



4.1 Air Surveillance

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Atmospheric releases of radioactive material from the Hanford Site to the surrounding region are a potential source of human exposure. Radioactive constituents in air are monitored at a network of air sampling locations on and around the Hanford Site. Detailed descriptions of all routine radiological sampling and analytical techniques are provided in the environmental monitoring plan (DOE/RL-91-50). Comparing measured radionuclide concentrations from locations on and

around the Hanford Site to upwind sites assumed to be uninfluenced by Hanford Site operations provides an evaluation of the impact of radionuclide air emissions from the Hanford Site. A complete listing of all radiological analytical results summarized in this section is reported separately (PNNL-13910, APP. 1). Non-radiological, particulate monitoring data is also summarized in Section 4.1.3.

4.1.1 Collection of Air Samples and Analytes Tested

Airborne radionuclide samples were collected at 45 continuously operating samplers: 24 on the Hanford Site, 11 near the site perimeter, 8 in nearby communities, and 2 in distant communities (Figure 4.1.1 and Table 4.1.1). Nine of the stations were community-operated environmental surveillance stations (discussed in Section 8.4) that were managed and operated by local school teachers (under contract with Pacific Northwest National Laboratory) as part of an ongoing DOE-sponsored program to promote public awareness of Hanford Site environmental monitoring programs. Air samplers on the Hanford Site were located primarily around major operational areas to maximize the ability to detect radiological contaminants resulting from site operations. Perimeter samplers were located around the site, with emphasis on the prevailing downwind directions to the south and east of the site (discussed in Section 8.1). Samplers located in Basin City, Benton City, Kennewick, Mattawa, Othello, Pasco, and Richland provided data for the nearest population centers. Samplers in the distant communities of Toppenish and Yakima provided background data for communities essentially unaffected by Hanford Site operations.

Samples were collected according to a schedule established before the monitoring year (PNNL-13418). The air sampling locations and the analytes tested for at each location are given in Table 4.1.1. Airborne particles were sampled at each of these locations by continuously drawing air through a high efficiency glass-fiber filter. The samples were transported to an analytical

laboratory and stored for at least 72 hours. The storage period was necessary to allow for the decay of short-lived, naturally occurring radionuclides (e.g., radon gas decay products) that would otherwise obscure detection of longer-lived radionuclides potentially present from Hanford Site emissions. The filters were then analyzed for gross beta radioactivity, and most filters were also analyzed for gross alpha radioactivity.

Historically, for most radionuclides, the amount of radioactive material collected on the filter during a 2-week period has been too small for accurate analysis. In order to increase the sensitivity and accuracy of the analysis, biweekly samples were combined into quarterly composite samples. The quarterly composite samples were analyzed for specific gamma-emitting radionuclides (see Appendix F), strontium-90, and plutonium isotopes. Selected composite samples also were analyzed for uranium isotopes.

Samples were collected for iodine-129 analysis at four locations by drawing air through a chemically treated, low-background petroleum-based charcoal adsorbent cartridge. Samples were collected monthly and combined to form quarterly composite samples for each location.

Atmospheric water vapor was collected for tritium analysis at 21 locations by continuously drawing air through cartridges containing silica gel, which were exchanged every 4 weeks. The collection efficiency of

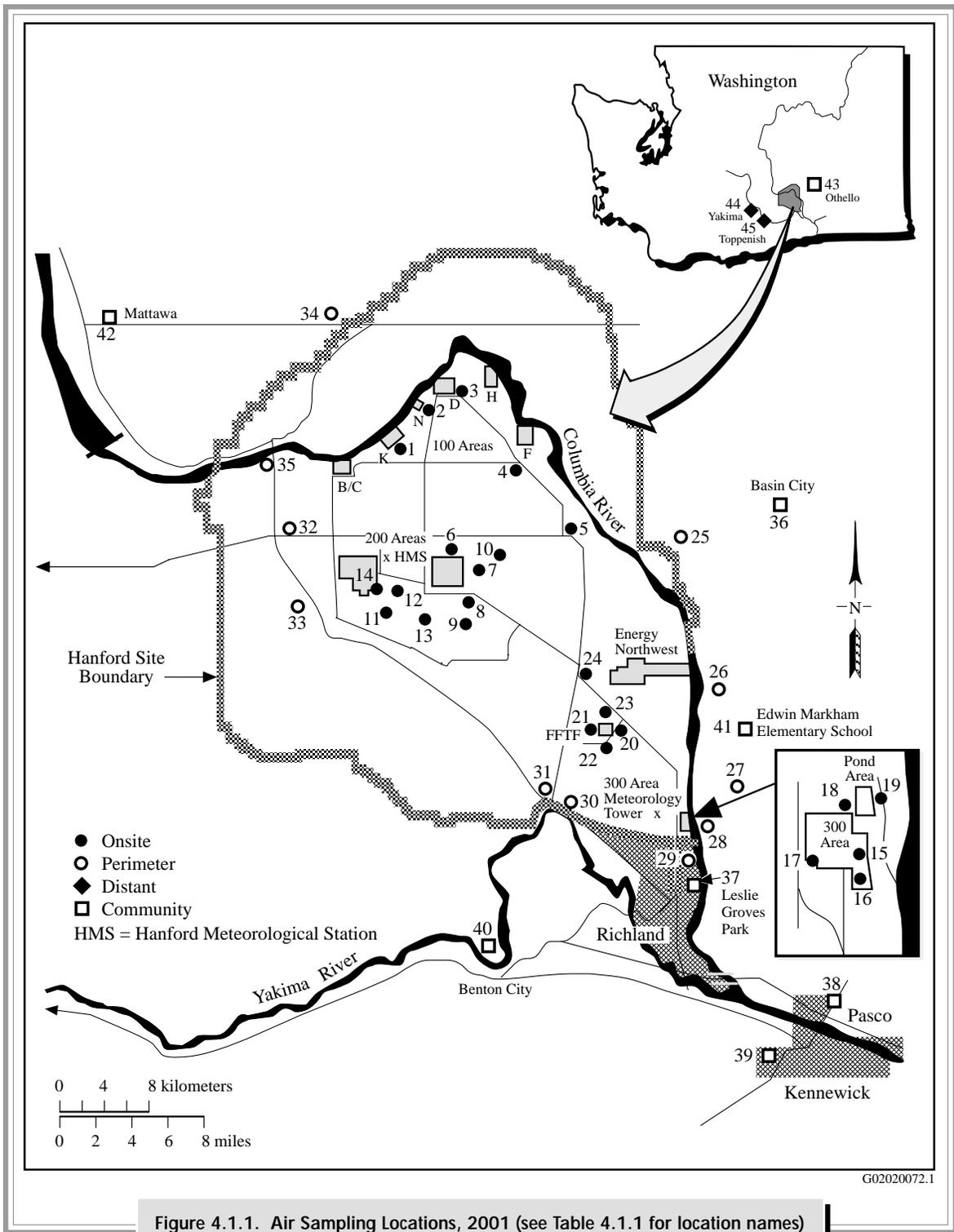


Figure 4.1.1. Air Sampling Locations, 2001 (see Table 4.1.1 for location names)

Table 4.1.1. Air Sampling Locations, Sample Composite Groups, and Analytes, 2001

Map^(a) Location	Sampling Location	Analytes^(b)	Composite Group	Analytes^(c)
Onsite				
1	100 K Area	Alpha, Beta, ³ H	100 Areas	Gamma, Sr, Pu
2	100 N-1325 Crib	Alpha, Beta, ³ H		
3	100 D Area	Alpha, Beta		
4	100 F Met Tower	Alpha, Beta	Hanford Townsite	Gamma, Sr, Pu
5	Hanford Townsite	Alpha, Beta		
6	N of 200 E	Beta	N of 200 E	Gamma
7	E of 200 E	Alpha, Beta	200 E Area	Gamma, Sr, Pu, U
8	200 ESE	Alpha, Beta, ³ H, ¹²⁹ I		
9	S of 200 E	Alpha, Beta		
10	B Pond	Alpha, Beta	B Pond	Gamma, Sr, Pu, U
11	Army Loop Camp	Alpha, Beta	200 W South East	Gamma, Sr, Pu, U
12	200 Tel. Exchange	Alpha, Beta, ³ H		
13	SW of B/C Crib	Alpha, Beta		
14	200 W SE	Alpha, Beta	200 West	Gamma, Sr, Pu, U
15	300 Water Intake	Alpha, Beta, ³ H	300 Area	Gamma, Sr, Pu, U
16	300 South Gate	Alpha, Beta, ³ H		
17	300 South West	Alpha, Beta, ³ H		
18	300 Trench	Alpha, Beta, ³ H	300 NE	Gamma, Sr, Pu, U
19	300 NE	Alpha, Beta, ³ H		
20	400 E	Alpha, Beta, ³ H	400 Area	Gamma, Sr, Pu
21	400 W	Alpha, Beta		
22	400 S	Alpha, Beta		
23	400 N	Alpha, Beta		
24	Wye Barricade	Alpha, Beta	Wye Barricade	Gamma, Sr, Pu, U
Perimeter				
25	Ringold Met Tower	Alpha, Beta, ³ H, ¹²⁹ I	Ringold Met Tower	Gamma, Sr, Pu
26	W End of Fir Road	Alpha, Beta	W End of Fir Road	Gamma, Sr, Pu, U
27	Dogwood Met Tower	Alpha, Beta, ³ H	Dogwood Met Tower	Gamma, Sr, Pu, U
28	Byers Landing	Alpha, Beta, ³ H, ¹²⁹ I	Byers Landing	Gamma, Sr, Pu, U
29	Battelle Complex	Beta	Battelle Complex	Gamma
30	Horn Rapids Substation	Alpha, Beta	Prosser Barricade	Gamma, Sr, Pu, U
31	Prosser Barricade	³ H		
32	Yakima Barricade	Alpha, Beta	Yakima Barricade	Gamma, Sr, Pu
33	Rattlesnake Springs	Alpha, Beta		
34	Wahluke Slope	Alpha, Beta, ³ H	Wahluke Slope	Gamma, Sr, Pu
35	S End Vernita Bridge	Alpha, Beta		

Table 4.1.1. (contd)

Map^(a) Location	Sampling Location	Analytes^(b)	Composite Group	Analytes^(c)
Nearby Communities				
36	Basin City School ^(d)	Alpha, Beta, ³ H	Basin City School	Gamma, Sr, Pu, U
37	Leslie Groves-RchInd ^(d)	Alpha, Beta, ³ H	Leslie Groves-RchInd	Gamma, Sr, Pu, U
38	Pasco ^(d)	Beta	Tri-Cities	Gamma, Sr, Pu
39	Kennewick ^(d)	Alpha, Beta		
40	Benton City ^(d)	Beta	Benton City	Gamma
41	Edwin Markham School ^(d)	Alpha, Beta, ³ H	Edwin Markham School	Gamma, Sr, Pu, U
42	Mattawa ^(d)	Beta	Mattawa	Gamma
43	Othello ^(d)	Beta	Othello	Gamma
Distant Communities				
44	Yakima	Alpha, Beta, ³ H, ¹²⁹ I	Yakima	Gamma, Sr, Pu, U
45	Toppenish ^(d)	Alpha, Beta, ³ H	Toppenish	Gamma, Sr, Pu, U

(a) See Figure 4.1.1.

(b) Alpha (gross) and beta (gross) samples are collected and analyzed every 2 weeks, ³H samples are collected and analyzed every 4 weeks, and ¹²⁹I samples are collected every 4 weeks, combined into a quarterly composite sample and analyzed for each location.

(c) Gamma spectroscopy, strontium-90, isotopic plutonium (²³⁸Pu, ^{239/240}Pu), and isotopic uranium (²³⁴U, ²³⁵U, ²³⁸U) analyses are performed on quarterly composite samples.

(d) A community-operated environmental surveillance station.

the silica gel adsorbent is discussed in Patton et al. (1997). The collected water was distilled from the silica gel and analyzed for its tritium content.

The samples collected at the community-operated environmental surveillance stations were submitted to the analytical laboratory and treated the same as all other submitted samples.

4.1.2 Radiological Results for Air Samples

Radiological air sampling results for onsite, site perimeter, nearby communities, and distant communities for gross alpha, gross beta, and specific radionuclides are summarized in Table 4.1.2.

A detectable value is defined in this section as a value reported above the minimum detectable level and above the total propagated analytical uncertainty. A nominal detection limit is defined as the average total propagated analytical uncertainty of the population of reported values.

For 2001, the average gross alpha concentrations in air on the Hanford Site were comparable to levels measured at distant stations (see Table 4.1.2), indicating that the onsite levels were predominantly a result of natural sources and worldwide radioactive fallout. The average

gross alpha concentrations for perimeter locations and nearby communities were higher than the onsite and distant averages. The differences between perimeter, distant, and onsite concentrations were not statistically significant. The average of the community samples collected in 2001 was significantly higher (two-sample means t-test, 95% confidence level) than onsite alpha concentrations in 2001, and community samples from 1996 through 2000. Gross alpha concentrations measured onsite and at distant locations were lower in 2001 than in recent years (see Table 4.1.2). Figure 4.1.2 compares all 2001 data for the community and distant locations. The reason the average gross alpha concentration for the community locations was higher than the average for the distant locations was a spike in early July. This spike is suspected to be the result of laboratory error or contamination. All of the elevated samples

Table 4.1.2. Airborne Radionuclide Concentrations in the Hanford Environs, 2001 Compared to Previous Years

Radionuclide	Location Group ^(a)	2001				1996-2000				Derived Concentration Guide ^(e)
		No. of Samples	No. of Detections ^(b)	Maximum ^(c)	Average ^(d)	No. of Samples	No. of Detections ^(b)	Maximum ^(c)	Average ^(d)	
				pCi/m ^{3(f)}	pCi/m ^{3(f)}			pCi/m ^{3(f)}	pCi/m ^{3(f)}	
Tritium	300 Area	77	77	20 ± 2.3	5.5 ± 7.6	291	197	25 ± 3.0	2.9 ± 6.9	100,000
	Onsite	63	39	13 ± 1.9	2.4 ± 4.0	316	158	7.9 ± 1.9	1.4 ± 2.5	
	Perimeter	78	56	36 ± 3.6	3.6 ± 9.3	318	119	24 ± 2.3	1.4 ± 4.1	
	Nearby communities	37	28	8.1 ± 1.2	2.7 ± 4.0	188	81	15 ± 1.3	1.8 ± 4.9	
	Distant communities	26	13	4.8 ± 1.1	1.6 ± 2.1	130	34	7.9 ± 1.1	1.0 ± 2.6	
Gross beta	Onsite	612	611	0.054 ± 0.0087	0.016 ± 0.017	2,721	2,714	0.084 ± 0.014	0.016 ± 0.018	No standard
	Perimeter	288	288	0.050 ± 0.0080	0.016 ± 0.017	1,125	1,124	0.098 ± 0.010	0.016 ± 0.019	
	Nearby communities	210	210	0.045 ± 0.0074	0.017 ± 0.018	1,047	1,046	0.059 ± 0.0060	0.016 ± 0.017	
	Distant communities	58	58	0.037 ± 0.0062	0.015 ± 0.016	282	281	0.059 ± 0.010	0.014 ± 0.016	
Gross alpha	Onsite	612	378	2,800 ± 1,100	480 ± 810	2,519	1,803	5,500 ± 1,300	640 ± 810	No standard
	Perimeter	288	187	5,100 ± 1,300	530 ± 1,200	1,034	784	2,600 ± 1,200	650 ± 1,200	
	Nearby communities	112	83	6,300 ± 1,700	720 ± 1,700	551	396	3,200 ± 1,100	660 ± 1,700	
	Distant communities	58	33	2,300 ± 820	440 ± 890	282	190	5,500 ± 1,900	590 ± 890	
	Onsite	40	5	230 ± 59	18 ± 120	108	36	340 ± 130	33 ± 110	
Perimeter	28	2	60 ± 59	5.3 ± 66	77	16	390 ± 79	21 ± 100		
Nearby communities	16	0	53 ± 66	3.0 ± 51	44	9	210 ± 190	29 ± 100		
Distant communities	8	0	14 ± 56	-29 ± 63	22	2	79 ± 37	11 ± 83		
Iodine-129	Onsite	4	4	18 ± 2.5	13 ± 8.4	20	20	50 ± 12	25 ± 18	70,000,000
	Perimeter	8	8	0.82 ± 0.085	0.45 ± 0.38	40	40	1.9 ± 0.20	0.78 ± 0.90	
	Distant communities	4	4	0.077 ± 0.016	0.052 ± 0.057	20	20	0.22 ± 0.015	0.059 ± 0.090	
Plutonium-238	Onsite	40	4	5.3 ± 1.7	0.017 ± 2.6	108	2	2.9 ± 5.8	-0.050 ± 1.0	30,000
	Perimeter	28	0	0.90 ± 1.9	-0.37 ± 0.78	77	1	1.9 ± 1.4	-0.080 ± 0.80	
	Nearby communities	16	0	1.1 ± 2.1	-0.22 ± 1.0	44	1	1.5 ± 1.8	-0.11 ± 1.1	
	Distant communities	8	0	0.15 ± 1.8	-0.53 ± 0.69	22	0	0.31 ± 1.8	-0.29 ± 0.67	
Plutonium-239/240	Onsite	40	16	36 ± 6.4	3.0 ± 13	108	42	12 ± 2.5	1.1 ± 4.1	20,000
	Perimeter	28	1	5.2 ± 2.5	0.41 ± 2.2	77	13	4.3 ± 2.0	0.48 ± 1.7	
	Nearby communities	16	1	1.4 ± 1.9	0.18 ± 1.1	44	7	1.7 ± 2.3	0.40 ± 1.0	
	Distant communities	8	0	1.6 ± 2.1	0.19 ± 1.6	22	2	3.2 ± 2.9	0.32 ± 1.9	
Uranium-234	Onsite	32	31	32 ± 23	18 ± 13	88	83	85 ± 21	22 ± 36	90,000
	Perimeter	16	16	64 ± 19	28 ± 31	44	44	135 ± 32	30 ± 46	
	Nearby communities	12	12	38 ± 13	23 ± 23	33	32	54 ± 17	26 ± 27	
	Distant communities	8	8	27 ± 11	13 ± 13	22	21	41 ± 15	18 ± 17	
Uranium-235	Onsite	32	1	1.9 ± 4.3	0.21 ± 2.1	88	8	3.7 ± 2.7	0.52 ± 2.3	100,000
	Perimeter	16	0	2.7 ± 2.8	0.48 ± 1.9	44	7	6.0 ± 6.0	0.89 ± 3.1	
	Nearby communities	12	0	6.1 ± 8.1	0.70 ± 4.9	33	5	6.2 ± 5.6	0.65 ± 3.2	
	Distant communities	8	0	0.67 ± 2.9	0.30 ± 0.40	22	0	7.0 ± 9.3	0.41 ± 4.2	



Table 4.1.2. (contd)

Radionuclide	Location Group ^(a)	2001				1996-2000				Derived Concentration Guide ^(e)
		No. of Samples	No. of Detections ^(b)	Maximum ^(c)	Average ^(d)	No. of Samples	No. of Detections ^(b)	Maximum ^(c)	Average ^(d)	
				aCi/m ^{3(g)}	aCi/m ^{3(g)}			aCi/m ^{3(g)}	aCi/m ^{3(g)}	
Uranium-238	Onsite	32	29	42 ± 17	16 ± 14	88	80	92 ± 27	20 ± 35	100,000
	Perimeter	16	16	50 ± 16	25 ± 26	44	42	136 ± 32	28 ± 45	
	Nearby communities	12	11	52 ± 16	23 ± 25	33	32	56 ± 18	23 ± 25	
	Distant communities	8	8	24 ± 10	14 ± 11	22	22	33 ± 15	17 ± 16	
Cobalt-60	Onsite	49	1	3,300 ± 750	190 ± 1,100	228	17	3,800 ± 2,500	74 ± 780	80,000,000
	Perimeter	33	0	910 ± 740	-32 ± 600	159	9	1,000 ± 530	8.0 ± 840	
	Nearby communities	29	0	680 ± 650	180 ± 600	120	4	1,800 ± 3,600	-5.3 ± 930	
	Distant communities	9	0	450 ± 120	20 ± 700	44	4	680 ± 440	125 ± 530	
Cesium-137	Onsite	49	1	480 ± 300	10 ± 470	228	11	710 ± 530	-3.2 ± 600	400,000,000
	Perimeter	33	0	650 ± 600	80 ± 380	159	6	1,200 ± 2,000	6.8 ± 640	
	Nearby communities	29	0	450 ± 490	75 ± 480	120	8	2,100 ± 3,100	47 ± 710	
	Distant communities	9	0	400 ± 510	100 ± 420	44	1	390 ± 290	9.1 ± 520	

(a) Location groups are identified in Table 4.1.1.

(b) Detection is defined as a value reported above the minimum detectable activity and above the total propagated analytical uncertainty.

(c) Maximum single sample result ± total analytical uncertainty. Negative concentration values are explained in Appendix A.

(d) Average of all samples ± 2 times the standard deviation.

(e) DOE derived concentration guide (see Appendix D, Table D.5).

(f) 1 pCi = 0.037 Bq.

(g) There are 1 million attocuries (aCi) in 1 picocurie (pCi).

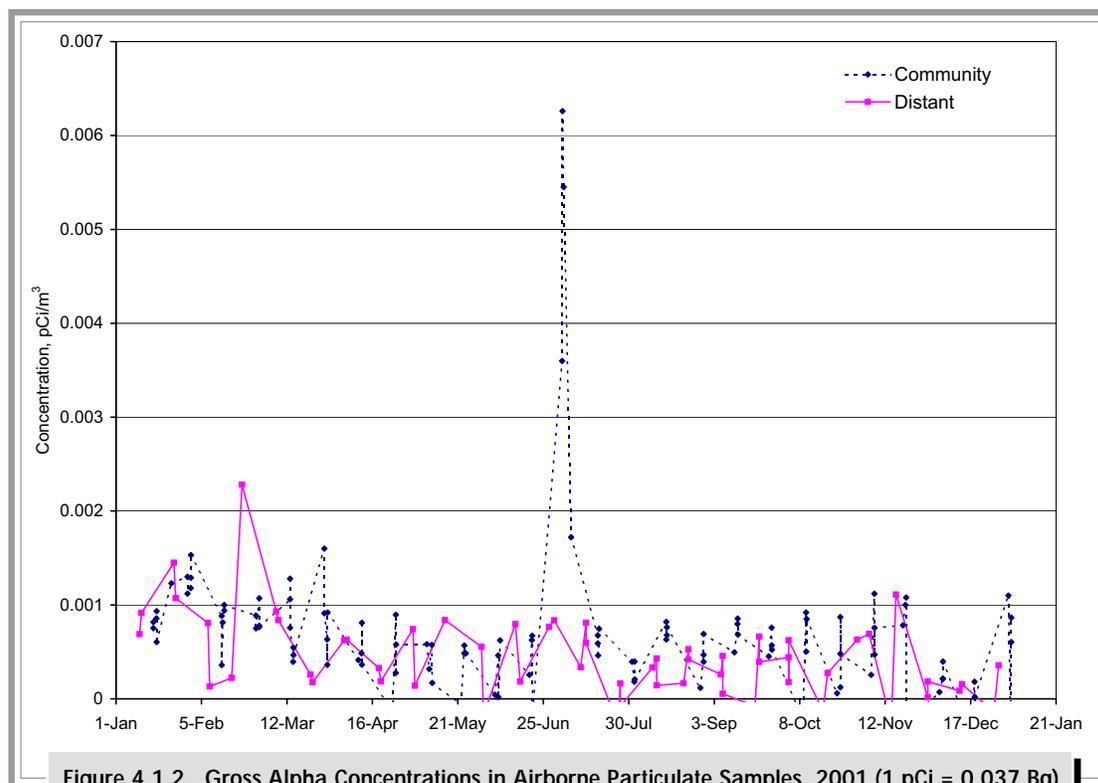


Figure 4.1.2. Gross Alpha Concentrations in Airborne Particulate Samples, 2001 (1 pCi = 0.037 Bq)

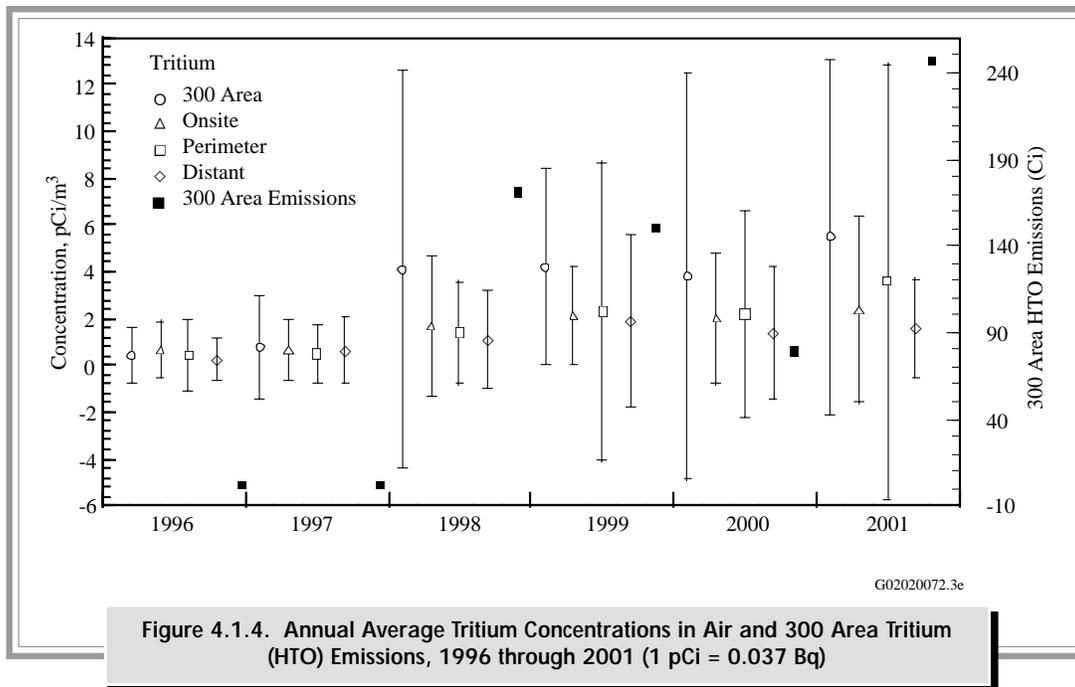
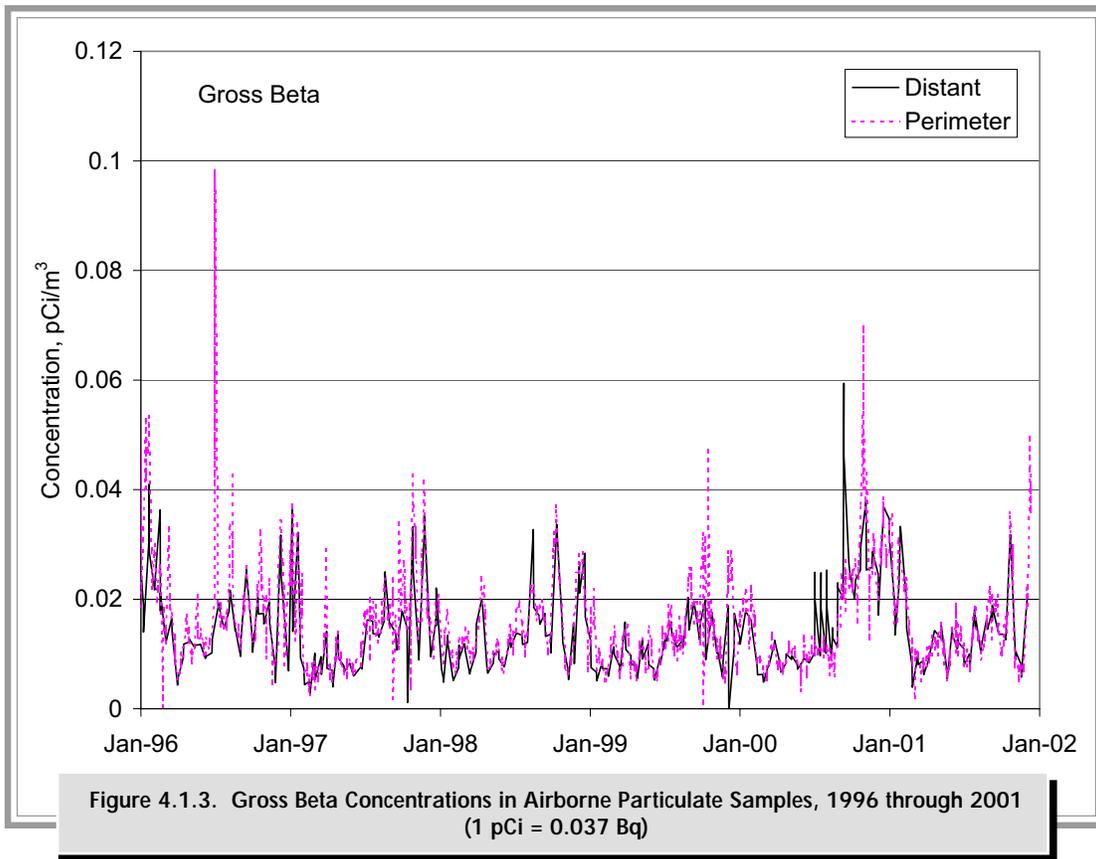
were analyzed in the same batch, and the locations of the elevated samples make it highly unlikely that the increased values are a result of actual environmental concentrations.

Gross beta concentrations in air for 2001 (Figure 4.1.3) peaked during the winter, repeating a pattern of natural annual radioactivity fluctuations (Eisenbud 1987). The average gross beta concentration was slightly higher at the site perimeter than the annual average concentration at the distant location; however, the difference was not statistically significant (two-tailed t-test, 5% significance level). The 2001 average values were similar to the average values reported for 1996 through 2000 (see Table 4.1.2).

Average tritium concentrations measured in 2001 were slightly higher than values reported for 1996 through 2000 (see Table 4.1.2 and Figure 4.1.4). For non-300 Area samples in 2001, ~67% were considered detected (the analytical method is capable of detecting concentrations below 3 pCi/m³ [0.11 Bq/m³]). All 300 Area sample results were above the minimum detectable concentration. Tritium releases in the 300 Area (associated with research and development activities; see Table 3.1.1) resulted in 300 Area concentrations that were elevated relative to other sampling locations. Figure 4.1.4 shows the 2001 average tritium concentrations for all distance classes between 1996 and

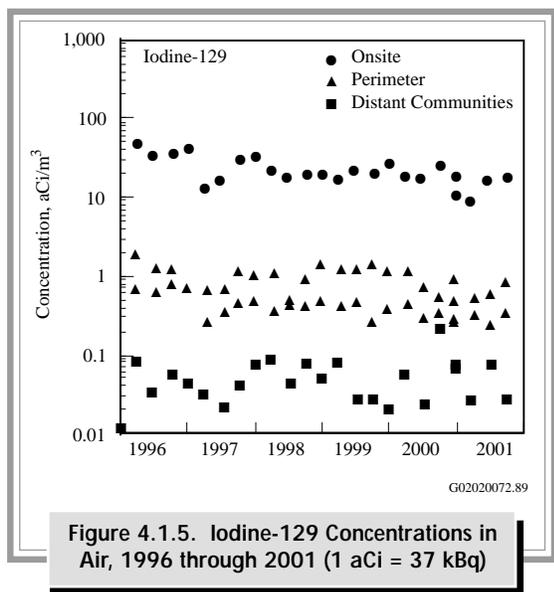
2001, and the tritiated water released from the 300 Area for each year. More tritium was released from the 300 Area in 2001 than in 2000, accounting for the increase in averages from 2000 to 2001. Despite the slight increase in tritium emissions in 2001, the highest measured concentration (36 pCi/m³ [1.3 Bq/m³]) detected at location 29 on Figure 4.1.1 on October 2, 2001 was only 0.036% of the DOE derived concentration guide (see Appendix D, Table D.5)

The annual average tritium concentration measured at the site perimeter (3.6 ± 9.3 pCi/m³ [0.13 ± 0.34 Bq/m³]) was significantly higher (two-tailed t-test, 5% significance level) than the annual average value at the distant locations (1.6 ± 2.1 pCi/m³ [0.059 ± 0.078 Bq/m³]). This difference is largely influenced by the proximity of locations 28 and 29 (see Figure 4.1.1) to the 300 Area (<3.2 kilometers [2 miles]). However, even with these two locations removed, the difference between perimeter and distant sampling locations is statistically significant. The significant difference between distant and perimeter locations indicate a detectable Hanford source of tritium. However, the annual average tritium concentration measured at the site perimeter in 2001 was less than 0.004% of the DOE derived concentration guide (100,000 pCi/m³ [3,704 Bq/m³]; DOE Order 5400.5). For further evaluation of the trends in tritium concentration on and around the Hanford Site, see PNNL-13909.



A total of 94 samples were analyzed for strontium-90 in 2001 (see Table 4.1.2). Only 7.6% (7 of 92) samples analyzed were above the detection limit. Comparison of the average reported concentration at different distance classes was impossible due to the low number of samples above the minimum detectable concentration. The highest measured strontium-90 concentration (230 ± 59 aCi/m³ [8.5 ± 2.2 (Bq/m³)] was in the 100 Areas composite sample in the third quarter of 2001. This maximum value was 0.0026% of the DOE derived concentration guide (9 million aCi/m³ [0.33 Bq/m³]).

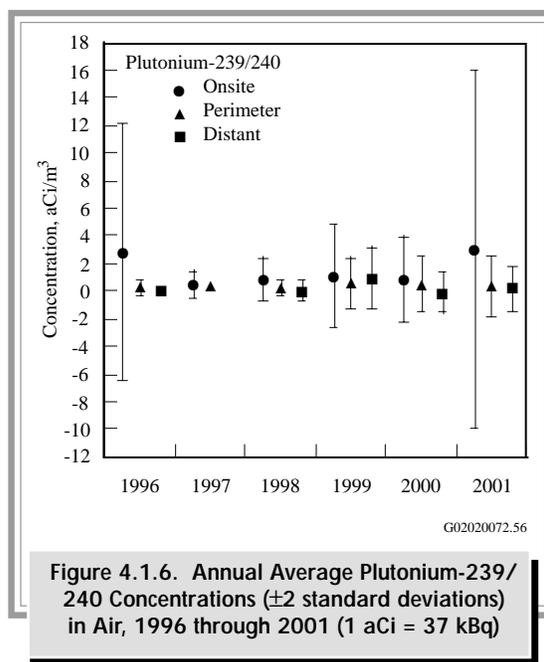
Iodine-129 analyses were performed on samples collected onsite at a location downwind of the Plutonium-Uranium Extraction Plant, at two downwind perimeter locations, and at a distant location (Yakima) in 2001 (see Table 4.1.1). Onsite concentrations in 2001 were elevated compared to those measured at the site perimeter, and perimeter levels were higher than those measured at the distant location, Yakima (Figure 4.1.5 and Table 4.1.2). Concentration differences between these locations were statistically significant (log transformed, two-tailed t-test, 5% significance level) and indicated a Hanford source. Onsite and perimeter air concentrations have remained at their respective levels from 1996 through 2001 (see Figure 4.1.5). Onsite air concentrations of iodine-129 were influenced by minor emissions (0.00084 curie [31 MBq]; see Table 3.1.1) from the Plutonium-Uranium Extraction Plant and possible releases from waste storage tanks and cribs. The annual average iodine-129 concentration (0.45 ± 0.38 aCi/m³ [0.017 ± 0.014 μBq/m³]) at the downwind perimeter in 2001 was less than 0.000001% of the DOE derived concentration guide (70 million aCi/m³ [2.6 Bq/m³]).



Plutonium-238 was detected in four of the onsite composite samples in 2001 (nominal detection limit of 1.8 aCi/m³ [0.067 μBq/m³]). The four samples were all from the 100 Areas composite group. The maximum reported plutonium-238 concentration in 2001 was 5.3 ± 1.7 aCi/m³ (0.1 ± 0.063 μBq/m³), or five thousand times below the DOE derived concentration guide for plutonium-238 (30,000 aCi/m³ [1.1 mBq/m³]).

The average plutonium-239/240 concentrations detected in onsite and offsite air samples are given in Table 4.1.2 and Figure 4.1.6. The annual average air concentration of plutonium-239/240 at the site perimeter was 0.41 ± 2.2 aCi/m³ (0.015 ± 0.081 μBq/m³), which was 0.002% of the DOE derived concentration guide (20,000 aCi/m³ [741 (Bq/m³)). The annual average air concentrations appeared to be higher for the site perimeter locations than the distant locations; however, the difference was not statistically significant (log transformed, two-tailed t-test, 5% significance level). The maximum Hanford Site plutonium-239/240 air concentration (36 ± 6.4 aCi/m³ [1.3 ± 0.2 μBq/m³]) was observed for the 100 Areas composite sample (locations 1, 2, and 3 on Figure 4.1.1). This represented less than 0.18% of the DOE derived concentration guide (20,000 aCi/m³ [741 (Bq/m³)] for plutonium-239/240.

Average isotopic uranium concentrations (uranium-234, -235, and -238) in airborne particulate matter in 2001 were similar to average concentrations between 1996 and 2000 for all distance classes (see Table 4.1.2 and Figure 4.1.7). The 2001 annual average uranium-238 concentration for the site perimeter was



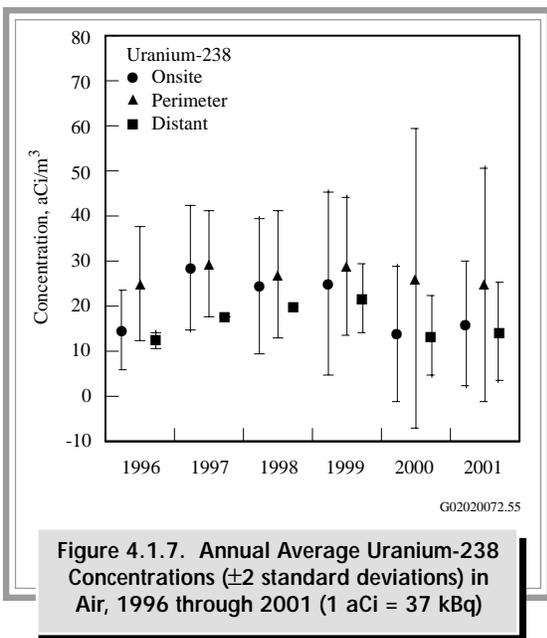


Figure 4.1.7. Annual Average Uranium-238 Concentrations (± 2 standard deviations) in Air, 1996 through 2001 (1 aCi = 37 kBq)

25 ± 26 aCi/m³ (0.93 ± 0.96 μ Bq/m³), which is less than 0.03% of the DOE derived concentration guide (100,000 aCi/m³ [3.7 mBq/m³]).

Quarterly composite samples were analyzed by gamma spectroscopy. Naturally occurring beryllium-7 and potassium-40 were routinely identified. The potential Hanford-origin gamma-emitting radionuclides of cobalt-60 and cesium-137 were of particular interest. Cobalt-60 and cesium-137 results for 2001 samples are included in Table 4.1.2. Of the 120 samples analyzed by gamma spectroscopy, only one had cobalt-60 or cesium-137 concentrations measured above the minimum detectable activity. This sample was collected from the 100 Areas composite group during the second quarter of 2001. The detected sample had a cobalt-60 concentration of $3,300 \pm 750$ aCi/m³ (120 ± 28 μ Bq/m³), and a cesium-137 concentration of 480 ± 300 aCi/m³ (18 ± 11 μ Bq/m³). The cobalt-60 concentration was 0.004% of the DOE derived concentration guide for cobalt-60. For cesium-137, the sample with the highest measured concentration was collected at location 28 during the third quarter (650 ± 600 aCi/m³ [24 ± 22 μ Bq/m³]). This maximum was 0.00016% of the DOE derived concentration guide (400 million aCi/m³ [14.8 Bq/m³]) for cesium-137.

4.1.3 Air Particulate Monitoring

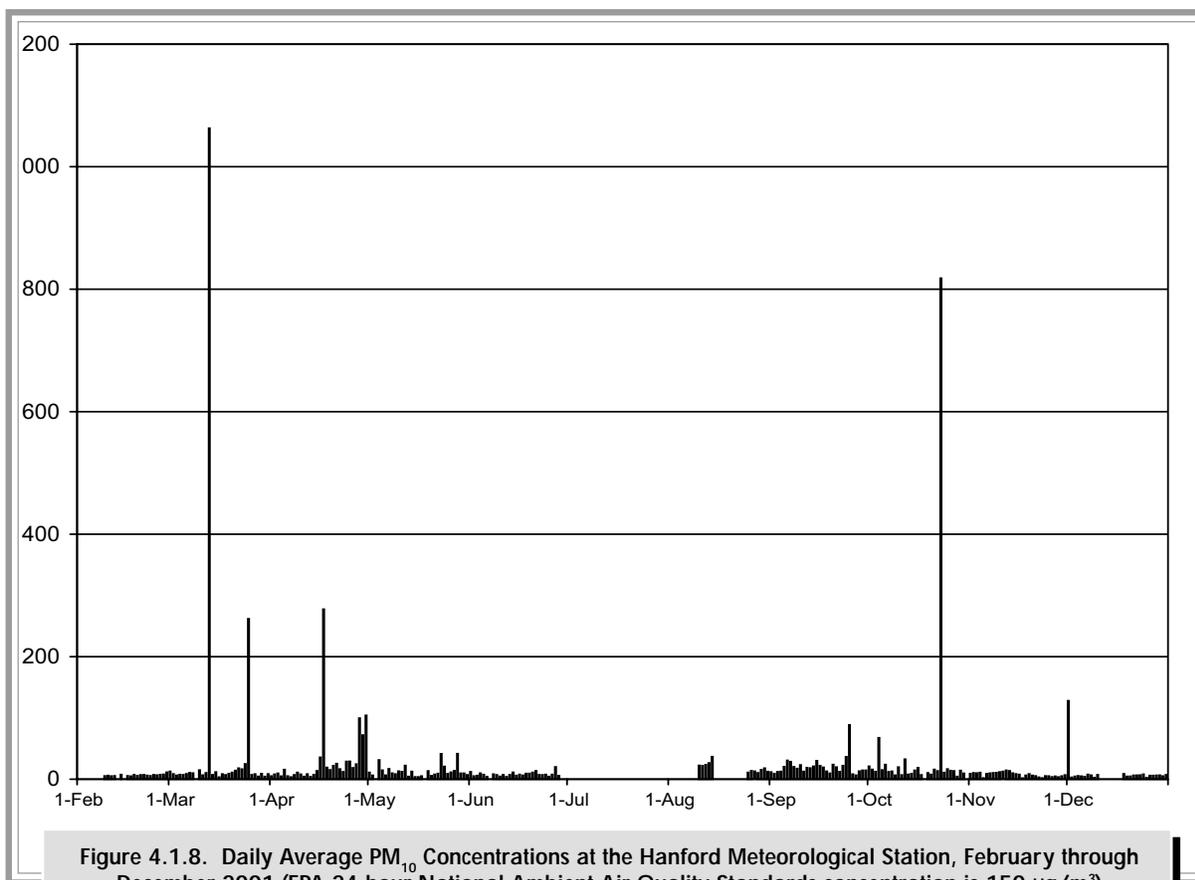
Airborne particulate matter (dust) is one of the U.S. Environmental Protection Agency's (EPA's) criteria pollutants. The EPA classifies particulate matter by particle size. PM₁₀ is defined as a particle having an aerodynamic diameter less than 10 micrometers. Similarly, PM_{2.5} is defined as a particle having an aerodynamic diameter <2.5 micrometers (a sample of PM₁₀ includes PM_{2.5}). The EPA's National Ambient Air Quality Standard for PM₁₀ requires less than a 150 μ g/m³ for a 24-hour average concentration, and less than a 50 μ g/m³ annual average. There is currently no EPA standard for PM_{2.5}. Health risk studies have shown a positive correlation between increases in concentrations of airborne particulate matter and increased hospital admissions for pulmonary and heart conditions (Schwartz 1994; Morgan et al. 1998; Ostro et al. 1999). Various studies have indicated that a 100 μ g/m³ increase in PM₁₀ concentrations (difference between EPA 24-hour and annual averages) has a relative risk^(a) of ~1.17 for hospital admissions for pneumonia and chronic obstructive pulmonary disorder (Schwartz 1994). Similar relationships were found between PM₁₀ concentrations and daily human mortality in areas where

windblown dust was the main contributor to high PM₁₀ concentrations (similar to the Hanford Site) (Ostro et al. 1999).

In February of 2001, continuous monitoring of particulate matter mass concentrations in air on the Hanford Site began. The motivation for this was the decrease in vegetative cover on a large portion of the site after the 24 Command Fire in 2000 (PNNL-13487) as well as information requests from the public. It was theorized that the decrease in vegetative cover would result in increased wind erosion, and subsequently, increased particulate matter concentrations in air. Particulate monitoring was done with a tapered element oscillating microbalance located at the base of the Hanford Meteorological Station's meteorological tower located between the 200-East and 200-West Areas (see Figure 4.1.1). The tapered element oscillating microbalance collected sample continuously, and PM₁₀ data were gathered throughout most of 2001.

Figure 4.1.8 shows the daily average PM₁₀ concentrations recorded at the Hanford Meteorological Station

(a) Relative risk here refers to the increase in hospital admissions after PM₁₀ levels rise. When PM₁₀ increased by 100 μ g/m³, a 17% increase in hospital admissions for pneumonia and chronic obstructive pulmonary disorder occurred.



during 2001. The EPA 24-hour standard for PM₁₀ (150 µg/m³) was exceeded four times during 2001 (March 13, March 25, April 17, October 23). However, the Hanford Site is not required to meet the EPA standard. The Benton Clean Air Authority maintains an air monitoring network that is responsible for determining Benton County's compliance with the EPA standards for ambient air quality pollutant concentrations, which includes PM₁₀. The 4 days that exceeded the EPA standard at the Hanford Meteorological Station were days characterized by dry, windy conditions.

By the end of October 2001, three additional tapered element oscillating microbalances were purchased and installed. One of these instruments was installed at the Hanford Meteorological Station and configured to monitor PM_{2.5}. The other two instruments were installed at the 300 Area meteorological tower (see Figure 4.1.1) and configured to measure PM¹⁰ and PM^{2.5}. Figure 4.1.9 illustrates data collected after all four tapered element

oscillating microbalances were installed. Although Figure 4.1.9 represents less than 20% of the calendar year, the trend it reveals is expected to continue into 2002. The particulate concentrations are generally low, consisting mainly of PM_{2.5} (PM_{2.5} ≈ PM₁₀), and show little spatial variability. This indicates that most of the measured particulate matter on these low concentration days is not generated locally, but transported into the region, since larger PM₁₀ particles do not remain suspended in air as long as smaller PM_{2.5} particles. On the other hand, on the day with high particulate matter concentration (December 1), the PM₁₀ concentration was much larger than the PM_{2.5} concentration. Also, the higher PM₁₀ levels at the Hanford Meteorological Station on December 1 compared to the 300 Area might reflect the 200 Areas' proximity to the area burned by the 2000 range fire. Similar to other days in 2001 with high PM₁₀ concentrations, December 1 had high winds (gusts >80 km/h [>50 mph]).

