

# **Appendix A**

## **Additional Monitoring Results for 1996**

This appendix contains additional information on 1996 monitoring results, supplementing the data summarized in the main body of the report. More detailed information is available in Bisping (1997).

### **References**

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

Bisping, L. E. 1997. *Hanford Site Environmental Data for Calendar Year 1996*. PNNL-11473, Pacific Northwest National Laboratory, Richland, Washington.

U.S. Environmental Protection Agency (EPA). 1976. *National Interim Primary Drinking Water Regulations*. EPA-570/9-76-003, Office of Water Supply, Washington, D.C.

Washington Administrative Code (WAC) 246-290, *Group A Public Water Systems*.

Washington Administrative Code (WAC) 173-201A, *Water Quality Standards for Surface Waters of the State of Washington*.

**Table A.1.** Radionuclide Concentrations in Columbia River Water at Priest Rapids Dam, 1996 Compared to Values from the Previous 5 Years

Radionuclide <sup>(a)</sup>	1996			1991-1995			Ambient Surface-Water Quality Standard, pCi/L	
	No. of Samples	Concentration, <sup>(b)</sup> pCi/L ( $10^6 \mu\text{Ci/L}$ )		No. of Samples	Concentration, <sup>(b)</sup> pCi/L			
		Maximum	Average		Maximum	Average		
<b>Composite System</b>								
Alpha	13	1.1 ± 0.76	0.38 ± 0.21	59	1.3 ± 0.92	0.44 ± 0.099	15 <sup>(c,d)</sup>	
$\beta^-$ Be	13	1.2 ± 24	-0.72 ± 5.1	59	1.9 ± 15	-1.7 ± 7.3	6,000 <sup>(e)</sup>	
Beta	13	3.0 ± 1.7	0.99 ± 0.47	59	4.9 ± 2.4	1.1 ± 0.36	50 <sup>(c,d)</sup>	
$^{60}\text{Co}$	13	1.5 ± 0.9	0.17 ± 0.61	59	1.6 ± 0.99	-0.032 ± 0.21	100 <sup>(e)</sup>	
$^{134}\text{Cs}$	13	0.61 ± 1.1	-0.23 ± 0.32	59	1.4 ± 1.1	0.055 ± 0.16	20,000 <sup>(e)</sup>	
$^{137}\text{Cs}$	13	1.2 ± 1.7	0.12 ± 0.31	59	1.2 ± 1.2	0.093 ± 0.13	200 <sup>(e)</sup>	
$^{154}\text{Eu}$	13	5.2 ± 2.9	0.93 ± 1.2	59	4.4 ± 2.7	0.20 ± 0.49	200 <sup>(e)</sup>	
$^{155}\text{Eu}$	13	3.5 ± 4.1	0.78 ± 0.87	58	3.5 ± 5.1	-0.26 ± 0.32	600 <sup>(e)</sup>	
$^{40}\text{K}$	13	140 ± 43	45 ± 23	59	280 ± 54	40 ± 10	- <sup>(f)</sup>	
$^{106}\text{Ru}$	5	2.7 ± 11	-5.9 ± 8.4	50	13 ± 12	-1.5 ± 1.9	30 <sup>(e)</sup>	
$^{125}\text{Sb}$	5	0.25 ± 2.5	-1.0 ± 1.2	50	3.2 ± 2.2	-0.11 ± 0.47	300 <sup>(e)</sup>	
$^{90}\text{Sr}$	13	0.11 ± 0.37	0.079 ± 0.0075	59	0.18 ± 0.085	0.088 ± 0.0070	8 <sup>(c,d)</sup>	
$^{99}\text{Tc}$	13	0.29 ± 0.54	0.0077 ± 0.008	59	1.2 ± 2.8	-0.017 ± 0.27	900 <sup>(e)</sup>	
Tritium	13	37 ± 8.9	31 ± 1.6	59	110 ± 16	41 ± 2.9	20,000 <sup>(e)</sup>	
$^{234}\text{U}$	13	0.27 ± 0.057	0.24 ± 0.018	59	0.44 ± 0.13	0.23 ± 0.014	--	
$^{235}\text{U}$	13	0.023 ± 0.015	0.0088 ± 0.0031	59	0.032 ± 0.039	0.0096 ± 0.0021	--	
$^{238}\text{U}$	13	0.22 ± 0.05	0.18 ± 0.018	59	0.35 ± 0.11	0.19 ± 0.011	--	
U-Total	13	0.51 ± 0.076	0.42 ± 0.033	59	0.83 ± 0.17	0.43 ± 0.025	--	
$^{129}\text{I}$ <sup>(g)</sup>	4	0.000020 ± 0.0000022	0.000013 ± 0.0000058	16	0.000013 ± 0.000013	0.000019 ± 0.000016	1 <sup>(e)</sup>	
<b>Continuous System</b>								
$^{29,240}\text{Pu}$	P	4	0.000073 ± 0.000016	0.00003 ± 0.000029	19	0.000097 ± 0.000040	0.000025 ± 0.000011	
	D	4	0.000037 ± 0.000049	0.000012 ± 0.000021	19	0.00063 ± 0.00021	0.00066 ± 0.00069	

(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, "Surface Water and Sediment Surveillance").

(b) Maximum values are ± total propagated analytical uncertainty (2-sigma). Averages are ±2 standard error of the calculated mean.

(c) WAC 246-290.

(d) 40 CFR 141.

(e) WAC 173-201A-050 and EPA (1976).

(f) Dashes indicate no concentration guides are available.

(g) From 1991 through 1995, iodine-129 concentrations were obtained from the dissolved fraction of the continuous system.

**Table A.2.** Radionuclide Concentrations in Columbia River Water at the Richland Pumphouse, 1996 Compared to Values from the Previous 5 Years

Radionuclide <sup>(a)</sup>	1996			1991-1995			Ambient Surface-Water Quality Standard, <sup>(c)</sup> pCi/L	
	No. of Samples	Concentration, <sup>(b)</sup> pCi/L ( $10^{-6}$ $\mu$ Ci/mL)		No. of Samples	Concentration, <sup>(b)</sup> pCi/L			
		Maximum	Average		Maximum	Average		
<b>Composite System</b>								
Alpha	13	1.7 ± 0.93	0.43 ± 0.24	59	3.4 ± 1.5	0.66 ± 0.58	15 <sup>(d)</sup>	
$\gamma$ Be	13	20 ± 12	5.9 ± 3.6	59	16 ± 14	-2.7 ± 19	6,000 <sup>(e)</sup>	
Beta	13	2.8 ± 1.7	1.1 ± 0.49	59	9.2 ± 3.0	0.95 ± 1.5	50 <sup>(d)</sup>	
$^{60}$ Co	13	0.73 ± 0.65	-0.0087 ± 0.30	59	2.0 ± 1.1	0.11 ± 0.80	100 <sup>(e)</sup>	
$^{134}$ Cs	13	1.1 ± 0.89	0.0049 ± 0.35	59	1.2 ± 0.89	-0.19 ± 0.70	20,000 <sup>(e)</sup>	
$^{137}$ Cs	13	1.3 ± 1.3	0.48 ± 0.39	59	1.6 ± 1.5	0.098 ± 0.60	200 <sup>(e)</sup>	
$^{154}$ Eu	13	1.0 ± 3.2	-1.1 ± 0.82	59	4.3 ± 2.6	0.31 ± 1.6	200 <sup>(e)</sup>	
$^{155}$ Eu	13	1.5 ± 2.8	0.43 ± 0.61	58	3.5 ± 2.8	-0.059 ± 1.3	600 <sup>(e)</sup>	
$^{40}$ K	13	100 ± 28	53 ± 17	59	77 ± 27	37 ± 19	— <sup>(f)</sup>	
$^{106}$ Ru	5	4.8 ± 6.5	1.3 ± 4.3	50	18 ± 12	0.39 ± 6.4	30 <sup>(e)</sup>	
$^{123}$ Sb	5	0.86 ± 2.5	0.20 ± 0.86	50	3.9 ± 2.5	-0.08 ± 1.6	300 <sup>(e)</sup>	
$^{90}$ Sr	13	0.31 ± 0.081	0.097 ± 0.036	58	0.18 ± 0.073	0.089 ± 0.026	8 <sup>(g,h)</sup>	
$^{99}$ Tc	13	0.20 ± 0.53	0.0053 ± 0.087	59	6.5 ± 2.7	0.32 ± 0.96	900 <sup>(e)</sup>	
Tritium	13	140 ± 16	68 ± 16	59	210 ± 23	96 ± 32	20,000 <sup>(d)</sup>	
$^{234}$ U	13	0.39 ± 0.072	0.25 ± 0.028	59	0.50 ± 0.13	0.27 ± 0.077	—	
$^{235}$ U	13	0.015 ± 0.013	0.0075 ± 0.0026	59	0.048 ± 0.022	0.010 ± 0.0096	—	
$^{238}$ U	13	0.27 ± 0.056	0.21 ± 0.016	59	0.53 ± 0.14	0.21 ± 0.066	—	
U-Total	13	0.66 ± 0.092	0.47 ± 0.041	59	1.1 ± 0.19	0.49 ± 0.14	—	
$^{129}$ I <sup>(g)</sup>	4	0.00016 ± 0.000078	0.00011 ± 0.000059	14	0.00017 ± 0.000020	0.00011 ± 0.000021	1 <sup>(e)</sup>	
<b>Continuous System</b>								
$^{239,240}$ Pu	P	4	0.000041 ± 0.0000083	0.000027 ± 0.000012	17	0.000056 ± 0.000026	0.000017 ± 0.000067	
	D	4	0.000081 ± 0.000077	0.000031 ± 0.000035	17	0.000062 ± 0.000020	0.000082 ± 0.000071	

(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, "Surface Water and Sediment Surveillance").

(b) Maximum values are ± total propagated analytical uncertainty ( $\sigma$ -sigma). Averages are ±2 standard error of the calculated mean.

(c) WAC 246-290.

(d) 40 CFR 141.

(e) WAC 173-201A-050 and EPA (1976).

(f) Dashes indicate no concentration guides are available.

(g) From 1991 through 1995, iodine-129 concentrations were obtained from the dissolved fraction of the continuous system.

**Table A.3.** Radionuclide Concentrations Measured in Columbia River Water Along Transects of the Hanford Reach, 1996

Transect/Radionuclide	No. of Samples	Concentration, <sup>(a)</sup> pCi/L		
		Maximum	Minimum	Mean
<b>Vernita Bridge</b>				
Tritium	16	33 ± 8.6	25 ± 7.8	29 ± 1.3
<sup>90</sup> Sr	16	0.13 ± 0.055	0.044 ± 0.03	0.083 ± 0.011
U-Total	16	0.52 ± 0.079	0.35 ± 0.063	0.42 ± 0.024
<b>100-N Area</b>				
Tritium	11	45 ± 9.5	20 ± 130	35 ± 4.4
<sup>90</sup> Sr	10	0.18 ± 0.054	0.071 ± 0.034	0.11 ± 0.022
U-Total	11	0.48 ± 0.077	0.31 ± 0.058	0.39 ± 0.031
<b>100-F Area</b>				
Tritium	10	38 ± 8.9	31 ± 8.3	35 ± 1.3
<sup>90</sup> Sr	10	0.11 ± 0.042	0.058 ± 0.033	0.089 ± 0.01
U-Total	10	0.45 ± 0.08	0.35 ± 0.06	0.41 ± 0.02
<b>Old Hanford Townsite</b>				
Tritium	10	9,000 ± 770	32 ± 8.4	960 ± 1,800
<sup>90</sup> Sr	10	0.12 ± 0.052	0.081 ± 0.038	0.1 ± 0.0082
U-Total	10	0.61 ± 0.087	0.34 ± 0.059	0.4 ± 0.049
<b>300 Area</b>				
Tritium	10	150 ± 18	29 ± 8.3	53 ± 25
<sup>90</sup> Sr	10	0.11 ± 0.044	0.063 ± 0.04	0.085 ± 0.011
U-Total	10	1.1 ± 0.12	0.39 ± 0.068	0.6 ± 0.14
<b>Richland Pumphouse</b>				
Tritium	42	120 ± 15	27 ± 8.4	40 ± 6.4
<sup>90</sup> Sr	41	0.21 ± 0.066	0.045 ± 0.059	0.10 ± 0.0096
U-Total	42	0.63 ± 0.089	0.33 ± 0.06	0.44 ± 0.019

(a) Maximum and minimum values are ± total propagated analytical uncertainty (2-sigma). Mean values are ±2 standard error of the mean.

**Table A.4.** Select Provisional U.S. Geological Survey Columbia River Water Quality Data, 1996<sup>(a)</sup>

Analysis	Units	Vernita Bridge (upstream)				Richland Pumphouse (downstream)				Washington Ambient Surface-Water Quality Standard <sup>(b)</sup>
		No. of Samples	Maximum	Median	Minimum	No. of Samples	Maximum	Median	Minimum	
Temperature	°C	6	19.0	10.8	4.5	5	18.5	13.0	3.5	20 (maximum)
Dissolved oxygen	mg/L	6	13.4	12.9	11.0	5	13.2	12.5	9.5	8 (minimum)
Turbidity	NTU <sup>(c)</sup>	6	1.4	0.6	0.4	5	1.6	0.6	0.4	5 + background
pH	pH units	6	8.1	8.0	7.7	5	8.1	8.0	8.0	6.5 - 8.5
Fecal coliform	#/100 mL	0	NR <sup>(d)</sup>	NR	NR	0	NR	NR	NR	100
Suspended solids, 105°C	mg/L	6	5	3	2	5	6	4	1	— <sup>(e)</sup>
Dissolved solids, 180°C	mg/L	6	100	85	73	5	96	85	63	--
Specific conductance	µS/cm <sup>(f)</sup>	6	141	135	131	5	141	138	130	--
Total hardness, as CaCO <sub>3</sub>	mg/L	6	66	62	56	5	67	60	57	--
Phosphorus, total	mg/L	6	<0.01	<0.01	<0.01	5	0.02	0.01	<0.01	--
Chromium, dissolved	µg/L	0	NR	NR	NR	5	11	<1	<1	--
Dissolved organic carbon	mg/L	6	2.2	1.6	1.3	5	2.2	1.5	1.2	--
Iron, dissolved	µg/L	6	15	6	<3	5	46	12	6	--
Ammonia, dissolved, as N	mg/L	6	0.03	0.02	<0.002	5	0.03	<0.015	<0.015	--
Nitrogen, total Kjeldahl, as N	mg/L	0	NR	NR	NR	0	NR	NR	NR	--
Nitrite + Nitrate, dissolved, as N	mg/L	6	0.14	0.11	0.09	5	0.13	0.12	0.09	--

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

(b) From WAC I73-201A.

(c) NTU = nephelometric turbidity units.

(d) NR = not reported.

(e) Dashes indicate no standard available.

(f) µ Siemens/cm.

**Table A.5.** Radionuclide Concentrations in Columbia River and Riverbank Spring Sediment, 1996 Compared to Values from the Previous 5 Years

Location	Radionuclide	1996			1991-1995 <sup>(a)</sup>		
		Number of Samples	Concentration, pCi/g		Number of Samples	Concentration, pCi/g	
			Maximum <sup>(b)</sup>	Median <sup>(c)</sup>		Maximum <sup>(b)</sup>	Median
<b>River Sediment</b>							
100-F Slough	<sup>60</sup> Co	1	0.033 ± 0.011		6	0.032 ± 0.015	0.026
	<sup>137</sup> Cs	1	0.47 ± 0.053		6	0.76 ± 0.082	0.29
	<sup>158</sup> Eu	1	0.033 ± 0.026		6	0.064 ± 0.048	0.038
	<sup>239+240</sup> Pu	1	0.0024 ± 0.00072		6	0.0024 ± 0.00082	0.0013
	<sup>90</sup> Sr	1	0.0062 ± 0.0047		6	0.013 ± 0.0052	0.0033
	<sup>235</sup> U	1	0 ± 0.11		6	0.056 ± 0.024	0.022
	<sup>238</sup> U	1	1.4 ± 0.41		6	1.4 ± 0.17	0.86
Hanford Slough	<sup>60</sup> Co	1	0.27 ± 0.046		6	0.32 ± 0.046	0.083
	<sup>137</sup> Cs	1	0.59 ± 0.068		6	0.57 ± 0.067	0.37
	<sup>158</sup> Eu	1	0.083 ± 0.045		6	0.16 ± 0.077	0.074
	<sup>239+240</sup> Pu	1	0.0076 ± 0.0014		6	0.0073 ± 0.0023	0.0028
	<sup>90</sup> Sr	1	0.016 ± 0.009		6	0.017 ± 0.0052	0.0061
	<sup>235</sup> U	1	0.16 ± 0.15		6	0.24 ± 0.16	0.085
	<sup>238</sup> U	1	1.7 ± 0.66		6	2.4 ± 0.89	0.8
McNary Dam	<sup>60</sup> Co	4	0.069 ± 0.015	0.048	28	0.37 ± 0.061	0.1
	<sup>137</sup> Cs	4	0.54 ± 0.061	0.45	28	1.2 ± 0.14	0.53
	<sup>158</sup> Eu	4	0.09 ± 0.043	0.064	28	0.15 ± 0.085	0.073
	<sup>239+240</sup> Pu	4	0.0097 ± 0.0025	0.008	28	0.014 ± 0.0018	0.009
	<sup>90</sup> Sr	4	0.048 ± 0.011	0.026	28	0.061 ± 0.014	0.027
	<sup>235</sup> U	4	0.12 ± 0.16	0.022	28	0.2 ± 0.16	0.055
	<sup>238</sup> U	4	2.3 ± 0.81	1.6	28	2.3 ± 0.71	1.2
Priest Rapids Dam	<sup>60</sup> Co	4	0.0022 ± 0.014	-0.0034	24	0.038 ± 0.049	0.0029
	<sup>137</sup> Cs	4	0.67 ± 0.077	0.35	24	1 ± 0.15	0.44
	<sup>158</sup> Eu	4	0.063 ± 0.039	0.047	24	0.11 ± 0.084	0.049
	<sup>239+240</sup> Pu	4	0.014 ± 0.0036	0.0074	24	0.018 ± 0.0032	0.0084
	<sup>90</sup> Sr	4	0.019 ± 0.0058	0.013	24	0.025 ± 0.0068	0.014
	<sup>235</sup> U	4	0.17 ± 0.16	0.038	24	0.33 ± 0.17	0.054
	<sup>238</sup> U	4	1.5 ± 0.56	0.98	24	2.2 ± 0.71	0.89

**Table A.5.** (contd)

Location	Radionuclide	1996			1991-1995 <sup>(a)</sup>		
		Number of Samples	Concentration, pCi/g		Number of Samples	Concentration, pCi/g	
			Maximum <sup>(b)</sup>	Median <sup>(c)</sup>		Maximum <sup>(b)</sup>	Median
Richland	<sup>60</sup> Co	1	0.039 ± 0.019		5	0.075 ± 0.024	0.065
	<sup>137</sup> Cs	1	0.24 ± 0.033		5	0.41 ± 0.053	0.34
	<sup>155</sup> Eu	1	0.03 ± 0.036		5	0.077 ± 0.045	0.059
	<sup>239,240</sup> Pu	1	0.002 ± 0.00068		5	0.003 ± 0.00071	0.0023
	<sup>90</sup> Sr	1	0.005 ± 0.0035		5	0.003 ± 0.003	0.0023
	<sup>235</sup> U	1	0.068 ± 0.13		5	0.14 ± 0.08	0.076
	<sup>238</sup> U	1	2.1 ± 0.54		5	1.6 ± 0.19	1.2
White Bluffs Slough	<sup>60</sup> Co	1	0.2 ± 0.031		6	0.11 ± 0.025	0.081
	<sup>137</sup> Cs	1	0.46 ± 0.053		6	0.97 ± 0.11	0.82
	<sup>155</sup> Eu	1	0.065 ± 0.034		6	0.56 ± 0.026	0.049
	<sup>239,240</sup> Pu	1	0.0049 ± 0.00097		6	0.0073 ± 0.0017	0.0041
	<sup>90</sup> Sr	1	0.01 ± 0.0057		6	0.017 ± 0.0055	0.0062
	<sup>235</sup> U	1	0.14 ± 0.14		6	0.19 ± 0.044	0.036
	<sup>238</sup> U	1	1.9 ± 0.52		6	2.3 ± 0.26	1.2
Riverbank Spring Sediment	<sup>60</sup> Co	1	0.01 ± 0.012		1	0.029 ± 0.0097	
	<sup>137</sup> Cs	1	0.024 ± 0.013		1	0.095 ± 0.015	
	<sup>155</sup> Eu	1	0.074 ± 0.036		1	0.065 ± 0.021	
	<sup>90</sup> Sr	1	0.0027 ± 0.0033		1	0.0041 ± 0.005	
	<sup>235</sup> U	1	0.1 ± 0.08		1	-0.017 ± 0.14	
	<sup>238</sup> U	1	1.3 ± 0.38		1	1.1 ± 0.5	
	<sup>100-B</sup> Spring						
100-F Spring	<sup>60</sup> Co	1	0.04 ± 0.021		1	0.0044 ± 0.015	
	<sup>137</sup> Cs	1	0.32 ± 0.04		1	0.19 ± 0.035	
	<sup>155</sup> Eu	1	0.055 ± 0.031		1	0.037 ± 0.035	
	<sup>90</sup> Sr	1	0.0097 ± 0.01		1	0.0043 ± 0.0044	
	<sup>235</sup> U	1	0.17 ± 0.076		1	0.17 ± 0.13	
	<sup>238</sup> U	1	1.4 ± 0.54		1	1.2 ± 1	

**Table A.5.** (contd)

Location	Radionuclide	1996			1993-1995 <sup>(a)</sup>		
		Number of Samples	Concentration, pCi/g		Number of Samples	Concentration, pCi/g	
			Maximum <sup>(b)</sup>	Median <sup>(c)</sup>		Maximum <sup>(b)</sup>	Median
300 Area Spring	<sup>60</sup> Co	1	0.0048 ± 0.012		3	0.016 ± 0.0076	
	<sup>137</sup> Cs	1	0.15 ± 0.026		3	0.074 ± 0.017	0.07
	<sup>152</sup> Eu	1	0.045 ± 0.032		3	0.13 ± 0.14	0.064
	<sup>90</sup> Sr	1	0.0073 ± 0.011		3	0.012 ± 0.006	0.0076
	<sup>235</sup> U	1	0.073 ± 0.071		3	0.41 ± 0.17	0.12
	<sup>238</sup> U	1	1.2 ± 0.48		3	5.2 ± 1.1	4.2
	<sup>60</sup> Co	1	0.059 ± 0.016		3	0.09 ± 0.021	
	<sup>137</sup> Cs	1	0.17 ± 0.024		3	0.29 ± 0.032	0.25
Hanford Spring	<sup>152</sup> Eu	1	0.068 ± 0.034		3	0.062 ± 0.02	0.061
	<sup>90</sup> Sr	1	0.0079 ± 0.005		3	0.0086 ± 0.011	0.0068
	<sup>235</sup> U	1	0.25 ± 0.077		3	0.23 ± 0.14	0.023
	<sup>238</sup> U	1	1.3 ± 0.36		3	1.9 ± 0.54	0.97

(a) 1996 river sediment values compared to values from 1991 through 1995, 1996 riverbank spring sediment values compared to values from 1993 through 1995.

(b) Values are ± total propagated analytical uncertainty (2-sigma).

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

**Table A.6.** Median Metal Concentrations in Columbia River Sediment, 1996

Metal	Median Concentration, mg/kg (dry weight)			
	Priest Rapids Dam	Hanford Reach	McNary Dam	Riverbank Springs
Aluminum	6,300	5,400	8,100	5,800
Antimony	2.4	4.1	4	2.1
Barium	48	44	60	52
Beryllium	0.21	0.20	0.29	0.21
Cadmium	2.2	1.6	0.93	1.1
Calcium	2,800	3,000	2,900	3,200
Chromium	13	12	11	18
Cobalt	4.3	4.0	4.4	4.6
Copper	11	14	12	8.8
Iron	12,000	11,000	13,000	14,000
Magnesium	3,200	2,800	2,800	3,000
Manganese	160	120	270	180
Nickel	13	11	11	9.4
Potassium	820	710	1,000	760
Silver	<0.52	<0.52	<0.52	<0.52
Sodium	260	260	300	220
Strontium	20	19	21	22
Tin	11	8.6	9.6	7.0
Vanadium	30	28	28	34
Zinc	200	240	100	84

**Table A.7.** Radionuclide Concentrations Measured in Riverbank Spring Water, 1996 Compared to Values from the Previous 5 Years

Location/Radionuclide	1996			1991-1995			Washington State Ambient Surface- Water Quality Standard, <sup>(b)</sup> pCi/L
	No. of Samples	Concentration, <sup>(a)</sup> pCi/L ( $10^{-6}$ $\mu$ Ci/L)	Maximum	No. of Samples	Concentration, <sup>(a)</sup> pCi/L	Median	
<b>100-B Spring</b>							
Alpha	1	1.2 ± 0.98	5	3.5 ± 1.8	1.8	1.5	
Beta	1	10 ± 2.4	5	38 ± 4.6	11	50	
<sup>90</sup> Sr	1	0.031 ± 0.045	5	0.072 ± 0.11	0.02	8	
<sup>99</sup> Tc	1	18 ± 2.3	5	25 ± 3.2	10	900 <sup>(c)</sup>	
Tritium	1	24,000 ± 1,800	5	23,000 ± 1,700	14,000	20,000	
<b>100-D Spring</b>							
Alpha	1	0.27 ± 0.48	6	2.9 ± 1.9	1.3	15	
Beta	1	4.3 ± 1.8	6	21 ± 3.3	9.4	50	
<sup>90</sup> Sr	1	1.8 ± 0.34	6	9.4 ± 1.8	4.4	8	
Tritium	1	1,000 ± 200	6	13,000 ± 1,000	6,500	20,000	
<b>100-F Spring</b>							
Alpha	1	41 ± 18	2	3.7 ± 1.7	3.2	15	
Beta	1	65 ± 11	2	2.0 ± 1.6	1.9	50	
<sup>90</sup> Sr	1	0.094 ± 0.057	2	0.099 ± 0.091	0.034	8	
Tritium	1	1,800 ± 240	2	1,600 ± 230	1,100	20,000	
U-T Total	1	9.2 ± 0.79	2	2.6 ± 0.35	1.7	-- <sup>(d)</sup>	
<b>100-N Spring<sup>(e)</sup></b>							
Alpha	1	0.46 ± 0.63	6	8.9 ± 14	1.6	15	
Beta	1	4.5 ± 1.8	6	24,000 ± 1,700	6.6	50	
<sup>90</sup> Sr	1	0.053 ± 0.048	6	11,000 ± 2,000	0.10	8	
Tritium	1	17,000 ± 1,300	6	31,000 ± 2,400	20,000	20,000	
<b>300 Area Spring</b>							
Alpha	1	21 ± 4.6	7	110 ± 21	55	15	
Beta	1	9.6 ± 2.4	7	29 ± 4.7	16	50	
<sup>129</sup> I	1	0.0022 ± 0.00035	3	0.0049 ± 0.00063	0.0044	1	
<sup>99</sup> Tc	1	1.2 ± 0.61	6	14 ± 1.9	5.7	900 <sup>(c)</sup>	
Tritium	1	3,400 ± 360	7	12,000 ± 940	9,900	20,000	
U-T Total	1	34 ± 2.5	7	65 ± 6.2	28	--	

Table A.7. (contd)

Location/Radionuclide	1996			1991-1995			Washington State Ambient Surface- Water Quality Standard, <sup>(b)</sup> pCi/L
	No. of Samples	Concentration, <sup>(a)</sup> pCi/L ( $10^6 \mu\text{Ci/L}$ )	Maximum	No. of Samples	Concentration, <sup>(a)</sup> pCi/L	Median	
<b>Hanford Spring</b>							
Alpha	1	1.2 ± 0.86	7	7	4.9 ± 2.2	3.0	15
Beta	1	18 ± 3.2	7	7	95 ± 140	26	50
$^{129}\text{I}$	1	0.086 ± 0.01	4	4	0.22 ± 0.014	0.14	1
$^{99}\text{Tc}$	1	38 ± 4.5	7	7	130 ± 16	110	900 <sup>(c)</sup>
Tritium	1	41,000 ± 3,100	7	7	170,000 ± 13,000	140,000	20,000
U-total	1	1.6 ± 0.2	5	5	2.6 ± 0.29	1.2	--

(a) Maximum values are ± total propagated analytical uncertainty (2-sigma).

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

(c) WAC 173-201A-050 and EPA (1976).

(d) Dashes indicate no concentration guides available.

(e) 1991 sample is from well 199-N-8T, 1992 sample is from well 199-N-46, 1993-1996 samples are from shoreline spring.