross)	7	2.8 ± 2.2	0.71	6	10 ± 3.7	2.0	15
Beta (gross)	7	27 ± 4.7	8.1	6	72 ± 8.6	20	50
Strontium-90	4	14 ± 3.2	1.9	5	17 ± 3.1	5.6	8
Technetium-99	4	4.5 ± 0.41	0.025	6	77 ± 8.7	0.77	900
Tritium	7	5,500 ± 470	840	6	2,300 ± 270	480	20,000
Uranium (total)	4	2.5 ± 0.33	1.3	6	9.3 ± 0.70	1.2	--
100-K Area							
Alpha (gross)	2	0.025 ± 0.71 ^(c)	-0.072 ^(c)	5	4.1 ± 2.1	1.9	15
Beta (gross)	2	3.8 ± 2.0	3.1	5	6.3 ± 2.1	5.0	50
Strontium-90	0			5	2.1 ± 0.52	0.035	8
Technetium-99	0			1	0.27 ± 0.26		900 ^(d)
Tritium	2	5,800 ± 640	2,900	5	12,000 ± 970	5,400	20,000



Table B.9. (contd)

<u>Location/Radionuclide</u>	<u>No. of Samples</u>	<u>2001</u>		<u>No. of Samples</u>	<u>1996-2000</u>		<u>Washington State Ambient Surface Water Quality Standard,^(b) pCi/L</u>
		<u>Concentration,^(a) pCi/L</u>			<u>Concentration,^(a) pCi/L</u>		
		<u>Maximum</u>	<u>Median</u>		<u>Maximum</u>	<u>Median</u>	
100-N Area							
Alpha (gross)	2	2.2 ± 1.5	1.9	6	2.8 ± 1.2	1.1	15
Beta (gross)	2	5.5 ± 20	4.6	6	16,000 ± 1,400	4.0	50
Strontium-90	2	0.039 ± 0.044 ^(c)	0.026 ^(c)	6	9,900 ± 1,800	0.053	8
Tritium	2	17,000 ± 800	12,000	6	24,000 ± 1,900	17,000	20,000
300 Area							
Alpha (gross)	4	88 ± 21	76	7	230 ± 49	69	15
Beta (gross)	4	33 ± 5.4	23	7	49 ± 7.9	26	50
Iodine-129		±		7	0.0062 ± 0.00056	0.0050	1
Technetium-99	2	11 ± 0.96	10.4	5	16 ± 2.0	12	900 ^(d)
Tritium	6	12,000 ± 580	6,900	7	11,000 ± 570	9,600	20,000
Uranium (total)	6	100 ± 13	62	7	210 ± 26	58	--
Hanford Town Site							
Alpha (gross)	2	5.0 ± 2.5	4.0	9	14 ± 5.9	3.1	15
Beta (gross)	2	36 ± 5.8	34	9	49 ± 7.9	23	50
Iodine-129		±		9	0.41 ± 0.024	0.17	1
Technetium-99	2	110 ± 7.5	97	9	120 ± 8.0	72	900 ^(d)
Tritium	2	110,000 ± 4,100	100,000	9	120,000 ± 8,800	75,000	20,000
Uranium (total)	2	3.9 ± 0.52	3.8	9	8.6 ± 1.0	3.1	--
Richland (HRM 44.4)							
Tritium	1	230 ± 23	230	0			20,000
Uranium (total)	1	1.6 ± 0.24	1.6	0			--
Vernita Bridge							
Alpha (gross)	1	4.2 ± 1.8	4.2	0			--
Beta (gross)	1	8.4 ± 1.8	8.4	0			--
Strontium-90	1	0.026 ± 0.061 ^(c)	0.026 ^(c)	0			--
Tritium	1	35 ± 6.9	35	0			--
Uranium (total)	1	0.43 ± 0.075	0.43	0			--

(a) Maximum values are ± total propagated analytical uncertainty. To convert to international metric system units, multiply pCi/L by 0.037 to obtain Bq/L.

(b) WAC 246-290, 40 CFR 141, and Appendix D, Table D.2.

(c) Value below the detection limit.

(d) WAC 173-201A-050 and EPA-570/9-76-003.

(e) Dashes indicate no concentration guides available.

Table B.10. Annual Average Dose Rates Measured on and around the Hanford Site in Calendar Year 2001

Location	Location Number	Annual Average (mrem/yr)^(a)	Location	Location Number	Annual Average (mrem/yr)^(a)
Onsite^(b)			Community^(c)		
100 K Area	1	79 ± 16	Mattawa	12	79 ± 10
100 D Area	2	86 ± 19	Othello	13	76 ± 9
100 F Met Tower	3	87 ± 10	Basin City	14	78 ± 12
Hanford Townsite	4	80 ± 6	Edwin Markham School	15	76 ± 5
N of 200 E	5	90 ± 12	Leslie Groves - Richlnd ^(d)	16	91 ± 0
B Pond	6	96 ± 8	Pasco	17	86 ± 5
E of 200 E	7	90 ± 12	Kennewick - Ely Street	18	76 ± 9
200ESE	8	87 ± 11	Benton City	19	86 ± 18
S of 200 E	9	87 ± 30			
200 Tel. Exchange	10	85 ± 17	Distant^(c)		
SW of B/C Cribs	11	88 ± 17	Yakima	20	73 ± 8
200 W SE	12	84 ± 4	Toppenish	21	71 ± 10
Army Loop Camp	13	87 ± 10	Columbia River Shoreline^(e)		
3705 Bldg. 300 Area	14	82 ± 11	S End Vernita Bridge ^(f)	1	74 ± 9
300 Water Intake	15	80 ± 8	Above 100 B Area	2	89 ± 14
300 Southwest Gate	16	80 ± 12	Below 100B Ret Basin	3	97 ± 15
300 South Gate	17	83 ± 9	Above 1K Boat Ramp	4	83 ± 7
300 Trench	18	83 ± 7	Below 100N Outfall	5	110 ± 11
300 NE	19	87 ± 8	Above Tip 100N Berm	6	93 ± 5
400 E	20	82 ± 5	100 N Trench Spring	7	129 ± 6
400 W	21	86 ± 9	Below 100 D Area	8	77 ± 12
400 S	22	82 ± 13	100-D Island	9	79 ± 10
400 N	23	81 ± 9	100 H Area	10	86 ± 9
US Ecology NE Corner	24	88 ± 10	Lo End Locke Isl	11	93 ± 12
US Ecology SE Corner	25	88 ± 7	White Bluffs Fy Lnd.	12	87 ± 9
US Ecology NW Corner	26	88 ± 10	White Bluffs Slough ^(g)	13	101 ± 22
US Ecology SW Corner	27	94 ± 7	Below 100 F	14	81 ± 5
Wye Barricade	28	88 ± 14	100 F Flood Plain	15	87 ± 9
WPPSS 1; S of WNP 2	29	89 ± 4	Hanford Slough	16	96 ± 13
Perimeter^(c)			Hanf Powerline Xing	17	94 ± 9
Ringold Met Tower	1	94 ± 7	Hanford RR Track	18	96 ± 9
W End of Fir Road	2	93 ± 8	Savage Isl Slough	19	79 ± 7
Dogwood Met Tower	3	94 ± 7	Ringold Island	20	85 ± 8
Byers Landing	4	99 ± 16	Powerline Crossing	21	87 ± 7
Battelle Complex	5	80 ± 10	S End Wooded Island	22	98 ± 21
WPPSS 4; WPS Warehse	6	82 ± 12	Islnd Above 300 Area	23	92 ± 11
Horn Rapids Substa	7	87 ± 8	Island Near 300 Area	24	90 ± 14
Prosser Barricade	8	92 ± 9	Port of Benton-River	25	85 ± 15
Yakima Barricade	9	95 ± 10	Isl DS Bateman Isl	26	95 ± 7
Rattlesnake Springs	10	94 ± 13			
Wahluke Slope	11	90 ± 7			

- (a) ±2 standard deviations of the dose rate.
- (b) All locations are shown on Figure 4.7.1.
- (c) All locations are shown on Figure 4.7.2.
- (d) Only one quarter of data.
- (e) All locations are shown on Figure 4.7.3.
- (f) Moved to Shoreline grouping due to vandalism.
- (g) Only two quarters of data.

References

40 CFR 141. U.S. Environmental Protection Agency. "National Primary Drinking Water Regulations; Radionuclides; Proposed Rule." *Code of Federal Regulations*.

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