3. ENVIRONMENTAL SURVEILLANCE PROGRAM

This section presents the Environmental Surveillance Program results at the INEEL. The Environmental Surveillance Program monitors air, surface water runoff, soil, biota, and direct radiation to comply with applicable DOE Orders and other requirements. Section 3.1 presents the air surveillance results, including the results from the wildfires in 2000 (Section 3.1.3), Section 3.2 presents the surface water runoff surveillance results, Section 3.3 presents the soil surveillance results, Section 3.4 presents the biota surveillance results, and Section 3.5 presents the direct radiation surveillance results.

The overall Environmental Surveillance Program is divided between two distinct programs: the Site Surveillance Program and the Waste Management Surveillance Program. The management and operating contractor conducts the Site Environmental Surveillance Program at INEEL facilities and selected off-Site locations. This surveillance is conducted in conjunction with the off-Site monitoring contractor (S. M. Stoller). The off-Site monitoring contractor and the management and operating contractor monitoring comprise the overall INEEL Environmental Surveillance Program.

The management and operating contractor also conducts environmental surveillance in and around waste management facilities (Radioactive Waste Management Complex [RWMC], Waste Experimental Reduction Facility [WERF] and Test Area North [TAN]) for compliance with DOE Order 435.1.[11] The basis for the Waste Management Surveillance Program differs from the Site Surveillance Program in that it is more facility- or source-specific.

The Environmental Surveillance Program section of this report is presented by media, with separate subsections for waste management surveillance and site surveillance. These activities are listed in Tables 3-1 and 3-2, respectively. Approximately 3,500 samples were collected and analyzed in 2000.

The Environmental Surveillance Program emphasizes measurement of airborne radionuclides because of the importance of the air transport pathway. Site surveillance data are used to monitor potential trends in radioactivity in the environment at the INEEL in order to assess possible impact on-Site and off-Site.

Soils are sampled to determine if long-term deposition of airborne materials released from the INEEL has resulted in a buildup of radionuclides in the environment. Food chain surveillance and off-Site air and soil measurements are conducted by the off-Site monitoring contractor. The off-Site contractor compiles the Annual Site Environmental Report,[41] which provides additional information and dose calculations.

The analytical results reported in the following surveillance sections are those that are greater than two times the analytical uncertainty. Analytical uncertainties reported in text and tables are the 2-sigma uncertainty for the radiological analyses.

Table 3-1. Summary of waste management surveillance activities.

Facility	Media	Description	Frequency of Analyses	Type of Analyses
RWMC				
Subsurface Disposal Area (SDA)	**Air**			
	• PM_{10}	8 air monitors operated at 0.113 m^3/min (includes 1 control and 1 replicate)	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	• Suspended particulate	1 air monitor operated at 0.113 m^3/min	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	• Atmospheric moisture	1 monitor at 110 cc/min	4–13 weeks	Tritium
	Surface Water	One 4-L sample from Subsurface Disposal Area and control location	Quarterly, depending on precipitation	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a,b,c]
	Direct Radiation			
	• Surface gamma activity	GPRS[d] detector system	Semiannually	External radiation levels
	• Ionizing radiation	4 TLD[e] packets and 7 background communities	Semiannually	External radiation levels
	Soil	5 surface locations in each of 5 major areas (plus 2 control areas)	Triennially	Gamma spectrometry Radiochemistry[a]
	Vegetation	3 composites in each of 5 major areas (plus 2 control areas)[c]	Annually, species sampled varies each year as determined by availability	Gamma spectrometry Radiochemistry[a]
	Visual Inspection	Tour Subsurface Disposal Area and Transuranic Storage Area	Monthly	Results reported for any required corrective action
Stored Waste Examination Pilot Plant (SWEPP)	**Air**			
	• PM_{10}	7 air monitors operated at 0.113 m^3/min (includes 1 control)	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	• Suspended particulate	2 air monitors operated at 0.113 m^3/min	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	Surface Water	One 4-L sample from TSA-1, TSA-2, TSA-3, TSA-4, and control locations	Quarterly, depending on precipitation	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	Soil	9 locations sampled (plus 1 control area)	Triennially	Gamma spectrometry Radiochemistry[a]

Table 3-1. (continued).

Facility	Media	Description	Frequency of Analyses	Type of Analyses
Waste Experimental Reduction Facility (WERF)	**Air**			
	• PM_{10}	4 air monitors operated at 0.113 m^3/min (includes 1 control)	Semimonthly Semimonthly Monthly	Gross alpha Gross beta Gamma spectrometry
	• Suspended particulate	1 air monitor operated at 0.113 m^3/min	Semimonthly Semimonthly Monthly	Gross alpha Gross beta Gamma spectrometry
	• Ionizing radiation	11 TLD packets and 7 background communities	Semiannually	External radiation levels
	Soil			
	• Surface soils	15 surface locations	Triennially[f]	Gamma spectrometry
	• Seepage basins	3 locations	Annually	Gamma spectrometry
	Surface Water	One 4-L sample from seepage basins	Quarterly, depending on precipitation	Gamma spectrometry
	Vegetation	11 locations (includes 3 controls)	Triennially	Gamma spectrometry
Mixed Waste Storage Facility (MWSF)	**Air**			
	• PM_{10}	1 air monitor operated at 0.113 m^3/min	Semimonthly Semimonthly Monthly	Gross alpha Gross beta Gamma spectrometry
Test Area North (TAN)	**Air**			
	• Suspended particulate	5 air monitors operated at 0.113 m^3/min	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry
Organic Moderated Reactor Experiment (OMRE)	**Direct Radiation**			
	Surface gamma activity	GPRS detector system	Annually	External radiation levels

a. Analysis for americium-241, plutonium-238, plutonium-239/240, uranium-234, uranium-235, uranium 238, and strontium-90.

b. Samples for radiochemical analyses usually collected during second quarter only.

c. Exact number of samples may vary due to availability.

d. GPRS—Global positioning radiometric scanner.

e. TLD—thermoluminescent dosimetry.

f. Sampling frequency may vary if air radioactivity levels increase.

Table 3-2. Summary of site surveillance activities.

Sample Type	Analyses	Collection Frequency	Locations: Distant Communities	Locations: INEEL (On-Site)
Air—low volume (particulate)	Gross alpha	Weekly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
	Gross beta	Weekly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
	Gamma spectrometry	Quarterly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
	Radiochemistry[a]	Quarterly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
	Particulate	Quarterly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
Air—low volume (cartridge)	I-131 (gamma screen)	Weekly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
Air—nitrogen oxide	Nitrogen oxide	Continuously	NA[b]	EFS, Van Buren
Air—sulfur dioxide	Sulfur dioxide	Continuously	NA	Van Buren
Air—moisture	Tritium	4 to 13 weeks	Craters of the Moon, Idaho Falls	EFS, Van Buren
Soil	Gamma spectrometry	Annually	NA	Each major facility[c] once every 7 years
	Radiochemistry	Annually	NA	Each major facility once every 7 years
Direct radiation	TLD[d]	Semiannually	Aberdeen, Arco, Atomic City, Blackfoot, Craters of the Moon, Howe, Idaho Falls, Minidoka, Monteview, Mud Lake, Reno Ranch, Rexburg, Roberts	ANL-W, ARA, CFA, EBR- I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
	Surface surveys	Annually	NA	Each perimeter of the major facilities every 3 years

a. Radiochemistry—americium-241, plutonium-238, plutonium-239/240, and strontium-90 are included.

b. NA—not applicable.

c. Major facilities include ANL-W, ARA, CFA, INTEC, NRF, PBF, RWMC, TAN, and TRA.

d. TLD—thermoluminescent dosimetry.

3.1 Air Surveillance

The Waste Management Surveillance Program collects particulate material on 102 mm (4-inch) membrane filters using two types of air monitors: particulate matter with a nominal size of 10 μm (PM_{10}) and total suspended particulate air monitors. While the PM_{10} monitors are designed to only admit respirable particles with a 50% cutpoint of 10 microns in diameter, the suspended particulate air monitors admit larger particles. The PM_{10} monitors the respirable size fraction of particulate materials, which is also the range of particle sizes that can be suspended in air for long periods and is therefore readily transported to off-Site locations by wind. Filters are collected and analyzed semimonthly for gross alpha and gross beta, and monthly composites of each location are analyzed quantitatively for gamma-emitting radionuclides. Filters from each sample location are also composited quarterly and are analyzed for specific alpha- and beta-emitting radionuclides. Appendix B presents the approach used for data analysis of these samples.

The Site Surveillance Program collects filters from a network of low-volume air monitors weekly. Air flows at an average of about 57 L/min (2 cfm) through a set of filters consisting of a 5-cm (2-inch) 1.2-μm pore membrane filter followed by a charcoal cartridge. These filters are analyzed weekly for gross alpha and gross beta and are composited quarterly by location. The composite samples are analyzed using gamma spectrometry and specific radiochemical methods for alpha- and beta-emitting radionuclides. In addition to the particulate filter samples, charcoal cartridges are collected and analyzed weekly using gamma spectrometry.

There is no requirement to monitor the dust burden at the INEEL, but it is monitored to provide comparison information to other monitoring programs and to the U.S. Department of Energy Idaho Operations Office. The suspended particulate dust burden is monitored with the same low-volume filters used to collect the radioactive particulate samples.

Nitrogen oxides are monitored at Van Buren Boulevard (VANB) and Experimental Field Station (EFS) following an Environmental Protection Agency-equivalent method to implement the *Ambient Nitrogen Dioxide Monitoring Plan for the INEL.*[42] This monitoring fulfills one of the conditions specified in the "Permit to Construct, Idaho Chemical Processing Plant Nitrogen Oxide Sources."[43]

Sulfur dioxide measurements are recorded to confirm that the INEEL does not release significant amounts of sulfur dioxide with respect to national ambient air quality standards. Sulfur dioxide is monitored at the VANB location.

Samplers for tritium in water vapor in the atmosphere are located at the EFS and VANB locations (Figure A-1). Air passes through a column of molecular sieve. The molecular sieve adsorbs water vapor in the air; columns are changed when the molecular sieve adsorbs sufficient moisture to obtain a sample. Tritium concentrations are then determined by liquid scintillation counting of the water extracted from the molecular sieve columns.

3.1.1 Data Summary and Assessment for Waste Management Surveillance

Gross alpha and gross beta data provide initial detection of significant changes in airborne radioactivity. The gross alpha and gross beta data are also used as a criteria to screen samples for immediate gamma and radiochemical analyses for specific radionuclide identification. Specific radionuclide concentrations are compared to applicable Derived Concentration Guides for the public (Appendix D).

Figures 3-1 and 3-2 summarize the 1999 and 2000 gross alpha and gross beta concentrations by facility and monitor type and illustrate short-term changes in concentrations. Tables 3-3 and 3-4 summarize corresponding 1999 and 2000 concentrations.

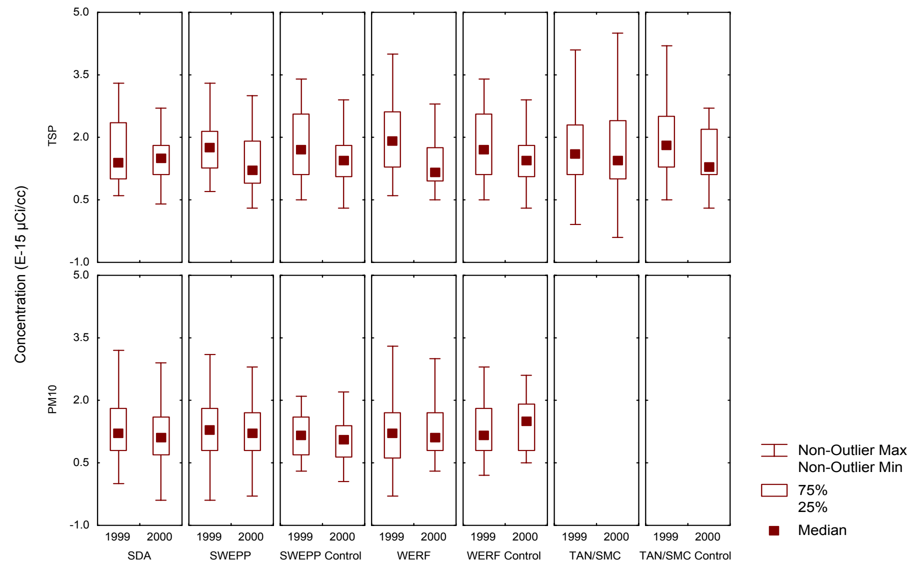


Figure 3-1. Gross alpha concentrations by year, facility, and monitor type.

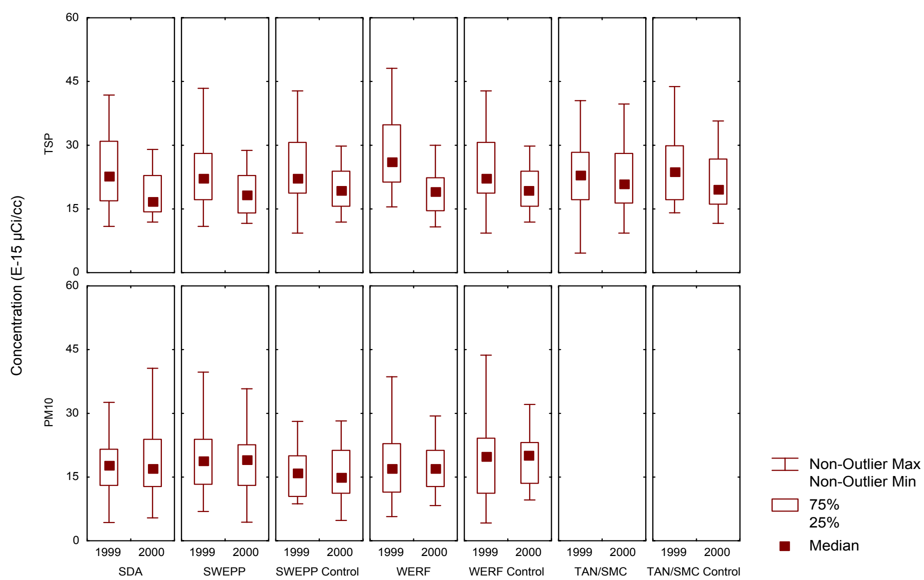


Figure 3-2. Gross beta concentrations by year, facility, and monitor type.

Table 3-3. Summary statistics for gross alpha concentrations (4-in. filters).

Monitor Type	Facility	Year	Number of Samples	Mean (E-15 μCi/cc)	Median (E-15 μCi/cc)	Minimum (E-15 μCi/cc)	Maximum (E-15 μCi/cc)
Suspended particulate	Subsurface Disposal Area (SDA)	1999	24	1.7	1.4	0.6	4.5
		2000	24	1.5	1.5	0.4	3.1
	SWEPP	1999	48	1.8	1.8	0.7	4.1
		2000	48	1.4	1.2	0.3	3.0
	Control[a]	1999	24	1.8	1.7	0.5	3.4
		2000	24	1.5	1.5	0.3	3.0
	WERF	1999	23	2.0	1.9	0.6	4.0
		2000	24	1.4	1.2	0.5	3.1
	TAN/SMC	1999	93	1.7	1.6	-0.09	4.1
		2000	88	1.7	1.5	-0.4	4.5
	Control[b]	1999	24	2.0	1.8	0.5	4.2
		2000	23	1.6	1.3	0.3	4.0
PM_{10}	SDA	1999	129	1.4	1.2	0.0	4.4
		2000	139	1.3	1.1	-0.4	5.8
	SWEPP	1999	138	1.4	1.3	-1.0	5.3
		2000	138	1.4	1.2	-1.2	7.1
	Control[c]	1999	24	1.1	1.2	0.3	2.1
		2000	24	1.0	1.1	0.05	2.2
	WERF	1999	59	1.2	1.2	-0.3	3.3
		2000	65	1.3	1.1	0.3	3.6
	Control[d]	1999	20	1.4	1.2	0.2	2.8
		2000	23	1.4	1.5	0.5	2.6

a. SDA/SWEPP/WERF.

b. TAN/SMC.

c. SDA/SWEPP.

d. WERF.

Table 3-4. Summary statistics for gross beta concentrations (4-in. filters).

Monitor Type	Facility	Year	Number of Samples	Mean (E-15 μCi/cc)	Median (E-15 μCi/cc)	Minimum (E-15 μCi/cc)	Maximum (E-15 μCi/cc)
Suspended particulate	SDA	1999	24	24.2	22.6	10.9	41.8
		2000	24	20.1	16.6	11.9	47.7
	SWEPP	1999	48	23.6	22.2	10.9	43.4
		2000	48	19.8	18.3	11.6	50.9
	Control[a]	1999	24	24.4	22.2	9.3	42.8
		2000	24	21.0	19.2	11.9	43.7
	WERF	1999	23	27.6	26.0	15.5	48.1
		2000	24	20.5	18.9	10.8	43.4
	TAN/SMC	1999	93	24.4	23.0	4.6	70.8
		2000	88	23.6	20.9	9.3	57.6
	Control[b]	1999	24	26.3	23.8	14.1	75.1
		2000	23	23.5	19.4	11.6	52.5
PM_{10}	SDA	1999	129	18.5	17.8	4.3	44.1
		2000	139	19.4	16.9	5.4	47.9
	SWEPP	1999	138	20.1	18.6	6.9	61.7
		2000	138	21.1	18.9	4.4	87.7
	Control[c]	1999	24	16.5	15.9	8.7	37.0
		2000	24	17.6	14.9	4.8	43.2
	WERF	1999	59	17.7	16.9	5.7	38.6
		2000	65	19.1	16.8	8.3	44.8
	Control[d]	1999	20	19.2	19.8	4.2	43.7
		2000	23	20.0	20.1	9.6	46.3

a. SDA/SWEPP/WERF.

b. TAN/SMC.

c. SDA/SWEPP.

d. WERF.

During 2000, as with past gross alpha concentrations, the facility groupings varied very little (Figure 3-1). From 1999 to 2000, for the suspended particulate monitors, the median concentrations decreased slightly for all facility grouping, except the SDA, where the median concentration slightly increased. For the PM_{10} monitors, the median concentrations decreased for all groupings, except for the WERF control group, which slightly increased. To test for statistical significance of the variations in medians of gross alpha concentrations from 1999 to 2000, the Kruskal-Wallis significance test was performed on data from each facility grouping. The changes in median concentrations from 1999 to 2000 for the gross alpha PM_{10} monitors at SWEPP and WERF were statistically significant at the 0.05 level. For the remaining facility/monitor type groupings, the changes in gross alpha median concentrations from 1999 and 2000 were not significant.

Variability among facility groupings during 2000 for median gross beta concentrations is graphically presented in Figure 3-2. Median gross beta concentrations from suspended particulate monitors for all facility groupings decreased from 1999 to 2000. Median gross beta concentrations from PM_{10} monitors decreased for all groupings, except for SWEPP and the WERF control location, which slightly increased. For suspended particulate monitors, these changes were significant at the 0.05 level for SWEPP and WERF, while for PM_{10} monitors, none of the changes were significant.

Quarterly averages of RWMC and WERF gross beta concentrations (cesium-137 equivalent) since 1990 are shown in Figures 3-3 and 3-4, respectively, which show a continued seasonal trend.

Cesium-137 and cobalt-60 were the only manmade, gamma emitting radionuclides detected in 2000. Cesium-137 was detected in two samples collected in July at EBR-I and the Main Gate (both are control locations). The maximum concentration was 7.0 ± 2.0 E-16 microcuries per cubic centimeter (µCi/cc), which is near the stated detection limit and represent 0.0002% of the Derived Concentration Guide. Cobalt-60 was detected in three samples (monitors SDA 2 and SDA 4.2) at the northeast corner of the SDA. The maximum concentration was 19.0 ± 2.0 E-16 µCi/cc, which is 0.0007% of the Derived Concentration Guide.

No manmade alpha and beta-emitting radionuclides were above the laboratory-stated detection limits for 2000.

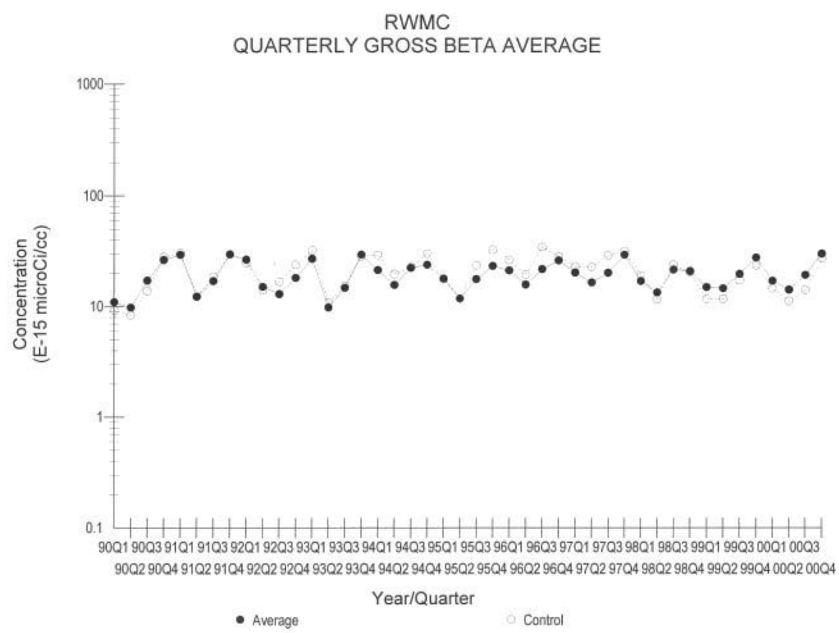


Figure 3-3. Quarterly average of gross beta air concentrations (cesium-137 equivalent) measured at Radioactive Waste Management Complex for the past 10 years.

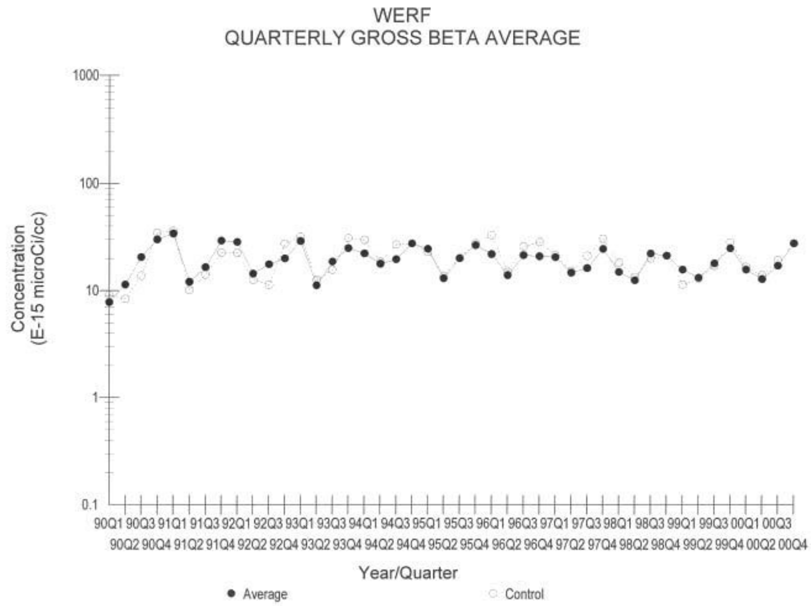


Figure 3-4. Quarterly average of gross beta air concentrations (cesium-137 equivalent) measured at Waste Experimental Reduction Facility for the past 10 years.

3.1.2 Data Summary and Assessment for Site Surveillance

Table 3-5 presents the maximum gross alpha concentration for each location. During 2000, most maximum concentrations occurred during the third quarter as a result of natural activity being released and concentrated due to fires in the area. Gross alpha concentrations for the remaining quarters were, in general, typical of those measured previously. The mean gross alpha concentrations are shown in Table 3-6 and also reflect a slight increase in the third quarter.

The highest mean concentrations of gross beta were detected in the third quarter of 2000 (Table 3-7). The maximum quarterly average gross beta concentration was 48 E-15 μCi/cc at the Argonne National Laboratory-West (ANL-W) and represents 0.5% of the Derived Concentration Guide for strontium-90 (most restrictive).

Cesium-137 and cobalt-60 were the only gamma-emitting radionuclides detected in the quarterly composite of 5-cm (2-in.) low-volume filter samples during 2000. These samples were collected from Test Reactor Area (TRA) in the third quarter. The concentrations were 0.44 ± 0.1 E-15 μCi/cc and 0.86 ± 0.11 E-15 μCi/cc respectively. Cobalt-60 is a radionuclide that has been commonly detected around TRA in surface soils. Cobalt-60 detections at TRA are more likely from the resuspension of these soils. No iodine-131 was detected in 2000.

Plutonium-239/240 was also detected by radiochemical analysis at the Rest Area, TRA, and TRA Location B (Table 3-8). The maximum Pu-239/240 concentration was at the TRA Location B during the third quarter and was 0.02 ± 0.008 E-15 μCi/cc, which represents 0.1% of the Derived Concentration Guide. Strontium-90 was also detected at the Rest Area. The concentration was 0.11 ± 0.04 E-15 μCi/cc and represents 0.001% of the Derived Concentration Guide. The Rest Area location was added in

August 2000 to better monitor the burned area (Section 3.1.3 discusses the fire). At these locations, the particulate loading was extremely high because high winds resuspended soil after the areas were burned.

The 2000 annual mean suspended particulate concentrations are shown in Table 3-9, and the 2000 maximum quarterly suspended particulate concentrations are shown in Figure 3-5. Higher suspended particulate concentrations were found at the locations near the burned areas, in particular the Rest Area and TRA. The largest source of airborne particulates on the INEEL in 2000 was resuspended dust from wildfire-burned areas.

No tritium concentrations were above the laboratory-stated detection limits.

Ambient nitrogen dioxide concentrations were obtained continuously at the stations at the intersection of Van Buren Boulevard and U.S. Highway 20/26 and the EFS (Figure A-1). The New Waste Calcining Facility at INTEC, the largest single source of nitrogen dioxide on the INEEL, operated from March 7 to June 29, 2000. The mean nitrogen dioxide concentrations for 2000 at VANB and EFS were 2.2 $\mu g/m^3$ (1.2 parts per billion [ppb]) and 7.6 $\mu g/m^3$ (4.1 ppb), respectively. These were significantly lower than the Environmental Protection Agency national primary ambient air quality standard of 100 $\mu g/m^3$ (53 ppb).

Ambient sulfur dioxide was continuously monitored at VANB during 2000 (Figure A-1). The mean sulfur dioxide concentration was 0.3 $\mu g/m^3$ (0.13 ppb), or 0.4% of the annual primary air quality standard. The maximum daily concentration of 13.3 $\mu g/m^3$ (1.5 ppb) was 3.7% of the primary standard for a 24-hour period. The maximum recorded three-hour average of 7.5 $\mu g/m^3$ (2.8 ppb) was 0.6% of the secondary standard.

Table 3-5. Maximum gross alpha concentrations for 2000 per location.

Location	Date	Maximum Concentration[a] (E-15 μCi/cc)
ANL-W	08/30	10.0 ± 1.2
ARA	08/02	3.7 ± 1.3
CFA	08/02	7.1 ± 1.9
EBR-I	08/02	3.4 ± 1.5
EFS	07/26–07/31[c]	12.0 ± 3.0
INTEC	08/02	8.0 ± 5.0
NRF	08/23	4.6 ± 1.4
PBF	08/02	5.5 ± 1.4
Rest Area[b]	10/04	3.6 ± 1.6
RWMC	07/26–07/31[c]	3.5 ± 1.2
TAN	08/09	2.6 ± 0.8
TRA	07/26–07/31[c]	5.0 ± 3.0
VANB	07/26–07/31[c]	10.0 ± 4.0
Off-Site	03/29	5.2 ± 1.6

a. Uncertainties shown are the associated 2 sigma.

b. Rest Area (new monitor) in place beginning 8/23.

c. Wildfires 7/26 to 7/29.

Table 3-6. Mean gross alpha concentrations for 2000 per location.

Location	1st Quarter Concentration (E-15 μCi/cc)	2nd Quarter Concentration (E-15 μCi/cc)	3rd Quarter Concentration (E-15 μCi/cc)	4th Quarter Concentration (E-15 μCi/cc)	Annual Mean Concentration (E-15 μCi/cc)	% of DCG[a]
ANL-W	0.26	0.7	1.9	0.4	0.8	3.9
ARA	-0.2	0.8	1.0	0.5	0.5	2.5
CFA	0.4	0.3	2.1	1.4	1.1	5.5
EBR-I	-0.06	0.7	1.3	0.5	0.6	3.0
EFS	0.7	0.5	2.4	0.5	1.0	5.1
INTEC	-0.2	-0.4	1.7	0.1	0.3	1.5
NRF	-0.3	0.8	1.7	0.7	0.7	3.6
PBF	0.5	0.7	2.0	0.3	0.9	4.5
Rest Area	—[b]	—[b]	1.4	1.1	1.3	6.5
RWMC	-0.06	0.6	0.9	0.8	0.6	3.0
TAN	0.6	0.8	1.1	0.3	0.7	3.5
TRA	-0.09	0.6	1.9	1.5	1.0	5.0
VANB	0.03	0.7	1.8	0.8	0.8	4.0
Off-Site	0.6	1.1	1.5	1.0	1.0	5.0

a. DCG—Derived Concentration Guide.

b. Rest Area (new monitor) in place beginning 8/23/00.

Table 3-7. Mean gross beta concentrations for 2000 per location.

Location	1st Quarter Concentration (E-15 μCi/cc)	2nd Quarter Concentration (E-15 μCi/cc)	3rd Quarter Concentration (E-15 μCi/cc)	4th Quarter Concentration (E-15 μCi/cc)	Annual Mean Concentration (E-15 μCi/cc)	% of DCG[a]
ANL-W	20	19	48	30	29	0.3
ARA	18	19	26	31	24	0.3
CFA	25	19	28	34	27	0.3
INTEC	22	18	28	26	24	0.3
EBR-I	21	18	25	32	24	0.3
EFS	26	21	30	33	28	0.3
NRF	23	19	29	33	26	0.3
PBF	17	18	23	30	22	0.2
Rest Area	—[b]	—[b]	31	27	29	0.3
RWMC	16	15	21	24	19	0.2
TAN	19	17	23	31	23	0.3
TRA	21	19	29	36	26	0.3
VANB	22	18	30	33	26	0.3
Off-Site	20	20	26	32	24	0.3

a. DCG—Derived Concentration Guide.

b. Rest Area (new monitor) in place beginning 8/23/00.

Table 3-8. Site surveillance radiochemistry detections for air.

Location	Quarter	Analyses Type	Concentration (E-15 µCi/cc)[a]	% of DCG[b]
Rest Area	3rd	Pu-239/240	0.01 ± 0.008	0.06
TRA	3rd	Pu-239/240	0.01 ± 0.006	0.07
TRA Location B	3rd	Pu-239/240	0.02 ± 0.008	0.1
Rest Area	4th	Sr-90	0.11 ± 0.04	0.001

a. Uncertainties shown are the associated 2 sigma.

b. DCG—Derived Concentration Guide.

Table 3-9. 2000 annual mean suspended particulate concentrations.

Location	Annual Mean Concentration ($\mu g/m^3$)	Number of Samples
ANL-W	16	51
ARA	11	50
CFA	10	50
EBR-I	15	50
EFS	21	50
INTEC	17	51
NRF	27	48
PBF	16	51
RWMC	14	51
TAN	15	51
TRA	42	50
VANB	18	51
Blackfoot	23	49
Craters of the Moon	12	51
Idaho Falls	26	48
Rexburg	32	51
Rest Area	88	17

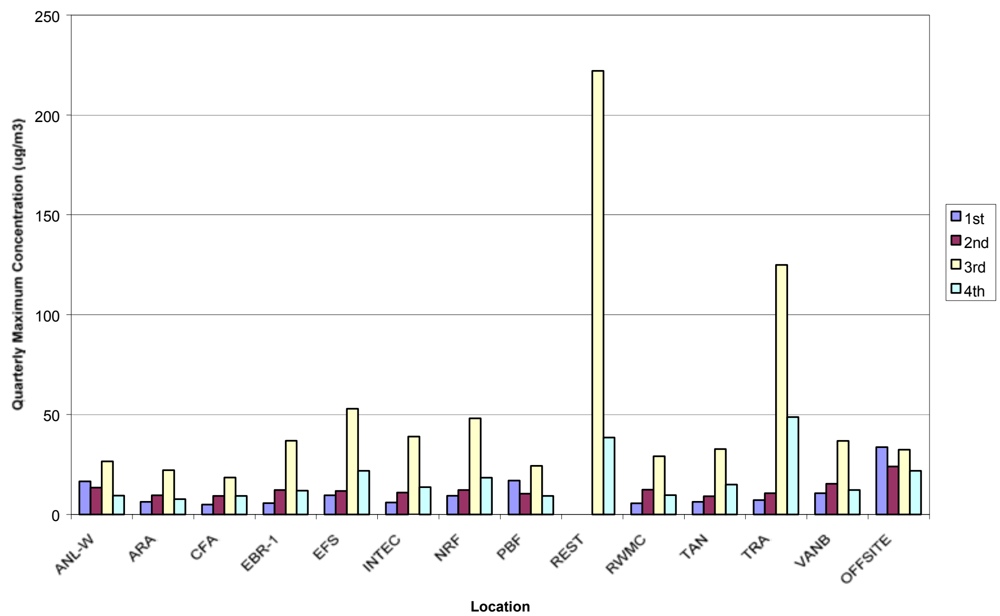


Figure 3-5. 2000 maximum quarterly suspended particulate concentrations.

3.1.3 Special Study

In 2000, wildfires burned 36,000 acres at the INEEL (Figure 3-6). To assess the impact of the fires, air filters were collected and analyzed from six of the monitors before the scheduled routine collection. These monitors were selected based on proximity to the fires and wind direction. The six monitors were at: TRA, RWMC, INTEC, EFS, Van Buren, and NRF.

Natural radioactivity in soil and vegetation increased radioactivity in airborne dust during and following the wildfires. Screening analyses for gross alpha and gross beta radioactivity concentrations in air particulate filters collected the week of the fires were slightly elevated compared to filters collected the preceding weeks and compared to the same period in 1999.

Measurable increases of gross alpha and gross beta concentrations are expected during and following wildfires due to increased particulate matter in the air (Table 3-9). The natural radioactivity in the soil and vegetation is redistributed by the fire and winds. Gross alpha and gross beta concentrations also slightly increased during the summers of 1994 and 1996, when other large fires burned on or near the INEEL. Similar increases occur in communities where wood burning stoves are used for home heating. Changing meteorological conditions often cause daily and seasonal fluctuations in airborne radioactive concentrations.

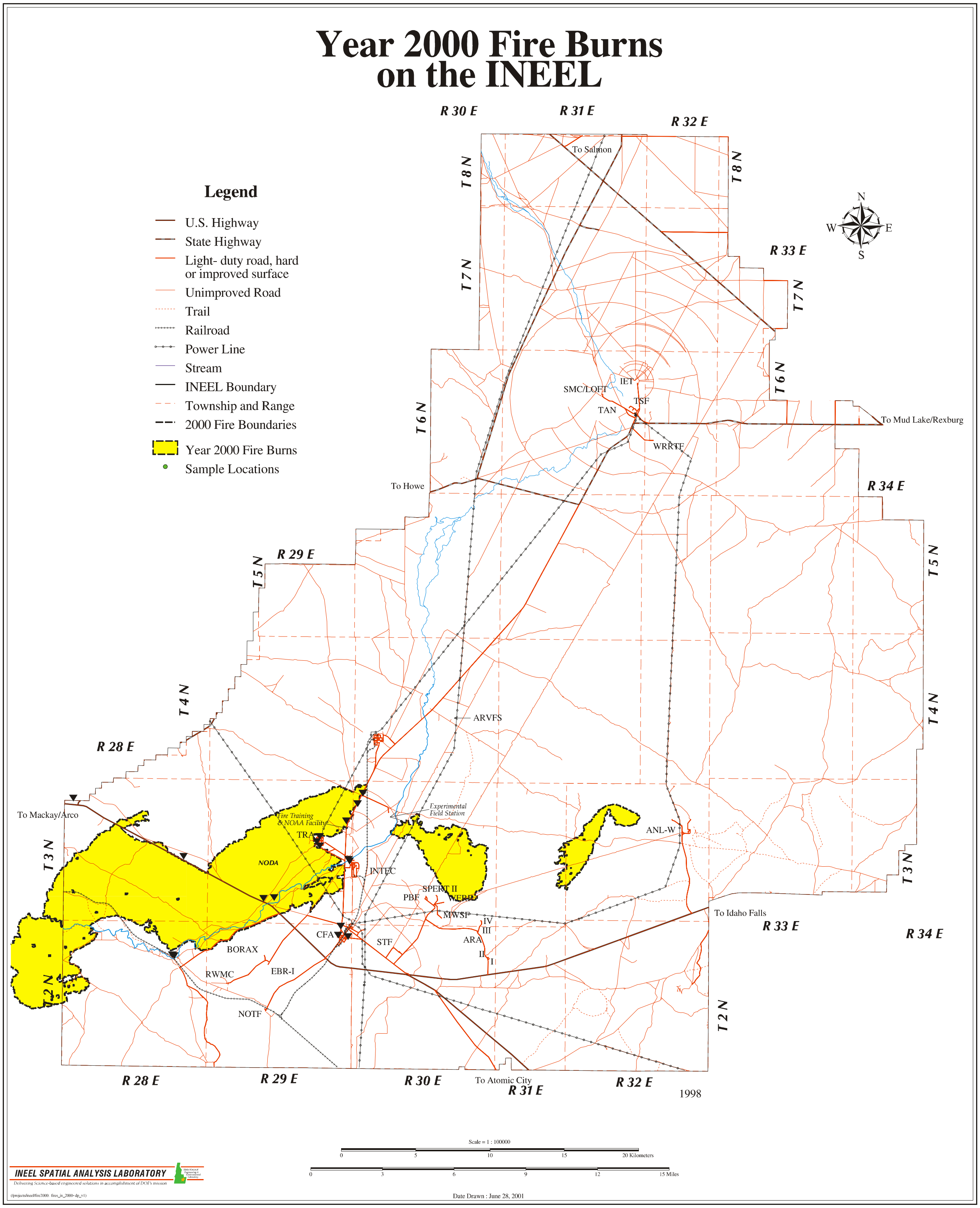


Figure 3-6. Year 2000 fire burns on the INEEL.

During 2000, the maximum gross alpha and gross beta concentrations occurred during the wildfires in July 2000. The maximum gross alpha concentration was 12.0 ± 3.0 E-15 μCi/cc at EFS (Table 3-10). The maximum gross beta concentration was 58.0 ± 9.0 E-15 μCi/cc at INTEC (Table 3-10). These on-Site concentrations were not significantly different from off-Site concentrations during the fires. The highest off-Site gross alpha concentration was 8.0 ± 2.0 E-15 μCi/cc, and the highest off-Site gross beta was 67.0 ± 2.0 E-15 μCi/cc. These concentrations occured at Blackfoot where there was also a fire close to the monitor. All the concentrations were well below radiation protection guidelines and represent no threat to human health.

All air filters collected during the wildfires were analyzed for specific gamma-emitting and alpha-emitting radionuclides. No manmade radionuclides were detected on these filters. Table 3-10 presents the analysis results for the six filters collected during the fires.

Table 3-10. Air monitoring concentrations during July 2000 widlfires.

Location[a]	Sampling Period Start	Sampling Period Stop	Gross Alpha (E-15 μCi/cc)	Gross Beta (E-15 μCi/cc)	Specific Gamma	Specific Alpha	Sr-90
TRA	07/26	07/31	5.0 ± 3.0	37 ± 6	ND[b]	ND	ND
RWMC	07/26	07/31	3.5 ± 1.2	33 ± 3	ND	ND	ND
INTEC	07/26	07/31	8.0 ± 5.0	58 ± 9	ND	ND	ND
EFS	07/26	07/31	12.0 ± 3.0	45 ± 6	ND	ND	ND
Van Buren	07/26	07/31	10.0 ± 4.0	54 ± 7	ND	ND	ND
NRF	07/26	07/31	1.3 ± 1.4	41 ± 4	ND	ND	ND

a. Samples selected for early analysis.

b. ND = Nondetect. No samples were greater than 2 sigma.

3.2 Surface Water Runoff

Surface water runoff is collected at waste management facilities (RWMC and WERF) (see Appendix A) to determine if radionuclide concentrations exceed alert levels or if concentrations have increased significantly compared to historical data.

Radionuclides could be transported outside the RWMC boundaries via surface water runoff. Surface water runs off at the Subsurface Disposal Area only during periods of rapid snow melt or heavy precipitation. At these times, water may be pumped out of the Subsurface Disposal Area into a drainage canal. Water also runs off the asphalt pads around the Transuranic Storage Area and into drainage culverts and the drainage canal, which direct the flow outside the RWMC. The canal also carries outside runoff that has been diverted around the RWMC. Ponding of the runoff in a few low areas may increase subsurface saturation, which would increase subsurface migration of radionuclides.

Since in 1994, quarterly surface water runoff samples have been collected at the WERF seepage basins to determine if stored waste has released contamination. Two control locations 2.0 km (1.24 mi) north of the RWMC are sampled. The control location for the Transuranic Storage Area and WERF is on the west side of the rest rooms at the Lost River Rest Area, and the control location for the Subsurface Disposal Area is 1.5 km (0.93 mi) west on U.S. Highway 20 from the Van Buren Boulevard intersection and 10 m (33 ft) north on the T-12 access road (see Figures A-12 and -18).

3.2.1 Data Summary and Assessment for Waste Management Surveillance

Surface water runoff samples were collected during all quarters of 2000 at the RWMC. Cobalt-60 and cesium-137 were the only manmade, gamma-emitting radionuclides detected at RWMC. The maximum cobalt-60 concentration was 3.7 ± 1.0 E-09 μCi/mL and was collected during the second quarter at the control location. This concentration represents 0.01% of the Derived Concentration Guide for releases of cobalt-60 to the public. The maximum cesium-137 concentration was 3.8 ± 0.6 E-07 μCi/mL and was collected during the second quarter at the TSA-2 location. This concentration represents 0.12% of the Derived Concentration Guide and is comparable to historical concentrations.

Second-quarter samples were analyzed for alpha- and beta-emitting radionuclides. Americium-241 and plutonium-239/240 were detected in one sample collected from the TSA-2 sample location. The americium-241 concentration was 3.22 ± 1.22 E-11 μCi/mL. This concentration represents 0.11% of the Derived Concentration Guide. The plutonium-239/240 concentration was 2.27 ± 0.63 E-11 μCi/mL. This concentration represents 0.07% of the appropriate Derived Concentration Guide. These concentrations are consistent with samples collected from waters with higher volumes of suspended particulates.

Samples were collected from the WERF seepage basins during all quarters of 2000. Cesium-137 was detected in one sample collected during the first quarter at the WERF south basin. The concentration was 9.0 ± 3 E-10 μCi/mL. This concentration represents 0.12% of the Derived Concentration Guide and is comparable to historical concentrations.

3.3 Soil Surveillance

During 2000, soil was sampled at both waste management facilities (RWMC) and site surveillance locations (Argonne National Laboratory-West [ANL-W]) (see Appendix A). The samples were analyzed by gamma spectrometry. Selected samples were submitted for radiochemistry analysis.

3.3.1 Data Summary and Assessment for Waste Management Surveillance

3.3.1.1 ***Radioactive Waste Management Complex.*** During 2000, 24 soil samples were collected from the RWMC and analyzed by gamma spectroscopy. The maximum cesium-137 concentration was 1.19 ± 0.10 E+00 pCi/g (19.8% of the Environmental Concentration Guide), and was collected at the RWMC control location. Eleven RWMC soil samples were submitted for radiochemistry analyses. Americium-241, plutonium-239/240, and strontium-90 were detected in all samples. The maximum americium-241 detection was 1.54 ± 0.12 E+00 pCi/g and represents 3.85% of the Environmental Concentration Guide. The maximum plutonium-239/240 concentration was 1.22 ± 0.12 E+00 pCi/g and represents 1.53% of the Environmental Concentration Guide. The maximum strontium-90 concentration was 3.08 ± 0.29 E-01 pCi/g and represents 5.13% of the Environmental Concentration Guide. These concentrations were above background for the INEEL but are consistent with historical concentrations at RWMC.

3.3.2 Data Summary and Assessment for Site Surveillance

3.3.2.1 ***Argonne National Laboratory-West.*** During 2000, 13 soil samples were collected from outside the ANL-W and analyzed by gamma spectroscopy. Cesium-137 was the only manmade gamma radionuclide detected. The maximum cesium-137 concentration was 1.20 ± 0.06 E+00 pCi/g (20% of Environmental Concentration Guide), which was collected at location EBR II-11.

Thirteen ANL-W soil samples were submitted for radiochemistry analyses. Americium-241, plutonium-239/240, and strontium-90 were detected in all samples. The maximum americium-241 concentration was 8.41 ± 1.93 E-03 pCi/g and represents 0.02% of the Environmental Concentration Guide. The maximum plutonium-239/240 concentration was 2.75 ± 0.51 E-02 pCi/g and represents 0.03% of the Environmental Concentration Guide. The americium-241 and plutonium-239/240 concentrations were all within the background range for the INEEL and surrounding areas and are attributable to past fallout. The maximum strontium-90 concentration was 3.69 ± 0.32 E-01 pCi/g and represents 6.15% of the Environmental Concentration Guide. The strontium-90 concentrations were above background for the INEEL, but are consistent with historical concentrations at ANL-W.

3.4 Biotic Surveillance

Plant uptake of radionuclides at the RWMC has been documented by the Radiological and Environmental Sciences Laboratory.[44] Therefore, biotic surveillance is conducted at waste management facilities (RWMC and WERF).

At the RWMC, vegetation is collected from the five major areas. Crested wheatgrass is collected in odd-numbered years and is clipped at ground level within a 0.9 × 0.9-m (3 × 3-ft) frame. Russian thistle is collected in even-numbered years, and the entire plant is pulled up within a 0.9 × 0.9-m (3 × 3-ft) frame. Either rabbitbrush or sagebrush is collected in odd-numbered years by clipping 20% of the branches from the designated plants. Thus, the same plant can be sampled biennially. Soil excavated by small burrowing mammals is collected in even-numbered years. Vegetation sample collection from WERF began in 1984 and is scheduled every 3 years.

3.4.1 Data Summary and Assessment for Waste Management Surveillance

3.4.1.1 Russian thistle was scheduled to be collected during 2000. However, due to increased operational activity and the disturbance of the ground cover in and around the RWMC, representative samples could not be obtained; thus, no Russian thistle samples were collected during 2000.

Samples of soil excavated by burrowing animals was scheduled to be collected during 2000 at the RWMC. No samples were collected due to lack of small mammal burrows. Perennials and crested wheatgrass are scheduled to be collected during 2001.

Vegetation collection at WERF is performed every 3 years. The next vegetation (sagebrush) samples are scheduled to be collected during 2002.

3.5 Direct Radiation

Thermoluminescent dosimeters (TLDs) measure cumulative exposures to ambient ionizing radiation for both waste management surveillance and site surveillance (see Appendix A for locations). The TLDs detect changes in ambient exposures attributed to handling, processing, transporting, or disposing radioactive waste. The TLDs are sensitive to beta energies greater than 200 kilo-electron-volts

(KeV) and to gamma energies greater than 10 KeV. The TLD packets contain five lithium fluoride chips and are placed about 0.9 m (3 ft) above the ground at specified locations. The five chips provide replicate measurements at each location. The TLD packets are replaced in May and November of each year. The sampling periods for 2000 were from November 1999 through May 2000 (spring) and from May through November 2000 (fall).

Background exposures result from direct radiation from:

- Natural terrestrial sources (rocks and soil)
- Cosmic radiation
- Fallout from testing nuclear weapons
- Local industrial processes.

The background exposures used in this report are exposure averages measured by TLDs in distant communities located outside the INEEL boundary.

In addition to TLDs, the Environmental Surveillance Program uses a global positioning radiometric scanner system to conduct gamma-radiation surveys. The global positioning radiometric scanner is mounted on a four-wheel drive vehicle; two plastic scintillation detectors identify contaminated areas, and both global positioning system and radiometric data are recorded. The vehicle is driven at approximately 8 kilometers per hour (5 mph) to collect survey data.

3.5.1 Data Summary and Assessment for Waste Management Surveillance

3.5.1.1 *Thermoluminescent Dosimeters.* Thermoluminescent dosimeter cumulative 6-month area exposure data for 1989 through 2000 from RWMC (Subsurface Disposal Area and Transuranic Storage Area) and WERF are presented in Figure 3-7. (Data from the distant communities are excluded from the trend chart.) To indicate the general trend in values over time, data in the graph were smoothed using negative exponential smoothing. The data are plotted on a logarithmic scale to more clearly illustrate the trends. Although some values have cycled, the graph illustrates a gradual declining trend in penetrating radiation exposures over time.

Table 3-11 summarizes TLD exposures for 1999 and 2000 by facility. Figure 3-8 provides box and whisker plots of the TLD exposure by facility (including the distant communities) for both 1999 and 2000. The 1999 TLD exposures are included to illustrate short-term changes in levels.

When comparing the median 2000 exposures to 1999, all groupings increased (WERF, Subsurface Disposal Area, Transuranic Storage Area, and the distant communities). The differences in median exposures for all of the groupings, except for WERF, were statistically significant (at the 0.05 level), using the Kruskal-Wallis test for differences in medians.

Table 3-12 presents thermoluminescent dosimeter exposures for 1999 and 2000 by season. Figure 3-9 presents the thermoluminescent dosimeter exposures (including all facilities and the distant communities) for 1999 and 2000 by season. (The 1999 data are provided for comparison purposes.) From 1999 to 2000, both the overall spring and fall median exposures increased. For 2000, the overall median exposures for the spring (ending May 2000) was 76 mR, while for the fall (ending November 2000) was 71 mR. The Kruskal-Wallis test for differences in medians indicated that the difference in the spring and fall exposures during 2000 was statistically significant (at the 0.05 level).

Figure 3-10 shows the exposures at Stations 40 and 41 (located along the east and northeast borders of the Transuranic Storage Area). Station 41 exposures are expected to remain elevated due to the increased waste stored in the Type II storage buildings.

Station 8 is located 50 m (164 ft) northwest of WERF, which is near a temporary waste storage area. Exposures at Station 8 have changed over the past few years due to periodic movement of waste and are shown in Figure 3-11.

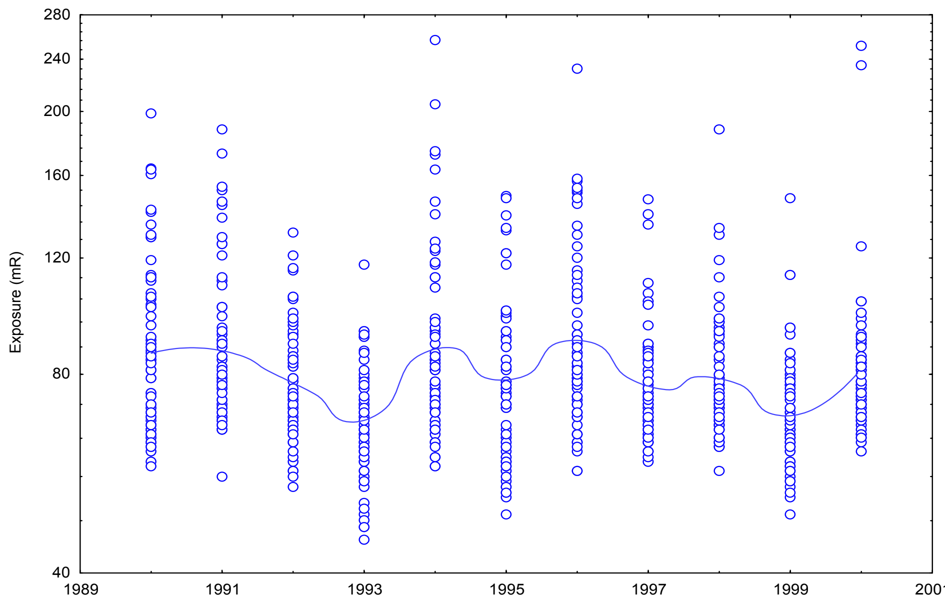


Figure 3-7. 1989–2000 RWMC and WERF thermoluminescent dosimeter exposures using negative exponential smoothing.

Table 3-11. Thermoluminescent dosimeter summary statistics by facility.

Location	Number of Samples	Mean (mR)	Median (mR)	Minimum (mR)	Maximum (mR)
			1999		
Subsurface Disposal Area	38	67	64.5	49	94
Transuranic Storage Area	24	71	63.0	52	148
WERF	22	71	67.0	59	113
Distant Communities	14	58	58.0	50	70
			2000		
Subsurface Disposal Area	37	80	76.0	64	125
Transuranic Storage Area	23	92	77.0	61	251
WERF	22	72	71.0	63	85
Distant Communities	14	67	67.5	60	74

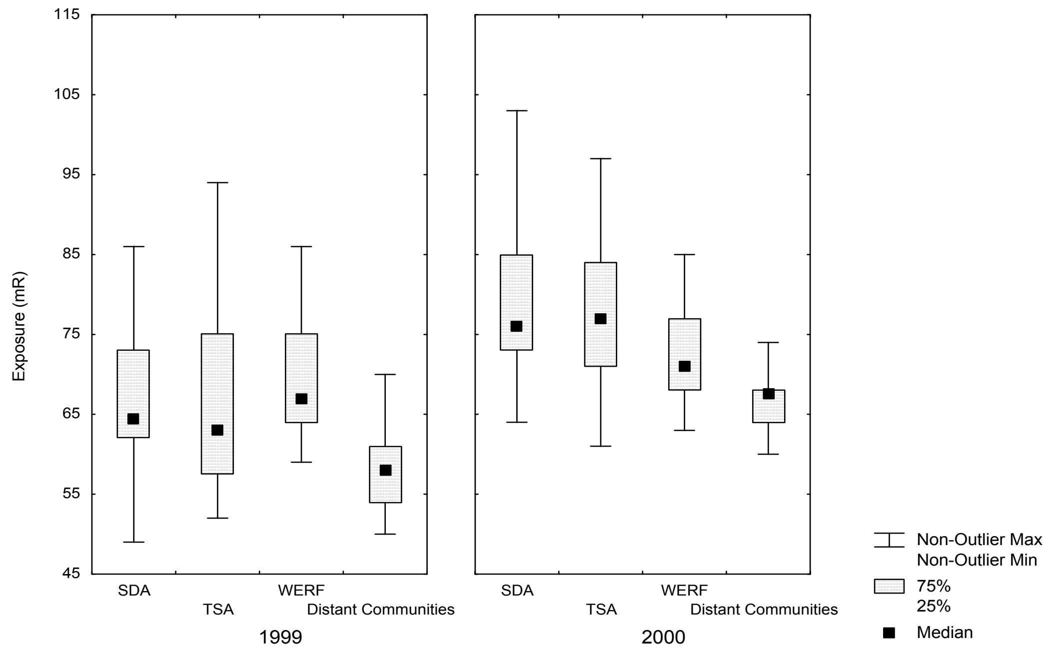


Figure 3-8. Comparison of 1999 and 2000 thermoluminescent dosimeter exposure by facility.

Table 3-12. Thermoluminescent dosimeter summary statistics by season.

Location	Season	Number of Samples	Mean (mR)	Median (mR)	Minimum (mR)	Maximum (mR)
		1999				
SDA	Spring	19	69	66.0	58	94
SDA	Fall	19	65	64.0	49	86
TSA	Spring	12	69	63.5	57	113
TSA	Fall	12	72	62.5	52	148
WERF	Spring	11	68	65.0	59	92
WERF	Fall	11	75	70.0	63	113
Distant Communities	Spring	7	57	58.0	53	61
Distant Communities	Fall	7	59	59.0	50	70
1999 Overall	Spring	49	67	64.0	53	113
1999 Overall	Fall	49	68	65.0	49	148
		2000				
SDA	Spring	19	85	77.0	73	125
SDA	Fall	18	75	72.5	64	92
TSA	Spring	12	93	76.5	68	251
TSA	Fall	11	91	78.0	61	235
WERF	Spring	11	77	77.0	70	85
WERF	Fall	11	67	68.0	63	72
Distant Communities	Spring	7	66	68.0	62	70
Distant Communities	Fall	7	67	67.0	60	74
2000 Overall	Spring	49	83	76.0	62	251
2000 Overall	Fall	47	76	71.0	60	235

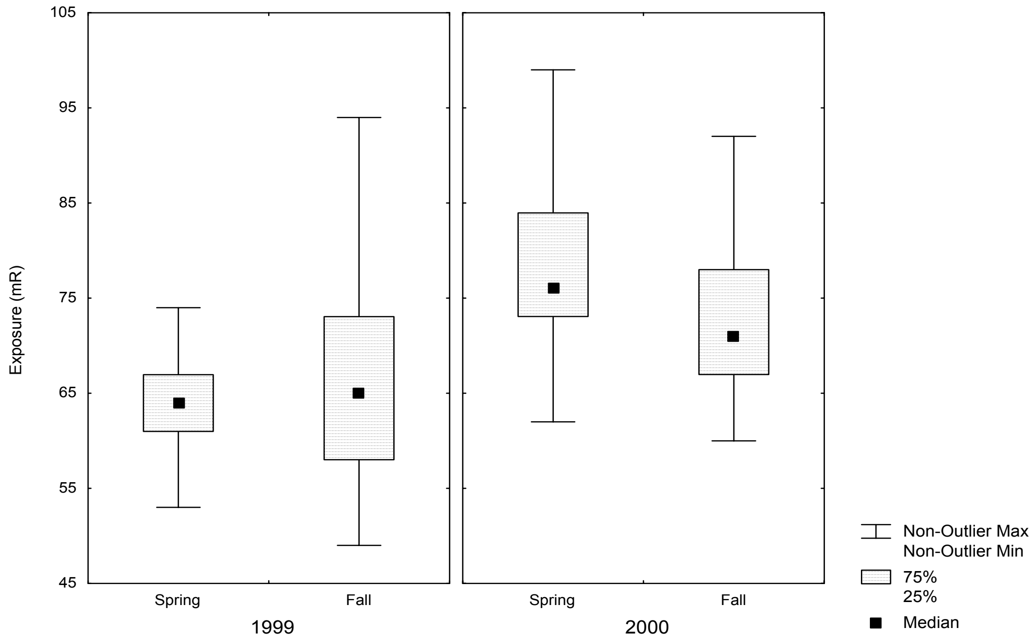
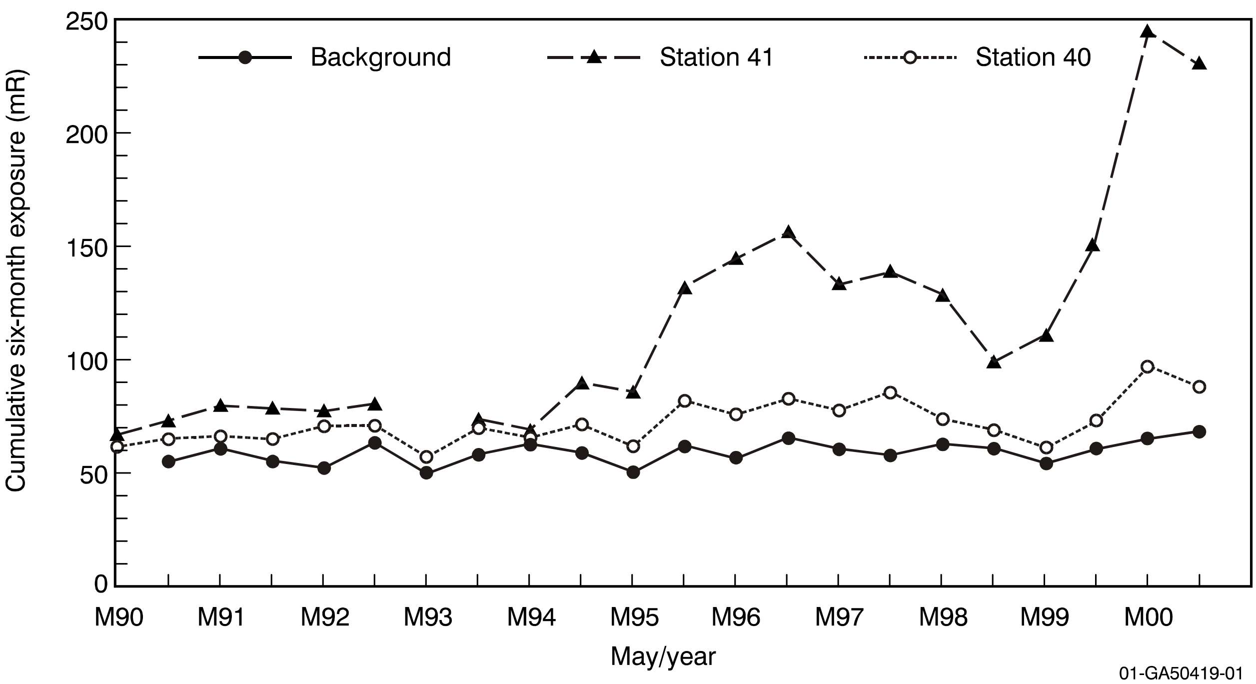


Figure 3-9. Comparison of 1999 and 2000 thermoluminescent dosimeter exposure by season.



NOTE: TLD missing or destroyed in May 1993.

Figure 3-10. Six-month exposures measured by thermoluminescent dosimeters on the east and northeast borders of Transuranic Storage Area.

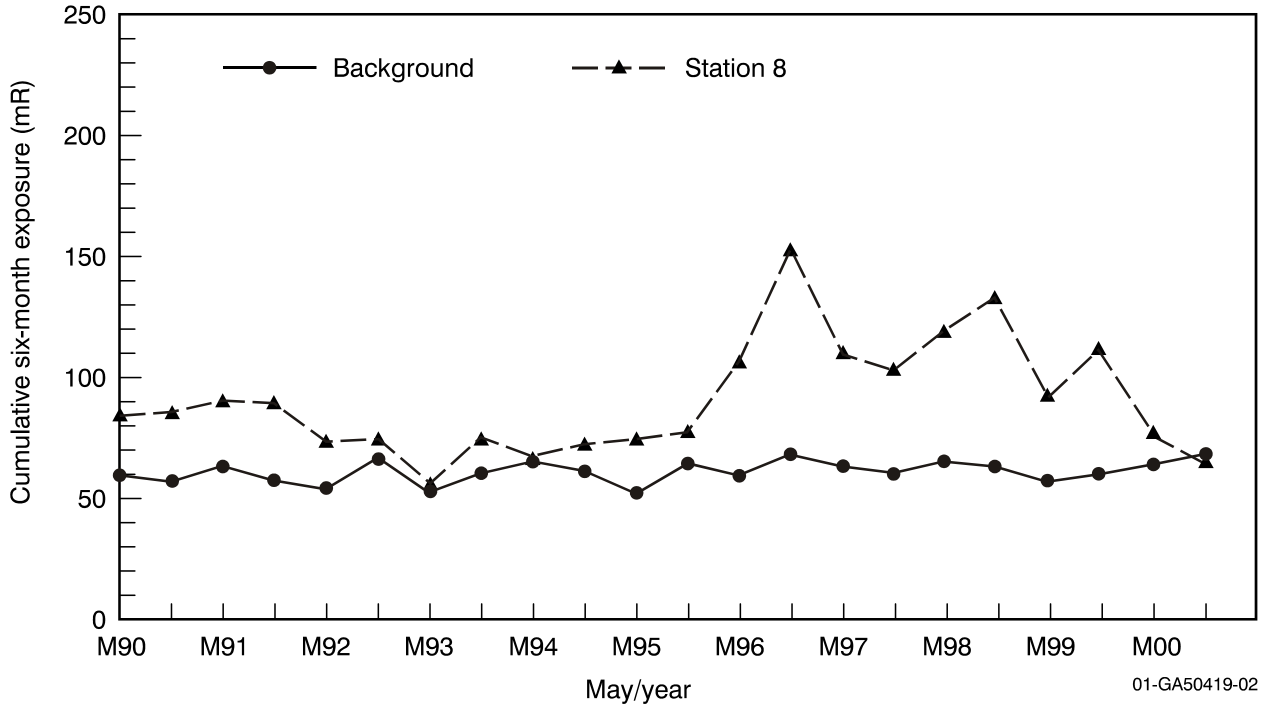


Figure 3-11. Six-month exposures measured by thermoluminescent dosimeters around Waste Experimental Reduction Facility.

3.5.1.2 ***Surface Radiation.*** Figure 3-12 shows the radiation readings from the 2000 RWMC spring global positioning radiometric scanner (GPRS) survey, and Figure 3-13 shows the radiation readings from the 2000 RWMC fall GPRS survey. The spring and fall surveys around the active pit were comparable to or lower than historical measurements for that area. No new elevated readings were identified during either survey. In the spring survey, the maximum activity, excluding the operating low-level waste pit, was 582 microR/hr and located along Soil Vault Row #18. The maximum activity, excluding the operating low-level waste pit, for the fall survey was 607 microR/hr and was also along Soil Vault Row #18. These are comparable to 1999 measurements taken at the same location.

Pad A cannot be surveyed via the GPRS because of driving restrictions. Therefore, it was traversed with a hand-held HHD-440. No elevated readings were identified on Pad A during either survey.

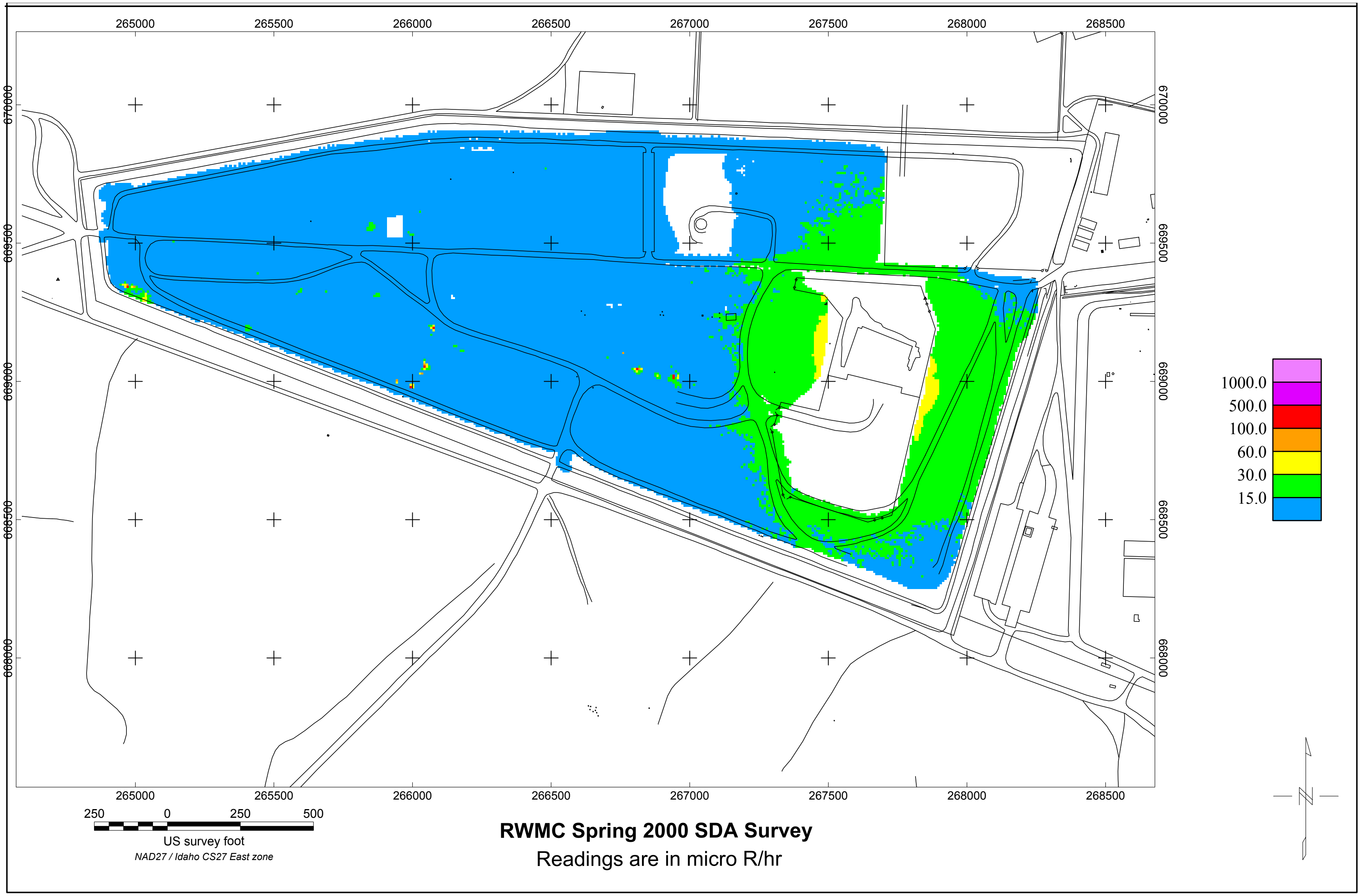


Figure 3-12. Spring 2000 Radioactive Waste Management Complex surface radiation

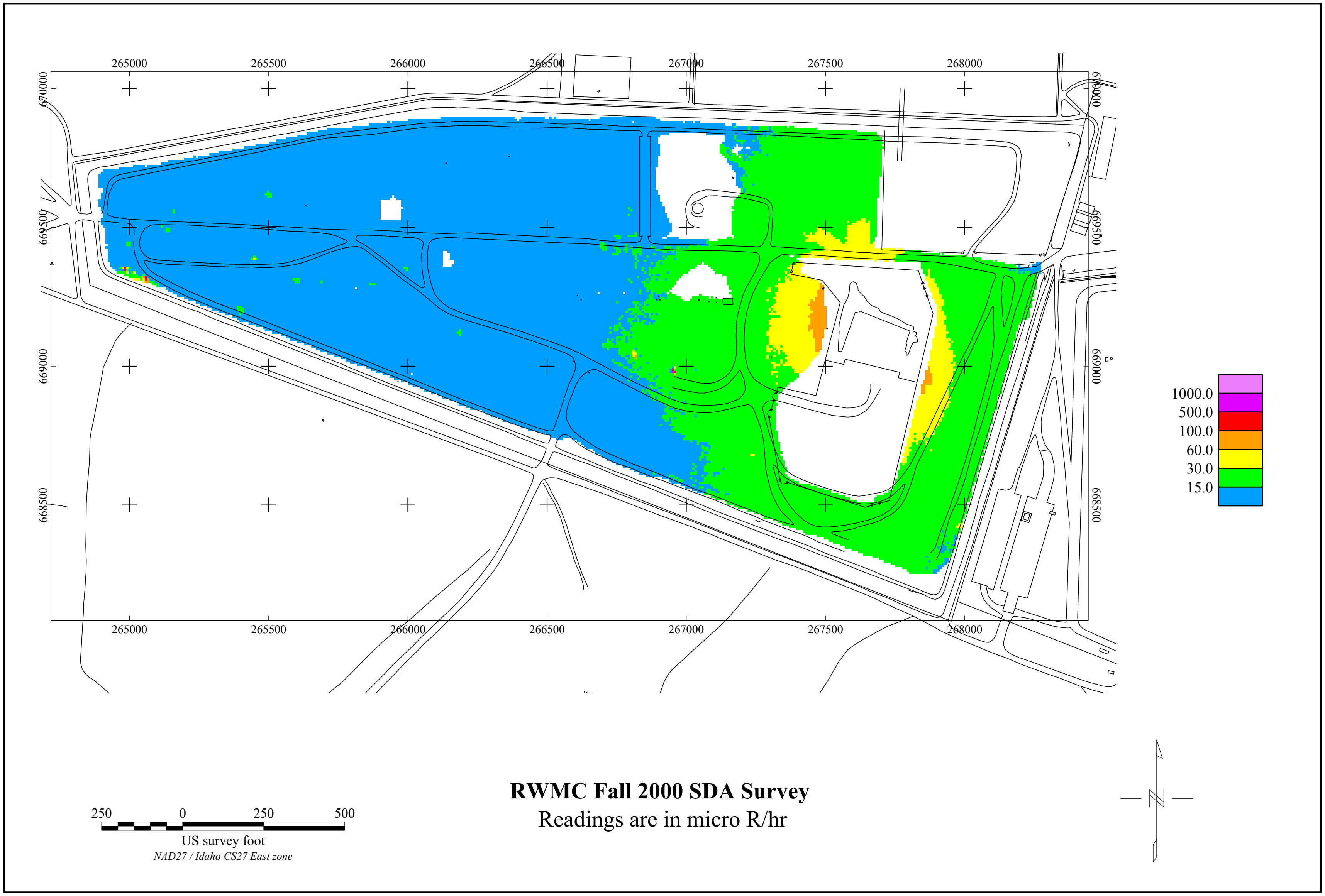


Figure 3-13. Fall 2000 Radioactive Waste Management Complex surface radiation

3.5.2 Data Summary and Assessment for Site Surveillance

3.5.2.1 ***Thermoluminescent Dosimeters.*** Table 3-13 shows the maximum TLD exposures from the site surveillances from 1996 through 2000.

The ICPP 9 TLD is located in a controlled access area, which used to be a contaminated soil area, and ICPP 20 is near a radioactive material storage area. Calendar Year 2000 exposures at ICPP 9, ICPP 20, and INTEC Tree Farm 1 were all comparable to historical exposures.

TRA 2, 3, and 4 are adjacent to the former radioactive disposal pond, which has been drained and covered with clean soil. These locations are also close to a radioactive storage area, which is inside the facility fence line. TRA 3 had the maximum exposure at 692 ± 98 mR. This location is the closest to the radioactive storage area, where the amount of temporarily stored material increased.

Table 3-13. Comparison of the site surveillance 2000 thermoluminescent dosimeter exposures to past exposures.

	Maximum Annual Exposures[a] (mR)				
Location	1996	1997	1998	1999	2000
ICPP 9	283 ± 36	196 ± 16	200 ± 16	172 ± 22	211 ± 29
ICPP 20	251 ± 26	245 ± 20	233 ± 18	229 ± 32	268 ± 37
INTEC Tree Farm 1	214 ± 30	208 ± 24	214 ± 24	163 ± 18	205 ± 29
TRA 2	270 ± 20	257 ± 18	293 ± 24	254 ± 32	466 ± 68
TRA 3	345 ± 32	328 ± 28	574 ± 116	468 ± 42	692 ± 98
TRA 4	255 ± 20	246 ± 24	250 ± 12	215 ± 22	282 ± 39

a. Uncertainties shown are the associated 2 sigma.

b. Removed during decontamination and decommission.

3.6 Quality Assurance/Quality Control

The management and operating contractor analytical laboratories analyze all Environmental Surveillance Program samples as specified in the statements of work. These laboratories participate in a variety of intercomparison quality assurance programs, which verify all the methods used to analyze environmental samples. The programs include the DOE Environmental Measurements Laboratory Quality Assurance Program and the Environmental Protection Agency Environmental Measurements Systems Laboratory Quality Assurance Program. The results of quality control sample analyses and laboratory performance in these programs are available in the annual site environmental report.[41] The laboratories met the performance objectives specified by the Environmental Measurements Laboratory and Environmental Measurements Systems Laboratory.

The Environmental Surveillance Program met its completeness goals. Samples were collected and analyzed as planned from all available media. The Environmental Surveillance Program submitted duplicate, blank, and control samples with routine samples for analyses. Quality assurance/quality control samples were also routinely submitted with program samples and demonstrated an acceptable agreement ratio with spiked values for all radionuclides.