5.0 Air Pathway

This chapter describes the air pathway monitoring program used to track and evaluate airborne emissions from the Fernald site. It includes a discussion of radiological air particulates, radon, direct radiation, and biota monitoring. In addition, this chapter provides a summary of radiological emissions from stacks and vents, as well as non-radiological emissions associated with the combustion of fossil fuel.

Results in Brief: 2003 Air Pathway

Radiological Air Particulates — Data collected from fenceline air monitoring stations show that average concentrations for each radionuclide monitored were less than 1 percent of the corresponding DOE-derived concentration guide.

Radon — There were no exceedances of the DOE standard (3 pCi/L annual average above background) at the site fenceline and off-property locations. The maximum annual average concentration at the FCP fenceline measured by continuous radon monitors was 0.3 pCi/L above background.

Direct Radiation — Direct radiation measurements decreased significantly at the site fenceline and the K-65 Silos boundary when compared to 2002. This was attributed to the operation of the RCS.

Boiler Plant — There were no opacity excursions reported during 2003.

Biota – Uranium results were less than detectable in 21 of 28 samples, with the remaining samples within historical ranges. Thorium-230 analyses also indicated results significantly less than 1 percent of the applicable standard. The results suggest there is no substantial impact from past or current FCP emissions on locally grown produce.

Air pathway monitoring focuses on airborne pollutants that may be carried from the site as a particle or gas, and how these pollutants are distributed in the environment. The physical form and chemical composition of pollutants influence how they are dispersed in the environment and how they may deliver radiation doses. For example, fine particles and gases remain suspended, while larger, heavier particles tend to settle and deposit on the ground. Chemical properties determine whether the pollutant will dissolve in water, be absorbed by plants and animals, or settle in sediment and soil.

Monitoring the air pathway is critical to ensuring the continued protection of the public and the environment during the remediation process because airborne contaminants can potentially migrate beyond the Fernald site. The site's air monitoring approach (presented in the IEMP) provides an ongoing assessment of the collective emissions originating from remediation activities. The results of this assessment are used to provide feedback to remediation project organizations regarding the sitewide effectiveness of project-specific emission controls relative to DOE, EPA, and OEPA standards. In response to this feedback, project organizations modify or maintain emission controls.

5.1 Remediation Activities Affecting the Air Pathway

When the mission of the Fernald site changed from production to remediation, work activities also changed. This change in work scope altered the characteristics of sources that emit pollutants in the environment via the air pathway. During the production years, the primary emission sources were point sources (i.e., stacks and vents) from process facilities. Today the dominant emission sources are associated with remediation activities in the form of fugitive emissions (i.e., excavation, hauling and processing of waste and contaminated soil, demolition of production facilities, and general construction activities supporting the remediation process), and the storage of radon-generating waste materials.

The following primary emission sources were active during 2003:

- Decontamination and demolition activities, most notably Plant 2/3 and Plant 8 (Operable Unit 3)
- Excavation of the waste pits and the associated waste processing and rail car load-out operations at the Waste Pits Project (Operable Unit 1)
- Excavation of contaminated soil and debris (Operable Unit 5)
- Construction activities associated with the on-site disposal facility including excavation, screening, and hauling activities in the on-site disposal facility borrow area (Operable Unit 2)
- Transportation and placement of contaminated material in the on-site disposal facility and interim storage at the on-site material transfer area (Operable Unit 2)
- Construction activities associated with the Silos Project (Operable Unit 4).

Each project is responsible for designing and implementing engineered and administrative controls for each remediation activity. The fugitive emissions control policy mandates that fugitive emissions be visually monitored and controls be implemented as necessary. The following types of controls are used to keep point source and fugitive emissions to a minimum.

- **Engineered Controls** − Typical engineered controls include physical barriers, wetting agents, filtration, fixatives, sealants, dust suppressants and control, collection, and treatment systems. Engineered designs help reduce point source and fugitive emissions by using the best available technology. The selection of the best available technology for controlling project emissions is conducted during the design process and frequently includes the evaluation of several treatment alternatives.
- **Administrative Controls** − Typical administrative controls include management and control procedures; record keeping; periodic assessments; and established speed limits, control zones, and construction zones.

5.2 Air Monitoring Program Summary for 2003

The site's air monitoring program, as defined in the IEMP, is comprised of three distinct components:

- Radiological air particulate monitoring
- Radon monitoring
- Direct radiation monitoring.

Each component of the air monitoring program is designed to address a unique aspect of air pathway monitoring, and as such, reflects distinct sampling methodologies and analytical procedures. The key elements of the air monitoring program design are:

- **Sampling** – Sample locations, frequency, and the constituents were selected to address DOE and EPA requirements for assessing radiological emissions from the Fernald site. Key considerations in the design of the sampling program included prevailing wind directions, location of potential sources of emissions, and the location of off-property receptors. The IEMP program includes monitoring radiological air particulates at 18 locations, radon measurements at 33 locations, and direct radiation at 37 locations on and off the property.
- **Data Evaluation** – The data evaluation process focuses on tracking and trending data against historical ranges and DOE, EPA, and OEPA standards. Each section in this chapter presents an evaluation of data and a comparison to applicable standards and guidelines.
- **Reporting** – All data are reported through the IEMP program and annual site environmental reports.

5.3 Radiological Air Particulate Sampling Results

As described in the IEMP, Revision 3, a network of 18 high-volume air particulate monitoring stations is used to measure the collective contributions from all fugitive and point source particulate emissions from the site. The IEMP, Revision 3, differs from Revision 2 with regard to air monitoring because there was a reduction from two background air monitors to one background air monitor. The current monitoring network includes 16 monitoring locations on the fenceline and one background location. In addition, one thorium monitor was operated on the western fenceline. Figure 5-1 provides the locations of the IEMP air monitoring stations.

The sampling and analysis program for the 16 fenceline and background locations consists of biweekly total uranium and total particulate analyses, and monthly composites (eight times per year) for isotopic thorium analyses, in addition to a quarterly composite sample. The quarterly composite sample is analyzed for the expected major contributors (i.e., uranium, thorium, and radium) to the radiological air inhalation dose at the site's boundary. The thorium monitor includes biweekly particulate and monthly isotopic thorium analyses. Analytical data from this program are used to assess the effectiveness of the emission control practices throughout the year to ensure particulate emissions remain below health protective standards.

The radiological air particulate monitoring program is designed to demonstrate compliance with the following:

- NESHAP Subpart H requirements which stipulate that radionuclide emissions (not including radon) to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem in a year above background levels. This dose is reported in the annual NESHAP Subpart H compliance report and is included as Appendix D of this report.
- DOE Order 5400.5, Radiation Protection of the Public and Environment (DOE 1990b), guidelines for concentrations of radionuclides in air emissions. These guidelines, referred to as derived concentration guide values, are concentrations of radionuclides that, under conditions of continuous exposure for one year by one exposure mode (e.g., inhalation or ingestion), would result in a dose of 100 mrem to the public. These derived concentration guide values are not limits, but serve as reference values to assist in evaluating the radiological air particulate data.

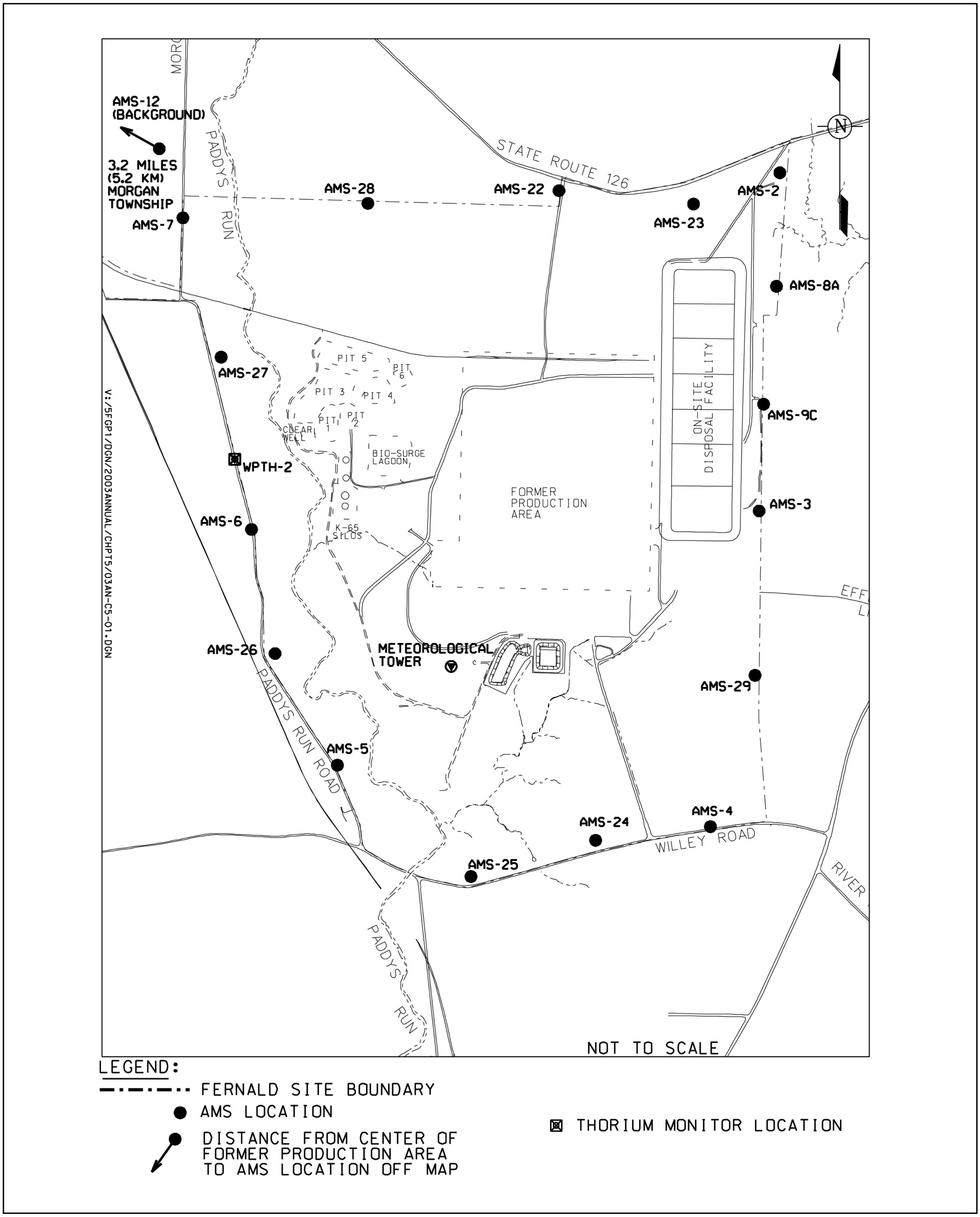

Figure 5-1. Radiological Air Monitoring Locations

Table 5-1 presents a summary of the minimum, maximum, and average concentrations for total uranium, thorium-230, and total particulate in 2002 and 2003 based on the biweekly and monthly sample results used for monitoring air emission trends. For 2003 the annual average concentrations of total uranium at all fenceline air monitoring stations were less than 1 percent of the DOE derived concentration guide (DCG) value (0.1 picoCuries per cubic meter [pCi/m^3]). In 2003 total uranium at all air monitoring locations ranged from 3.3E-06 pCi/m^3 to a maximum concentration of 2.3E-03 pCi/m^3 at AMS-3. For comparison, the background location ranged from 3.2E-06 pCi/m^3 to 4.0 E-05 pCi/m^3.

TABLE 5-1

SUMMARY OF BIWEEKLY TOTAL URANIUM, TOTAL PARTICULATE, AND MONTHLY THORIUM-230 CONCENTRATIONS IN AIR

Location	2003 Total Uranium (pCi/m^3)	2002 Total Uranium (pCi/m^3)	2003 Total Particulate (μg/m^3)	2002 Total Particulate (μg/m^3)	2003 Thorium-230 (pCi/m^3)	2002 Thorium-230 (pCi/m^3)
Fenceline Locations						
Minimum	3.3E-06	0.0E+00	5	13	0.0E+00	0.0E+00
Maximum	2.3E-03	1.9E-03	124	94	2.1E-04	5.8E-04
Average	1.7E-04	1.1E-04	34	34	6.0E-05	6.2E-05
Background Locations						
Minimum	3.2E-06	0.0E+00	14	4	0.0E+00	0.0E+00
Maximum	4.0E-05	6.3E-05	48	100	3.6E-05	1.5E-04
Average	1.4E-05	1.8E-05	25	38	1.2E-05	1.1E-05

Biweekly thorium monitoring at the fenceline provides timely feedback on project engineered and administrative controls that are implemented to control fugitive emissions, primarily at the Waste Pits Project. The fenceline concentrations of thorium-230 (the primary thorium isotope of concern in the waste pit material being excavated) ranged from less-than-detectable to 2.1E-04 pCi/m^3, which was detected at AMS-3. For comparison, the background location ranged from less-than-detectable to 3.6E-05 pCi/m^3.

In addition to the total uranium and isotopic thorium analyses, total particulate measurements are also obtained from each filter every two weeks as summarized in Table 5-1. Total particulate concentrations at the fenceline ranged from 5 micrograms per cubic meter (μg/m^3) to a maximum of 124 μg/m^3 at AMS-26. There are no general or site-specific regulatory limits associated with total particulate measurements used in the data evaluation process.

Total particulate, total uranium, and thorium-230 data were collectively evaluated to identify any increasing trends that may be related to remediation activities. Several temporary increases of these three constituents were observed at various monitoring locations; however, the short-lived increases did not pose a potential exceedance of the NESHAP dose limit of 10 mrem or DOE guidelines. The majority of increases in total uranium and thorium-230 concentrations were detected at some of the air monitoring stations on the eastern fenceline (AMS-3, AMS-8A, and AMS-9C) during 2003. Figures 5-2 and 5-3 show total uranium and thorium-230 concentrations, respectively, at the selected eastern fenceline locations. These temporary increases were due to the remediation activities associated with the Waste Pits Project, on-site disposal facility and its associated material transfer area, and decontamination and demolition activities. The radiological air particulate data are discussed with remediation project personnel to ensure that emission controls are operating as expected and to consider actions as necessary. Appendix C, Attachment C.1, of this report provides graphical displays of the 2003 total uranium, thorium-230, and total particulate data.

Quarterly composite air filter samples were formed from the biweekly samples at each IEMP air monitoring station during 2003 to determine the radiological air inhalation dose for each location. The samples were analyzed for isotopes of radium, thorium, and uranium. The quarterly results were used to track compliance with the NESHAP 10-mrem dose limit throughout the year and to demonstrate compliance with the limit at the end of 2003. The maximum dose associated with the quarterly composite results for 2003 was 0.82 mrem (compared to the 10-mrem limit) and occurred at AMS-9C. The composite results from the fenceline monitors show that, on average, thorium isotopes contribute 42 percent of the dose from 2003 airborne emissions. Isotopes of uranium and radium account for 39 and 2 percent of the dose, respectively. The higher percentage of dose from thorium isotopes is a result of thorium-230 becoming the major dose contributor through fugitive emissions from Waste Pits Project operations. Thorium-230 became the major dose contributor beginning in 2000 with the commencement of Waste Pits Project excavation activities. Given the methods required to excavate, transport, and process waste pit material, fugitive emissions were expected to increase the average concentration of thorium-230 at the fenceline. Although the project used several environmental compliance-based dust abatement practices and controls, some fugitive emissions were expected from the project based on the large-scale waste handling operations. Chapter 6 and Appendix D of this report provide more detailed information on the dose associated with the composite results.

The annual average radionuclide concentrations at each air monitoring station, as determined from the quarterly composite results, were compared to the DOE-derived concentration guide values. At each monitoring station, the annual average radionuclide concentrations were below 1 percent of the corresponding DOE-derived concentration guide values.

The WPTH-2 fenceline monitor was installed in late 1998 on the west property boundary to specifically monitor thorium emissions from the Waste Pits Project. Measured airborne concentrations of thorium-228 and thorium-232 were comparable to background concentrations throughout 2003. These fenceline data reflect that, in comparison to thorium-230, the concentrations of thorium-228 and thorium-232 in the waste pit material were relatively low in 2003. Appendix C, Attachment C.1, of this report provides graphical displays of the isotopic thorium data from the WPTH-2 monitor.

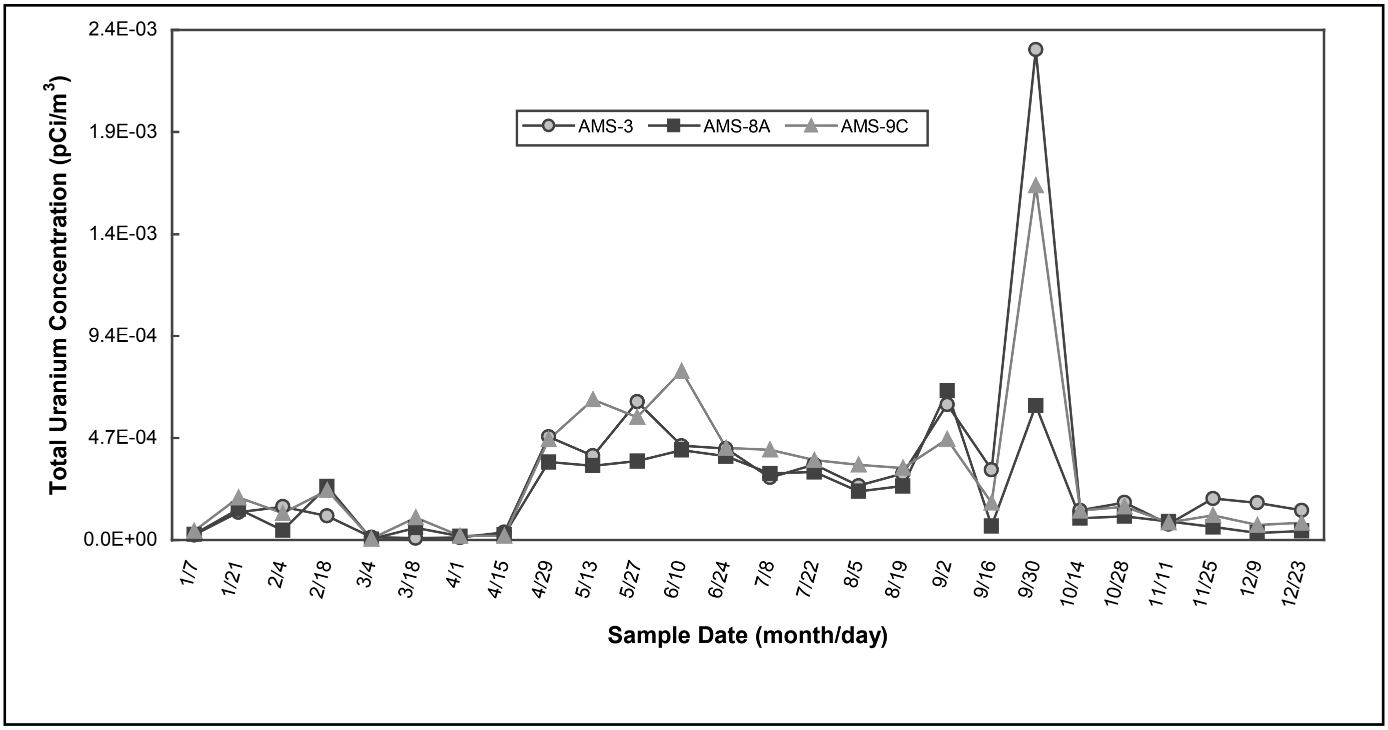

Figure 5-2. 2003 Total Uranium Concentrations in Air at Selected East Fenceline Monitors (AMS-3, AMS-8A, and AMS-9C)

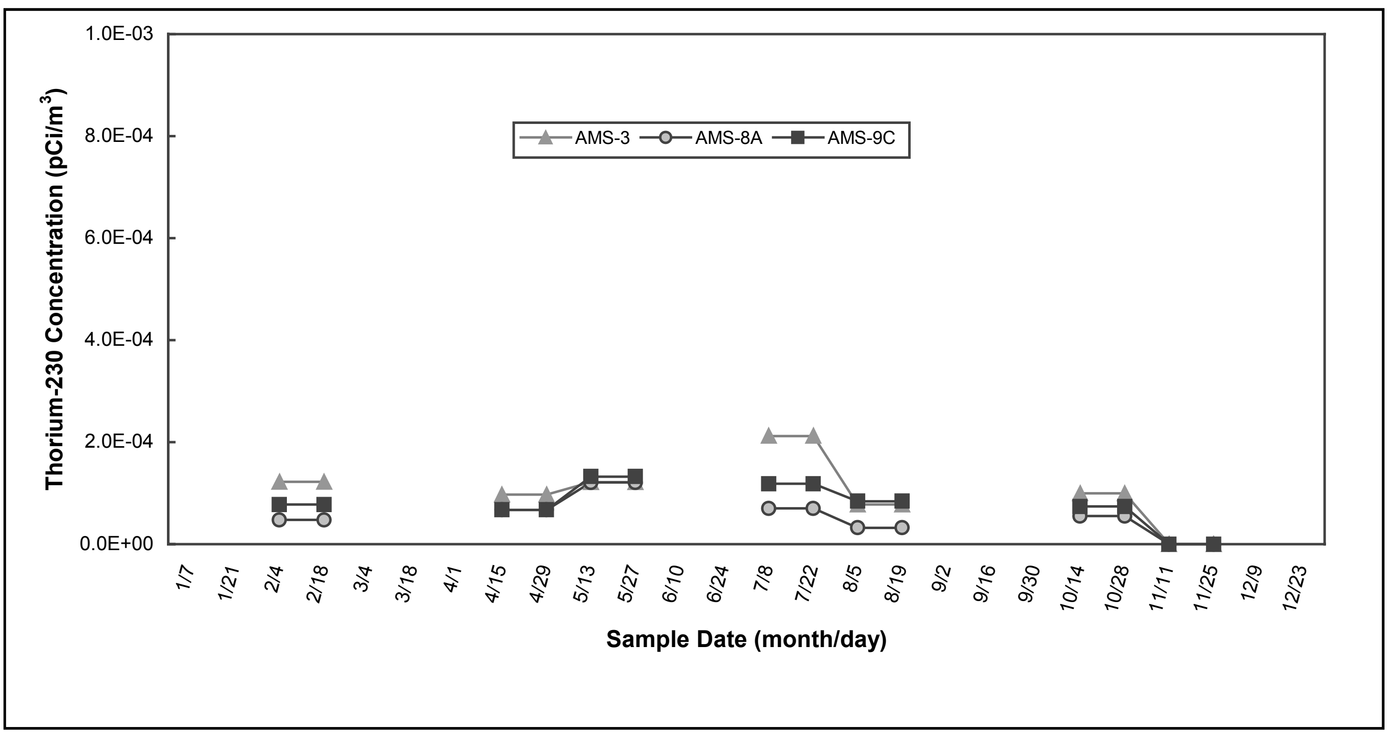

Figure 5-3. 2003 Thorium-230 Concentrations in Air at Selected East Fenceline Monitors (AMS-3, AMS-8A, and AMS-9C)

5.4 Radon Monitoring

Radon-222 (referred to in this section as radon) is a naturally occurring radioactive gas. It is produced by radioactive decay of radium-226, which can be found in varying concentrations in the earth's crust. Radon is also chemically inert, and tends to diffuse from the earth's crust to the atmosphere. The concentration of radon in the environment is dynamic and exhibits daily, seasonal, and annual variability.

Many factors influence the concentration of radon in the environment, including the distribution of radium-226 in the ground, porosity of the soil, weather conditions, etc. For instance, radon diffusion from the ground is minimized by the presence of precipitation and snow cover. Alternatively, elevated temperatures and the absence of precipitation can produce cracks in the ground and changes in porosity that increase the rate at which radon escapes. A summary of meteorological data from 2003 is presented in Figures 1-7 through 1-10 in Chapter 1, and Appendix C, Attachment C.5, of this report.

Environmental radon concentrations are also influenced by atmospheric conditions. During periods of calm winds and temperature inversions (when the air near the earth's surface is cooler than the air above it), air is held near the earth's surface, minimizing the mixing of air. Consequently, radon's movement is limited vertically and concentrations tend to increase near the ground.

Waste material that produces radon is stored at the Fernald site. This waste was generated from uranium extraction processes performed decades ago and contains radium-226. This material is contained in K-65 Silos 1 and 2, and Silo 3 (part of the Operable Unit 4 remediation) and the waste pits (currently being remediated per the Operable Unit 1 Record of Decision).

DOE Order 5400.5 defines radiological protection requirements, guidelines for cleanup of residual radioactive material, management of resulting wastes and residues, and the release of radiological property. Radon limits at interim storage facilities (such as at the Fernald site) are also defined under DOE Order 5400.5 and must not exceed:

- 100 pCi/L at any given location and any given time
- Annual average concentration of 30 pCi/L (above background) over the facility
- Annual average concentration of 3 pCi/L (above background) at and beyond the facility fenceline.

Figure 5-4 illustrates the continuous radon monitoring network used in 2003 for determining compliance with the above limits. The continuous monitoring network provides frequent feedback to remediation projects, regulatory agencies, and stakeholders on trends in ambient radon concentrations, while providing sufficient radon monitoring to ensure compliance with DOE Order 5400.5 requirements. Access to real-time radon monitoring data from selected continuous radon monitoring locations is available at the Public Environmental Information Center.

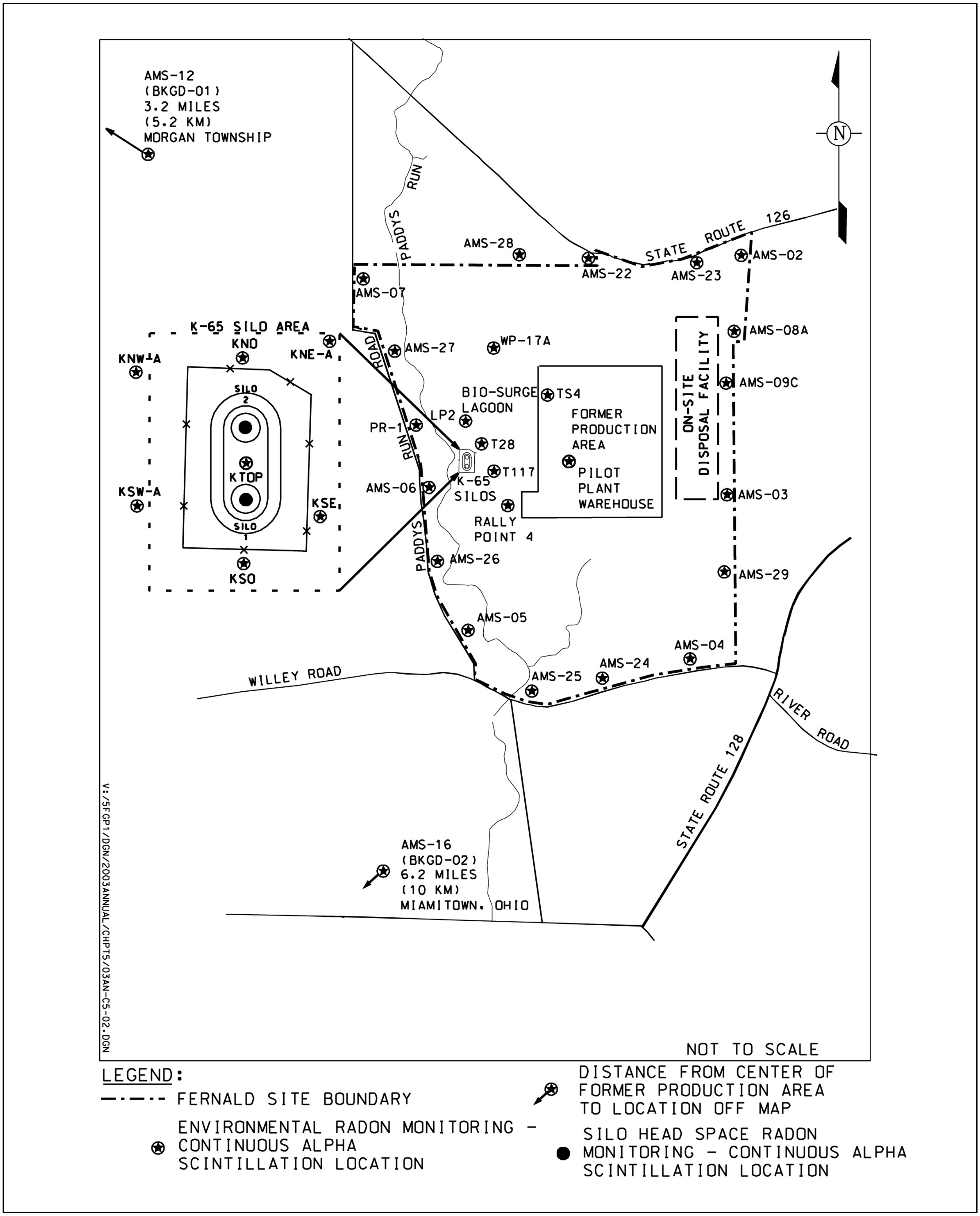

Figure 5-4. Radon Monitoring Locations

In general, monitoring locations were selected near radon-emitting sources, at the property fenceline, and at background locations. The FFA identifies additional environmental radon monitoring locations, as well as continuous measurement of radon concentrations in the headspace of the K-65 Silos. DOE guidance and EPA air monitor siting criteria were considered when selecting monitoring locations.

5.4.1 Continuous Radon Monitors

Continuous radon monitors use scintillation cells to continuously monitor environmental radon concentrations based on an hourly average. Radon gas in ambient air diffuses into the scintillation cell through a foam barrier without the aid of a pump (this technique is called passive sampling). Inside the cell, radon decays into more radioactive material (progeny products), which gives off alpha particles. The alpha particles interact with the scintillation material inside the cell, producing light pulses. The light pulses are amplified and counted. The number of light pulses counted is proportional to the radon concentration inside the cell.

Continuous monitors reveal important information regarding the dynamics of radon concentrations at different times during the day and at various locations on and off site. These monitors allow for timely review of radon concentrations, which may indicate concentrations are significantly changing from day to day and week to week. However, the use of these monitors is restricted by certain conditions. For example, potential monitoring sites are limited by the availability of electricity.

Table 5-2 provides monthly average radon concentration data from the continuous radon monitors for 2003. The data are used to track radon concentrations throughout the year to ensure the DOE limits are not exceeded. In addition to the summary data presented here, Appendix C, Attachment C.2, of this report provides graphical displays of monthly average radon concentrations from continuous radon monitors during 2003 and 2002.

Results from the fenceline monitoring locations indicate radon levels for 2003 were within historical ranges and well below the DOE limit of 3 pCi/L above background. The annual average radon concentrations at the fenceline ranged from 0.2 to 0.6 pCi/L. The annual average radon concentration at the background monitoring location was 0.3 pCi/L. A review of site fenceline data suggests that during 2003, Waste Pits Project operations did not significantly impact the radon concentrations at the site fenceline (refer to Table 5-2).

TABLE 5-2
CONTINUOUS ENVIRONMENTAL RADON MONITORING MONTHLY AVERAGE CONCENTRATIONS[a]

Location[b]	2003 Summary Results[c] (Instrument Background Corrected) (pCi/L) Min.	Max.	Avg.	2002 Summary Results[c] (Instrument Background Corrected) (pCi/L) Min.	Max.	Avg.
Fenceline						
AMS-02	0.1	0.6	0.3	0.0	0.8	0.4
AMS-03	0.1	0.5	0.3	0.2	0.8	0.4
AMS-04	0.2	0.6	0.4	0.1	0.7	0.3
AMS-05	0.2	0.9	0.4	0.1	0.9	0.4
AMS-06	0.3	0.8	0.5	0.1	0.8	0.4
AMS-07	0.3	0.9	0.6	0.2	1.2	0.5
AMS-08A	0.2	0.4	0.3	0.1	0.7	0.3
AMS-09C	0.2	0.5	0.4	0.0	0.7	0.3
AMS-22	0.1	0.4	0.2	0.1	0.6	0.2
AMS-23	0.2	0.4	0.3	0.0	0.4	0.2
AMS-24	0.3	0.7	0.5	0.1	1.1	0.4
AMS-25	0.2	0.6	0.3	0.1	0.8	0.3
AMS-26	0.2	0.6	0.4	0.1	0.7	0.3
AMS-27	0.2	0.8	0.5	0.1	1.0	0.4
AMS-28	0.3	0.9	0.5	0.1	0.8	0.4
AMS-29	0.2	0.5	0.4	0.1	0.5	0.3
Background						
AMS-12	0.2	0.4	0.3	0.1	0.5	0.2
On Site						
KNE-B	0.4	2.9	1.1	1.4	5.6	3.7
KN0	0.4	3.1	1.0	1.1	2.7	1.7
KNW-A	0.4	1.4	0.7	0.5	2.0	1.1
KSE	0.3	4.0	1.0	1.1	3.6	2.4
KSO	0.3	0.8	0.6	0.2	1.2	0.6
KSW-A	0.4	1.5	0.9	0.7	1.7	1.0
KTOP	0.4	12	3.3	2.8	8.8	4.7
LP2	0.4	0.9	0.7	0.4	1.4	0.8
Pilot Plant Warehouse	0.2	0.8	0.4	0.1	0.7	0.4
PR-1	0.3	0.8	0.5	0.1	1.2	0.5
Rally Point 4	0.3	0.7	0.5	0.2	0.8	0.4
Surge Lagoon	0.2	0.8	0.5	0.4	1.3	0.8
T117A	0.2	0.5	0.4	0.2	1.0	0.4
T28	0.2	0.9	0.6	0.4	1.0	0.6
TS4[d]	0.1	0.4	0.2	0.1	1.1	0.6
WP-17A	0.1	0.8	0.4	0.1	1.1	0.5

[a]Monthly average radon concentrations are calculated from the daily average concentrations.
[b]Refer to Figure 5-4 for sample locations.
[c]Instrument background changes as monitors are replaced.
[d]TS4 was removed from service in July 2003.

In accordance with the FFA, radon concentrations within the headspace of K-65 Silos 1 and 2 are continuously monitored to assess the effectiveness of control measures in reducing radon emissions. From 1993 to 2002, there was a gradual upward trend in silo headspace radon concentrations. The increases in the headspace concentration were attributable to degradation of the 1991 application of bentonite clay to the surface of the K-65 Silo residues. In December 2002 the headspace radon concentrations were temporarily lowered through the initial short-term test of the RCS. The headspace concentrations remained consistent through the end of April 2003. At that time, the RCS began operating on a fairly continual basis. Due to the operation of the RCS, radon headspace concentrations indicated a sharp drop, which lasted through 2003. Appendix C, Attachment C.2, of this report provides a graphical display of monthly average radon concentrations from continuous radon monitors for 2002 and 2003.

During 2003 there were no exceedance events related to the 100-pCi/L DOE limit measured on site, as compared with 10 recorded in 2002. The decrease in the exceedance events is attributable to the operation of the K-65 Silos RCS.

Long-term comparisons are performed on average radon concentrations recorded at the K-65 Silos exclusion fence locations. Historical alpha track-etch and continuous alpha scintillation detector data were used for this comparison (refer to Figure 5-5). The average concentrations adjacent to the K-65 Silos remain below the levels observed prior to the addition of bentonite to the K-65 Silos in 1991.

Long-term comparisons are also performed on average radon concentrations at western property fenceline locations and background locations as a basis for comparison to the 3-pCi/L annual average limit. In 2003 a marginal difference in radon concentrations was observed between background and western property fenceline monitoring locations (refer to Figure 5-6). The on-property monitoring locations also recorded radon levels well below the applicable DOE annual average limit of 30 pCi/L.

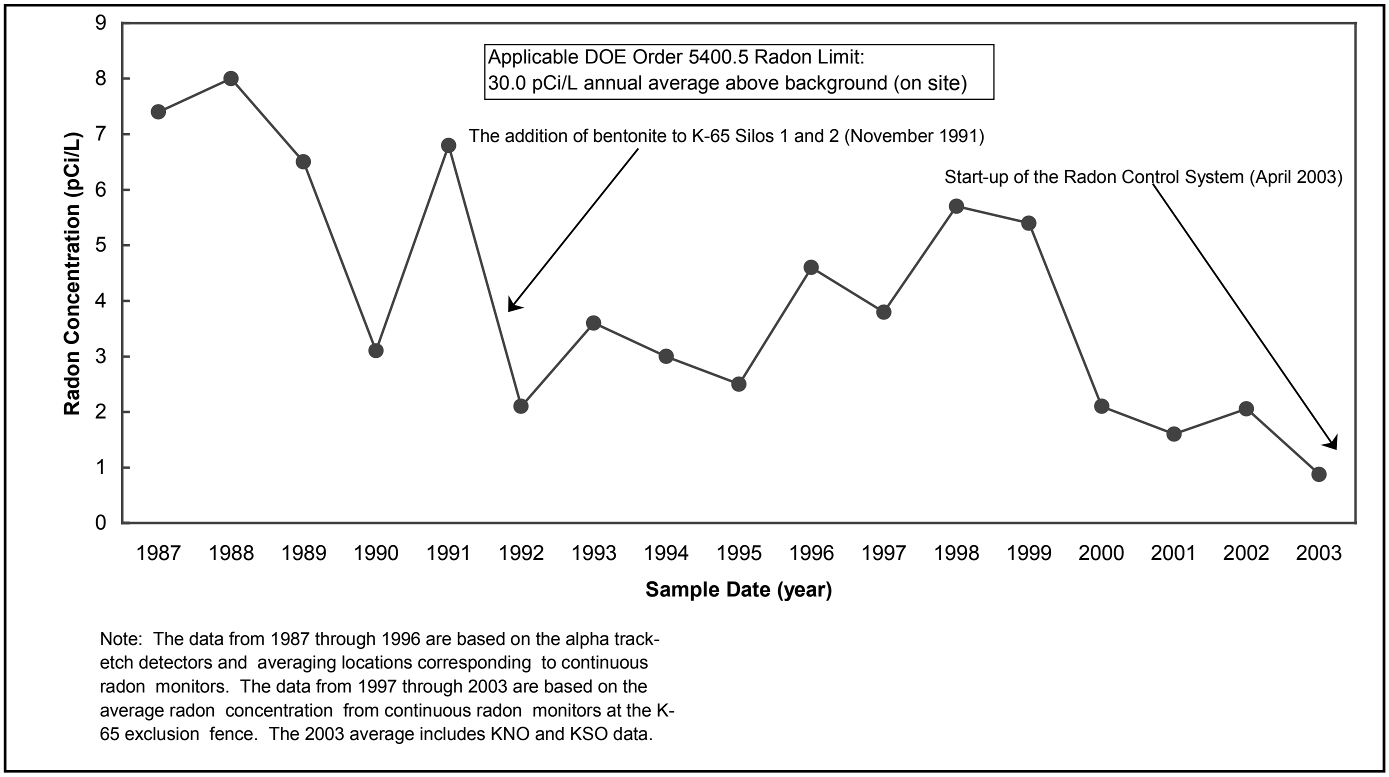

Figure 5-5. Annual Average Radon Concentrations at K-65 Silos Exclusion Fence, 1987-2003

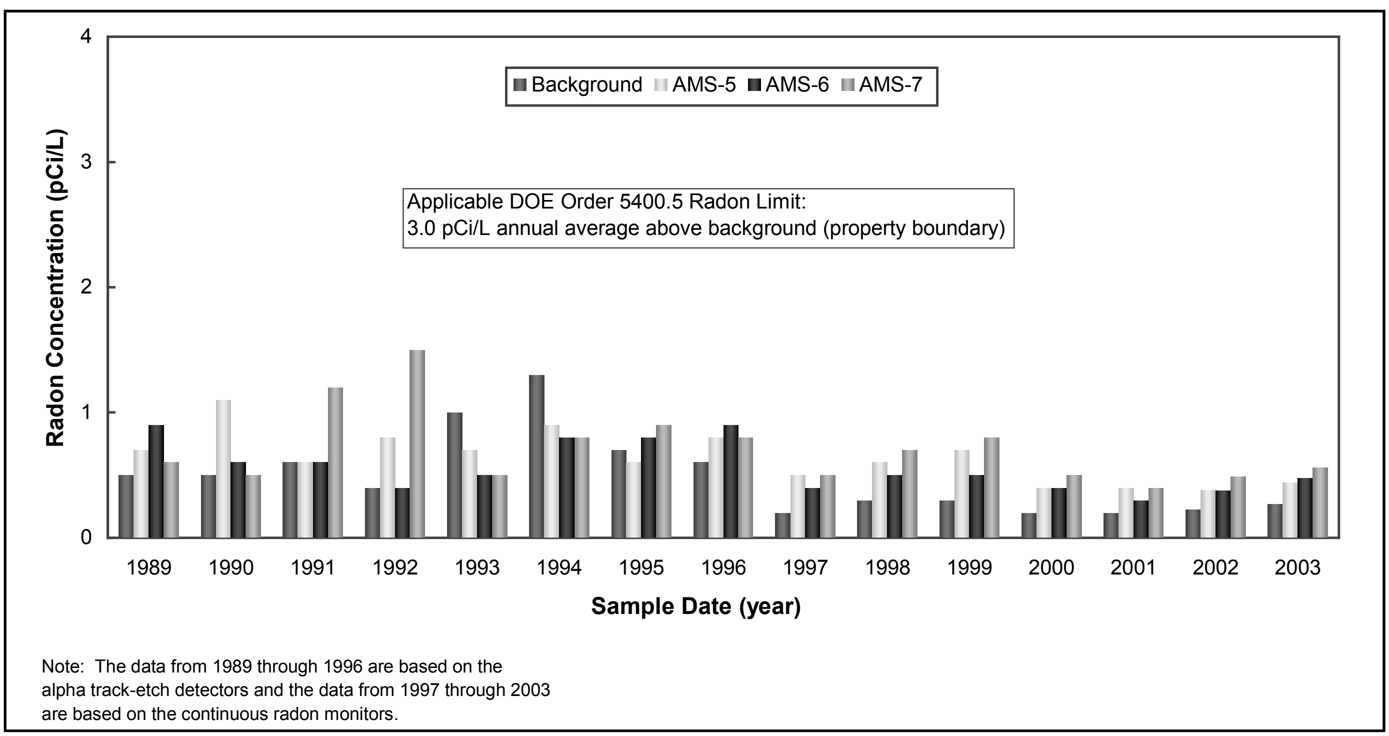

Figure 5-6. Annual Average Radon Concentrations at Selected Radon Locations, 1989-2003

5.5 Monitoring for Direct Radiation

Direct radiation (e.g., X-rays, gamma rays, energetic beta particles, and neutrons) originates from sources such as cosmic radiation, naturally occurring radionuclides in soil, as well as radioactive materials at the Fernald site. The largest source of direct radiation is the material stored in K-65 Silos 1 and 2. Gamma rays and X-rays are the dominant types of radiation emitted from the silos. Energetic beta particles, alpha particles, and neutrons are not a significant component of direct radiation at the Fernald site because uranium, thorium, and their decay products do not emit these types of radiation at levels that create a public exposure concern.

Direct radiation levels at and around the Fernald site were continuously measured at 37 locations with thermoluminescent dosimeters (TLDs) during 2003. TLDs absorb and store the energy of direct radiation within the thermoluminescent material. By heating the thermoluminescent material under controlled conditions in a laboratory, the stored energy is released as light, measured, and correlated to the amount of direct radiation. Figure 5-7 identifies the TLD monitoring locations. These monitoring locations were selected based on the need to monitor the K-65 Silos, the fenceline, and background locations. Table 5-3 provides summary level information pertaining to direct radiation measurements for 2003 and 2002.

TABLE 5-3
DIRECT RADIATION (THERMOLUMINESCENT DOSIMETER) MEASUREMENT SUMMARY

	Direct Radiation (mrem)	
TLD Location	**Summary of 2003 Results**	**Summary of 2002 Results**
Fenceline (21 locations)		
Minimum	64	71
Maximum	76	97
On Site (11 locations)		
Minimum (Health and Safety Bldg.)	56	56
Maximum (K-65 Silo area)	445	1,220
Background (5 locations)		
Minimum	61	70
Maximum	71	83

All monitoring results from TLDs for 2003 were within historical or expected ranges. From 1993 to 2001, there was a gradual upward trend in direct radiation measurements in the immediate area of the K-65 Silos, which stabilized in 2002 (refer to Figure 5-8). During 2003 there was a significant decrease in the direct radiation levels. This was attributed to a reduction of the radon concentrations and associated decay products within the K-65 Silos' headspace. This reduction was accomplished through operations of the Silos Project RCS.

The increasing trend in direct radiation levels at the site's western fenceline (1998 through 2001) also stabilized in 2002. During 2003 there was a significant decrease, particularly at TLD location 6, which is located closest to the K-65 Silos (refer to Figure 5-9). These changes at the fenceline are also attributable to the reduction of radon concentrations and associated decay products within the K-65 Silos' headspace by the operation of the RCS.

Chapter 6 provides more information on the dose associated with the direct radiation results. Detailed results of direct radiation measurements for 2003 and 2002 are provided in Appendix C, Attachment C.3, of this report.

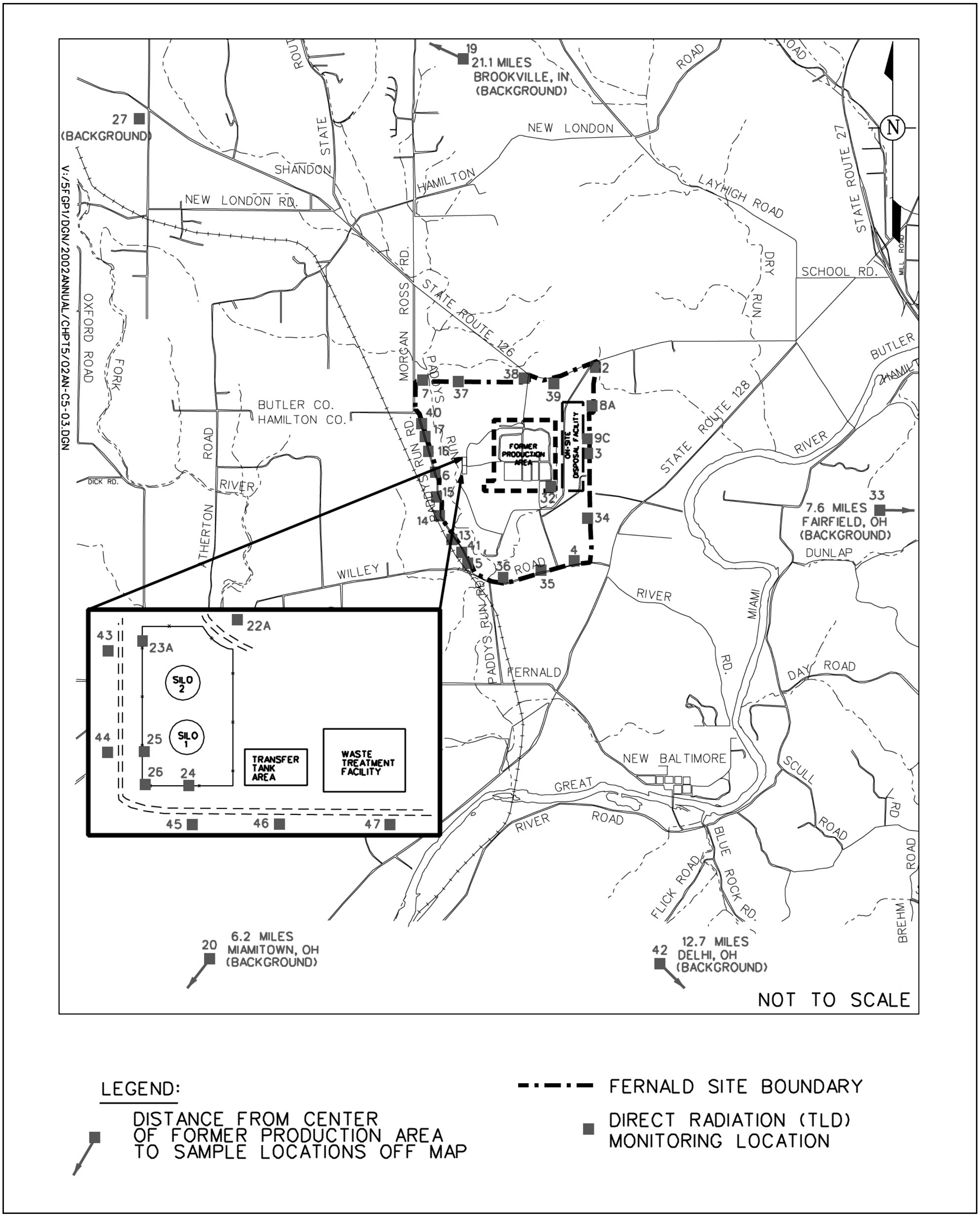

Figure 5-7. Direct Radiation (TLD) Monitoring Locations

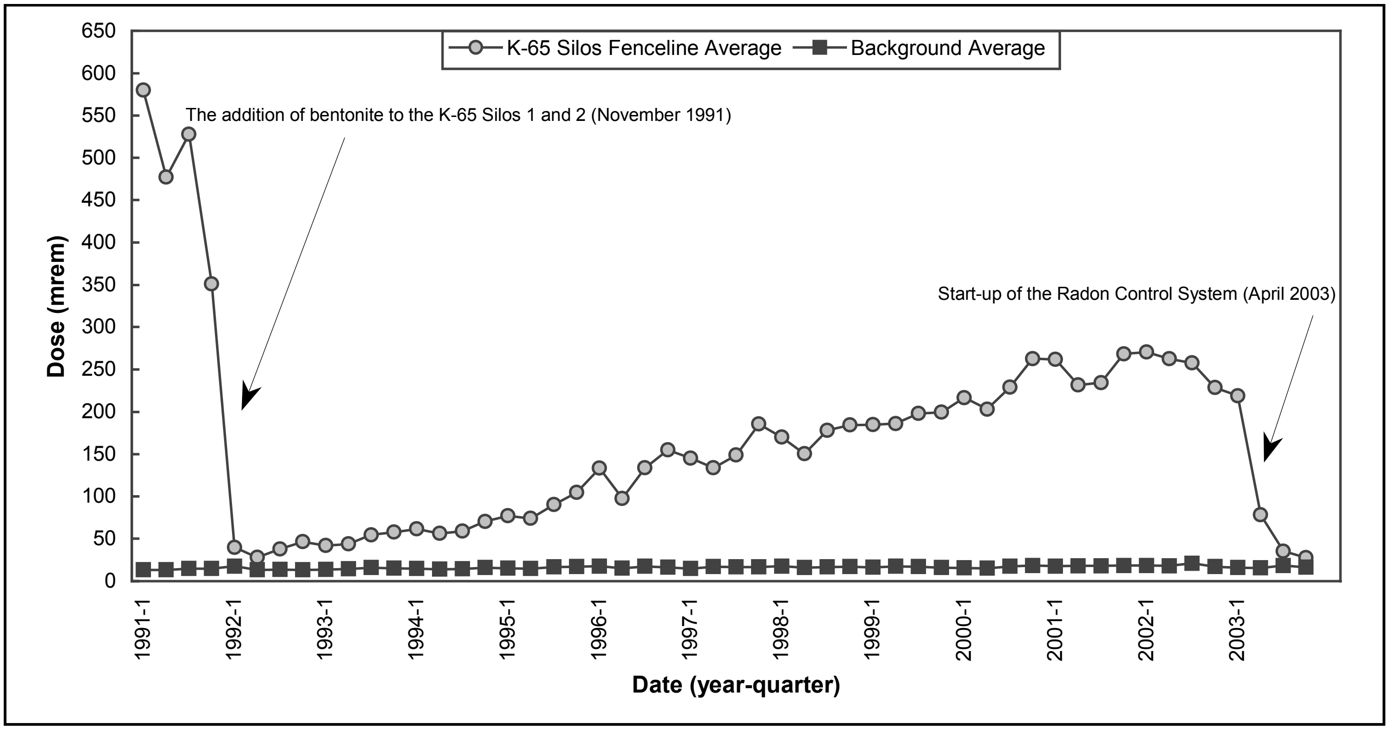

Figure 5-8. Direct Radiation (TLD) Measurements at K-65 Silos Boundary, 1991-2003 (K-65 Silos Fenceline Average vs. Background Average)

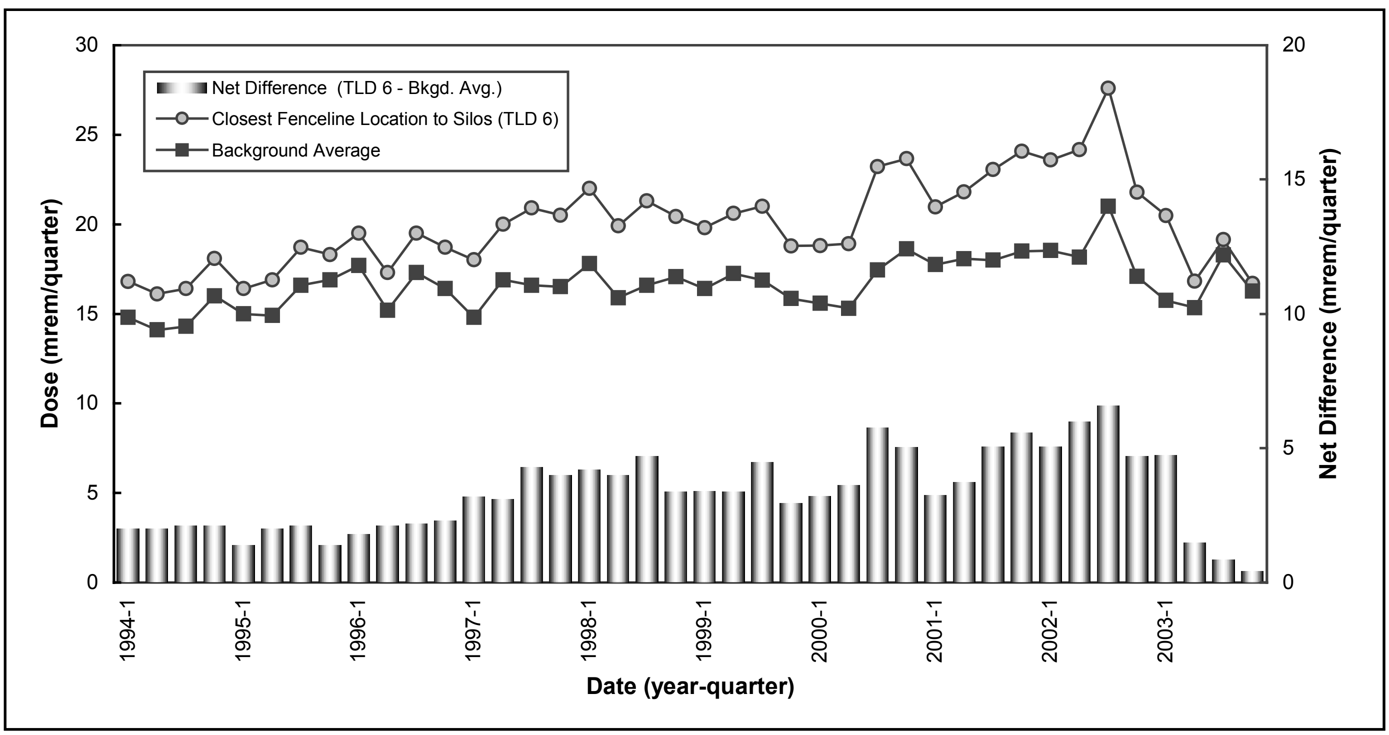

Figure 5-9. Direct Radiation (TLD) Measurements, 1994-2003 (Location 6 vs. Background Average)

5.6 Stack Monitoring for Radionuclide Emissions

During 2003 there were four stacks (or vents) that were monitored for radionuclide emissions as part of the requirements under the NESHAP Subpart H. The locations of the four stacks are show in Figure 5-10. Stack sampling systems typically consist of a continuously operating pump that draws a representative volume of air from the stack through a filter or, in the case of radon monitoring, through a detector. Periodically, the filter is exchanged and analyzed for radiological contaminants that have the potential to be released during remediation activities or processes.

The Building 71 stack filters were analyzed for total particulates, total uranium, and isotopes of uranium and thorium. Results for 2003 were very low and comparable to 2002 results. The results confirm that emissions from the waste processing operations conducted in Building 71 were not a significant source of airborne emissions to the environment. With the Building 71 waste processing operations completed at the end of the second quarter 2003, the Building 71 stack was removed from service on July 1, 2003.

The Waste Pits Project dryer stack particulate filters were analyzed for isotopes of uranium, thorium, and radium. The results confirmed that Waste Pits Project stack particulate emissions are very low and are not the primary source of thorium-230 concentrations at the site fenceline. The stack also contains a continuous radon monitor (for radon-220 and radon-222). The maximum hourly release rate of radon (radon-220 and radon-222) during 2003 was 6,081 microCuries per hour (µCi/hr), which is below the estimated maximum hourly release rate of 13,000 µCi/hr (DOE 1998b) for radon-222. Note there were no exceedances in 2003 of the 13,000 µCi/hr value. The total annual release of radon through the stack was estimated to be 7,680,000 microCuries (µCi). No significant changes in source operations associated with the Waste Pits Project dryer stack were noted during 2003.

In 2003 the Waste Pits Project pugmill ventilation stack (PVS) particulate filters were analyzed for isotopes of uranium, thorium, and radium. The results confirmed that Waste Pits Project PVS particulate emissions are very low and are not the primary source of thorium-230 concentrations at the site fenceline. No significant changes in source operations associated with the Waste Pits Project PVS were noted during 2003.

In 2003 the Silos Project RCS stack particulate filters were analyzed for total particulates, isotopes of uranium, thorium, radium, and polonium, in addition to radon monitoring. The results confirm that the Silos RCS stack particulate and radon emissions are very low. The maximum instantaneous measurement of radon being released from the stack was 203 µCi, and the total annual release of radon through the stack was estimated to be 3,380,000 µCi.

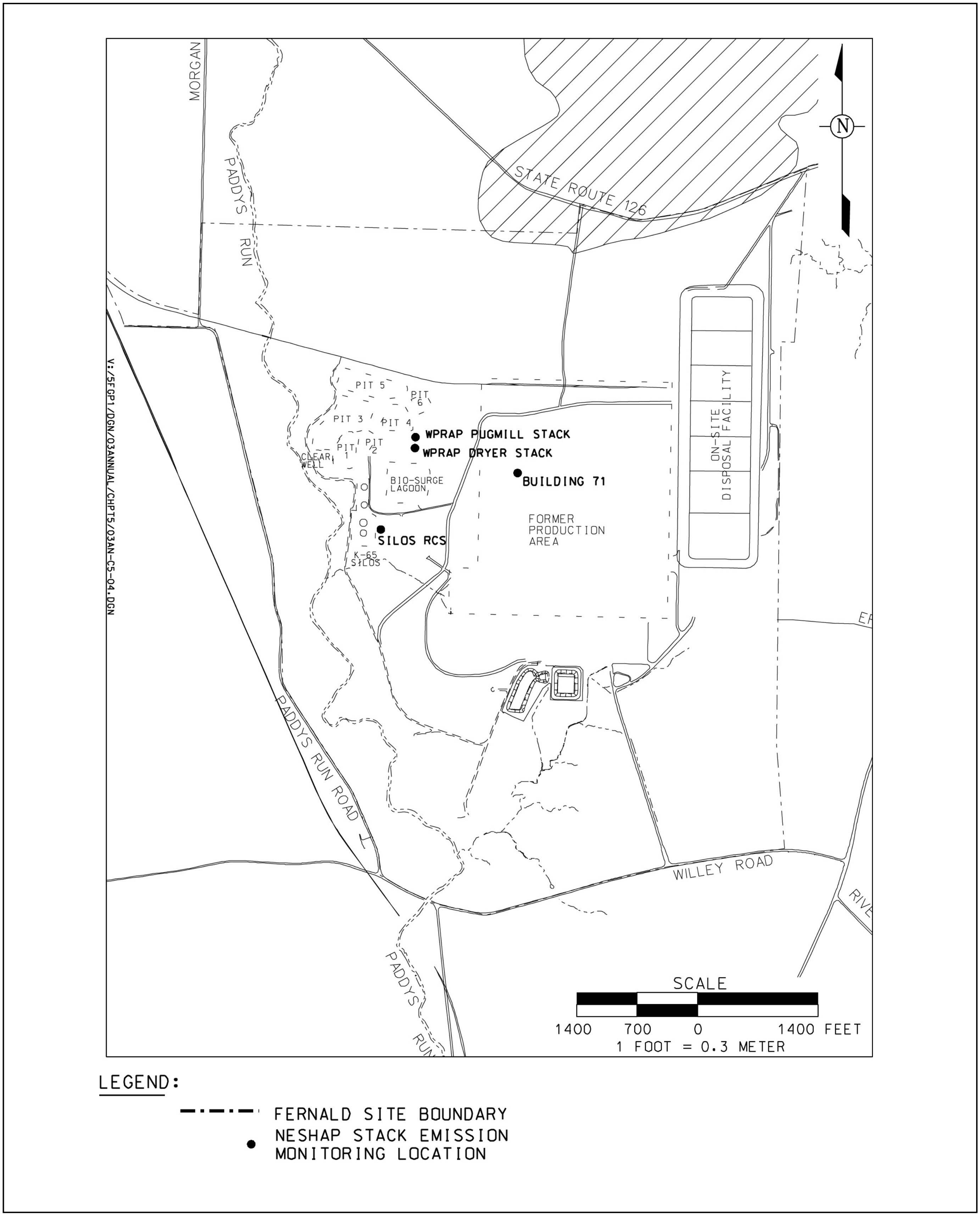

Figure 5-10. NESHAP Stack Emission Monitoring Locations

Table 5-4 presents the 2003 stack results for total particulates, radionuclides, and radon measurements. Typically, post-production era (i.e., 1990 and later) monitoring data have shown stack emissions of radionuclides to be very low or not detectable. The use of high-efficiency particulate air (HEPA) filtration systems in many remediation activities and processes effectively controls stack emissions and limits the release of airborne contaminants. In summary, the 2003 stack emissions are consistent with the low stack emission data for the post-production period.

TABLE 5-4
2003 NESHAP STACK EMISSIONS

Radionuclide (Unit)	WPP Dryer Stack[a, b]	WPP PVS Stack[a, b]	Silos RCS Stack[a, b]	Building 71 Stack[a, b]
Total Uranium (lbs/yr)	NS	NS	NS	8.8E-06
Uranium-238 (lbs/yr)	3.1E-05	1.2E-03	3.1E-05	2.8E-05
Uranium-235/236 (lbs/yr)	2.0E-07	3.4E-06	5.7E-07	6.3E-07
Uranium-234 (lbs/yr)	1.1E-09	3.1E-08	2.1E-09	1.6E-09
Thorium-232 (lbs/yr)	4.1E-06	2.6E-04	6.1E-05	2.2E-05
Thorium-230 (lbs/yr)	4.9E-10	4.4E-08	3.6E-09	3.6E-10
Thorium-228 (lbs/yr)	1.1E-15	4.4E-14	8.2E-15	9.1E-16
Thorium-227 (lbs/yr)	NS	NS	ND	NS
Radium-226 (lbs/yr)	4.6E-13	3.2E-11	ND	NS
Polonium-210 (lbs/yr)	NS	NS	6.3E-15	NS
Total Particulates (lbs/yr)	NS	NS	1.5E-01	0.0E+00
Total Radon (mCi/yr)	7,680	NS	3,380	NS

[a]Includes probe rinse results.
[b]NS = not sampled
ND = not detectable

5.7 Monitoring for Non-Radiological Pollutants

The FCP continued to operate the Waste Pits Project gas-fired dryers during 2003. The estimated emissions from the dryer operations were based on emission factors from the AP-42 technical reference document (Compilation of Air Pollution Emission Factors, Vol. 1; Stationary Point and Area Sources, 5th edition, January 1995 [EPA 1995]). The sulfur dioxide emissions were estimated to be 206 pounds (94 kg). Nitrogen oxide emissions for 2003 were estimated to be 17,192 pounds (7,805 kg). Carbon monoxide emissions were estimated to be 28,882 pounds (13,112 kg). The estimate for particulate as PM10 (particles with an aerodynamic diameter less than or equal to a nominal 10 micron) was 2,613 pounds (1,186 kg). Non-methane total organic compound emissions for 2003 were estimated to be 2,991 pounds (1,358 kg). There are no regulatory limits associated with non-radiological pollutants from the dryers; however, the dryers are required to employ the best available technology to limit emissions. In order to meet the best available technology requirement, burners designed to lower emissions of nitrogen oxides are used in the dryers.

OEPA requires an estimate of emissions from the boiler plant as part of the FCP's effort to demonstrate compliance with the Clean Air Act. The boilers at the site are dual fired by natural gas and diesel fuel. Non-radiological pollutants from boiler operations include particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, and non-methane total organic compounds. Opacity is a measure of how much light is blocked by particulate matter present in stack emissions. Excursions occur when regulatory limits for opacity are exceeded. There were no opacity excursions at the boilers for 2003. There have been no excursions since the site converted from coal-fired boilers to natural gas/diesel-fired boilers in 1997. By mid-2003 the services of the natural gas/diesel-fired boilers were no longer needed; therefore, the natural gas/diesel-fired boilers were permanently shut down on May 1, 2003.

In order to estimate sulfur dioxide emissions, scientists determine the sulfur and heat content of the fuel. Using this information and the total amount of fuel burned, the amount of sulfur dioxide emissions can be calculated. For 2003 sulfur dioxide emissions from all boilers were calculated at 28.6 pounds (13 kg). This was well below the allowable limit of 79 tons (72 metric tons) per year calculated from information in permits issued by OEPA.

The nitrogen oxide emissions were estimated using data obtained from stack emission test results. Nitrogen oxide emissions for all boilers for 2003 were estimated at 2,976 pounds (1,351 kg). Carbon monoxide emissions, based on emission factors from AP-42 for all boilers in 2003, were estimated at 2,674 pounds (1,214 kg). To date, OEPA has not set nitrogen oxide or carbon monoxide limits for the Fernald site. Particulate matter emissions, based on emission factors from AP-42 for all boilers in 2003, were estimated at 246 pounds (112 kg). This was below the allowable limit of 6.3 tons (5.7 metric tons) per year calculated from information in the permits issued by OEPA. Non-methane total organic compounds, based on emission factors from AP-42 for all boilers in 2003, were estimated at 276 pounds (125 kg). Table 5-5 provides a comprehensive list of 2003 emissions from the Waste Pits Project dryers and boiler plant.

TABLE 5-5
CHEMICAL EMISSIONS FROM WASTE PITS PROJECT DRYERS AND BOILER PLANT

Chemical Name	Emissions from WPP Dryers (lb/kg)	Emissions from Boiler Plant (lb/kg)	Sources of Emissions	Basis of Estimate
Particulates	2,613/1,186	246/112	Fossil Fuel Combustion	AP-42 Emission Factors[a]
Sulfur Dioxide	206/94	28.6/13	Fossil Fuel Combustion	AP-42 Emission Factors[a] or sulfur content of fuel
Nitrogen Oxide	17,192/7,805	2,976/1,351	Fossil Fuel Combustion	Stack Emission Test Results for natural gas or AP-42 Emission Factors[a] for diesel fuel
Carbon Monoxide	28,882/13,112	2,674/1,214	Fossil Fuel Combustion	AP-42 Emission Factors[a]
Non-Methane Total Organic Compounds	2,991/1,358	276/125	Fossil Fuel Combustion	AP-42 Emission Factors[a]

[a]Compilation of Air Pollution Emission Factors, Vol. 1; Stationary Point and Area Sources, 5th edition, January 1995 (EPA 1995); Section 1.3, Fuel Oil Combustion, Final Section, Supplement E, September 1998; and Section 1.4, Natural Gas Combustion, Final Section, Supplement D, July 1998.

5.8 Biota (Produce) Sampling

As mentioned in Chapter 1, the Fernald site is surrounded by farmland. Locally grown sweet corn and tomatoes are two of the major crops sold from roadside stands within 3 miles (4.8 km) of the FCP. Local residents also grow apples, beets, feed corn, cucumbers, lettuce, peppers, potatoes, soybeans, and squash.

Under the IEMP, produce is sampled once every three years to ensure that airborne emissions from the remediation of the site are not adversely affecting produce grown near the FCP. In 2003 produce and grain samples from 15 locations were collected and then analyzed for uranium and thorium-230. Figure 5-11 depicts produce monitoring locations. Historically, produce samples have been analyzed for uranium only because it has been the major contributor to dose from airborne emissions at the FCP. With the start of the Waste Pits Project in late 1999, thorium-230 has become the major contributor to dose via the air inhalation pathway. Therefore, thorium-230 analysis of produce samples was initiated in 2000. Table 5-6 presents the summary results of the produce sampling program.

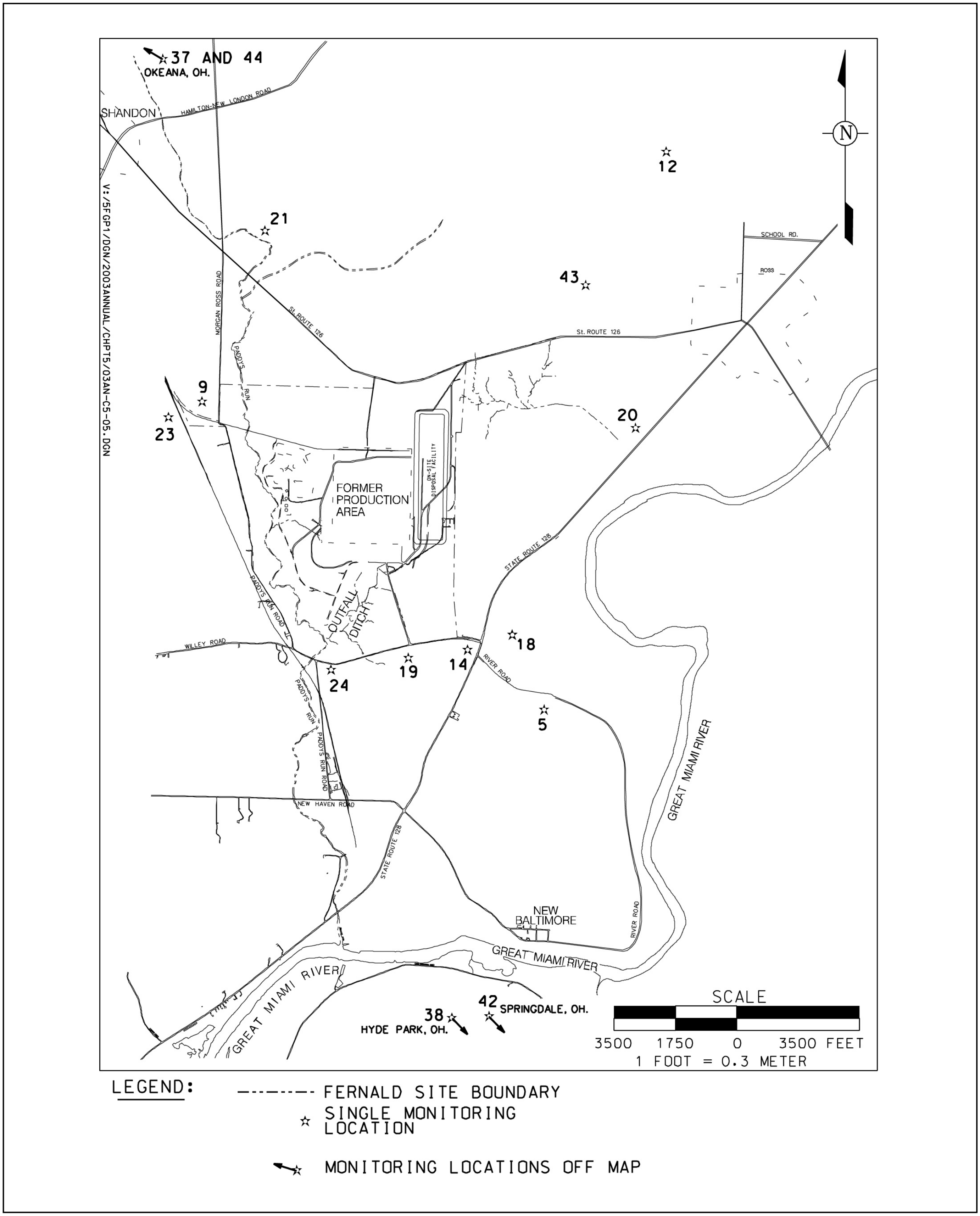

Figure 5-11. Produce Monitoring Locations

As indicated in Table 5-6, the total uranium results for 2003 remained within the range of historical background concentrations of produce samples collected from 1990 through 2000. In addition, as indicated in Table C.4-1 of Appendix C, Attachment 4, concentrations of uranium were less than detectable in 21 of the 28 samples analyzed. Therefore, the uranium data suggest there is no substantial impact from past or current FCP emissions on locally grown produce.

As mentioned above, thorium-230 analysis was only performed on locally grown produce in 2000. With a limited amount of historical thorium data for produce, comparisons to background would be inconclusive. Another mechanism for evaluating the impact of thorium-230 emissions on locally grown produce is a comparison of the effective dose equivalent (dose) from consuming locally grown produce to the applicable dose limits. The applicable and relevant standard is in DOE Order 5400.5: 100 millirem per year, all-pathways dose limit to members of the public. The dose from consuming locally grown produce for 2003 is calculated to be less than one percent of the standard (0.003% of the DOE standard). Therefore, the thorium data also suggest there is no substantial impact from past or current FCP emissions on locally grown produce. (Refer to Chapter 6 and Appendix C, Attachment C.4, of this report for further discussion of doses.)

Detailed results of produce sampling for 2003 are provided in Appendix C, Attachment C.4, of this report. Note that with the Waste Pits Project advancing toward completion, the anticipated accelerated remediation of the FCP, and both uranium and thorium results indicating no substantial impact on locally grown produce, it is likely that produce sampling, currently on a three-year frequency, will not be conducted in the future. Future revisions of the IEMP will address the need for this monitoring and discontinuation will be based on OEPA and EPA approval.

TABLE 5-6

2003 BIOTA (PRODUCE) SUMMARY RESULTS

		Minimum[b]	Maximum	Background[b]	1990-2000 Historical Background Range	
Produce[a]	Number of Samples	(All Concentrations in pCi/g [dry weight])			Minimum[b] (pCi/g, dry weight)	Maximum[b] (pCi/g, dry weight)
			Total Uranium			
Corn	8	ND	0.084	ND	ND	0.2
Soybeans	6	ND	0.07	ND	ND	1.2
Cucumbers	7	0.06	0.11	ND	ND	0.021
Tomatoes	7	ND	0.091	0.05	ND	0.61
			Thorium-230			
Corn	8	0.04	0.36	0.13	NA	NA
Soybeans	6	0.14	0.24	0.25	NA	NA
Cucumbers	7	0.22	0.38	0.29	ND	ND
Tomatoes	7	0.37	0.48	0.37	ND	ND

[a]Refer to Figure 5-11 for sample locations.
[b]ND = not detectable
NA = not applicable