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RESULTS OF THE RADIOLOGICAL SURVEY AT THE SACANDAGA SITE GLENVILLE, NEW YORK

R. D. Foley
W. D. Cottrell
R. F. Carrier

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(Site Code: SY002)

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Work performed by the
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ACKNOWLEDGMENTS

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ABSTRACT

The Sacandaga site, located on Sacandaga Road, Glenville, New York, was operated by the General Electric Company for the Atomic Energy Commission (AEC) between 1947 and 1951. Originally used for the study and development of radar during World War II, the facilities housed later operations involving physics studies and sodium technology development in support of breeder reactor design and other AEC programs. Though not in use since the original equipment was dismantled and removed in the early 1950s, portions of the 51–acre site are known to contain buried rubble from demolished structures used in former operations.

It is the policy of the U. S. Department of Energy (DOE) to verify that radiological conditions at such sites or facilities comply with current DOE guidelines. Furthermore, guidelines for release and use of such sites have become more stringent as research has provided more information since previous cleanups. Therefore, at the request of the Office of Naval Reactors through the Office of Remedial Action and Waste Technology, a characterization of current radiological conditions over the site was performed between August and October 1989.

The survey included the measurement of direct radiation levels (gamma, alpha, and beta-gamma) over all surfaces both inside and outside the building and tunnel, radionuclide analysis of systematic, biased, and auger hole soil samples, and analysis of sediments from underground structures. Gamma logging of auger holes was conducted and removable contamination levels inside the tunnel were determined. Samples of soil and structural materials from within and around an excavated concrete bunker were analyzed to determine concentrations of radionuclides and non-radioactive elemental beryllium.

Survey results indicate that no radioactive residuals from former Sacandaga site research operations remain at the Sacandaga property. Slightly elevated gamma exposure rates were clearly associated with coal ash and cinders containing naturally enhanced radioactivity or with slightly elevated concentrations of naturally occurring ^{40}K. Coal ashes are typically found at installations operating during the 40s and 50s since the coal-fired furnaces were the primary source of heat. Concentrations of ^{40}K in subsurface soil samples at approximately 1.8 times the amount found in surface soil from nearby background areas would not have resulted from any operations formerly conducted at the Sacandaga site. All radiation levels and radionuclide concentrations are within DOE criteria. These conservative criteria are based on possible exposure through inhalation, ingestion, or direct contact, and an examination of any credible scenario, including residential use, will not result in any measurable hazard to individuals who may frequent the site, the general public, or the environment.

Concentrations of beryllium in soil samples from across the site are consistent with natural background levels with one exception. Residual beryllium was found in samples of the gravel floor and subfloor soil from within the excavated bunker. As long as the soil and gravel in the bunker remain undisturbed, the beryllium should present no health risk.

RESULTS OF THE RADIOLOGICAL SURVEY AT THE SACANDAGA SITE, GLENVILLE, NEW YORK*

INTRODUCTION

The Sacandaga site, located on Sacandaga Road, Glenville, New York, was operated by the General Electric Company for the Atomic Energy Commission (AEC) between 1947 and 1951 (Fig. 1). Originally used for the study and development of radar during World War II, the facilities housed later operations involving physics studies and sodium technology development in support of breeder reactor design and other AEC programs. The equipment was dismantled and removed in the early 1950s. Figure 2 is a diagram of the site showing the locations of the original buildings. Building P (the Critical Assembly Building) and a concrete bunker at the east end of the property are the only aboveground structures still standing. The underground pipe tunnel that formerly connected buildings P and B is also intact. Figure 3 is a front view of building P; Fig. 4 shows the rear of the building and the access hole for the tunnel.

It is the policy of the U. S. Department of Energy (DOE) to verify that radiological conditions at such sites or facilities comply with current DOE guidelines. If conditions are found to significantly exceed those guidelines, remedial action may be implemented (where DOE has the authority to do so) to correct the condition. DOE established the Formerly Utilized Sites Remedial Action Program (FUSRAP) as part of that effort to confirm the closeout status of facilities under contract to agencies preceding DOE during early nuclear energy development. Furthermore, guidelines for release and use of such sites have become more stringent as research has provided more information since previous cleanups.

At the request of the Office of Naval Reactors through the Office of Remedial Action and Waste Technology, a site visit and preliminary scoping survey of the portion of the site that had contained the process and associated service buildings (5–6 acres) was conducted by Oak Ridge National Laboratory in July 1988.[1] The results of that survey revealed no residual radioactive contaminants from former research operations. However, because portions of the 51-acre site were known to contain buried rubble from demolished structures used in former operations, it was recommended that a second survey including subsurface investigations be conducted. Therefore, a characterization of current radiological conditions over that portion of the site comprising ~10 acres was performed between August and October 1989. Based on the results of this survey, a second survey consisting of comprehensive sampling in a small, isolated area of the site was conducted in February 1991.

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*The survey was performed by members of the Measurement Applications and Development Group of the Health and Safety Research Division of Oak Ridge National Laboratory under DOE contract DE-AC05-84OR21400.

SCOPE OF THE SURVEY

The survey of the property included: (1) a gamma scan near the ground surface over the property; (2) gamma exposure rates at 1 m above the ground surface and at the ground surface at grid line intersections; (3) collection and radionuclide analysis of systematic and biased surface and subsurface soil samples; (4) analysis of auger hole samples and sediment samples from selected areas of standing water; (5) gamma logging of auger holes; (6) direct measurement of gamma, alpha, and beta-gamma radiation levels inside building P and the pipe tunnel; (7) determination of removable contamination levels inside the underground tunnel; and (8) analysis of selected soil, gravel, and concrete samples to determine non-radioactive elemental beryllium concentrations because prior work involved some handling of beryllium.

SURVEY METHODS

A comprehensive description of the survey methods and instrumentation used in this survey is given in the *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*, Oak Ridge National Laboratory, ORNL/TM-8600 (April 1987).[2]

To facilitate locating measurements and data, a 100– by 100–ft grid was established over the portion of the property to be surveyed which included the area formerly surrounded by a security fence and a 100-ft wide swath surrounding that area. In addition, the survey included 10-ft wide traverses running along the north-to-south grid lines at 200-ft intervals, and 10-ft wide strips of land along either side of the entrance road east of the property (Fig. 5). The traverses extended north to the property line and south to the stone fence. Most of the site was covered with trees, brush, and heavy undergrowth. In order to access the ground surface with survey instruments, the brush and undergrowth were removed by mowing or clearing. Building rubble was surveyed and also moved to access the soil surface beneath. Disturbance of the upper layer of soil during these activities was kept to an absolute minimum. Entry to the pipe tunnel was gained by excavating a hole from above as shown (covered) in Fig. 4.

Using a portable gamma scintillation meter, a gamma scan was performed in these gridded areas to determine ranges of measurements. Gamma levels were determined at the ground surface and at 1 m above the surface at the intersections of grid lines. Systematic soil samples were collected at locations as close as possible to the center of each block without regard to radiation levels. Soil sampling was also performed in outdoor areas of elevated gamma radiation. Such samples are referred to as biased samples and are more likely to contain elevated concentrations of radionuclides than systematically chosen samples. At some systematic and biased sampling locations, samples were also taken from depths below 15 cm. Samples were analyzed to determine radionuclide concentrations. Directly measured radiation levels were determined on surfaces in building P and inside the pipe tunnel. Smears were taken on surfaces inside the tunnel to assess surface contamination levels. No indication of removable contamination was found in Building P during the preliminary survey.

To define the extent of possible subsurface soil contamination, auger holes were drilled to depths ranging from <1 to 3 m. A plastic pipe was placed in each hole, and a NaI scintillation probe was lowered inside the pipe. The probe was encased in a lead shield with a horizontal row of collimating slits on the side. This collimation allows measurement of gamma radiation intensities resulting from contamination within small fractions of the hole depth. If the gamma readings in the hole were elevated, a soil sample was scraped from the wall of the auger hole at the point showing the highest gamma radiation level. The auger hole loggings were used to select locations where further soil sampling would be useful. A split-spoon sampler was used to collect subsurface samples at known depths. In some auger holes, a combination of split-spoon sampling and side-wall scraping was used to collect samples.

SURVEY RESULTS

Table 1 details DOE guidelines for the release of property for unrestricted use.[3] Typical background radiation levels for the Glenville, New York, area are listed in Table 2. Direct measurement results presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations measured in environmental samples.

OUTDOOR SURVEY RESULTS

Gamma Measurements

Results of gamma scanning and grid point measurements are given in Table 3. Scan ranges are also shown in Fig. 6. Gamma levels were slightly elevated over the site in comparison with the average background at the surface (10 μR/h). That is, average levels within individual grid blocks were 12 to 16 μR/h. Exposure rates at grid points were 10 to 18 μR/h at 1 m from the surface and 10 to 20 μR/h at the surface. Scan measurements throughout grid blocks generally ranged from 7 to 18 μR/h. In addition, elevated levels of 20 to 24 μR/h were measured at several small, isolated spots. The maximum exposure rates were identified in association with a material resembling coal ash. These slight elevations may be attributed to the concentration of naturally occurring radioactive substances in coal during the combustion process. Coal ash, as well as many other natural substances, typically exhibits elevated gamma exposure rates when compared to surrounding soils. Furthermore, results of radionuclide analysis of the soil samples (see below) substantiate the probability of a source for the general elevations other than Sacandaga site operations (i.e., naturally occurring ^{40}K). None of the elevated gamma exposure rates appear to be caused by residual material from Sacandaga site research operations.

Soil Sample Results

Systematic soil samples. Radionuclide analysis was performed on systematic soil samples collected at the locations shown on Fig. 7. The results are listed in Table 4. Eight samples were collected at incremental depths of 15 cm from soil layers 15 to 45 cm deep. All others were taken from the top 15 cm of soil. Analysis revealed maximum concentrations of ^{238}U (3.4 pCi/g), ^{226}Ra

(2.2 pCi/g), ^{232}Th (2.2 pCi/g) and ^{137}Cs (1.7 pCi/g) that are below respective guidelines (Table 1). Cesium-137 concentrations are consistent with levels from fallout and are not a result of Sacandaga site operations. Concentrations of ^{40}K ranged from 10 to 31 pCi/g and averaged 20 pCi/g. By comparison, typical background concentrations of ^{40}K range from 13 to 16 pCi/g and average 14 pCi/g (Table 2). Based on radionuclide ratios and concentrations, it appears that the primary source of most of the radioactivity in the samples is due to radionuclides naturally present in soil and coal ash.

Biased soil samples. Biased soil samples were collected in areas of elevated gamma exposure rates as indicated on Fig. 7. Results (Table 4) show that the highest concentration of each radionuclide was found in samples taken from the top 15 cm of soil. Maximum concentrations of ^{238}U (4.6 pCi/g), ^{226}Ra (2.9 pCi/g), ^{232}Th (3.0 pCi/g), and ^{137}Cs (3.0 pCi/g) are below the respective DOE guidelines. Concentrations of ^{40}K were 9.1 to 31 pCi/g, averaging 19 pCi/g. The maximum ^{238}U was in approximate equilibrium with its daughter ^{226}Ra, indicating that they originated from a natural source in the observed coal ash.

Sediment samples. Radionuclide analysis was conducted on sediment samples from the pipe tunnel floor and from an underground tank discovered when a mound of dirt was cut in half for soil sampling. Locations of the pipe tunnel and tank samples are shown on Fig. 8. The 300- to 500-gal metal tank was accessed by removing the partial seal over a 3–ft tube in the tank's top side (Fig. 9). A 12-in. layer of water in the tunnel was drained down to ~4 in. for sample retrieval (E001). Sediments were sampled from the ~30-in. layer of dirt and water in the bottom of the tank (E002). Analysis of precipitates from samples E001 and E002 showed concentrations of 1.3 and 1.7 pCi/g ^{238}U, respectively. Concentrations of ^{238}Pu and $^{239/240}$Pu were all less than the MDA.*

Subsurface soil sampling and gamma logging of auger holes. Samples were collected from auger holes drilled at the locations shown on Fig. 8. Results of analysis are listed in Table 4. The samples were taken at 15–cm increments between 0 and 200 cm. In most samples, concentrations of ^{238}U and ^{226}Ra were again present in approximately equal amounts, indicating a natural origin. A few samples contained ^{238}U in a concentration from 1 to 3 times the concentration of ^{226}Ra found in the same sample. However, all radionuclide concentrations in all samples are below applicable guidelines (Table 1).

Gamma logging was performed in each of 40 auger holes to characterize and further define the extent of possible subsurface contamination. The logging technique used here is not radionuclide-specific. However, logging data, in conjunction with soil analyses data, may be used to estimate regions of elevated radionuclide concentrations in auger holes when compared with background levels for the area. Following a comparison of these data, it appears that any shielded scintillator readings of 1000 to 1500 counts per minute (cpm) or greater generally indicate the presence of elevated concentrations of gamma emitters. At this site, maximum readings were 1500 to 2000 cpm in all but one auger hole and were measured at depths between 1.1 m and 2.4 m. Analysis results of soil samples taken from these auger holes show low

*The minimum detectable activity (MDA) for plutonium radionuclides is 0.6 pCi/g.

concentrations of ^{238}U and ^{226}Ra, ranging from 0.70 to 3.6 pCi/g and 0.56 to 1.9 pCi/g, respectively. Concentrations of ^{40}K in samples collected from the auger holes ranged from 12 to 33 pCi/g, averaging 25 pCi/g. The average concentration is 1.8 times the typical background average of 14 pCi/g (Table 2). These results indicate that the slightly elevated gamma readings are apparently the result of the elevated concentrations of ^{40}K, a naturally occurring radionuclide. Data from the gamma profiles of the logged auger holes are graphically represented in Appendix A, Figs. A.1 through A.40.

Beryllium Analyses

Twenty-seven of the soil samples listed in Table 4 were selected for beryllium analysis from locations chosen to assess the complete site for non-radioactive elemental beryllium residuals. The results of analysis are detailed in Table 5. Based on historical data, beryllium that had been dissolved in sodium during experiments could have been released when the sodium was burned off in the concrete bunker.[4] Concentrations ranged from 1.0 to 4.1 μg/g with the exception of samples S83 (62 μg/g) and S84 (8.7 μg/g), which had been collected from the excavated floor of the concrete bunker. Several geochemical surveys of soil have reported natural beryllium concentrations averaging 0.6 to 6.0 μg/g. Average crustal rock contains 2.8 μg/g with granites enriched by 15 to 20 μg/g. Natural beryllium concentrations in coal ash of 5.0 to 15.3 μg/g have been reported.[5] Because the maximum concentration found in these samples is approximately a factor of 10 higher than the typical natural concentration, supplementary sampling for beryllium was conducted within the bunker in February 1991.

A photograph showing the open end of the concrete bunker prior to its excavation for the second survey (February 1991) is reproduced in Fig. 10. (The bunker floor had been only partially revealed for the earlier sampling.) Fifty-seven samples were taken from 28 locations in and around the concrete bunker before (Fig. 11) and after (Fig. 12) excavation to reveal the entire floor and walls of the structure. The results are listed in Table 6. Three samples, M1–M3, were chipped from the concrete walls of the bunker. Beryllium concentrations in these samples ranged from <0.3 to 1.5 μg/g. Six of the samples were taken from the dirt pile that covered the bunker prior to its excavation. One sample was collected during excavation, and 5 samples were extracted from the dirt piles following excavation. Concentrations of beryllium in those samples ranged from 1.6 to 4.7 μg/g, values consistent with natural beryllium concentrations in soil. Following excavation, a grid was established over the revealed gravel floor of the bunker, and samples were collected from grid block locations as indicated on Fig. 12. The results (Table 6) show concentrations of beryllium ranging from 5.1 to 630 μg/g in the top 15 cm of gravel and stone comprising the floor of the excavated bunker. Concentrations in subsurface samples ranged from 1.4 to 880 μg/g. Analytical results show that the majority of the beryllium is associated with soil and particulate matter. As long as the soil and gravel in the bunker remain undisturbed, the beryllium should present no health risk. However, because of the possibility of releasing dust should the gravel or soil be subjected to mechanical disturbance, the potential risk should be reevaluated.

INDOOR SURVEY RESULTS

Building P

Areas of the building used by the present owner for storage were inaccessible for surveying as shown. The portion of building P still standing is a concrete structure surrounding a concrete room that was formerly used as the critical assembly area. All walls of the building are ~24 in. thick. Directly measured radiation levels for building P and for the interior room are shown in Figs. 13 and 14, respectively.

Gamma levels near all surfaces inside the covered port area and inside the concrete room ranged from 7 to 11 μR/h. All exposure rates were consistent with background levels and well below the DOE guideline of 20 μR/h above background (Table 1).

Directly measured alpha activity levels in both areas of the building ranged from less than the minimum detectable activity (MDA)* to 45 dpm/100 cm^2 while beta-gamma dose rates ranged from 0.02 to 0.04 mrad/h. All results are below the guidelines shown in Table 1.

Analyses of smears demonstrated that all removable alpha radioactivity levels were below the MDA.* None of the smears taken inside the building were analyzed for transferable beta-gamma contamination because the surface measurements indicated no radiation levels above background levels. No indication of removable contamination exceeding guidelines was found in building P during the preliminary survey.[1]

Pipe Tunnel

All measurements taken in this underground structure were below guidelines (Table 1). Gamma exposure rates over the walls and roof ranged from 8 to 12 μR/h. Beta-gamma dose rates were 0.02 mrad/h and all directly measured alpha levels were below the MDA. These values are well below the guideline of 5000 dpm/100 cm^2 for fixed surface contamination resulting from uranium residuals (Table 1).

Smears from accessible surfaces inside the tunnel showed alpha activity levels below the MDA. None of the smears taken inside the tunnel were analyzed for transferable beta-gamma contamination because the surface measurements indicated no radiation levels above background values.

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*The instrument-specific minimum detectable activities (MDAs) for directly measured and removable alpha radiation levels are 25 and 10 dpm/100 cm^2, respectively. For directly measured and removable beta-gamma radiation, the respective MDAs are 0.01 mrad/h and 200 dpm/100 cm^2.

SIGNIFICANCE OF FINDINGS

Survey results indicate that no radioactive residuals from former SAPL operations remain at the Sacandaga property. All radiation levels and radionuclide concentrations are below DOE guidelines and are not inconsistent with radionuclide concentrations typical of soil and coal ash.

Outdoor gamma exposure rates averaged 12 to 16 μR/h within individual grid blocks, exceeding the typical average background for the Glenville area (10 μR/h). However, results of radionuclide analysis of soil samples demonstrate that the slight elevations may be attributed to two sources unrelated to former SAPL operations at the site. Concentrations of naturally occurring ^{40}K throughout the site were found to be higher than are typical for the area, especially in soil samples from below the surface. Such elevations would not have been caused by research operations formerly conducted at the Sacandaga site. Furthermore, coal ash and cinders were clearly observed in association with many of the slightly elevated gamma levels. Analysis of soil samples demonstrated that all radionuclide concentrations are well below DOE guidelines and, moreover, were generally found in naturally proportionate concentrations.

Concentrations of non-radioactive, elemental beryllium in soil samples from across the site ranged from 1.0 to 4.1 μg/g with the exception of samples taken within the concrete bunker; natural beryllium soil concentrations average from 0.6 to 6.0 μg/g. Beryllium concentrations in samples of gravel floor and subfloor soil collected from inside the bunker ranged from 1.4 to 880 μg/g. Analytical results show that the majority of the beryllium is associated with soil and particulate matter. As long as the soil and gravel in the bunker remain undisturbed, the beryllium should present no health risk.

In summary, all radiological survey measurements both in- and out-of-doors indicate no radioactive residuals from former site research operations and are within DOE FUSRAP criteria. These conservative criteria are based on possible exposure through inhalation, ingestion, or direct contact, and an examination of any credible scenario, including residential use, shows that unrestricted use will not result in measurable risk to individuals who may frequent the site, the general public, or the environment. Elevated concentrations of non-radioactive elemental beryllium contained within the bunker (see Appendix B, Fig. B.1) should pose no health risk as long as the gravel and soil remain undisturbed.

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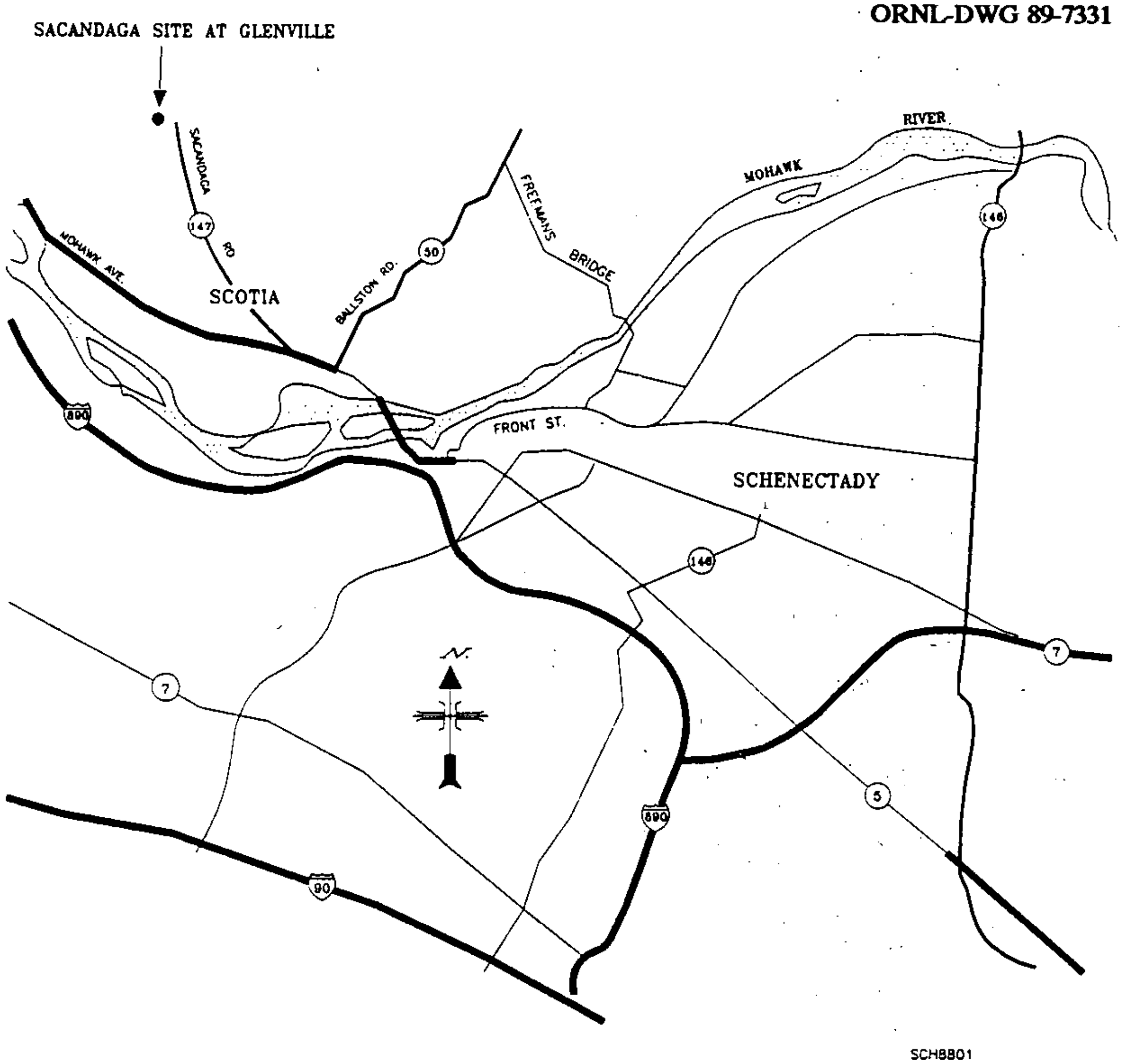
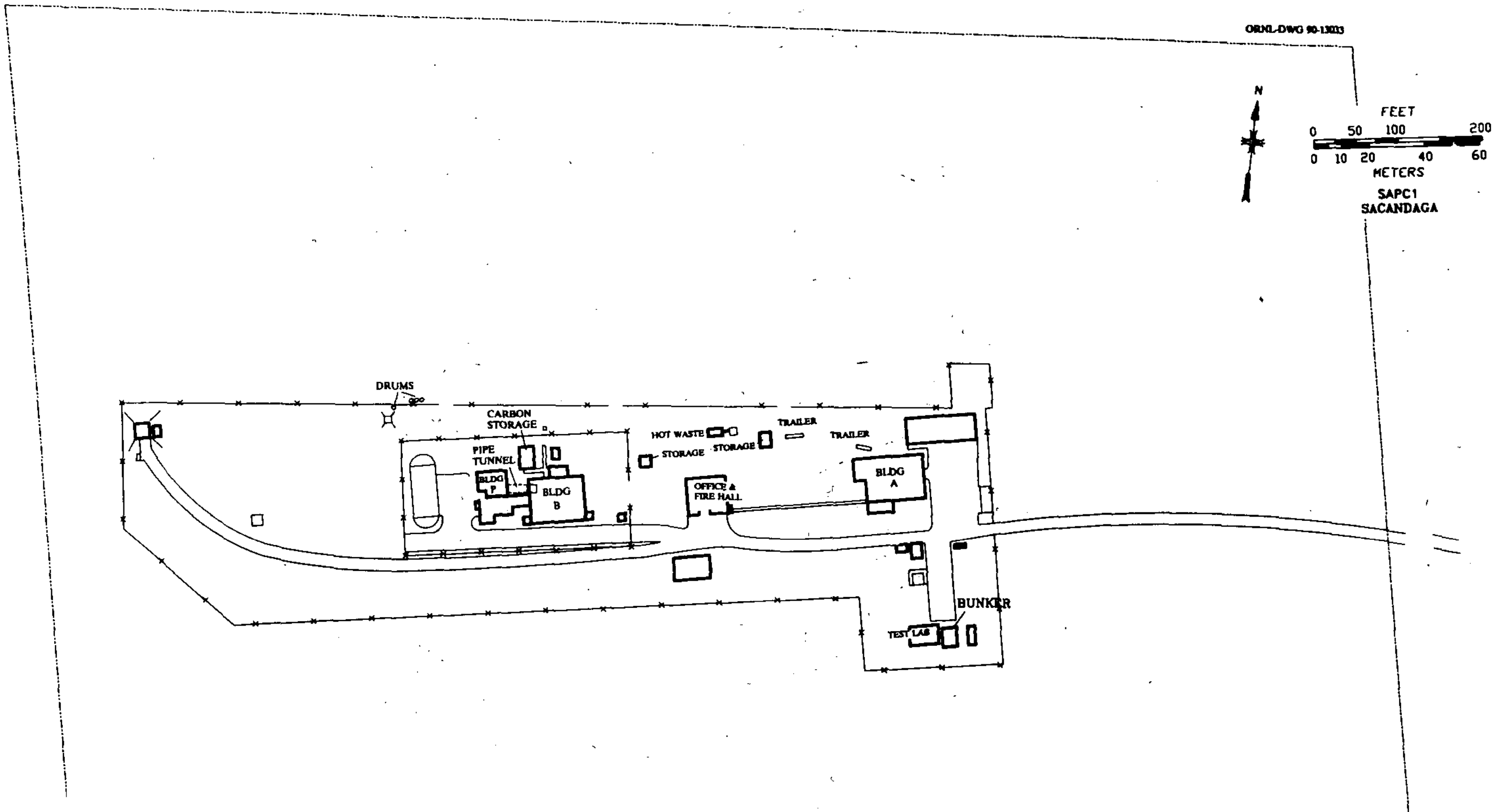


Fig. 1. Diagram showing the general location of the Sacandaga site.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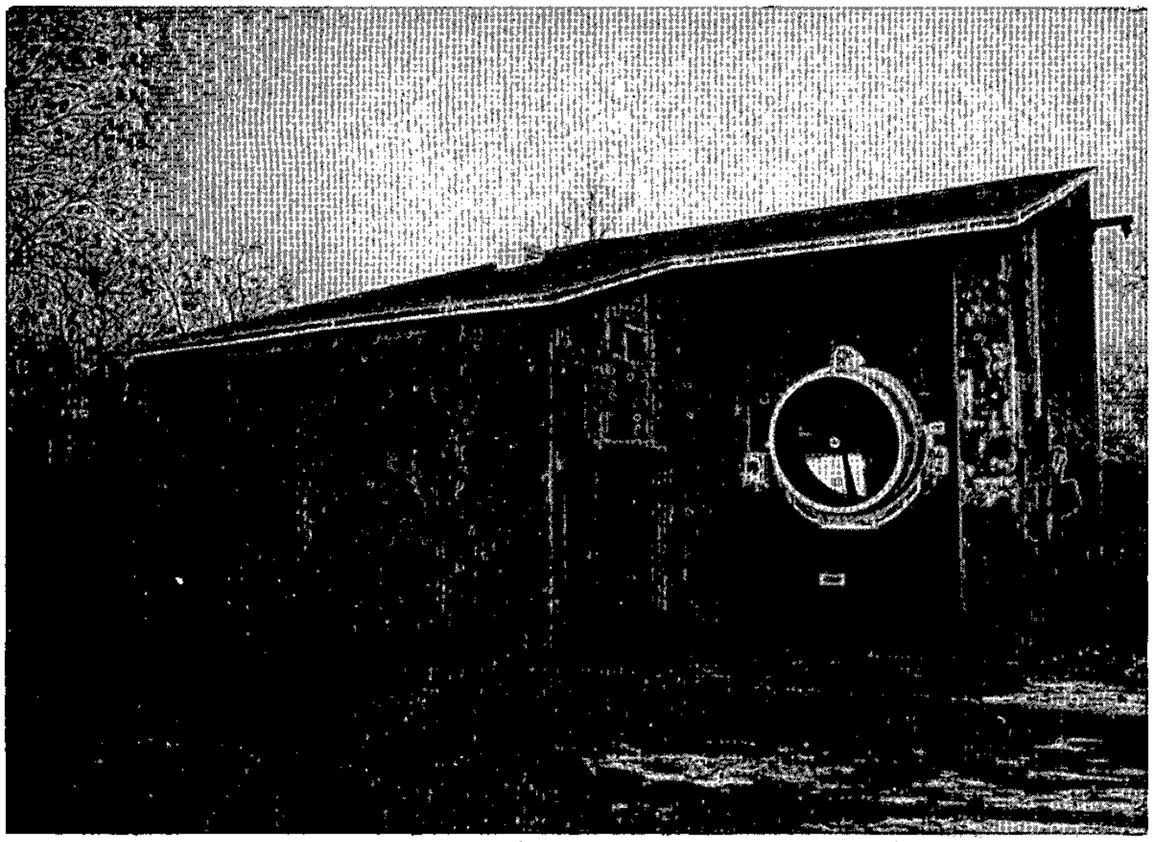

Fig. 3. View of the front of building P at the Sacandaga site, looking north.

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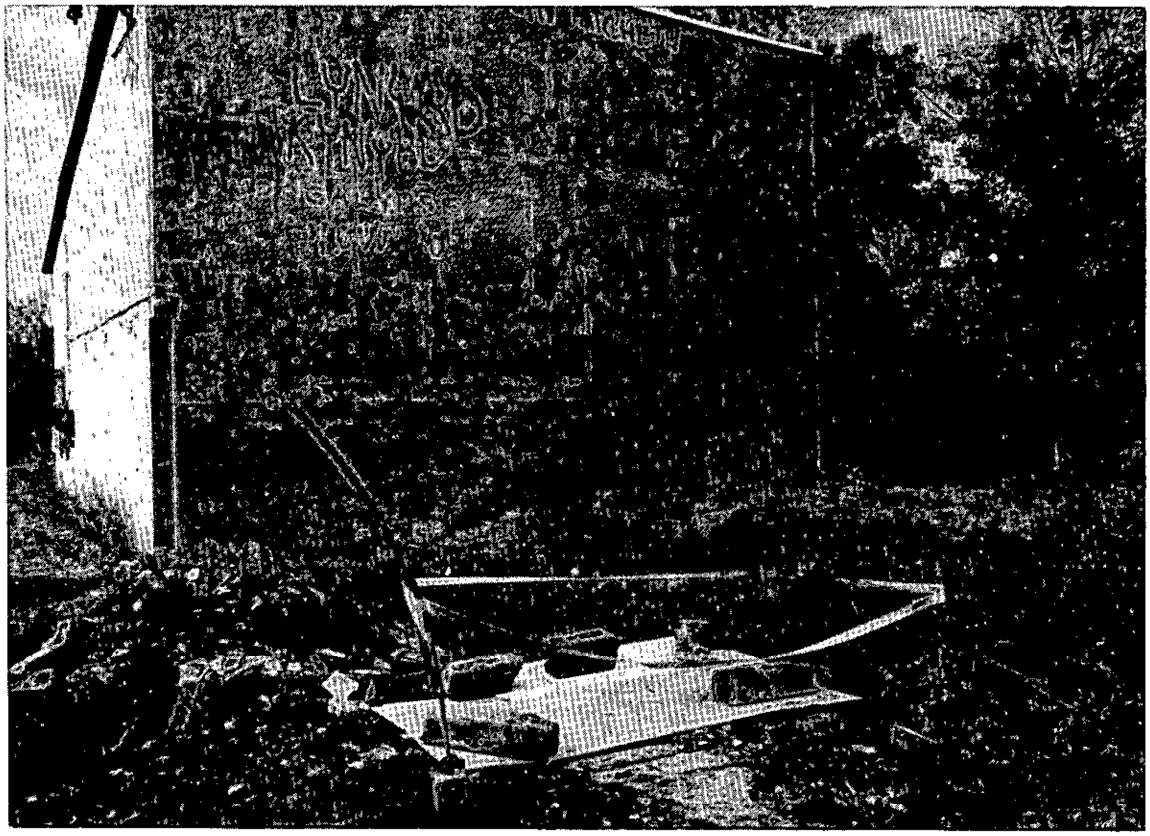

Fig. 4. View of the rear of building P at the Sacanadaga site, looking south. Note covered hole accessing the underground tunnel.

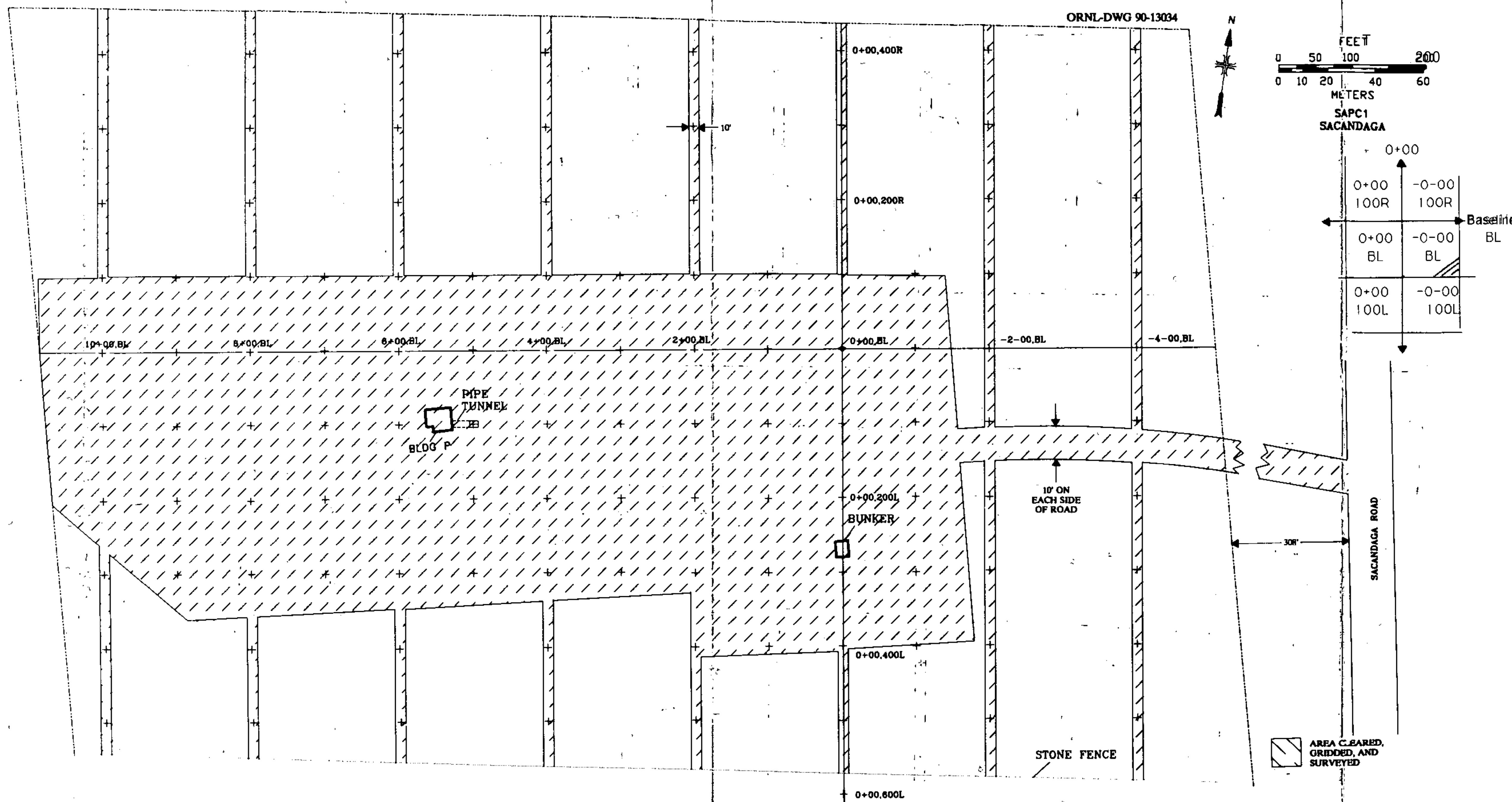

Fig. 5. Diagram showing existing structures at the Sacandaga site and area gridded for surveying.

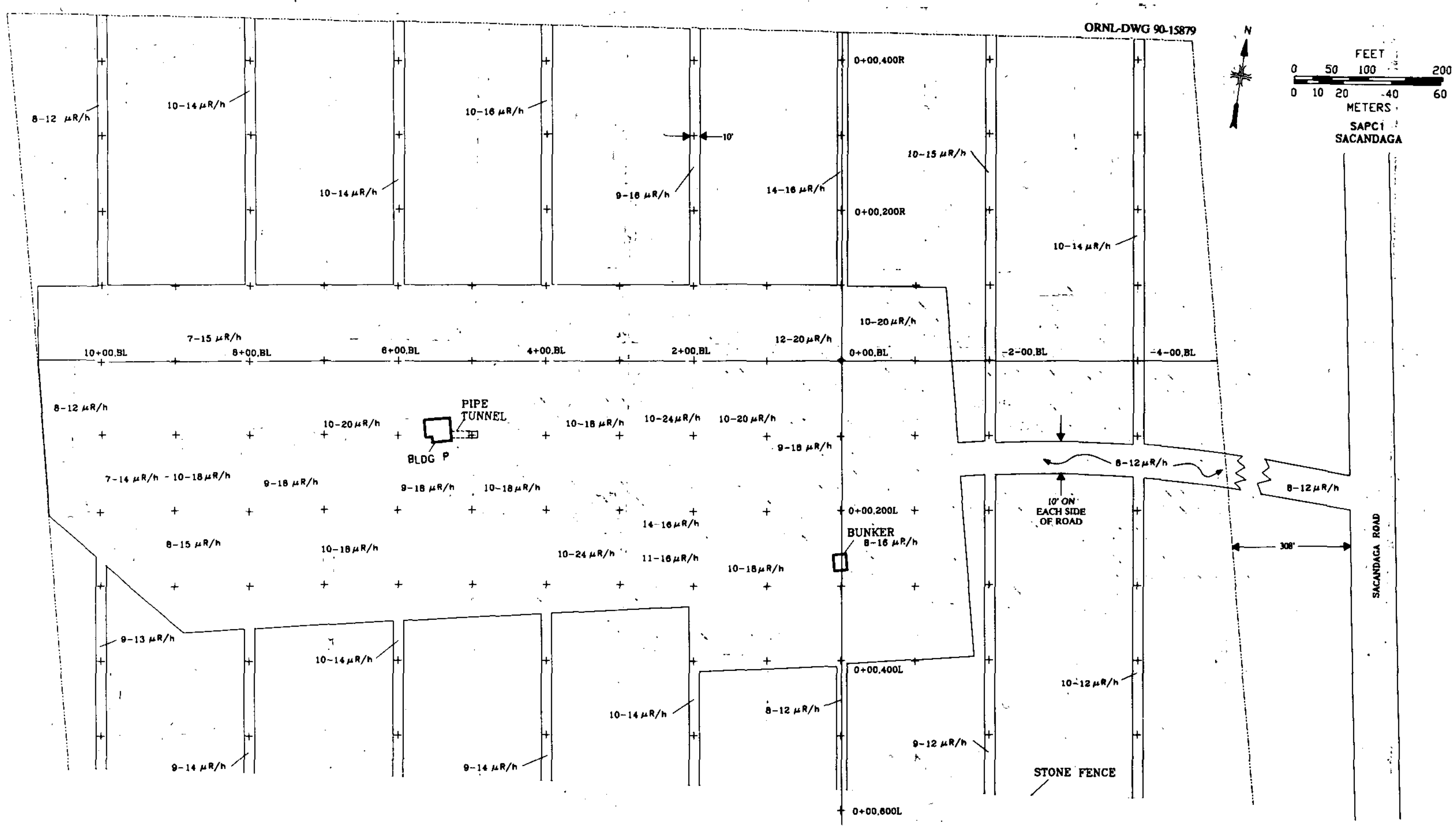

Fig. 6. Gamma exposure rate measurements outdoors at the Sacandaga site.

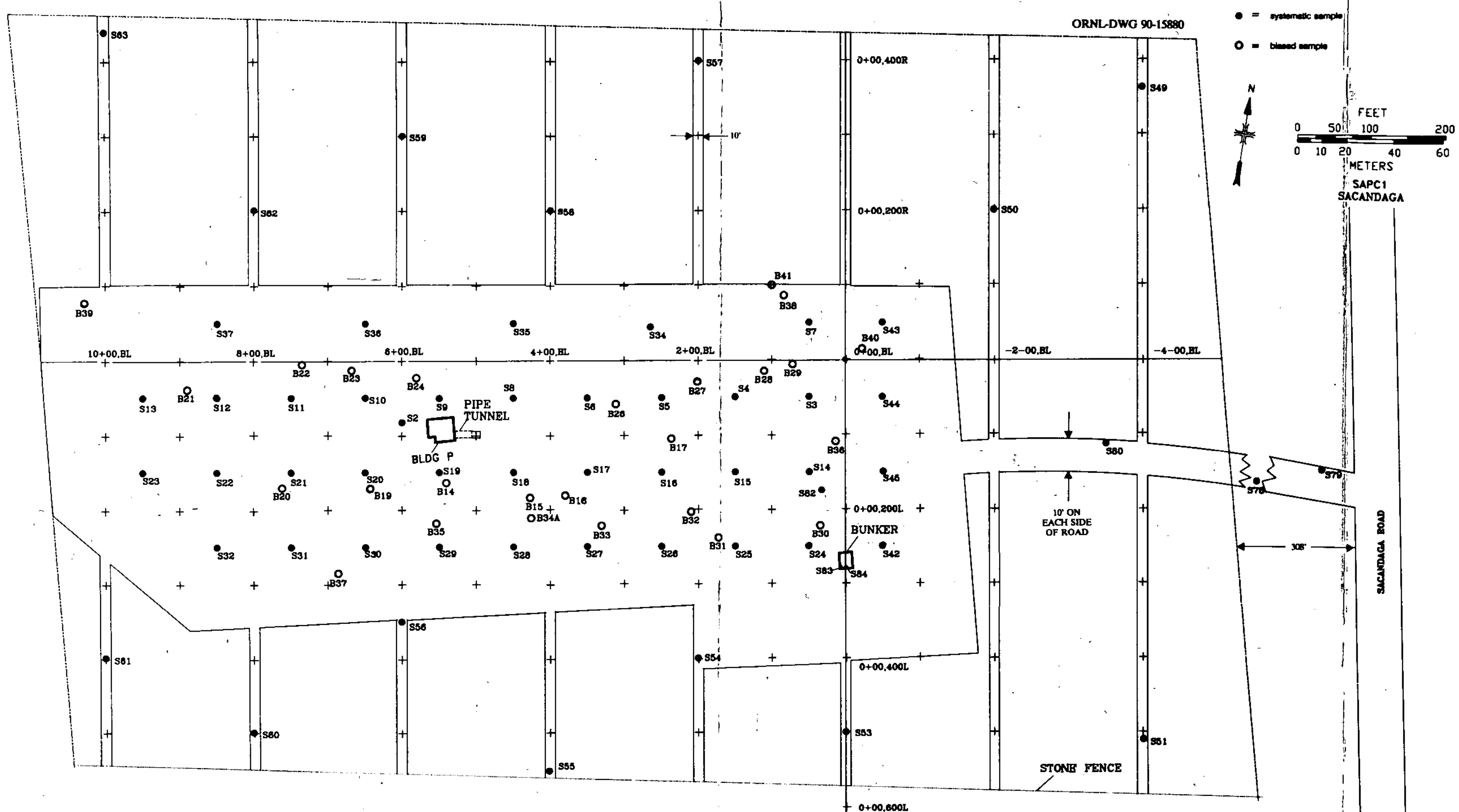

Fig. 7. Locations of systematic and biased soil samples collected at the Sacandaga site.

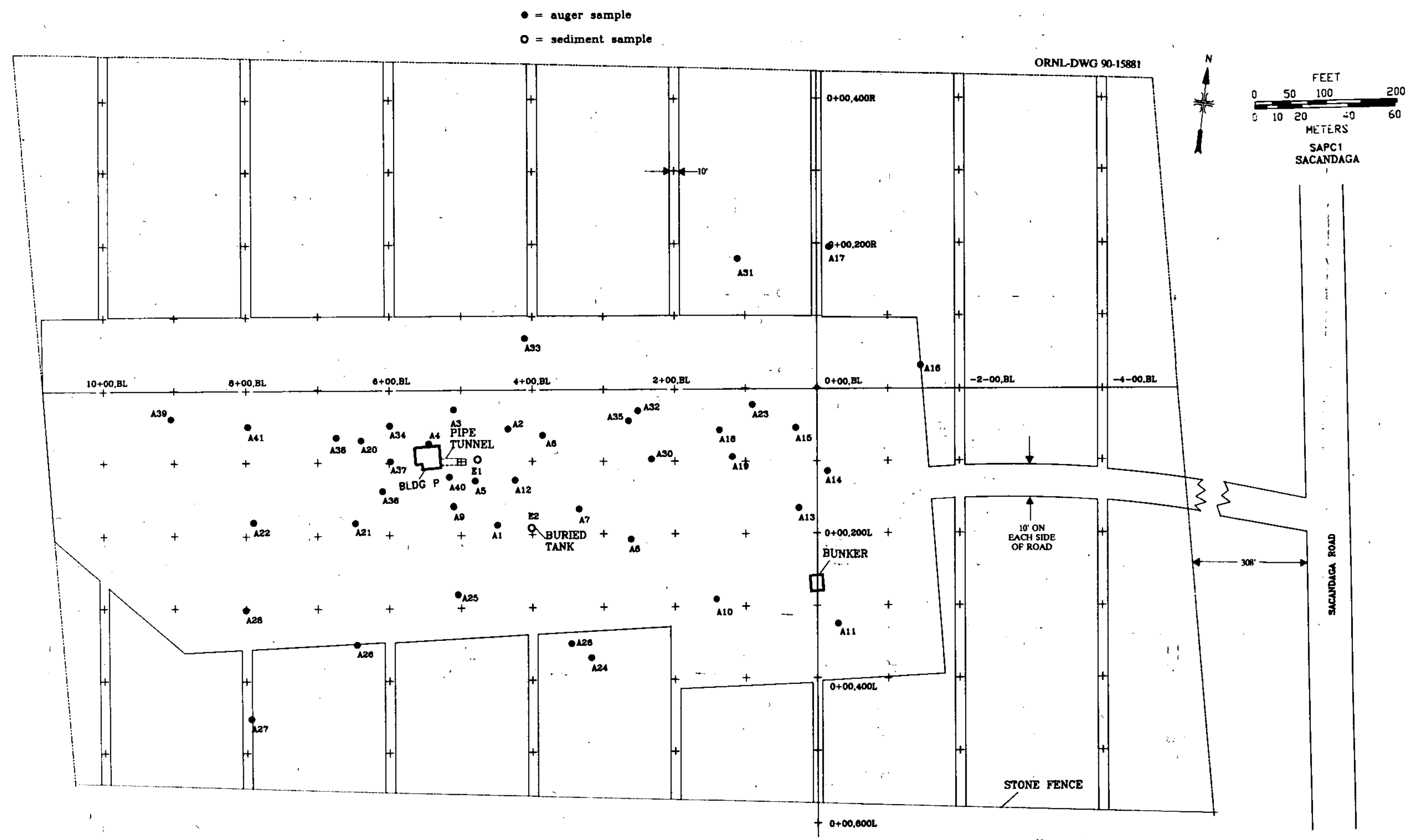

Fig. 8. Locations of auger holes drilled at the Sacandaga site and sediment samples taken at the Sacandaga site.

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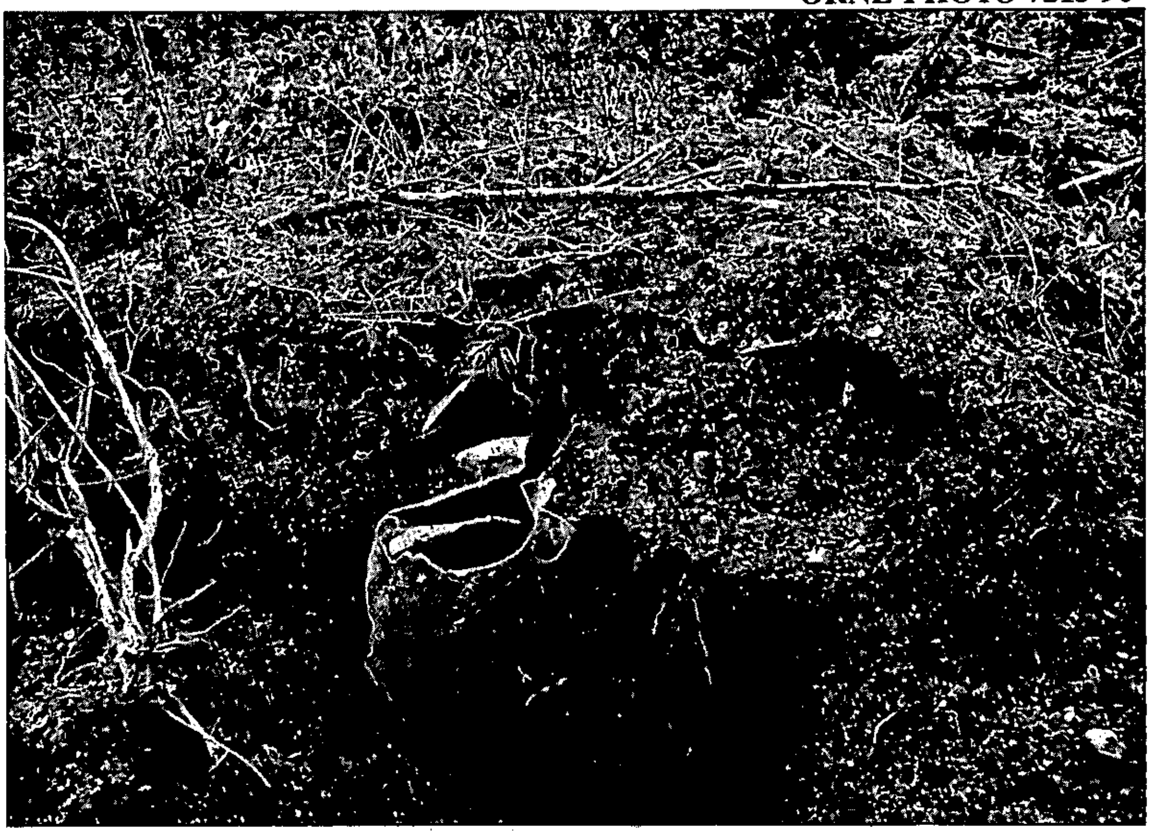

Fig. 9. Photograph showing metal tube through which sediments in buried tank were sampled.

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Fig. 10. View of the concrete bunker prior to its excavation, looking northeast.

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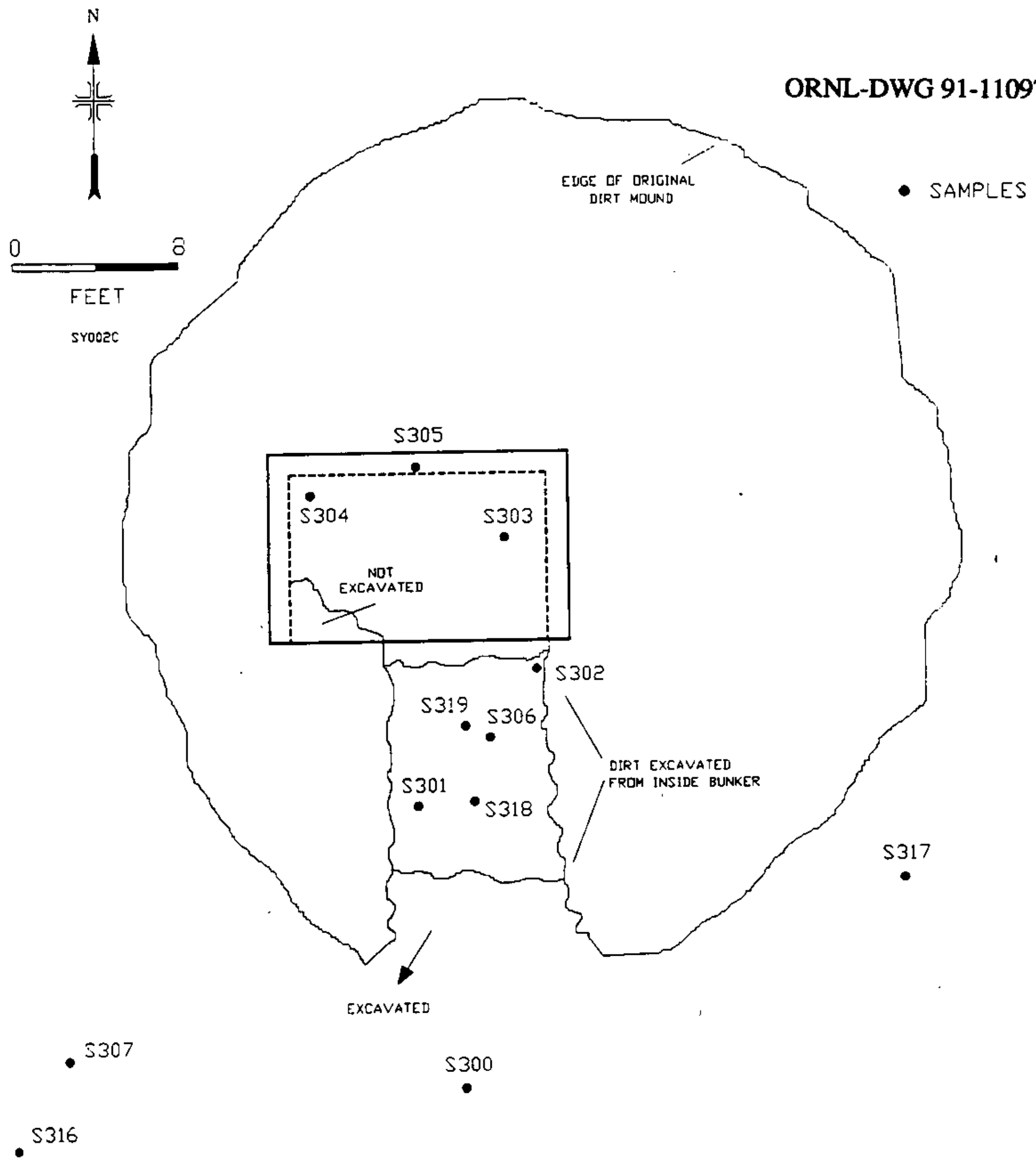

Fig. 11. Diagram showing the locations of soil samples collected before excavation to reveal the bunker floor and interior. The bunker and pile of soil covering it are shown as if viewed from above.

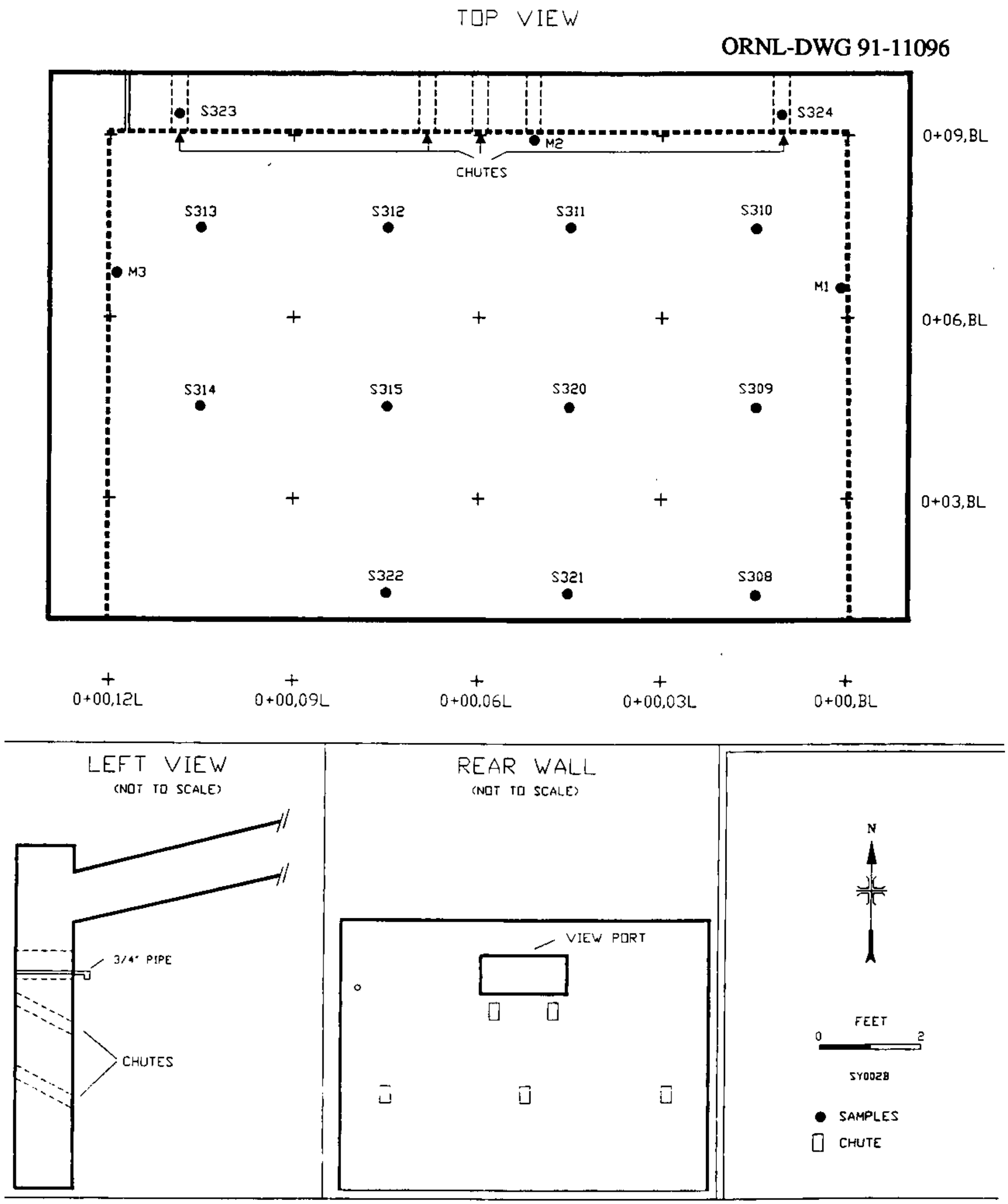

Fig. 12. Diagram showing grid and soil sample locations inside the bunker as viewed from above; side view, facing east, and inside rear wall (head-on).

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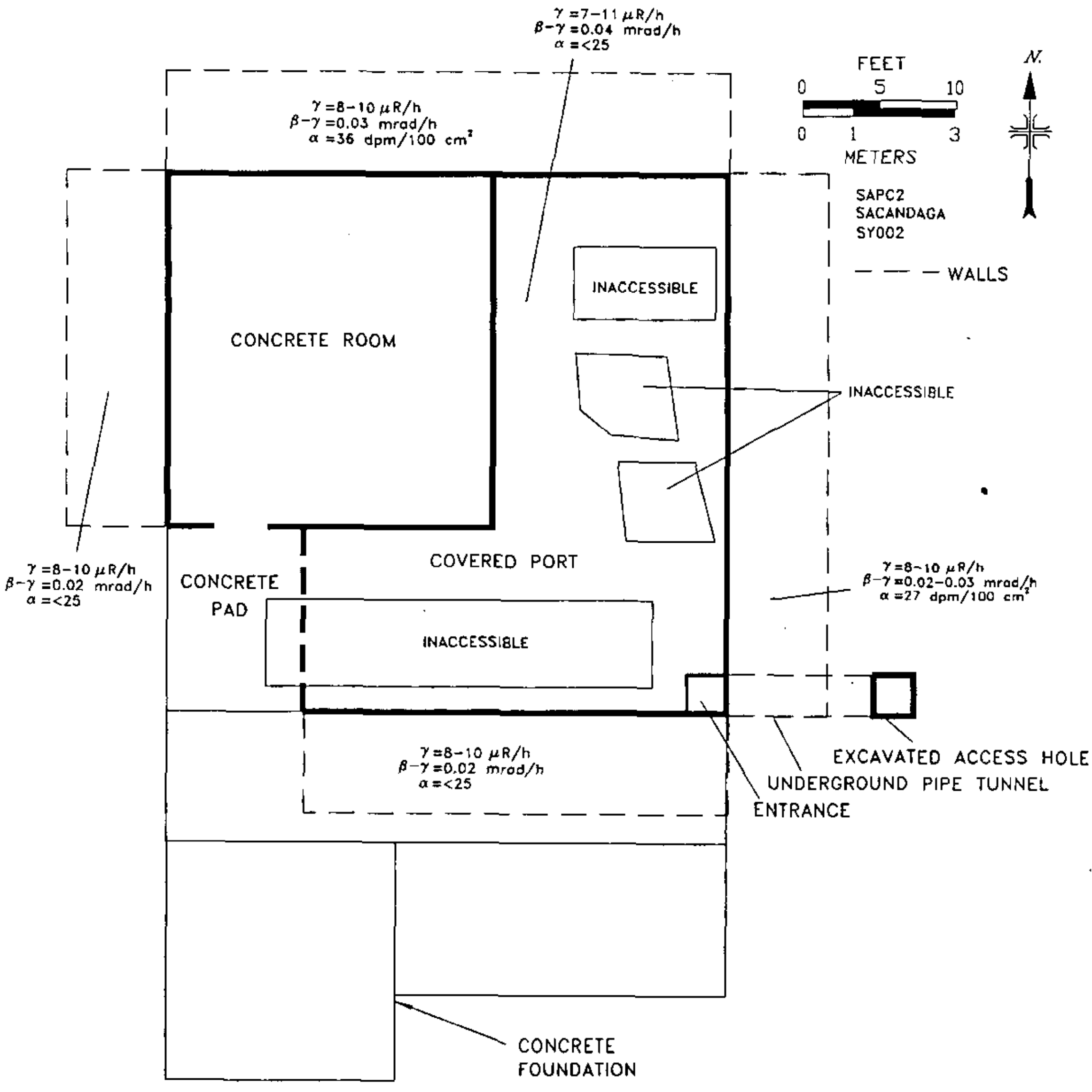

Fig. 13. Directly measured radiation levels inside the covered port of building P at the Sacandaga site.

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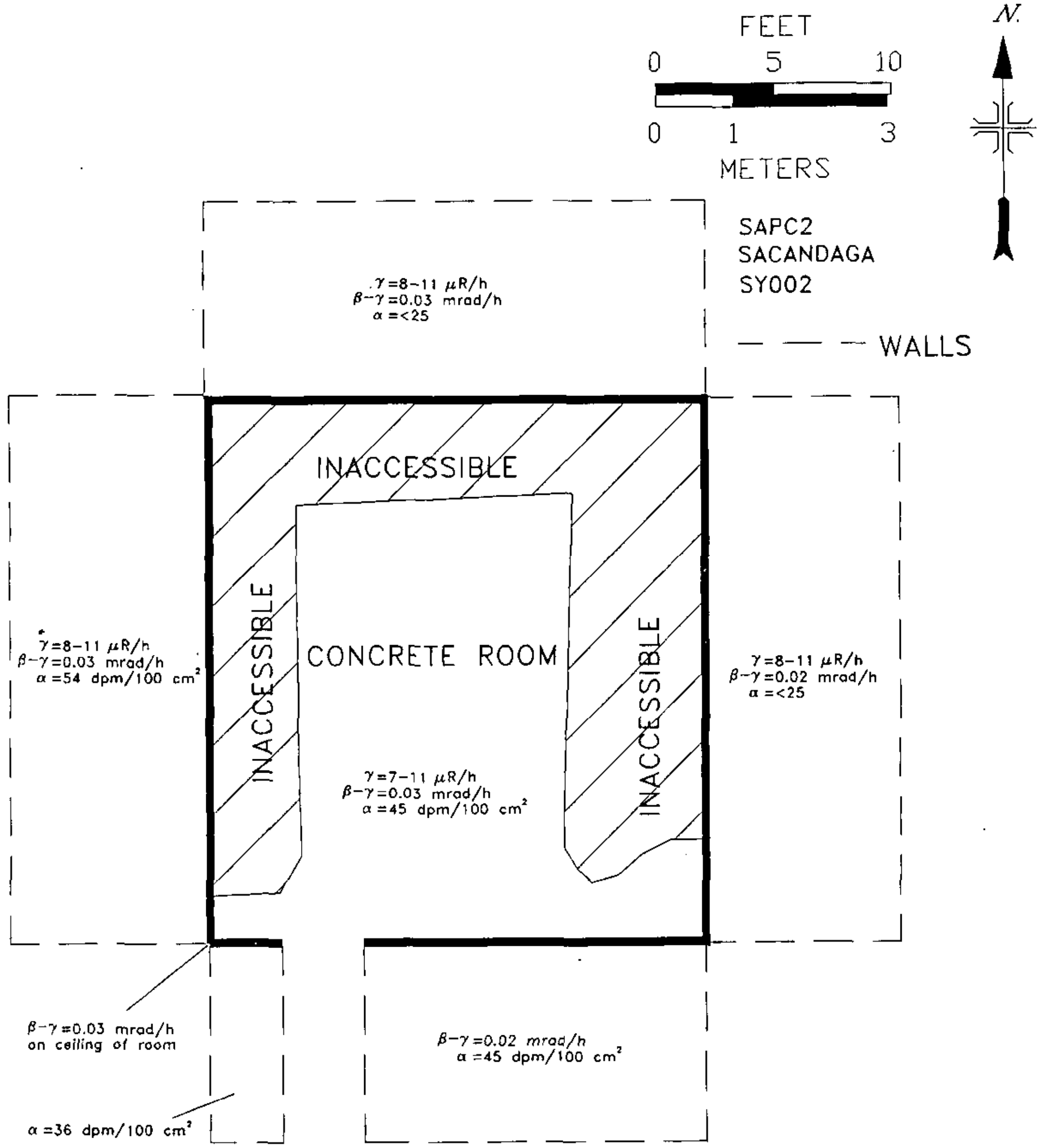

Fig. 14. Directly measured radiation levels inside the concrete room, building P at the Sacandaga site.

Table 1. Applicable guidelines for protection against radiation[a]
(Limits for uncontrolled areas)

Mode of exposure	Exposure conditions	Guideline value
Gamma radiation	Indoor gamma radiation level (above background)	20 μR/h[b]
Total residual surface contamination[c]	^{238}U, U-natural (alpha emitters)	
	Maximum	15,000 dpm/100 cm^2
	Average	5,000 dpm/100 cm^2
	Removable	1,000 dpm/100 cm^2
	Beta-gamma emitters[d]	
	Maximum	15,000 dpm/100 cm^2
	Average	5,000 dpm/100 cm^2
	Removable	1,000 dpm/100 cm^2
	^{232}Th, Th-natural, ^{90}Sr	
	Maximum	3,000 dpm/100 cm^2
	Average	1,000 dpm/100 cm^2
	Removable	200 dpm/100 cm^2
	^{226}Ra, transuranics	
	Maximum	300 dpm/100 cm^2
	Average	100 dpm/100 cm^2
	Removable	20 dpm/100 cm^2
Beta-gamma dose rates[d]	Surface dose rate averaged over not more than 1 m^2	0.20 mrad/h
	Maximum dose rate in any 100-cm^2 area	1.0 mrad/h
Radionuclide concentrations in soil (generic)	Maximum permissible concentration of the following radionuclides in soil above background levels averaged over 100-m^2 area ^{232}Th ^{230}Th ^{228}Ra ^{226}Ra	5 pCi/g averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over 15-cm-thick soil layers more than 15 cm below the surface
Derived concentrations	^{238}U ^{137}Cs	site specific[e]

[a] U.S. Department of Energy, *Guidelines for Residual Radioactivity at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites* (Revision 2, March 1987); Ibid, DOE Order 5400.5 (April 1990).

[b] The 20 μR/h level shall comply with the basic dose limit (100 mrem/yr) when an appropriate-use scenario is considered.

[c] DOE surface contamination guidelines are consistent with *NRC Guidelines for Decontamination at Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-Product, Source, or Special Nuclear Material* (May 1987).

[d] Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr, ^{228}Ra, ^{223}Ra, ^{227}Ac, ^{133}I, ^{131}I, ^{129}I, ^{126}I, ^{125}I.

[e] Site-specific guidelines of 35-40 pCi/g for ^{238}U and 80 pCi/g for ^{137}Cs have been applied at other FUSRAP sites.

Table 2. Background radiation levels and concentrations of selected radionuclides in soil samples taken from the Glenville, New York area

Type of radiation measurement or sample	Radiation level or radionuclide concentration	
	Range	Average
Gamma exposure rate at ground surface (μR/h)[a]	–	10
Gamma exposure rate at 1 m above floor or ground surface (μR/h)[b]	8–10	9
Concentration of radionuclides in soil (pCi/g dry wt)[a]		
^{238}U	0.94–1.3	1.2
^{226}Ra	0.83–0.98	0.93
^{232}Th	0.81–0.95	0.89
^{40}K	13–16	14
^{137}Cs	0.76–1.2	0.93

[a]Values and soil samples (SY075–SY077) were obtained from three undisturbed locations near the Sacandaga site in Glenville.

[b]Exposure rates obtained from four locations in the Albany area.[6]

Table 3. Gamma exposure rate measurements outdoors at the Sacandaga Site, Glenville, New York

Grid location[a]	Grid point measurements[b] (μR/h)		Range of gamma exposure rates from scan of grid block (μR/h)	Average gamma exposure rate at surface[c] (μR/h)
	Gamma exposure rate at 1 m	Gamma exposure rate at the surface		
0+00, BL	18	18	9–18	14
1+00, BL	16	17	10–20	13
2+00, BL	16	17	10–24	15
3+00, BL	15	16	10–18	14
4+00, BL	15	15	10–16	12
5+00, BL	15	16	10–18	14
6+00, BL	15	14	10–20	14
7+00, BL	15	15	10–18	12
8+00, BL	15	16	10–18	12
9+00, BL	13	14	8–14	*d*
10+00, BL	10	10	8–12	*d*
0+00, 100L	13	14	12–18	*d*
1+00, 100L	14	15	12–18	*d*
2+00, 100L	16	16	14–16	15
3+00, 100L	12	12	10–24	16
4+00, 100L	16	17	10–18	12
5+00, 100L	13	13	9–16	12
6+00, 100L	13	13	10–18	14
7+00, 100L	14	14	12–18	15
8+00, 100L	15	15	10–15	*d*
9+00, 100L	15	15	8–13	*d*
10+00, 100L	10	11	*d*	*d*
0+00, 200L	14	14	10–18	*d*
1+00, 200L	14	14	10–17	*d*
2+00, 200L	15	14	11–16	*d*
3+00, 200L	15	15	12–19	*d*
4+00, 200L	14	16	12–18	*d*
5+00, 200L	14	14	11–17	*d*
6+00, 200L	14	14	10–17	*d*
7+00, 200L	14	16	9–15	*d*
8+00, 200L	14	16	8–14	*d*
9+00, 200L	14	15	*d*	*d*
0+00, 300L	14	14	–	*d*
to 584L	–	–	8–14	*d*
1+00, 300L	14	14	*d*	*d*
2+00, 300L	14	15	–	*d*
to 586L	–	–	10–14	*d*

Table 3 (continued)

Grid location[a]	Grid point measurements[b] (μR/h)		Range of gamma exposure rates from scan of grid block (μR/h)	Average gamma exposure rate at surface[c] (μR/h)
	Gamma exposure rate at 1 m	Gamma exposure rate at the surface		
3+00, 300L	15	16	–	*d*
4+00, 300L	14	14	–	*d*
to 583L	–	–	9–14	*d*
5+00, 300L	14	14	*d*	*d*
6+00, 300L	14	15	–	*d*
to 579L	–	–	9–14	*d*
7+00, 300L	16	18	*d*	*d*
8+00, 300L	16	16	–	*d*
to 579L	–	–	9–14	*d*
9+00, 300L	14	14	*d*	*d*
10+00, 300L	14	15	–	*d*
to 600L	–	–	9–13	*d*
0+00, 400L	14	14	*d*	*d*
2+00, 400L	14	15	*d*	*d*
4+00, 400L	14	14	*d*	*d*
6+00, 400L	16	16	*d*	*d*
8+00, 400L	14	16	10–15	*d*
10+00, 400L	14	15	*d*	*d*
0+00, 500L	14	14	*d*	*d*
2+00, 500L	14	15	*d*	*d*
4+00, 500L	13	14	*d*	*d*
6+00, 500L	14	16	*d*	*d*
8+00, 500L	14	14	*d*	*d*
10+00, 500L	12	13	*d*	*d*
0+00, 100R	16	16	*d*	*d*
1+00, 100R	18	20	9–16	*d*
2+00, 100R	17	17	–	*d*
to 421R	–	–	9–16	*d*
3+00, 100R	16	16	8–14	*d*
4+00, 100R	16	16	–	*d*
to 430R	–	–	8–16	*d*
5+00, 100R	14	15	8–15	*d*
6+00, 100R	14	15	–	*d*
to 436R	–	–	9–14	*d*
7+00, 100R	15	15	8–15	*d*
8+00, 100R	13	14	–	*d*
to 438R	–	–	8–14	*d*
9+00, 100R	14	15	7–14	*d*

Table 3 (continued)

Grid location[a]	Grid point measurements[b] (μR/h)		Range of gamma exposure rates from scan of grid block (μR/h)	Average gamma exposure rate at surface[c] (μR/h)
	Gamma exposure, rate at 1 m	Gamma exposure rate at the surface		
10+00, 100R	10	11	–	*d*
to 438R	–	–	8–12	*d*
0+00, 200R	15	16	*d*	*d*
0+50, 50R	*d*	*d*	12–20	14
2+00, 200R	16	16	*d*	*d*
4+00, 200R	14	15	*d*	*d*
6+00, 200R	14	16	*d*	*d*
8+00, 200R	12	14	*d*	*d*
10+00, 200R	10	11	*d*	*d*
0+00, 300R	15	16	*d*	*d*
2+00, 300R	14	14	*d*	*d*
4+00, 300R	14	15	*d*	*d*
6+00, 300R	14	15	*d*	*d*
8+00, 300R	14	15	*d*	*d*
10+00, 300R	10	10	*d*	*d*
0+00, 400R	14	14	*d*	*d*
4+00, 400R	10	10	*d*	*d*
6+00, 400R	14	14	*d*	*d*
8+00, 400R	12	12	*d*	*d*
10+00, 400R	11	11	*d*	*d*
-1-00, BL	17	18	9–22	*d*
-2-00, BL	16	17	*d*	*d*
-3-00, BL	15	16	*d*	*d*
-4-00, BL	14	16	*d*	*d*
-1-00, 100R	*d*	*d*	10–20	*d*
-2-00, 100R	14	14	*d*	*d*
-4-00, 100R	14	14	*d*	*d*
-2-00, 200R	13	13	*d*	*d*
-4-00, 200R	14	15	*d*	*d*
-2-00, 300R	14	15	*d*	*d*
-4-00, 300R	15	16	*d*	*d*
-2-00, 400R	10	10	*d*	*d*
-4-00, 400R	12	14	*d*	*d*
-1-00, 100L	15	18	8–16	*d*
-2-00, 100L	14	14	–	*d*
to 410R	–	–	10–15	*d*
to 600L	–	–	9–12	*d*

Table 3 (continued)

Grid location[a]	Grid point measurements[b] (μR/h)		Range of gamma exposure rates from scan of grid block (μR/h)	Average gamma exposure rate at surface[c] (μR/h)
	Gamma exposure rate at 1 m	Gamma exposure rate at the surface		
-4-00, 100L	14	16	–	*d*
to 400R	–	–	10–14	*d*
to 560L	*d*	*d*	10–12	*d*
-1-00, 200L	14	14	8–16	*d*
-2-00, 200L	14	15	*d*	*d*
-1-00, 300L	15	15	8–14	*d*
-2-00, 300L	14	14	*d*	*d*
-4-00, 300L	14	14	*d*	*d*
-2-00, 400L	14	14	*d*	*d*
-4-00, 400L	14	14	*d*	*d*
-2-00, 500L	14	16	*d*	*d*
-4-00, 500L	13	14	*d*	*d*

[a]Location shown on Fig. 6.
[b]Grid point measurements are taken at intersections of grid lines.
[c]Average gamma exposure rates are obtained by scanning the entire block.
[d]No measurement made.

Table 4. Radionuclide concentrations in soil samples collected at the Sacandaga site

Sample ID	Grid location[a]	Depth (cm)	Radionuclide concentrations (pCi/g)[b]				
			^{238}U	^{232}Th	^{226}Ra	^{137}Cs	^{40}K
			Systematic samples[c]				
S3A	0+50, 50L	0-5	1.3 ± 0.63	0.90 ± 0.04	0.87 ± 0.02	0.16 ± 0.01	16 ± 0.38
S3B	0+50, 50L	5-15	0.87 ± 0.78	0.78 ± 0.03	0.77 ± 0.02	0.20 ± 0.01	17 ± 0.38
S4A	1+50, 50L	0-5	1.9 ± 0.91	1.2 ± 0.04	1.2 ± 0.03	0.98 ± 0.03	20 ± 0.48
S4B	1+50, 50L	5-15	2.2 ± 0.89	1.7 ± 0.06	1.7 ± 0.04	0.25 ± 0.02	16 ± 0.49
S4C	1+50, 50L	15-30	2.4 ± 1.1	1.5 ± 0.07	1.5 ± 0.04	0.04 ± 0.02	28 ± 0.68
S4D	1+50, 50L	30-40	1.9 ± 0.57	1.5 ± 0.04	1.5 ± 0.02	0.06 ± 0.01	29 ± 0.39
S5A	2+50, 50L	0-5	1.8 ± 1.0	1.4 ± 0.07	1.4 ± 0.05	0.78 ± 0.04	19 ± 0.68
S5B	2+50, 50L	5-15	1.9 ± 0.51	1.3 ± 0.04	1.3 ± 0.02	0.41 ± 0.02	21 ± 0.34
S6A	3+50, 50L	0-5	1.8 ± 1.0	1.2 ± 0.04	1.1 ± 0.03	0.59 ± 0.02	14 ± 0.40
S6B	3+50, 50L	5-15	1.5 ± 0.89	1.5 ± 0.05	1.5 ± 0.03	0.13 ± 0.02	10 ± 0.35
S7A	0+50, 50R	0-5	2.6 ± 1.2	1.3 ± 0.08	1.2 ± 0.05	0.32 ± 0.03	16 ± 0.70
S7B	0+50, 50R	5-15	1.8 ± 0.53	1.2 ± 0.04	1.3 ± 0.02	0.23 ± 0.01	23 ± 0.36
S8A	4+50, 50L	0-5	3.0 ± 1.7	1.2 ± 0.05	1.2 ± 0.03	0.19 ± 0.02	25 ± 0.55
S8B	4+50, 50L	5-15	1.6 ± 0.41	1.1 ± 0.03	1.2 ± 0.02	0.15 ± 0.01	24 ± 0.35
S9A	5+50, 50L	0-5	1.3 ± 0.94	0.87 ± 0.03	0.87 ± 0.02	0.10 ± 0.01	18 ± 0.42
S9B	5+50, 50L	5-15	1.0 ± 0.45	0.84 ± 0.03	0.94 ± 0.02	0.09 ± 0.01	19 ± 0.31
S10A	6+50, 50L	0-5	1.9 ± 0.52	1.4 ± 0.04	1.3 ± 0.02	0.75 ± 0.02	20 ± 0.36
S10B	6+50, 50L	5-15	1.6 ± 0.56	1.2 ± 0.05	1.4 ± 0.02	0.26 ± 0.01	24 ± 0.37
S11A	7+50, 50L	0-5	2.0 ± 1.1	1.1 ± 0.05	1.2 ± 0.03	1.1 ± 0.03	20 ± 0.49
S11B	7+50, 50L	5-15	1.5 ± 0.55	1.3 ± 0.04	1.5 ± 0.03	0.42 ± 0.02	23 ± 0.40
S12A	8+50, 50L	0-5	1.2 ± 0.86	1.1 ± 0.04	1.1 ± 0.03	0.97 ± 0.03	15 ± 0.43
S12B	8+50, 50L	5-15	1.1 ± 0.75	1.2 ± 0.04	1.3 ± 0.02	0.45 ± 0.02	16 ± 0.31
S13	9+50, 50L	0-15	1.7 ± 1.2	0.92 ± 0.06	0.98 ± 0.04	0.62 ± 0.04	18 ± 0.59
S14A	0+50, 150L	0-5	1.1 ± 0.42	0.85 ± 0.03	0.88 ± 0.02	0.23 ± 0.01	18 ± 0.32
S14B	0+50, 150L	5-15	1.1 ± 0.45	0.81 ± 0.02	0.90 ± 0.02	0.12 ± 0.01	19 ± 0.30
S15A	1+50, 150L	0-5	1.9 ± 0.81	1.2 ± 0.06	1.1 ± 0.03	0.44 ± 0.02	21 ± 0.54
S15B	1+50, 150L	5-15	1.2 ± 0.89	1.4 ± 0.05	1.4 ± 0.03	0.23 ± 0.02	26 ± 0.51
S16A	2+50, 150L	0-5	1.4 ± 0.85	1.2 ± 0.04	1.2 ± 0.02	0.62 ± 0.02	15 ± 0.32
S16B	2+50, 150L	5-15	1.5 ± 0.86	1.4 ± 0.05	1.4 ± 0.03	0.20 ± 0.02	13 ± 0.42
S17A	3+50, 150L	0-5	1.4 ± 0.91	1.1 ± 0.04	1.1 ± 0.03	0.94 ± 0.03	12 ± 0.37
S17B	3+50, 150L	5-15	1.3 ± 0.61	0.99 ± 0.03	1.0 ± 0.02	0.30 ± 0.01	14 ± 0.27
S18A	4+50, 150L	0-5	1.7 ± 1.1	1.4 ± 0.04	1.3 ± 0.02	0.06 ± 0.01	29 ± 0.43
S18B	4+50, 150L	5-15	2.2 ± 1.1	1.5 ± 0.05	1.5 ± 0.03	0.03 ± 0.01	29 ± 0.51
S19A	5+50, 150L	0-5	0.92 ± 0.82	0.58 ± 0.04	0.63 ± 0.02	0.72 ± 0.03	15 ± 0.42
S19B	5+50, 150L	5-15	1.4 ± 0.74	0.60 ± 0.03	0.67 ± 0.02	0.36 ± 0.02	15 ± 0.35
S20A	6+50, 150L	0-5	1.7 ± 1.3	1.1 ± 0.07	1.1 ± 0.04	1.2 ± 0.05	18 ± 0.70
S20B	6+50, 150L	5-15	1.8 ± 1.1	1.1 ± 0.05	1.3 ± 0.03	0.56 ± 0.02	21 ± 0.47
S21A	7+50, 150L	0-5	1.6 ± 0.60	1.0 ± 0.03	1.2 ± 0.02	1.3 ± 0.03	18 ± 0.34
S21B	7+50, 150L	5-15	1.1 ± 0.94	1.0 ± 0.04	1.2 ± 0.03	0.45 ± 0.02	18 ± 0.43
S22A	8+50, 150L	0-5	1.9 ± 0.47	1.1 ± 0.03	1.0 ± 0.02	0.92 ± 0.02	21 ± 0.35
S22B	8+50, 150L	5-15	1.4 ± 0.42	0.99 ± 0.03	1.1 ± 0.02	0.16 ± 0.01	19 ± 0.31

Table 4 (continued)

Sample ID	Grid location[a]	Depth (cm)	Radionuclide concentrations (pCi/g)[b]				
			^{238}U	^{232}Th	^{226}Ra	^{137}Cs	^{40}K
S23	9+50, 150L	0-15	1.2 ± 0.74	0.90 ± 0.04	0.86 ± 0.03	0.78 ± 0.03	18 ± 0.49
S24A	0+50, 250L	0-5	2.1 ± 1.1	0.96 ± 0.06	0.87 ± 0.03	0.28 ± 0.02	20 ± 0.61
S24B	0+50, 250L	5-15	1.4 ± 0.79	0.90 ± 0.05	1.0 ± 0.03	0.22 ± 0.02	21 ± 0.53
S24C	0+50, 250L	15-30	2.5 ± 1.4	1.2 ± 0.07	1.1 ± 0.04	0.04 ± 0.02	24 ± 0.78
S24D	0+50, 250L	30-45	2.2 ± 0.90	1.5 ± 0.04	1.5 ± 0.02	0.02 ± 0.01	28 ± 0.39
S25A	1+50, 250L	0-5	0.95 ± 0.67	1.1 ± 0.03	1.1 ± 0.02	0.79 ± 0.02	20 ± 0.33
S25B	1+50, 250L	5-15	1.9 ± 1.1	0.97 ± 0.06	1.2 ± 0.04	0.27 ± 0.02	22 ± 0.56
S26A	2+50, 250L	0-5	2.1 ± 1.0	0.97 ± 0.04	1.1 ± 0.03	0.76 ± 0.02	19 ± 0.46
S26B	2+50, 250L	5-15	1.4 ± 0.46	1.0 ± 0.03	1.2 ± 0.02	0.19 ± 0.01	21 ± 0.34
S27A	3+50, 250L	0-5	1.2 ± 0.75	1.0 ± 0.03	1.0 ± 0.02	1.1 ± 0.02	19 ± 0.33
S27B	3+50, 250L	5-15	1.6 ± 0.90	1.1 ± 0.05	1.2 ± 0.03	0.51 ± 0.02	19 ± 0.46
S27C	3+50, 250L	15-30	1.8 ± 1.2	1.2 ± 0.05	1.3 ± 0.03	0.11 ± 0.01	22 ± 0.49
S28A	4+50, 250L	0-5	1.0 ± 0.55	0.80 ± 0.03	0.80 ± 0.02	1.1 ± 0.02	18 ± 0.29
S28B	4+50, 250L	5-15	2.0 ± 1.0	0.82 ± 0.04	0.96 ± 0.02	0.36 ± 0.02	18 ± 0.41
S29A	5+50, 250L	0-5	1.1 ± 0.78	0.86 ± 0.05	0.90 ± 0.03	1.0 ± 0.04	17 ± 0.53
S29B	5+50, 250L	5-15	1.9 ± 0.92	0.89 ± 0.04	1.0 ± 0.02	0.39 ± 0.02	17 ± 0.41
S30A	6+50, 250L	0-5	2.0 ± 0.63	1.3 ± 0.03	1.2 ± 0.02	0.74 ± 0.02	22 ± 0.36
S30B	6+50, 250L	5-15	1.4 ± 0.48	1.4 ± 0.04	1.6 ± 0.02	0.24 ± 0.01	23 ± 0.37
S30C	6+50, 250L	15-30	3.0 ± 1.3	1.4 ± 0.09	1.4 ± 0.06	0.05 ± 0.02	25 ± 0.92
S30D	6+50, 250L	30-40	3.4 ± 2.0	1.6 ± 0.08	1.5 ± 0.05	0.07 ± 0.03	31 ± 0.86
S31	7+50, 250L	0-15	1.5 ± 0.55	0.96 ± 0.03	0.84 ± 0.02	0.53 ± 0.02	19 ± 0.37
S32	8+50, 250L	0-15	1.4 ± 0.69	0.84 ± 0.03	0.84 ± 0.02	0.53 ± 0.01	17 ± 0.27
S34	2+65, 45R	0-15	2.2 ± 0.55	1.2 ± 0.03	1.2 ± 0.02	0.49 ± 0.02	22 ± 0.36
S35	4+50, 50R	0-15	2.1 ± 1.1	1.2 ± 0.07	1.1 ± 0.03	0.81 ± 0.03	25 ± 0.64
S36	6+50, 50R	0-15	1.5 ± 0.86	0.98 ± 0.04	1.0 ± 0.03	0.45 ± 0.02	19 ± 0.48
S37	8+50, 50R	0-15	1.2 ± 0.50	0.83 ± 0.03	0.80 ± 0.02	0.52 ± 0.02	18 ± 0.32
S42	0-50, 250L	0-15	3.2 ± 1.2	2.2 ± 0.06	2.2 ± 0.04	0.54 ± 0.02	14 ± 0.41
S43	-0-50, 50R	0-15	3.0 ± 1.2	1.4 ± 0.05	1.4 ± 0.03	0.65 ± 0.03	17 ± 0.45
S44	-0-50, 50L	0-15	1.3 ± 0.69	0.77 ± 0.04	0.76 ± 0.02	0.51 ± 0.02	17 ± 0.43
S45	0-50, 150L	0-15	1.4 ± 0.80	1.1 ± 0.04	1.1 ± 0.03	0.52 ± 0.02	24 ± 0.50
S49	-4-00, 363R	0-15	3.3 ± 1.8	1.2 ± 0.05	1.2 ± 0.04	0.43 ± 0.03	21 ± 0.58
S50	-2-00, 200R	0-15	1.0 ± 1.0	0.91 ± 0.04	0.94 ± 0.03	0.68 ± 0.02	18 ± 0.46
S51	-4-00, 510L	0-15	2.3 ± 1.3	1.1 ± 0.06	1.1 ± 0.03	0.55 ± 0.02	19 ± 0.49
S53	0+00, 500L	0-15	1.3 ± 0.52	0.92 ± 0.03	0.99 ± 0.02	0.34 ± 0.01	18 ± 0.33
S54	2+00, 400L	0-15	1.2 ± 0.70	1.1 ± 0.04	1.1 ± 0.02	0.46 ± 0.02	21 ± 0.34
S55	4+00, 580L	0-15	2.3 ± 1.3	0.95 ± 0.05	0.99 ± 0.03	0.50 ± 0.03	19 ± 0.54
S56	6+00, 350L	0-15	2.4 ± 1.2	1.3 ± 0.05	1.2 ± 0.03	0.58 ± 0.03	23 ± 0.49
S57	2+00, 400R	0-15	1.5 ± 0.79	0.93 ± 0.03	0.93 ± 0.02	0.65 ± 0.02	16 ± 0.31
S58	4+00, 200R	0-15	1.6 ± 0.92	1.2 ± 0.03	1.1 ± 0.02	0.96 ± 0.02	23 ± 0.39
S59	6+00, 300R	0-15	1.9 ± 0.65	1.0 ± 0.03	1.1 ± 0.02	0.81 ± 0.02	18 ± 0.36
S60	8+00, 500L	0-15	1.7 ± 0.62	0.96 ± 0.03	0.92 ± 0.02	0.75 ± 0.02	18 ± 0.34
S61	10+00, 400L	0-15	2.4 ± 1.4	1.1 ± 0.06	1.1 ± 0.04	0.75 ± 0.04	20 ± 0.71
S62	8+00, 200R	0-15	1.5 ± 0.98	1.1 ± 0.04	1.1 ± 0.03	0.48 ± 0.02	19 ± 0.45
S63	10+00, 438R	0-15	1.8 ± 0.64	0.97 ± 0.09	1.1 ± 0.02	0.85 ± 0.02	18 ± 0.35
S75	*d*	0-15	1.2 ± 0.48	0.81 ± 0.03	0.83 ± 0.02	0.76 ± 0.02	13 ± 0.26
S76	*d*	0-15	0.94 ± 0.59	0.91 ± 0.03	0.98 ± 0.02	1.2 ± 0.02	13 ± 0.25

Table 4 (continued)

Sample ID	Grid location[a]	Depth (cm)	Radionuclide concentrations (pCi/g)[b]				
			^{238}U	^{232}Th	^{226}Ra	^{137}Cs	^{40}K
S77	*d*	0-15	1.3 ± 0.90	0.95 ± 0.04	0.97 ± 0.03	0.88 ± 0.03	16 ± 0.44
S78	*e*	0-15	0.88 ± 0.29	0.75 ± 0.02	0.76 ± 0.01	0.53 ± 0.01	18 ± 0.25
S79	*e*	0-15	1.9 ± 1.2	1.0 ± 0.06	1.1 ± 0.04	1.7 ± 0.05	18 ± 0.63
S80	*e*	0-15	2.6 ± 1.3	1.2 ± 0.06	1.3 ± 0.04	1.4 ± 0.04	20 ± 0.56
S82	*e*	30-45	1.4 ± 0.79	1.2 ± 0.03	1.2 ± 0.02	0.26 ± 0.01	17 ± 0.31
S83	*e*	0-0	0.75 ± 0.47	0.54 ± 0.03	0.65 ± 0.02	0.18 ± 0.01	21 ± 0.35
S84	*e*	0-0	1.6 ± 0.85	0.96 ± 0.04	0.97 ± 0.02	0.58 ± 0.02	19 ± 0.42
				Biased samples[f]			
B14A	5+40, 165L	0-5	1.3 ± 0.49	1.3 ± 0.03	1.2 ± 0.02	3.0 ± 0.04	9.1 ± 0.28
B14B	5+40, 165L	5-15	2.3 ± 1.7	1.2 ± 0.10	1.4 ± 0.06	1.0 ± 0.07	9.1 ± 0.75
B15A	4+27, 185L	0-5	<1.3	1.2 ± 0.03	1.1 ± 0.02	0.73 ± 0.02	14 ± 0.30
B15B	4+27, 185L	5-15	1.1 ± 1.2	1.2 ± 0.07	1.2 ± 0.05	0.69 ± 0.04	23 ± 0.83
B15C	4+27, 185L	15-30	2.1 ± 0.96	1.1 ± 0.07	1.2 ± 0.04	0.26 ± 0.03	23 ± 0.77
B15D	4+27, 185L	30-45	1.8 ± 1.9	1.1 ± 0.05	1.2 ± 0.03	0.06 ± 0.02	22 ± 0.55
B15E	4+27, 185L	45-60	1.6 ± 0.56	1.2 ± 0.03	1.3 ± 0.02	0.08 ± 0.01	24 ± 0.36
B16A	3+79, 182L	0-5	2.7 ± 1.5	2.6 ± 0.10	2.6 ± 0.06	0.43 ± 0.03	13 ± 0.63
B16B	3+79, 182L	5-15	4.6 ± 1.9	2.9 ± 0.10	2.9 ± 0.06	0.17 ± 0.03	14 ± 0.72
B16C	3+79, 182L	15-30	2.0 ± 1.1	2.0 ± 0.06	2.0 ± 0.03	0.18 ± 0.01	21 ± 0.39
B17A	2+36, 104L	0-5	2.0 ± 1.3	1.1 ± 0.05	1.1 ± 0.03	0.66 ± 0.03	20 ± 0.55
B17B	2+36, 104L	5-15	1.9 ± 0.58	1.5 ± 0.03	1.5 ± 0.03	0.14 ± 0.01	17 ± 0.35
B17C	2+36, 104L	15-30	1.4 ± 0.50	1.2 ± 0.03	1.3 ± 0.02	0.04 ± 0.01	21 ± 0.38
B19A	6+42, 173L	0-5	2.4 ± 0.42	1.5 ± 0.12	1.4 ± 0.07	0.42 ± 0.04	12 ± 0.65
B19B	6+42, 173L	5-15	2.3 ± 0.86	1.4 ± 0.04	1.5 ± 0.02	0.20 ± 0.01	9.9 ± 0.25
B19C	6+42, 173L	15-30	1.6 ± 0.47	1.2 ± 0.04	1.4 ± 0.03	0.06 ± 0.01	19 ± 0.33
B20A	7+61, 170L	0-5	1.6 ± 0.61	1.6 ± 0.04	1.6 ± 0.03	0.42 ± 0.02	12 ± 0.31
B20B	7+61, 170L	5-15	1.9 ± 1.4	1.3 ± 0.07	1.4 ± 0.04	0.15 ± 0.02	18 ± 0.54
B20C	7+61, 170L	15-30	1.7 ± 0.78	1.1 ± 0.04	1.2 ± 0.02	0.08 ± 0.01	18 ± 0.38
B21A	8+90, 39L	0-5	1.8 ± 0.66	1.2 ± 0.04	1.1 ± 0.03	0.34 ± 0.02	17 ± 0.42
B21B	8+90, 39L	5-15	1.7 ± 1.2	1.2 ± 0.08	1.2 ± 0.04	0.13 ± 0.03	20 ± 0.70
B22A	7+35, 5L	0-5	2.6 ± 0.91	1.5 ± 0.04	1.4 ± 0.02	2.0 ± 0.03	19 ± 0.36
B22B	7+35, 5L	5-15	2.3 ± 1.3	1.6 ± 0.06	1.6 ± 0.03	0.93 ± 0.02	21 ± 0.41
B22C	7+35, 5L	15-30	2.1 ± 1.1	1.4 ± 0.07	1.5 ± 0.05	0.36 ± 0.04	24 ± 0.75
B23A	6+67, 12L	0-5	3.5 ± 0.61	2.6 ± 0.05	2.5 ± 0.03	0.06 ± 0.02	11 ± 0.31
B23B	6+67, 12L	5-15	2.7 ± 1.0	2.2 ± 0.04	2.2 ± 0.03	0.03 ± 0.01	14 ± 0.31
B23C	6+67, 12L	15-30	1.0 ± 1.7	1.5 ± 0.10	1.5 ± 0.06	0.02 ± 0.02	16 ± 0.82
B24A	5+80, 23L	0-5	2.1 ± 1.0	1.5 ± 0.05	1.5 ± 0.03	0.66 ± 0.02	14 ± 0.42
B24B	5+80, 23L	5-15	1.9 ± 0.88	1.3 ± 0.06	1.4 ± 0.04	0.24 ± 0.02	21 ± 0.56
B26A	3+10, 60L	0-5	1.9 ± 1.1	2.1 ± 0.05	2.0 ± 0.03	0.12 ± 0.02	12 ± 0.40
B26B	3+10, 60L	5-15	3.3 ± 1.8	2.4 ± 0.10	2.4 ± 0.05	0.03 ± 0.03	15 ± 0.69
B26C	3+10, 60L	15-30	2.3 ± 0.96	1.8 ± 0.04	1.8 ± 0.03	0.03 ± 0.01	26 ± 0.38
B27A	2+01, 30L	0-5	3.0 ± 1.9	2.3 ± 0.09	2.3 ± 0.06	0.67 ± 0.04	11 ± 0.62
B27B	2+01, 30L	5-15	3.2 ± 1.2	3.0 ± 0.07	2.9 ± 0.04	0.22 ± 0.02	14 ± 0.43
B27C	2+01, 30L	15-30	2.4 ± 1.0	2.1 ± 0.06	2.1 ± 0.03	0.16 ± 0.02	16 ± 0.44

Table 4 (continued)

Sample ID	Grid location[a]	Depth (cm)	Radionuclide concentrations (pCi/g)[b]				
			^{238}U	^{232}Th	^{226}Ra	^{137}Cs	^{40}K
B28A	1+10, 15L	0-5	3.7 ± 0.47	2.2 ± 0.13	2.0 ± 0.08	0.26 ± 0.05	11 ± 0.68
B28B	1+10, 15L	5-15	2.1 ± 1.7	1.7 ± 0.08	1.8 ± 0.04	0.27 ± 0.02	18 ± 0.58
B29A	0+71, 6L	0-5	3.6 ± 1.5	2.3 ± 0.10	2.2 ± 0.06	0.61 ± 0.04	12 ± 0.61
B29B	0+71, 6L	5-15	3.2 ± 2.0	2.5 ± 0.13	2.4 ± 0.07	0.38 ± 0.04	12 ± 0.76
B29C	0+71, 6L	15-30	2.9 ± 0.69	2.4 ± 0.05	2.4 ± 0.03	0.26 ± 0.01	13 ± 0.29
B30A	0+33, 222L	0-5	1.1 ± 0.78	1.2 ± 0.03	1.2 ± 0.02	0.08 ± 0.01	24 ± 0.36
B30B	0+33, 222L	5-15	1.8 ± 1.4	1.5 ± 0.06	1.5 ± 0.04	0.02 ± 0.02	29 ± 0.69
B30C	0+33, 222L	15-30	2.7 ± 1.1	1.5 ± 0.05	1.5 ± 0.03	<0.02	30 ± 0.56
B30D	0+33, 222L	30-45	2.5 ± 0.54	1.4 ± 0.04	1.5 ± 0.02	<0.01	30 ± 0.40
B31A	1+73, 238L	0-5	2.1 ± 1.0	1.1 ± 0.05	1.2 ± 0.03	0.81 ± 0.03	21 ± 0.46
B31B	1+73, 238L	5-15	2.8 ± 2.1	1.2 ± 0.09	1.4 ± 0.05	0.11 ± 0.03	19 ± 0.85
B31C	1+73, 238L	15-30	1.4 ± 0.77	1.4 ± 0.04	1.3 ± 0.02	0.03 ± 0.01	27 ± 0.37
B31D	1+73, 238L	30-45	1.4 ± 0.88	1.5 ± 0.04	1.3 ± 0.03	0.01 ± 0.01	29 ± 0.49
B32A	2+10, 203L	0-5	1.5 ± 0.51	1.3 ± 0.04	1.4 ± 0.02	0.89 ± 0.02	21 ± 0.37
B32B	2+10, 203L	5-15	1.7 ± 1.7	1.3 ± 0.09	1.3 ± 0.05	0.27 ± 0.05	22 ± 0.87
B32C	2+10, 203L	15-30	2.0 ± 1.1	1.4 ± 0.07	1.4 ± 0.04	0.04 ± 0.02	26 ± 0.78
B32D	2+10, 203L	30-45	2.1 ± 0.50	1.5 ± 0.04	1.5 ± 0.02	0.02 ± 0.01	30 ± 0.41
B33A	3+30, 223L	0-5	2.3 ± 1.5	2.2 ± 0.04	2.1 ± 0.03	0.38 ± 0.02	9.3 ± 0.26
B33B	3+30, 223L	5-15	1.9 ± 2.3	2.1 ± 0.09	2.0 ± 0.06	<0.04	16 ± 0.70
B34A	4+25, 213L	0-5	2.6 ± 1.0	1.7 ± 0.05	1.7 ± 0.03	1.1 ± 0.03	12 ± 0.41
B34B	4+25, 218L	5-15	3.4 ± 1.9	2.3 ± 0.08	2.3 ± 0.06	0.26 ± 0.03	14 ± 0.63
B34C	4+25, 218L	5-10	1.8 ± 0.99	1.3 ± 0.04	1.4 ± 0.03	0.21 ± 0.02	17 ± 0.42
B35A	5+53, 218L	0-5	2.5 ± 2.2	2.1 ± 0.09	2.1 ± 0.07	0.88 ± 0.05	11 ± 0.75
B35B	5+53, 218L	5-15	2.1 ± 2.2	2.6 ± 0.11	2.5 ± 0.07	0.10 ± 0.03	11 ± 0.77
B35C	5+53, 218L	15-30	2.2 ± 1.4	1.8 ± 0.09	1.8 ± 0.05	0.08 ± 0.02	16 ± 0.68
B36A	0+13, 110L	0-5	1.7 ± 0.91	1.1 ± 0.03	1.1 ± 0.02	0.09 ± 0.01	15 ± 0.29
B36B	0+13, 110L	5-15	1.6 ± 1.2	1.4 ± 0.07	1.5 ± 0.04	0.04 ± 0.03	11 ± 0.54
B36C	0+13, 110L	15-30	1.5 ± 0.79	1.2 ± 0.05	1.4 ± 0.03	<0.02	14 ± 0.44
B37A	6+85, 287L	0-5	0.81 ± 0.79	1.3 ± 0.04	1.2 ± 0.02	1.2 ± 0.02	25 ± 0.37
B37B	6+85, 287L	5-15	2.5 ± 0.83	1.4 ± 0.07	1.4 ± 0.04	0.23 ± 0.02	30 ± 0.78
B37C	6+85, 287L	15-30	2.5 ± 1.3	1.3 ± 0.09	1.3 ± 0.05	0.14 ± 0.03	29 ± 0.98
B37D	6+85, 287L	30-45	2.1 ± 1.1	1.5 ± 0.08	1.5 ± 0.05	0.17 ± 0.03	31 ± 0.85
B38A	0+84, 85R	0-5	2.1 ± 1.5	1.5 ± 0.07	1.2 ± 0.04	1.8 ± 0.05	28 ± 0.77
B38B	0+84, 85R	5-15	1.8 ± 0.59	1.5 ± 0.04	1.4 ± 0.02	0.58 ± 0.02	31 ± 0.41
B38C	0+84, 85R	15-30	4.0 ± 2.3	1.4 ± 0.11	1.3 ± 0.07	0.30 ± 0.07	26 ± 1.3
B39A	10+27, 77R	0-15	1.7 ± 0.77	0.91 ± 0.04	0.90 ± 0.02	0.42 ± 0.02	17 ± 0.43
B39B	10+27, 77R	15-30	0.76 ± 0.45	0.96 ± 0.03	0.91 ± 0.02	0.26 ± 0.02	17 ± 0.33
B39C	10+27, 77R	30-45	1.8 ± 1.3	0.99 ± 0.07	0.95 ± 0.04	0.16 ± 0.03	16 ± 0.68
B40A	0-53, 14R	0-15	3.4 ± 0.70	2.4 ± 0.05	2.3 ± 0.03	0.57 ± 0.02	13 ± 0.31
B40B	0-53, 14R	15-30	3.4 ± 1.1	2.5 ± 0.06	2.5 ± 0.04	0.43 ± 0.02	13 ± 0.43
B41A	1+00, 100R	0-15	2.1 ± 0.88	1.4 ± 0.05	1.4 ± 0.03	0.48 ± 0.02	28 ± 0.52
B41B	1+00, 100R	15-30	1.7 ± 1.4	1.4 ± 0.05	1.4 ± 0.04	0.02 ± 0.02	29 ± 0.72

Table 4 (continued)

Sample ID	Grid location[a]	Depth (cm)	Radionuclide concentrations (pCi/g)[b] ^{238}U	^{232}Th	^{226}Ra	^{137}Cs	^{40}K
			Auger samples[g]				
A1A	4+50, 186L	0-15	2.6 ± 1.4	1.5 ± 0.06	1.5 ± 0.04	<0.02	30 ± 0.76
A1L	4+50, 186L	170-190	1.6 ± 0.95	1.4 ± 0.04	1.5 ± 0.03	<0.02	30 ± 0.54
A1M	4+50, 186L	190-200	1.7 ± 0.79	1.3 ± 0.04	1.5 ± 0.03	0.02 ± 0.01	28 ± 0.51
A2A	4+35, 55L	15-30	3.6 ± 1.2	1.2 ± 0.06	1.2 ± 0.03	0.11 ± 0.02	24 ± 0.57
A2B	4+35, 55L	30-45	1.1 ± 0.85	1.1 ± 0.04	1.1 ± 0.03	0.03 ± 0.01	21 ± 0.53
A2C	4+35, 55L	45-60	1.5 ± 0.85	0.98 ± 0.04	1.1 ± 0.03	<0.01	20 ± 0.45
A2E	4+35, 55L	75-90	1.3 ± 1.1	1.4 ± 0.04	1.6 ± 0.03	<0.02	27 ± 0.44
A2F	4+35, 55L	90-100	2.6 ± 0.62	1.5 ± 0.04	1.5 ± 0.02	<0.01	30 ± 0.44
A2G	4+35, 55L	100-120	2.0 ± 1.1	1.2 ± 0.05	1.3 ± 0.03	0.05 ± 0.01	24 ± 0.50
A2H	4+35, 55L	120-135	3.0 ± 1.9	1.4 ± 0.07	1.5 ± 0.04	<0.02	30 ± 0.77
A2I	4+35, 55L	140-150	2.3 ± 0.99	1.5 ± 0.07	1.6 ± 0.05	<0.03	30 ± 0.89
A2J	4+35, 55L	150-170	2.3 ± 1.5	1.5 ± 0.08	1.5 ± 0.05	<0.03	31 ± 0.94
A2K	4+35, 55L	170-190	1.8 ± 0.54	1.4 ± 0.03	1.5 ± 0.02	0.05 ± 0.01	29 ± 0.37
A3A	5+11, 27L	0-15	1.6 ± 0.79	1.3 ± 0.03	1.3 ± 0.02	0.07 ± 0.01	27 ± 0.36
A3B	5+11, 27L	15-30	1.2 ± 0.85	1.3 ± 0.03	1.3 ± 0.02	0.06 ± 0.01	27 ± 0.36
A3C	5+11, 27L	30-45	2.0 ± 1.3	1.1 ± 0.06	1.2 ± 0.04	0.30 ± 0.02	22 ± 0.69
A3D	5+11, 27L	45-60	1.6 ± 0.56	1.2 ± 0.03	1.4 ± 0.02	0.37 ± 0.01	21 ± 0.35
A3E	5+11, 27L	60-75	1.2 ± 0.94	1.3 ± 0.06	1.3 ± 0.04	0.06 ± 0.02	25 ± 0.66
A3F	5+11, 27L	75-90	1.7 ± 1.1	1.5 ± 0.06	1.4 ± 0.04	<0.02	30 ± 0.60
A3G	5+11, 27L	90-100	2.3 ± 1.4	1.5 ± 0.08	1.4 ± 0.05	<0.02	30 ± 0.82
A3H	5+11, 27L	100-120	2.6 ± 1.4	1.6 ± 0.08	1.5 ± 0.05	<0.03	31 ± 0.91
A4A	5+46, 83L	0-15	1.2 ± 0.90	1.0 ± 0.03	1.0 ± 0.02	0.30 ± 0.01	20 ± 0.32
A4B	5+46, 83L	15-30	0.89 ± 0.87	1.1 ± 0.04	1.2 ± 0.02	0.01 ± 0.01	20 ± 0.43
A4C	5+46, 83L	30-45	1.7 ± 0.88	1.2 ± 0.04	1.2 ± 0.03	0.08 ± 0.01	17 ± 0.40
A4D	5+46, 83L	45-60	1.6 ± 1.3	1.3 ± 0.05	1.3 ± 0.03	0.01 ± 0.01	23 ± 0.52
A4E	5+46, 83L	75-90	1.4 ± 0.92	1.1 ± 0.04	1.3 ± 0.02	0.02 ± 0.02	18 ± 0.43
A4F	5+46, 83L	90-100	2.1 ± 0.48	1.4 ± 0.03	1.3 ± 0.02	<0.01	26 ± 0.37
A4G	5+46, 83L	100-120	2.0 ± 1.0	1.5 ± 0.04	1.5 ± 0.03	<0.02	30 ± 0.51
A4H	5+46, 83L	135-150	2.2 ± 1.6	1.3 ± 0.08	1.4 ± 0.05	0.08 ± 0.04	26 ± 0.91
A4I	5+46, 83L	150-170	1.4 ± 0.84	1.5 ± 0.05	1.6 ± 0.03	<0.02	30 ± 0.56
A4J	5+46, 83L	170-180	1.7 ± 0.87	1.4 ± 0.04	1.7 ± 0.03	<0.01	29 ± 0.50
A5A	4+81, 126L	0-15	0.70 ± 0.84	0.83 ± 0.03	0.91 ± 0.02	0.25 ± 0.01	18 ± 0.30
A5B	4+81, 126L	180-200	2.4 ± 1.1	1.4 ± 0.07	1.6 ± 0.04	0.03 ± 0.02	30 ± 0.70
A6A	3+86, 64L	0-15	1.0 ± 0.39	0.86 ± 0.03	0.93 ± 0.02	0.07 ± 0.01	20 ± 0.31
A7	3+35, 166L	0-15	3.3 ± 2.2	1.5 ± 0.08	1.6 ± 0.05	0.18 ± 0.03	23 ± 0.90
A8A	2+62, 208L	0-15	1.6 ± 0.45	1.4 ± 0.04	1.5 ± 0.02	0.01 ± 0.01	29 ± 0.39
A8B	2+62, 208L	120-135	1.9 ± 0.82	1.5 ± 0.05	1.5 ± 0.03	<0.02	31 ± 0.51
A9A	5+11, 161L	0-15	1.1 ± 0.97	0.88 ± 0.04	0.97 ± 0.03	0.08 ± 0.01	19 ± 0.51
A10A	1+42, 291L	0-15	1.5 ± 0.47	1.3 ± 0.03	1.4 ± 0.02	0.15 ± 0.01	26 ± 0.36
A11A	0+29, 324L	0-15	2.0 ± 0.82	1.0 ± 0.05	1.2 ± 0.03	0.47 ± 0.02	22 ± 0.48
A11B	0-59, 324L	15-30	2.1 ± 1.2	1.1 ± 0.05	1.3 ± 0.03	0.09 ± 0.02	24 ± 0.55
A11C	0-59, 324L	30-45	1.7 ± 1.5	1.1 ± 0.07	1.3 ± 0.03	0.05 ± 0.03	25 ± 0.72
A11D	0-59, 324L	45-60	1.9 ± 0.89	1.3 ± 0.04	1.3 ± 0.02	<0.02	28 ± 0.39

Table 4 (continued)

Sample ID	Grid location[a]	Depth (cm)	Radionuclide concentrations (pCi/g)[b]				
			^{238}U	^{232}Th	^{226}Ra	^{137}Cs	^{40}K
A12A	4+25, 125L	0-15	1.3 ± 0.50	1.2 ± 0.03	1.2 ± 0.02	0.25 ± 0.01	25 ± 0.36
A13A	0+26, 165L	0-1 5	2.0 ± 1.0	1.9 ± 0.06	1.9 ± 0.04	0.09 ± 0.02	18 ± 0.55
A13B	0+26, 165L	15-30	1.5 ± 0.84	1.0 ± 0.04	1.1 ± 0.03	0.01 ± 0.01	21 ± 0.44
A13C	0+26, 165L	30-45	1.8 ± 0.62	1.4 ± 0.04	1.4 ± 0.02	<0.01	27 ± 0.40
A13D	0+26, 165L	45-60	1.8 ± 1.4	1.5 ± 0.06	1.6 ± 0.04	<0.02	27 ± 0.67
A13E	0+26, 165L	60-75	1.7 ± 0.88	1.4 ± 0.05	1.5 ± 0.03	0.02 ± 0.01	23 ± 0.47
A13F	0+26, 165L	75-90	1.9 ± 0.54	1.5 ± 0.03	1.7 ± 0.02	<0.01	30 ± 0.40
A13G	0+26, 165L	90-100	2.0 ± 1.5	1.4 ± 0.06	1.7 ± 0.04	<0.02	31 ± 0.66
A13H	0+26, 165L	105-120	1.6 ± 1.0	1.4 ± 0.04	1.5 ± 0.03	<0.01	29 ± 0.49
A13I	0+26, 165L	120-135	1.5 ± 1.6	1.4 ± 0.06	1.4 ± 0.04	0.05 ± 0.02	29 ± 0.74
A14A	0-14, 114L	0-15	1.8 ± 0.89	1.1 ± 0.04	1.3 ± 0.02	0.01 ± 0.01	25 ± 0.37
A14B	0-14, 114	135-150	2.0 ± 0.92	1.4 ± 0.04	1.6 ± 0.02	<0.02	29 ± 0.40
A15A	0+30, 54L	0-15	1.4 ± 0.72	0.81 ± 0.03	0.91 ± 0.02	0.05 ± 0.01	18 ± 0.39
A15B	0+30, 54L	120-135	1.5 ± 0.72	1.4 ± 0.04	1.5 ± 0.03	<0.01	29 ± 0.46
A16A	-1-45, 32R	105-120	1.0 ± 0.77	0.79 ± 0.04	0.86 ± 0.02	0.46 ± 0.02	18 ± 0.42
A17	-0-17, 195R	135-170	1.7 ± 0.54	1.2 ± 0.04	1.4 ± 0.02	0.34 ± 0.01	25 ± 0.39
A18A	1+37, 57L	0-18	1.7 ± 1.1	0.92 ± 0.06	1.1 ± 0.04	0.25 ± 0.02	24 ± 0.70
A18D	1+37, 57L	45-60	1.8 ± 0.91	1.4 ± 0.05	1.6 ± 0.03	0.04 ± 0.02	33 ± 0.62
A19A	1+19, 94L	0-15	2.0 ± 1.5	1.1 ± 0.07	1.3 ± 0.04	0.18 ± 0.02	22 ± 0.66
A19E	1+19, 94L	105-120	1.6 ± 0.91	1.4 ± 0.05	1.4 ± 0.02	<0.01	29 ± 0.50
A20	6+40, 70L	90-100	2.1 ± 0.49	1.4 ± 0.04	1.5 ± 0.02	<0.01	30 ± 0.39
A21A	6+48, 184L	0-15	1.7 ± 1.2	1.1 ± 0.07	1.3 ± 0.04	0.07 ± 0.02	21 ± 0.67
A21B	6+48, 184L	105-120	1.9 ± 0.53	1.3 ± 0.04	1.6 ± 0.02	<0.01	28 ± 0.37
A22A	7+90, 182L	0-15	2.7 ± 1.5	1.2 ± 0.07	1.3 ± 0.05	0.83 ± 0.04	20 ± 0.78
A22D	7+90, 182L	45-60	1.4 ± 0.98	1.5 ± 0.04	1.6 ± 0.03	<0.02	29 ± 0.51
A23	0+91, 22L	125-170	2.0 ± 1.3	1.4 ± 0.06	1.5 ± 0.04	0.04 ± 0.02	28 ± 0.63
A24A	3+18, 371L	0-15	2.2 ± 0.85	1.3 ± 0.04	1.4 ± 0.03	0.14 ± 0.01	27 ± 0.48
A25A	5+05, 282L	0-15	1.3 ± 0.91	1.1 ± 0.04	1.2 ± 0.03	0.46 ± 0.02	21 ± 0.39
A25D	5+05, 282L	45-60	1.6 ± 0.97	1.4 ± 0.04	1.4 ± 0.03	<0.02	28 ± 0.56
A26A	3+46, 351L	0-15	1.7 ± 1.1	1.1 ± 0.04	1.3 ± 0.03	0.34 ± 0.02	21 ± 0.48
A26H	6+46, 351L	105-120	1.7 ± 0.52	1.4 ± 0.03	1.4 ± 0.02	<0.01	27 ± 0.37
A27A	7+94, 453L	0-15	1.8 ± 0.83	1.0 ± 0.04	1.3 ± 0.03	0.55 ± 0.03	19 ± 0.44
A28A	8+01, 302L	0-15	1.8 ± 1.1	1.1 ± 0.05	1.3 ± 0.03	0.94 ± 0.03	21 ± 0.54
A28D	8+01, 302L	45-60	2.1 ± 1.4	1.5 ± 0.05	1.5 ± 0.03	0.01 ± 0.01	28 ± 0.53
A30A	2+33, 97L	0-15	2.0 ± 0.50	1.4 ± 0.03	1.5 ± 0.02	0.34 ± 0.01	12 ± 0.28
A30H	2+33, 97L	105-120	1.9 ± 1.1	1.5 ± 0.05	1.5 ± 0.03	<0.02	30 ± 0.58
A30K	2+33, 97L	135-170	1.9 ± 1.0	1.4 ± 0.05	1.4 ± 0.03	<0.01	29 ± 0.50
A31	1+11, 178R	135-170	2.5 ± 1.1	1.3 ± 0.06	1.4 ± 0.04	0.01 ± 0.01	29 ± 0.70
A32A	2+52, 30L	135-170	2.9 ± 1.2	1.4 ± 0.07	1.4 ± 0.04	0.06 ± 0.02	25 ± 0.75
A32B	2+52, 30L	0-15	3.2 ± 1.3	1.8 ± 0.05	1.7 ± 0.03	0.81 ± 0.03	16 ± 0.44
A33	4+11, 69R	135-170	2.3 ± 1.0	1.4 ± 0.04	1.4 ± 0.03	<0.01	28 ± 0.49
A34A	6+00, 49L	0-15	1.0 ± 0.86	0.56 ± 0.04	0.56 ± 0.02	0.04 ± 0.02	15 ± 0.47
A35A	2+65, 44L	0-15	2.6 ± 1.2	1.2 ± 0.06	1.2 ± 0.03	0.54 ± 0.03	21 ± 0.61
A35F	2+65, 44L	75-90	1.6 ± 0.46	1.4 ± 0.03	1.4 ± 0.02	<0.01	28 ± 0.36

Table 4 (continued)

Sample ID	Grid location[a]	Depth (cm)	Radionuclide concentrations (pCi/g)[b]				
			^{238}U	^{232}Th	^{226}Ra	^{137}Cs	^{40}K
A36A	6+10, 139L	0-15	0.99 ± 0.53	0.74 ± 0.03	0.74 ± 0.02	0.41 ± 0.02	17 ± 0.36
A37A	5+99, 98L	0-15	0.79 ± 0.39	0.69 ± 0.03	0.65 ± 0.02	0.11 ± 0.01	16 ± 0.28
A37B	5+99, 98L	15-30	1.7 ± 0.89	1.0 ± 0.06	1.1 ± 0.03	0.02 ± 0.01	18 ± 0.55
A37C	5+99, 98L	30-45	1.3 ± 0.69	1.3 ± 0.03	1.3 ± 0.02	<0.01	25 ± 0.37
A37D	5+99, 98L	45-60	1.9 ± 0.91	1.5 ± 0.04	1.3 ± 0.02	<0.01	28 ± 0.38
A38A	6+75, 65L	0-15	1.3 ± 0.54	0.92 ± 0.03	0.96 ± 0.02	0.32 ± 0.01	18 ± 0.32
A39A	9+05, 39L	0-15	1.6 ± 1.0	1.1 ± 0.05	1.0 ± 0.03	0.31 ± 0.02	20 ± 0.55
A39B	9+05, 39L	15-30	2.3 ± 1.4	1.1 ± 0.08	1.1 ± 0.04	<0.03	24 ± 0.88
A39C	9+05, 39L	30-45	2.0 ± 0.87	1.4 ± 0.06	1.2 ± 0.04	<0.02	28 ± 0.66
A39D	9+05, 39L	45-60	1.3 ± 0.94	1.5 ± 0.03	1.3 ± 0.02	<0.01	28 ± 0.38
A40A	5+17, 120L	0-15	0.99 ± 0.44	0.86 ± 0.03	0.84 ± 0.02	0.11 ± 0.01	19 ± 0.31
A41A	7+98, 50L	0-15	2.4 ± 1.9	1.1 ± 0.08	1.2 ± 0.05	0.39 ± 0.04	19 ± 0.86

[a]Locations shown on Figs. 7 and 8.

[b]Indicated counting error is at the 95% confidence level (± 2 σ).

[c]Systematic samples are taken at selected locations irrespective of gamma exposure.

[d]Background samples were collected from the site in relatively undisturbed areas (see Table 2).

[e]Sample S78 was taken from -5-80, 12 ft from center of drive; S79 from -7-78, 12 ft from center of drive; S80 from -3-64, 15 ft N. of road center; S82 from 8 ft S. of hole A13; S83 and S84 from bunker.

[f]Biased soil samples are taken from areas shown to have elevated gamma exposure rates.

[g]Auger samples are taken from holes drilled to further define the depth and extent of radioactive material. Holes are drilled where the surface may or may not be contaminated.

Table 5. Concentrations of elemental beryllium in selected soil samples collected from the Sacandaga site

Sample I.D.	Location[a]	Depth (cm)	Beryllium (μg/g)
	Systematic samples[b]		
S8A	4+50, 50L	0-5	1.9
S9B	5+50, 50L	5-15	1.5
S10A	6+50, 50L	0-5	3.0
S18B	4+50, 150L	5-15	2.7
S19B	5+50, 150L	0-5	1.0
S35	4+50, 50R	0-15	2.3
S45	-0-50, 150L	0-15	2.3
S63	10+00, 438R	0-15	2.0
S83	*c*	0-0	62
S84	*c*	0-0	8.7
	Biased samples[d]		
B17A	2+36, 104L	0-5	2.2
B20A	7+61, 170L	0-5	4.1
B21B	8+90, 39L	5-10	2.0
B22B	7+35, 5L	5-10	2.9
B26B	3+10, 60L	0-5	4.0
B29A	0+71, 6L	0-5	4.0
B32A	2+10, 203L	0-5	2.6
B37B	6+85, 287L	5-10	2.4
	Auger samples[e]		
A2A	4+35, 55L	15-30	2.2
A4F	5+46, 83L	90-110	2.4
A5A	4+81, 126L	0-15	1.7
A9A	5+11, 161L	0-15	1.6
A11D	0+29, 324L	45-60	2.6
A12A	4+25, 125L	0-15	2.1
A13G	0+26, 165L	90-110	3.2
A32A	2+52, 30L	150-160	3.2
A37B	5+99, 98L	15-30	1.8

[a]Locations are shown on Figs. 7 and 8.

[b]Systematic samples are taken at selected locations irrespective of gamma exposure rate.

[c]Samples S83 and S84 were taken from inside the bunker.

[d]Biased samples are taken from areas shown to have elevated gamma exposure rates.

[e]Auger samples are taken from holes drilled to further define the depth and extent of radioactive material. Holes are drilled where the surface may or may not be contaminated.

Table 6. Concentrations of beryllium in samples collected from in and around the concrete bunker at the Sacandaga Site

Sample ID	Layer[a]	Location[b]	Depth (cm)	Beryllium (µg/g)[c]
Prior to excavation				
S300	S	21 ft S	0-15	1.6
S301	S	~1.5 ft S of SE corner	0-15	1.9
S302	S	Over NE corner	0-15	2.7
S303	S	3 ft SW of NE corner	0-15	2.1
S304	S	Near NW corner	0-15	3.9
S305	S	At center, N end	0-10	1.6
During excavation				
S306	PG	6 ft N of bunker	–	1.9
From excavated dirt				
S307	S	Top of first dirt pile	0-15	4.0
S316	S	26 ft S, top of dirt pile	0-15	3.0
S317	S	16 ft SE, SE dirt pile	0-15	3.7
S318	S	9 ft S, center dirt pile	0-15	4.0
S319	S	4 ft S, center dirt pile	0-15	4.7
From bunker floor				
S308A	CS	0+1.5, 1.5L	0-15	5.1
S308B	CS	0+1.5, 1.5L	15-30	12.0
S308C	CS	0+1.5, 1.5L	30-45	8.2
S308D	PG	0+1.5, 1.5L	45-50	8.4
S309A	CS	0+04, 2L	0-15	12.0
S309B	CS	0+04, 2L	15-30	7.8
S309C	PG	0+04, 2L	30-50	5.0
S309D	S	0+04, 2L	50-65	1.4
S310A	CS	0+08, 2L	0-20	36
S310B	CS/S	0+08, 2L	0-35	4.2
S310C	S	0+08, 2L	35-45	2.4
S310D	S	0+08, 2L	45-55	2.3
S311A	CS	0+08, 4L	0-15	32
S311B	CS	0+08, 4L	15-30	14
S311C	PG/S	0+08, 4L	30-45	3.5
S311D	S	0+08, 4L	45-60	2.0
S312A	CS	0+08, 8L	0-15	28
S312B	PG	0+08, 8L	15-30	25
S312C	PG/S	0+08, 8L	30-45	17
S313A	CS	0+08, 10L	0-15	46
S313B	PG	0+08, 10L	15-30	46
S313C	S	0+08, 10L	30-45	28

Table 6 (continued)

Sample ID	Layer[a]	Location[b]	Depth (cm)	Beryllium (μg/g)[c]
S314A	CS	0+04, 10L	0-15	24
S314C	S	0+04, 10L	30-45	38
S315A	CS	0+04, 8L	0-15	630
S315B	S	0+04, 8L	15-30	880
S315C	S	0+04, 8L	30-45	590
S320A	CS	0+04, 4L	0-15	46
S320B	CS/PG	0+04, 4L	15-30	50
S320C	PG	0+04, 4L	30-45	35
S320D	S	0+04, 4L	45-60	13
S321A	–	0+02, 4L	0-15	33
S321B	–	0+02, 4L	15-30	20
S321C	–	0+02, 4L	30-45	68
S321D	PG	0+02, 4L	45-60	49
S321E	S	0+02, 4L	60-75	18
S322A	–	0+02, 8L	0-15	130
S322B	PG	0+02, 8L	15-30	190
S322C	PG/S	0+02, 8L	30-45	230
S322D	S	0+02, 8L	45-60	93
S323	S	Upper L chute	–	2.6
S324	S	Lower R chute	–	2.5
M1	CC	E wall	–	1.3
M2	CC	N wall	–	1.5
M3	CC	W wall	–	<0.3

[a]CS = Crushed stone; S = soil; PG = pea gravel; CC = concrete chips.

[b]Locations of samples having grid designations are shown on Fig. 12. Other samples were collected at the approximate distances indicated from south of the north wall of the bunker and/or from the indicated dirt pile.

[c]Samples M1, M2, and M3 were analyzed by inductively coupled mass spectrometry (ICP-MS). All other analyses were performed according to EPA procedure 200.7.

APPENDIX A

GAMMA PROFILE GRAPHS OF AUGER HOLES AT THE SACANDAGA SITE

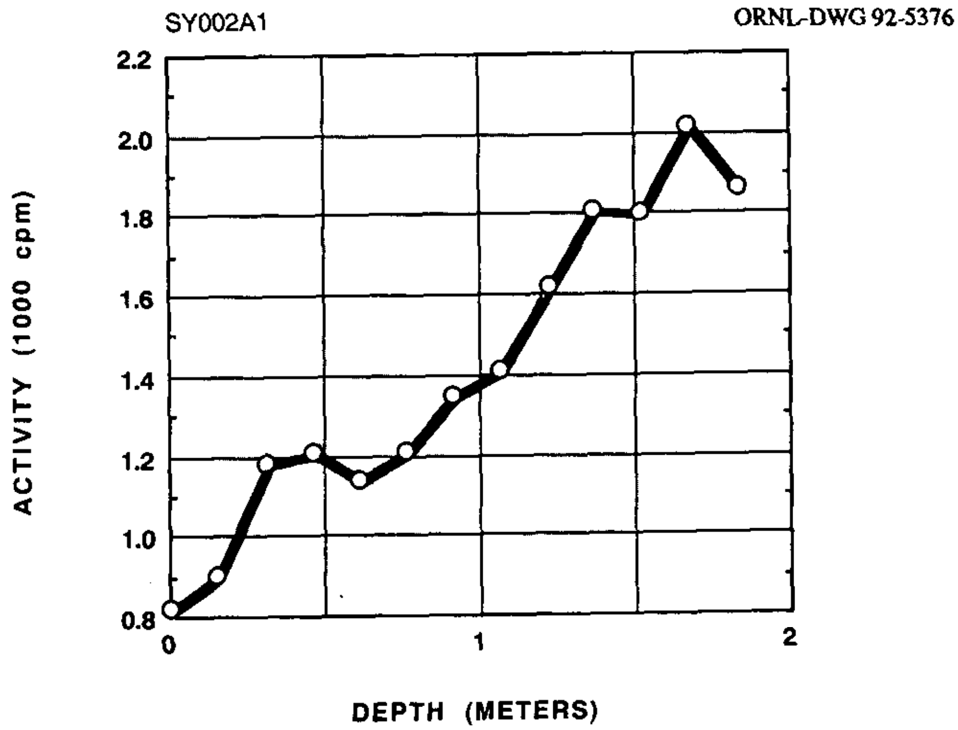

Fig. A.1. Gamma profile of auger hole A001.

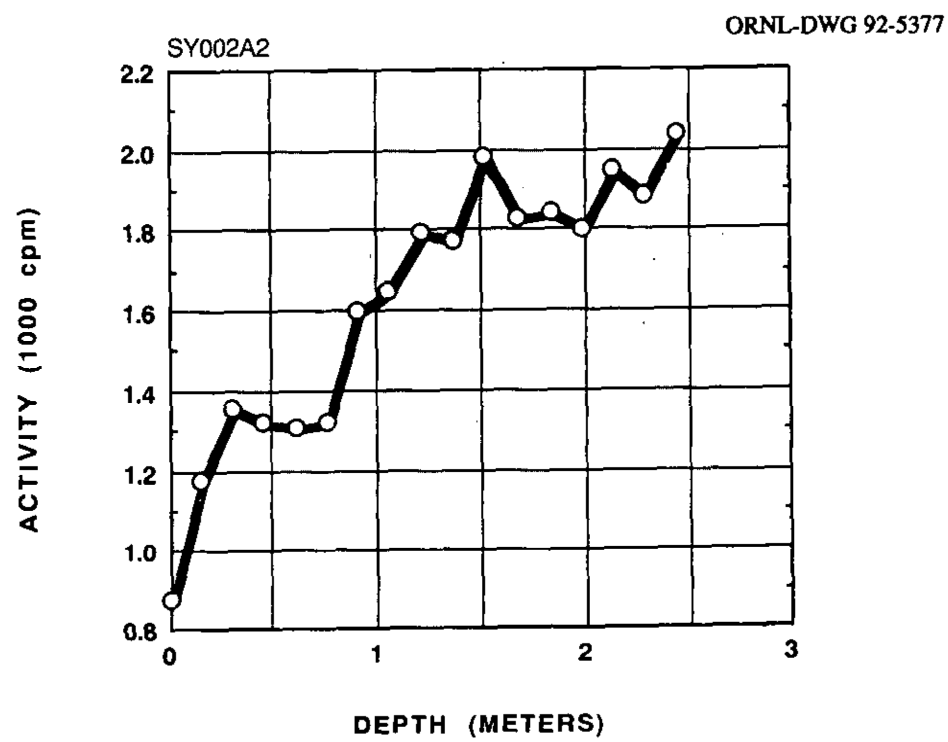

Fig. A.2. Gamma profile of auger hole A002.

ORNL-DWG 92-5378

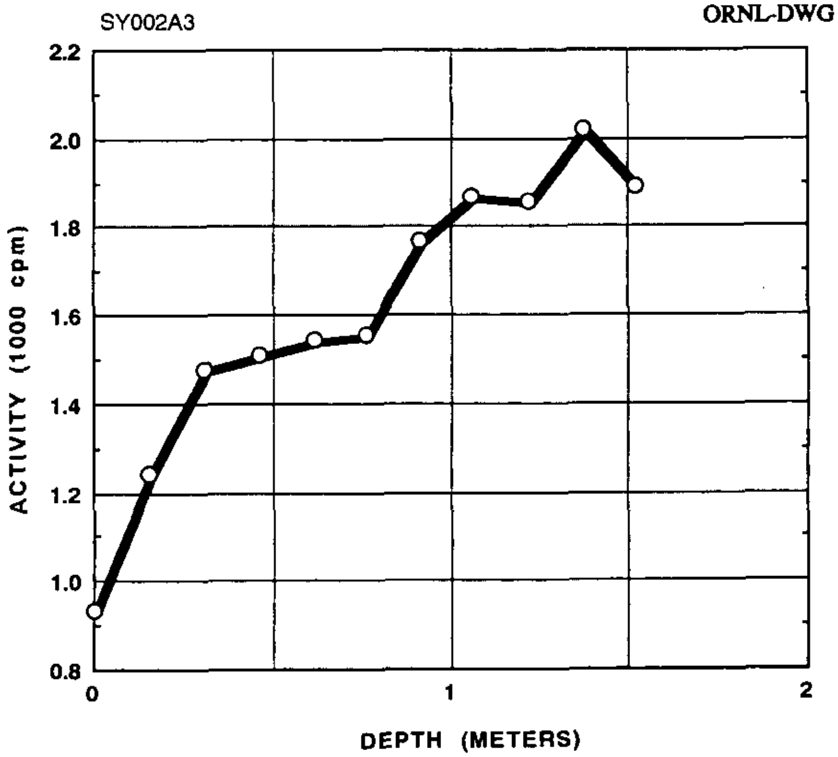

Fig. A.3. Gamma profile of auger hole A003.

ORNL-DWG 92-5379

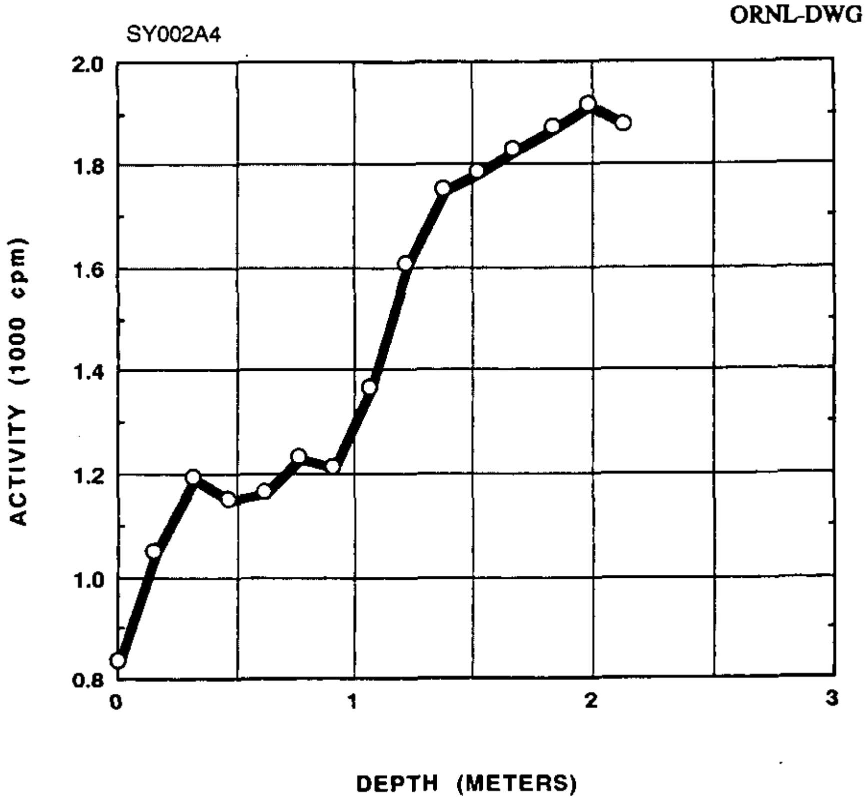

Fig. A.4. Gamma profile of auger hole A004.

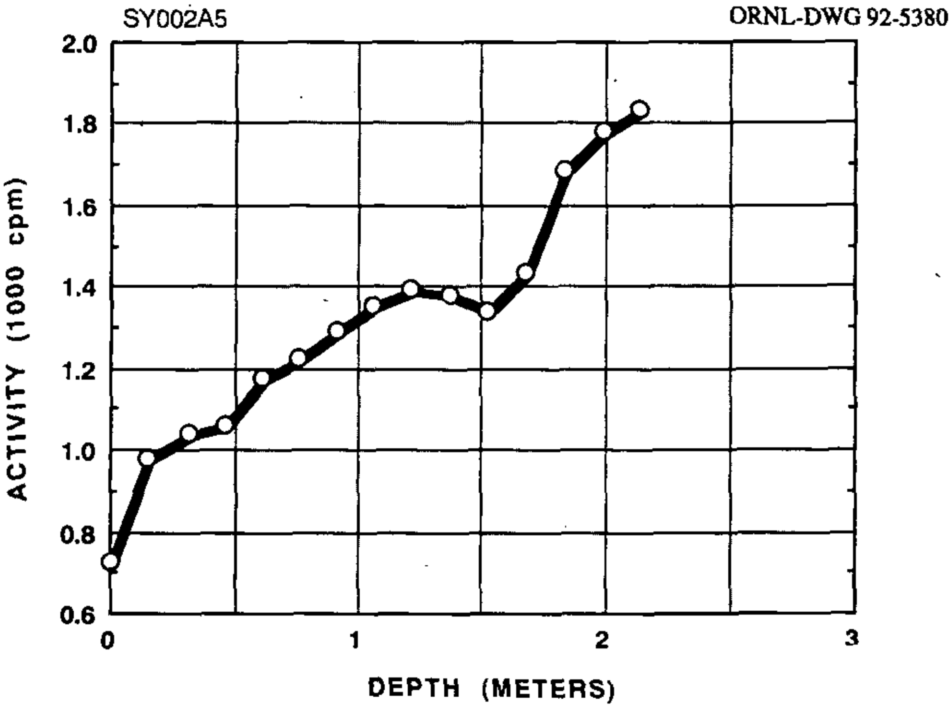

Fig. A.5. Gamma profile of auger hole A005.

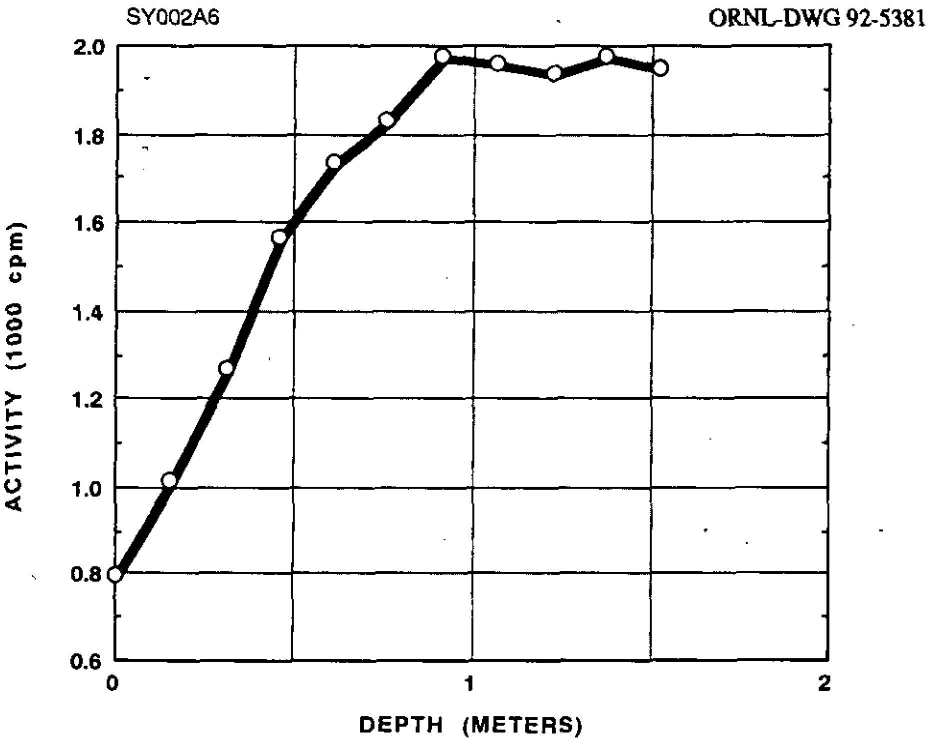

Fig. A.6. Gamma profile of auger hole A006.

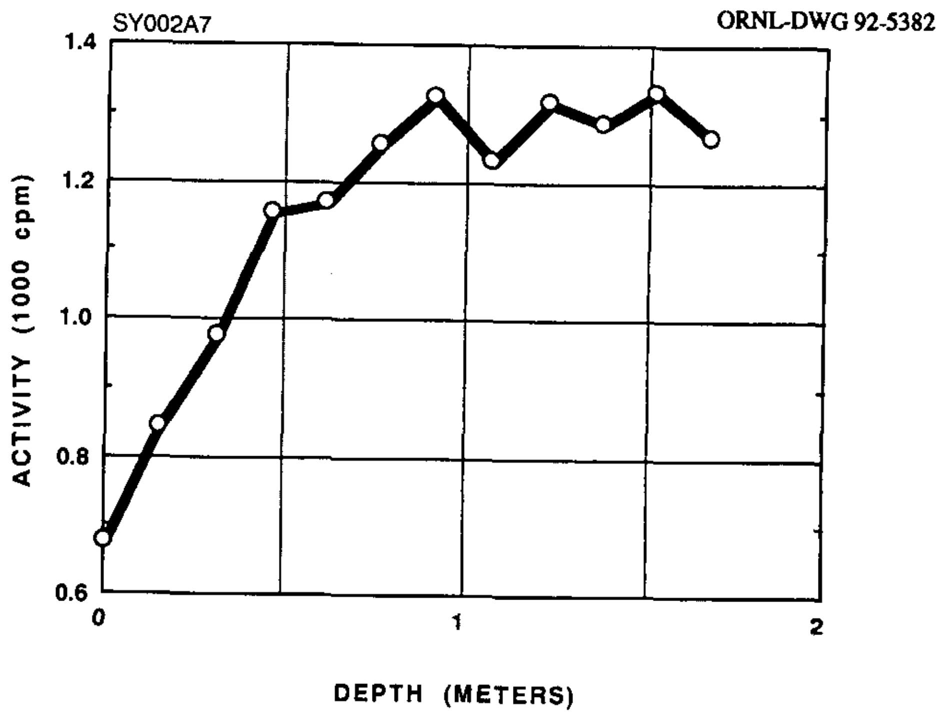

Fig. A.7. Gamma profile of auger hole A007.

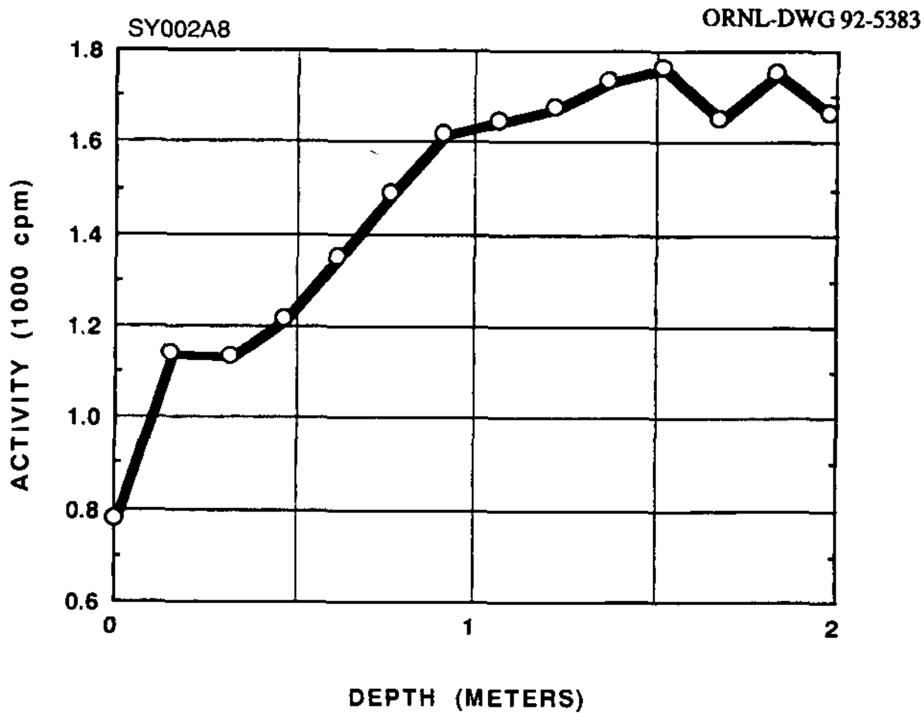

Fig. A.8. Gamma profile of auger hole A008.

ORNL-DWG 92-5384

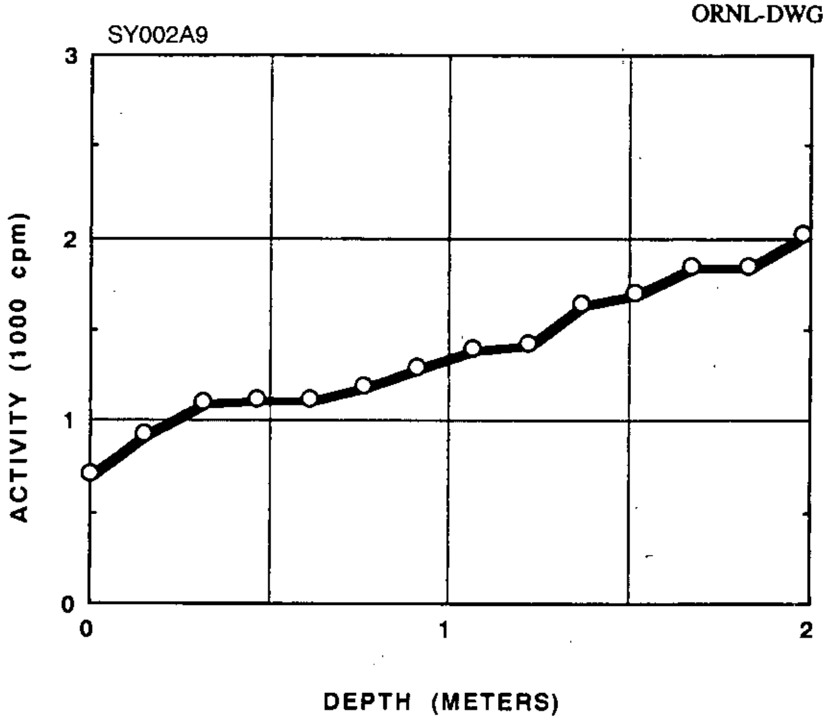

Fig. A.9. Gamma profile of auger hole A009.

ORNL-DWG 92-5385

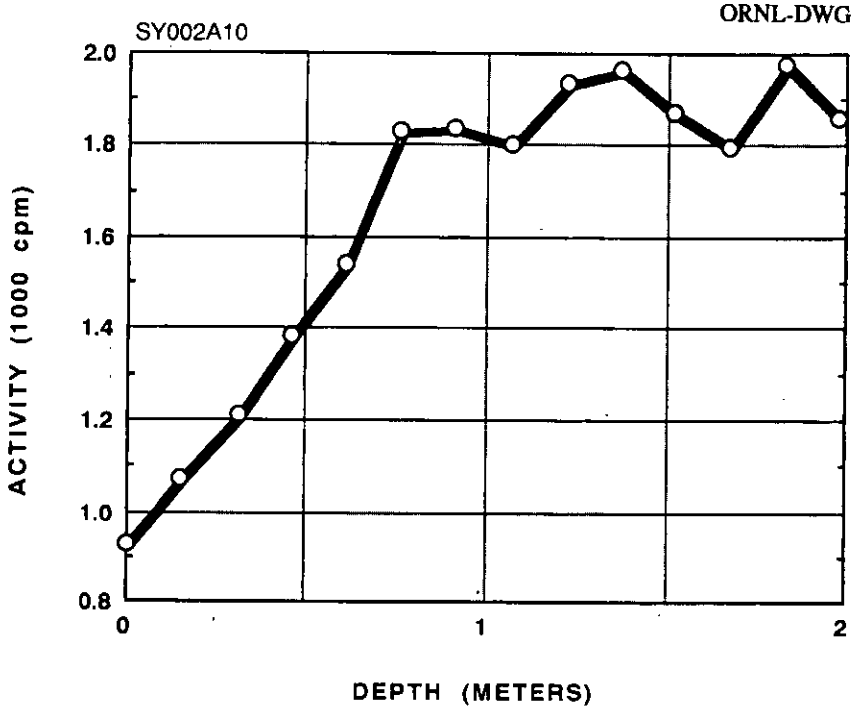

Fig. A.10. Gamma profile of auger hole A010.

ORNL-DWG 92-5386

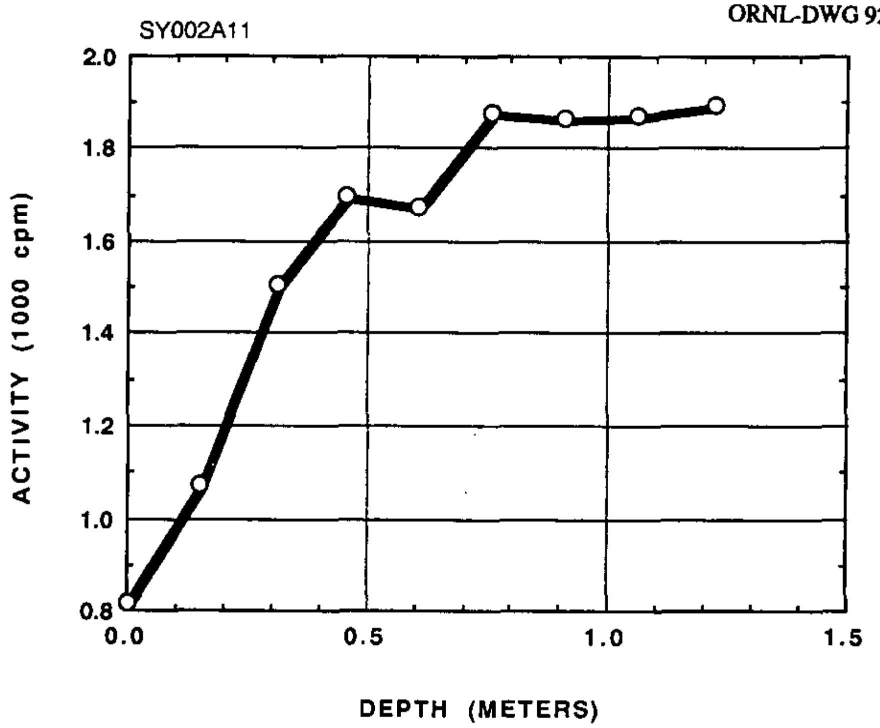

Fig. A.11. Gamma profile of auger hole A011.

ORNL-DWG 92-5387

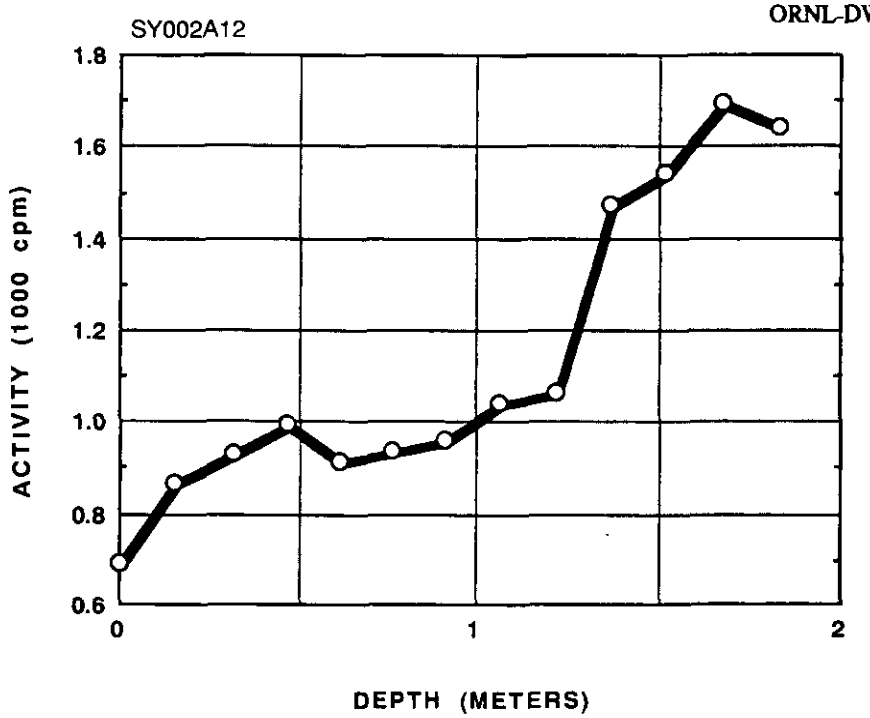

Fig. A.12. Gamma profile of auger hole A012.

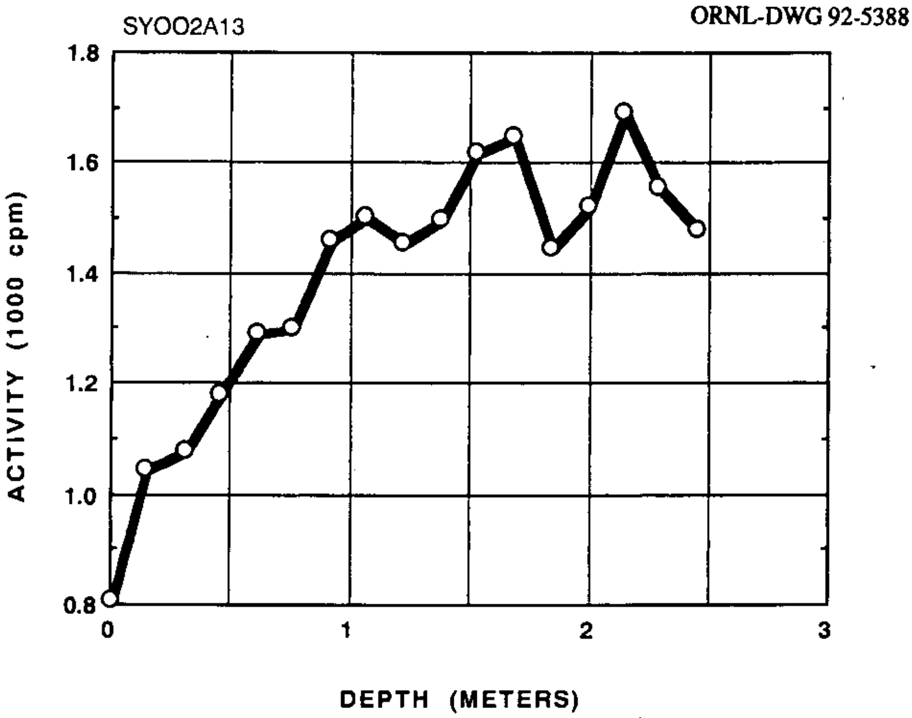

Fig. A.13. Gamma profile of auger hole A013.

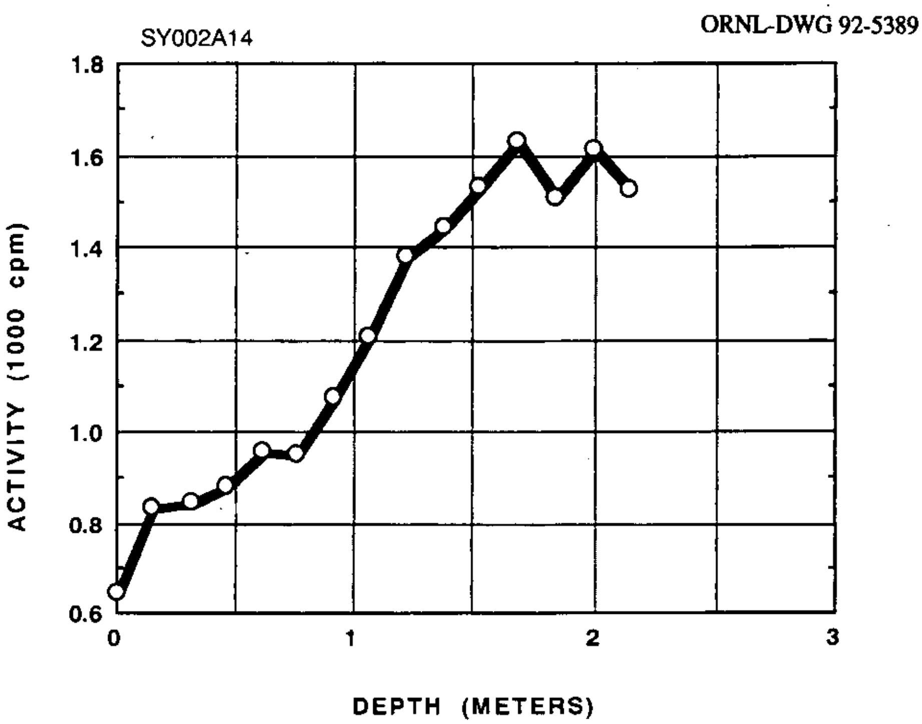

Fig. A.14. Gamma profile of auger hole A014.

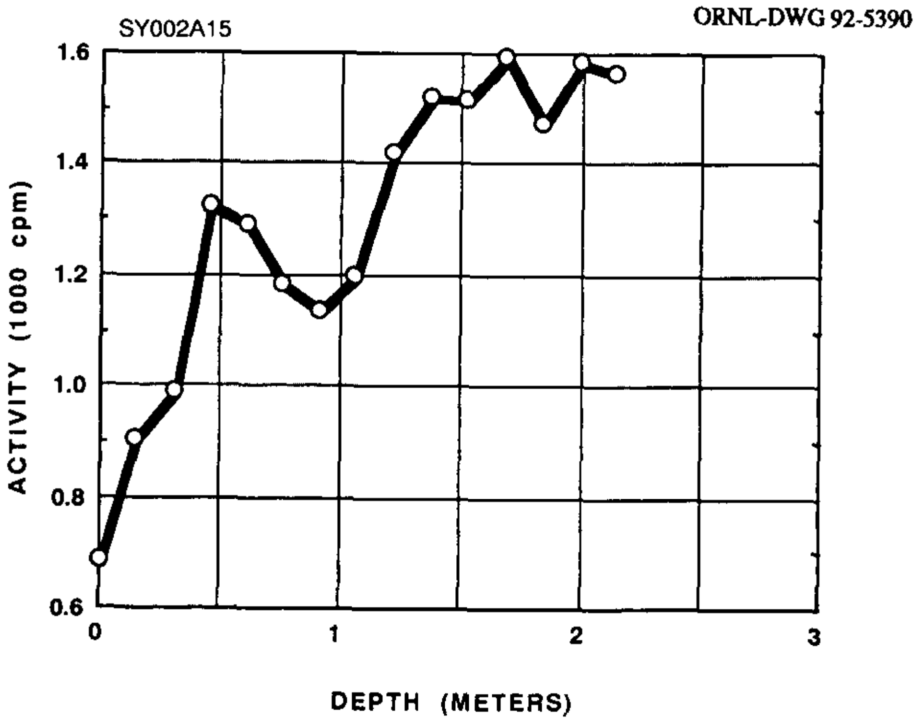

Fig. A.15. Gamma profile of auger hole A015.

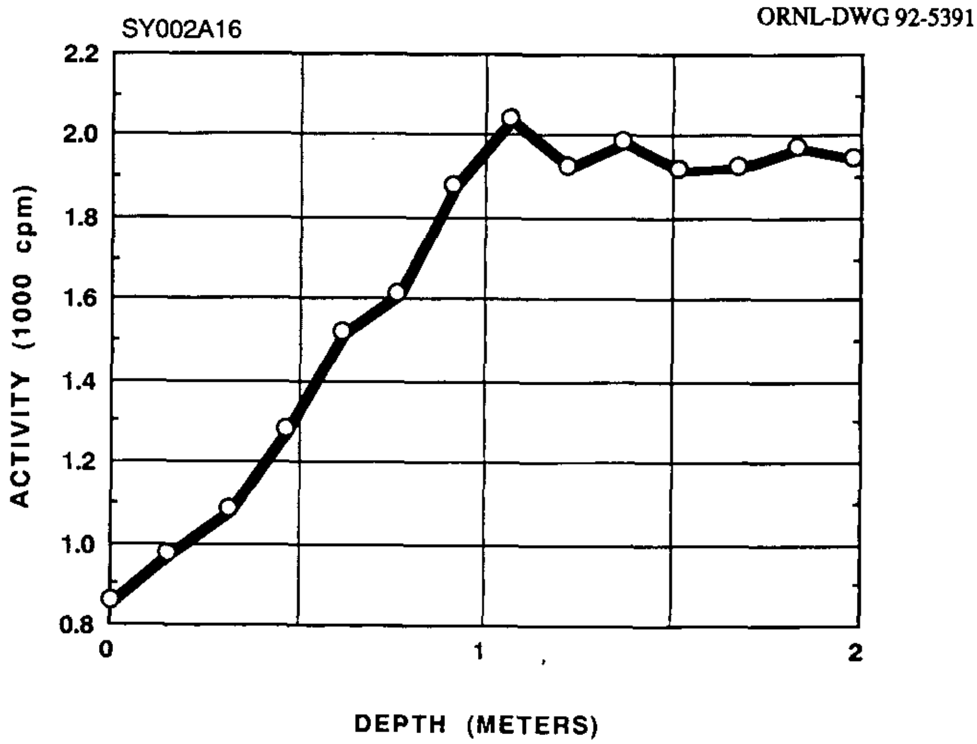

Fig. A.16. Gamma profile of auger hole A016.

ORNL-DWG 92-5392

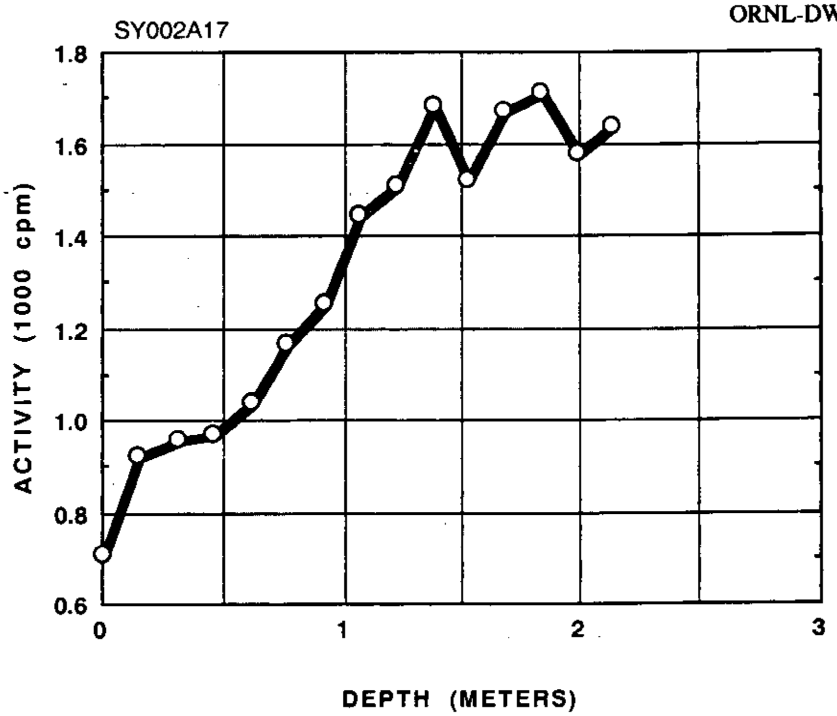

Fig. A.17. Gamma profile of auger hole A017.

ORNL-DWG 92-5393

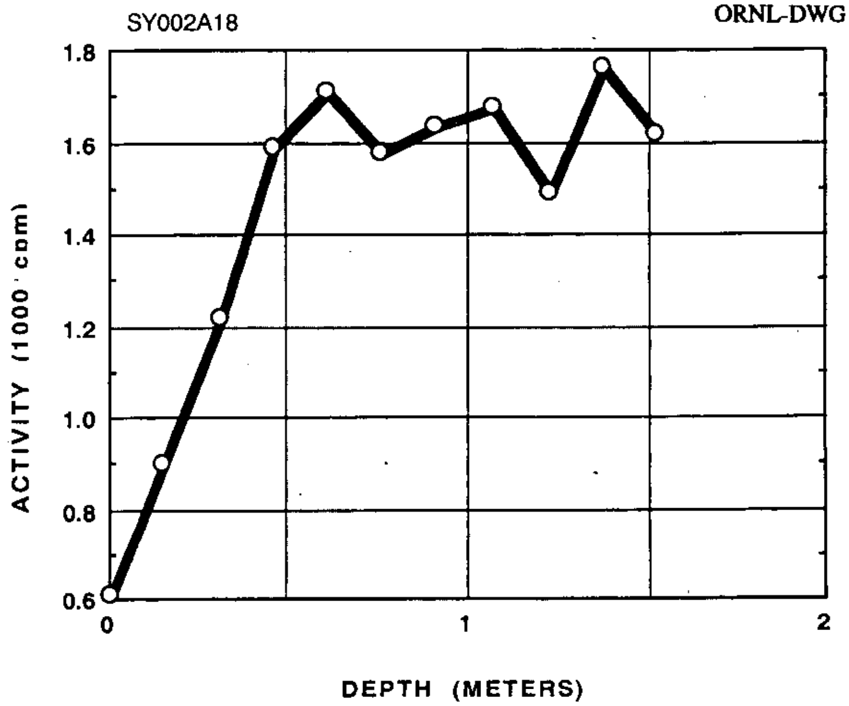

Fig. A.18. Gamma profile of auger hole A018.

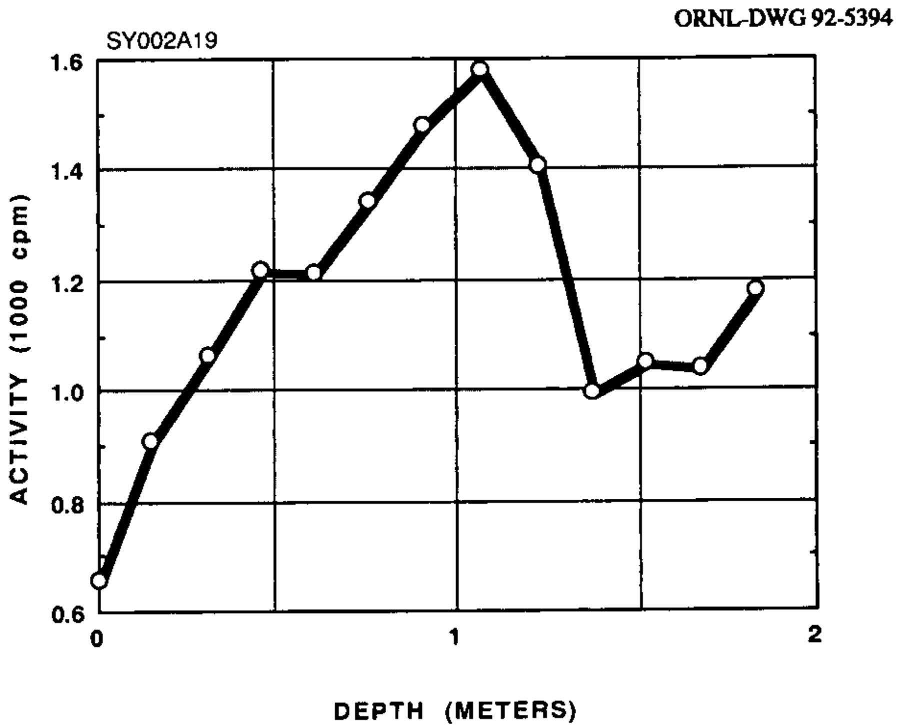

Fig. A.19. Gamma profile of auger hole A019.

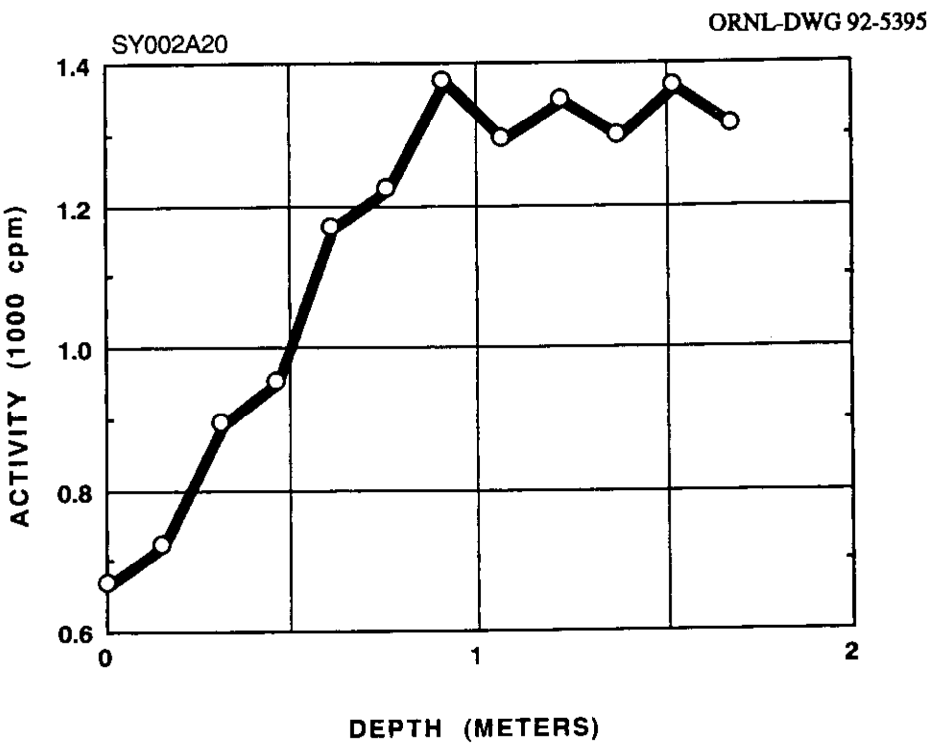

Fig. A.20. Gamma profile of auger hole A020.

ORNL-DWG 92-5396

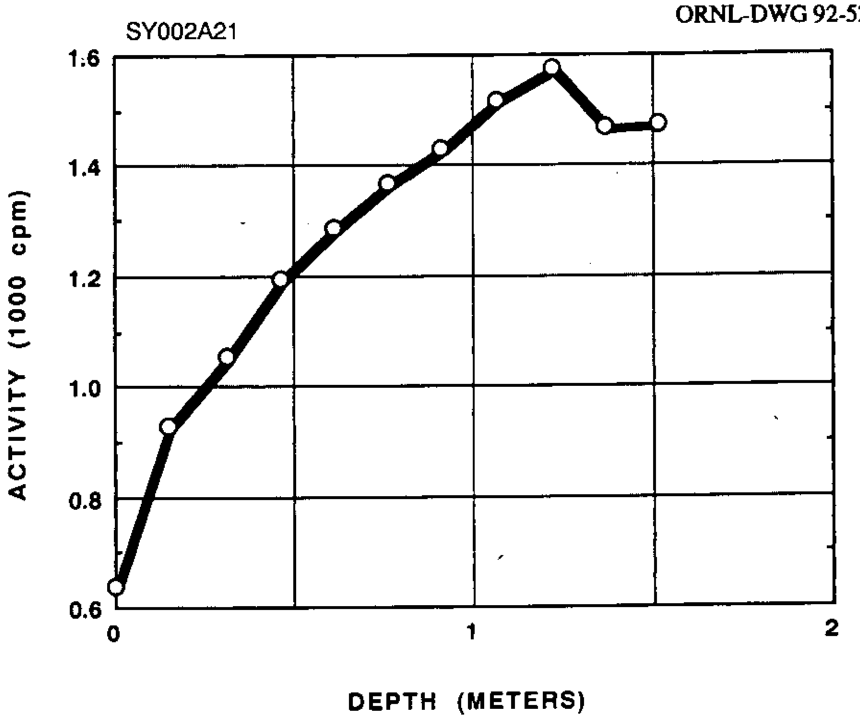

Fig. A.21. Gamma profile of auger hole A021.

ORNL-DWG 92-5397

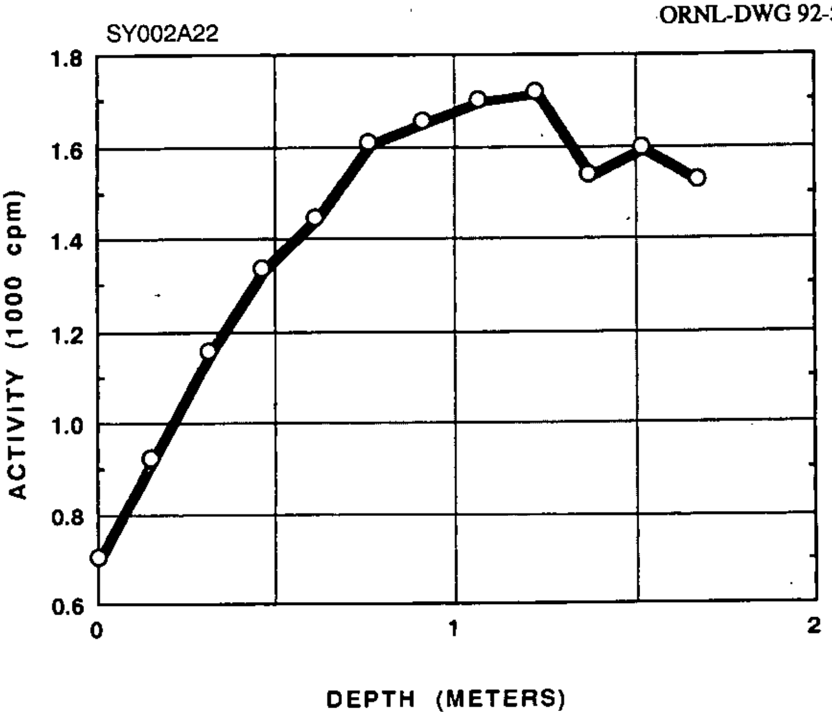

Fig. A.22. Gamma profile of auger hole A022.

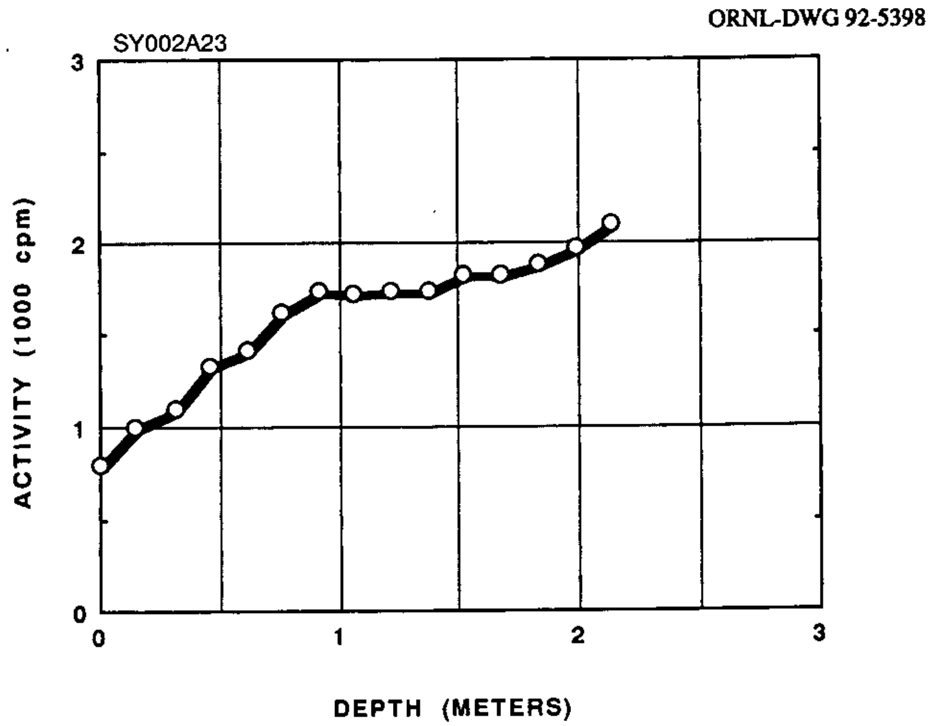

Fig. A.23. Gamma profile of auger hole A023.

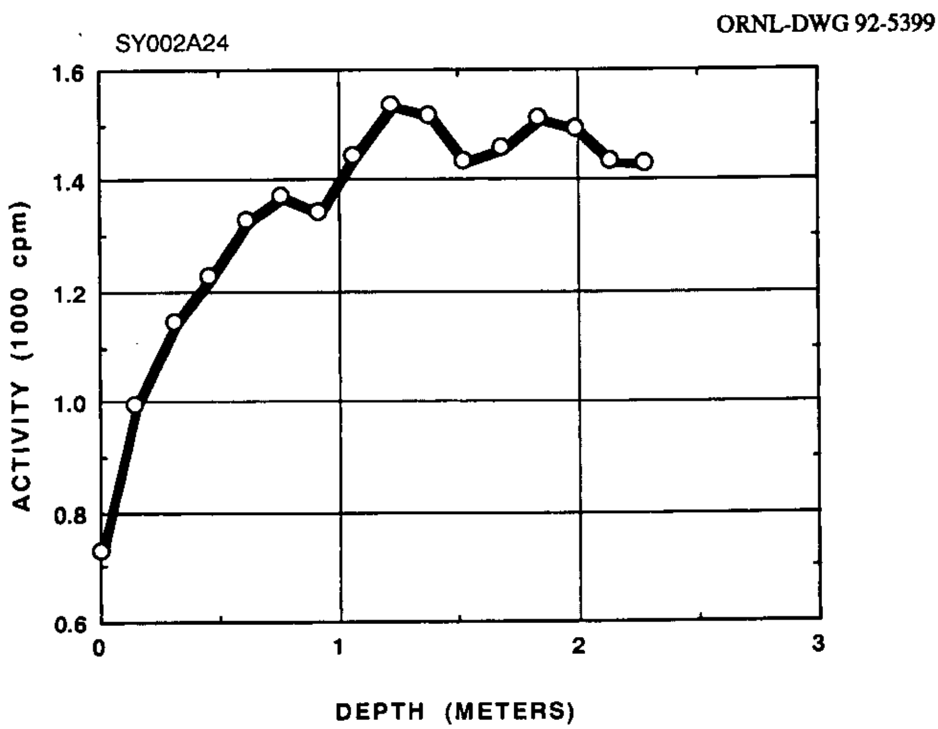

Fig. A.24. Gamma profile of auger hole A024.

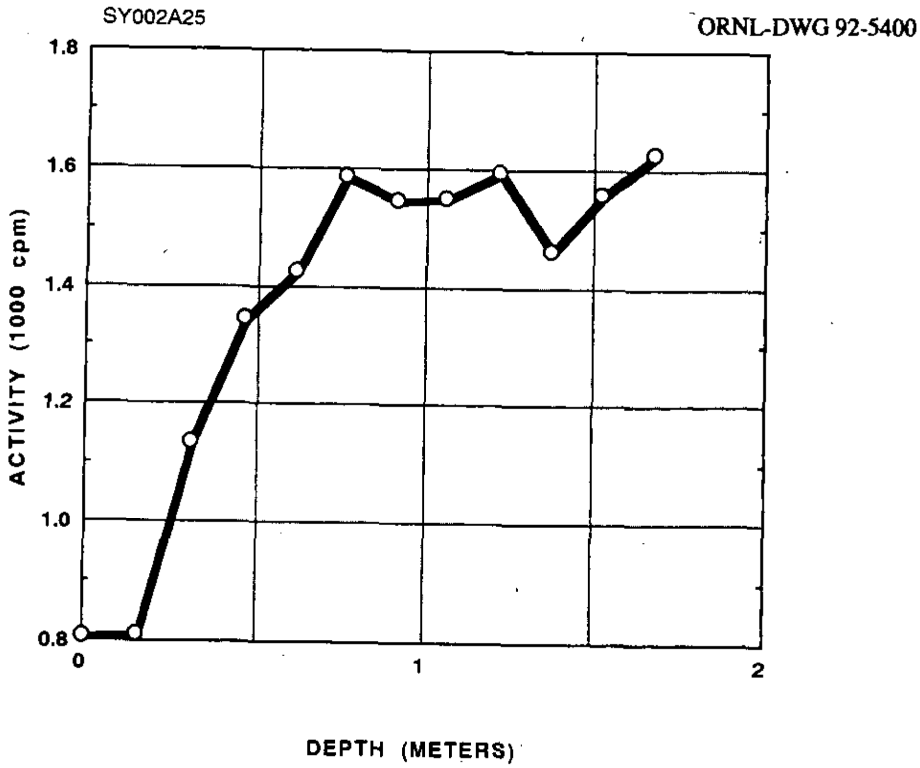

Fig. A.25. Gamma profile of auger hole A025.

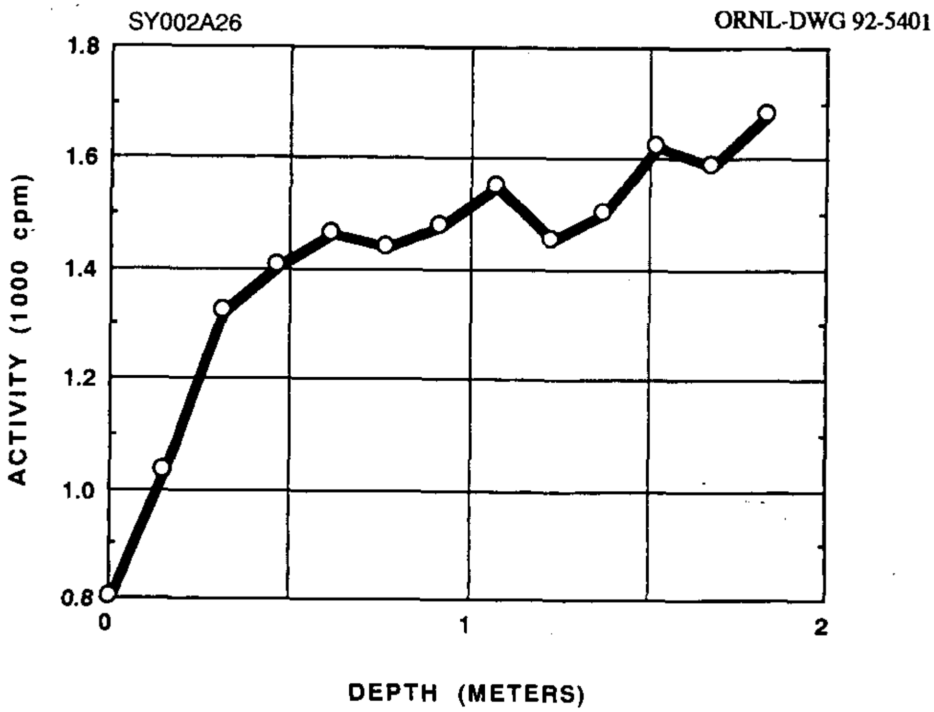

Fig. A.26. Gamma profile of auger hole A026.

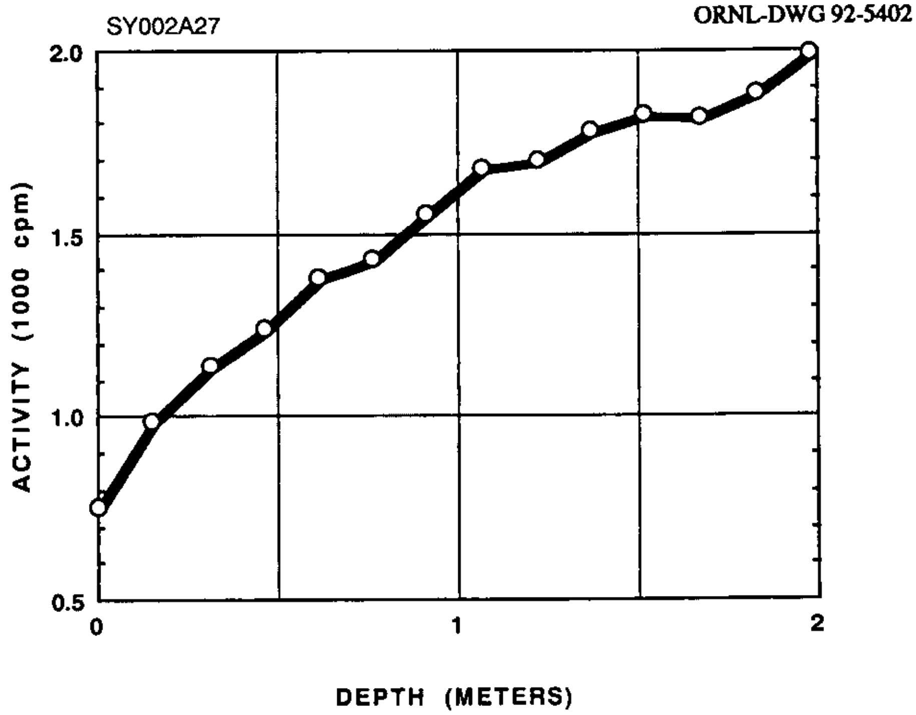

Fig. A.27. Gamma profile of auger hole A027.

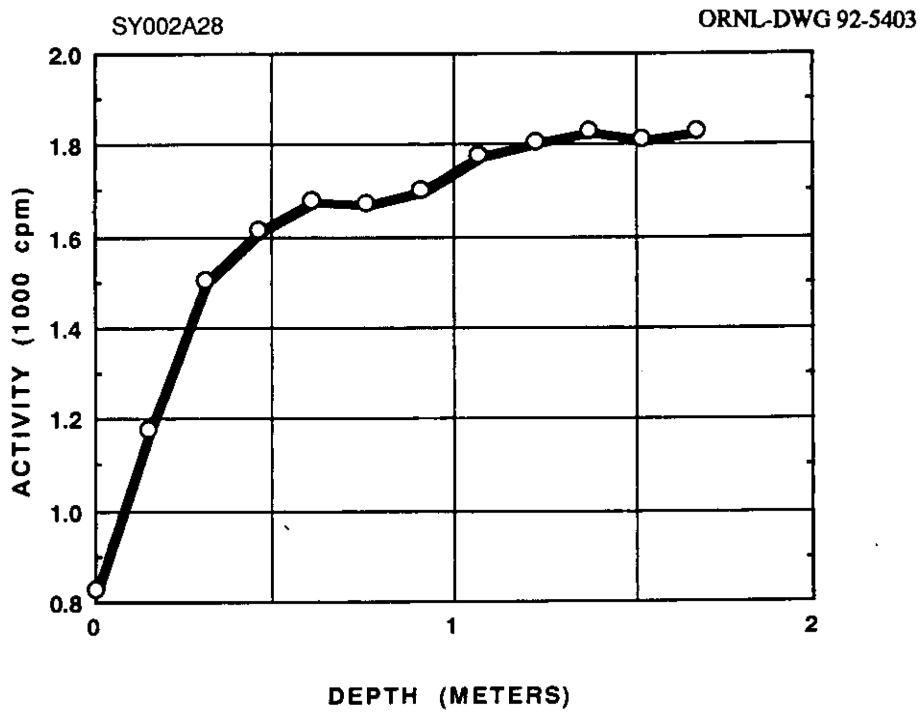

Fig. A.28. Gamma profile of auger hole A028.

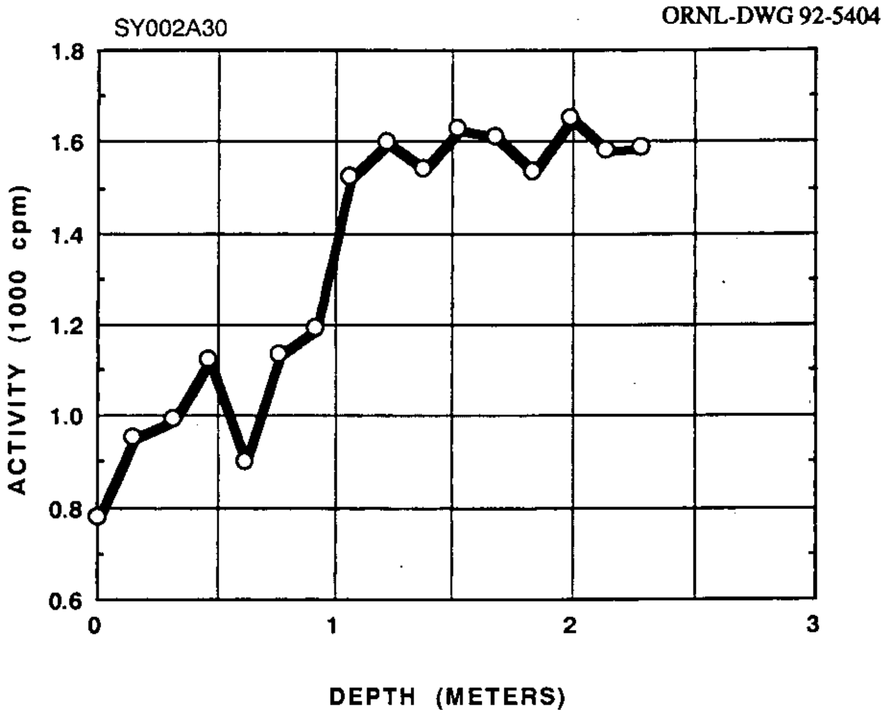

Fig. A.29. Gamma profile of auger hole A030.

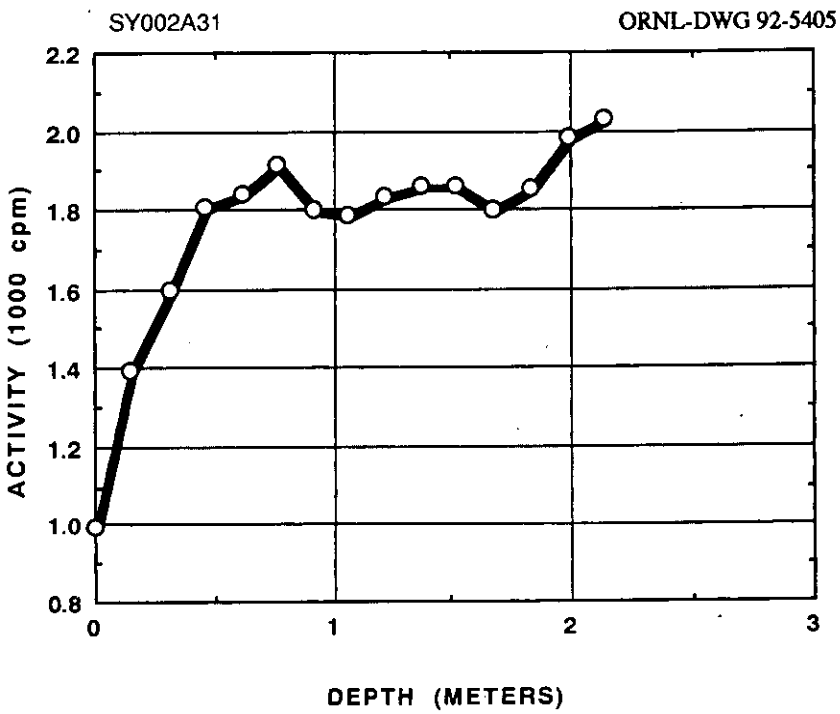

Fig. A.30. Gamma profile of auger hole A031.

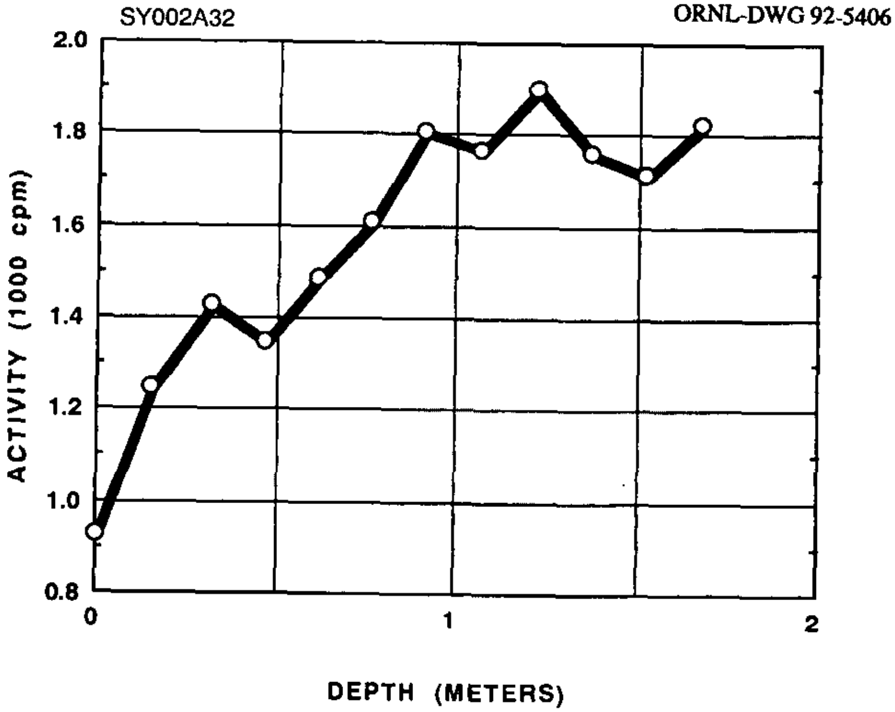

Fig. A.31. Gamma profile of auger hole A032.

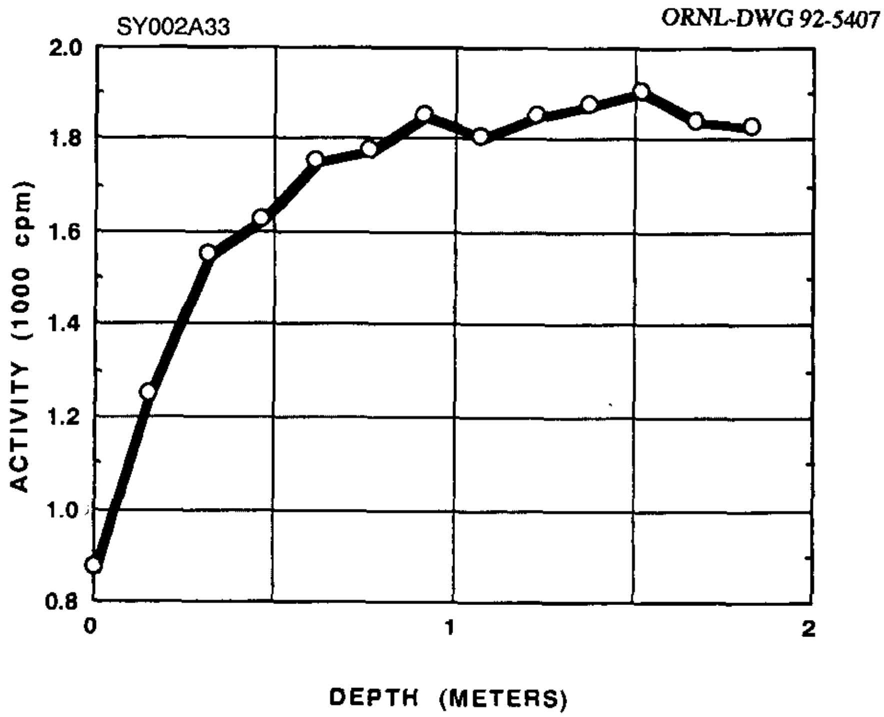

Fig. A.32. Gamma profile of auger hole A033.

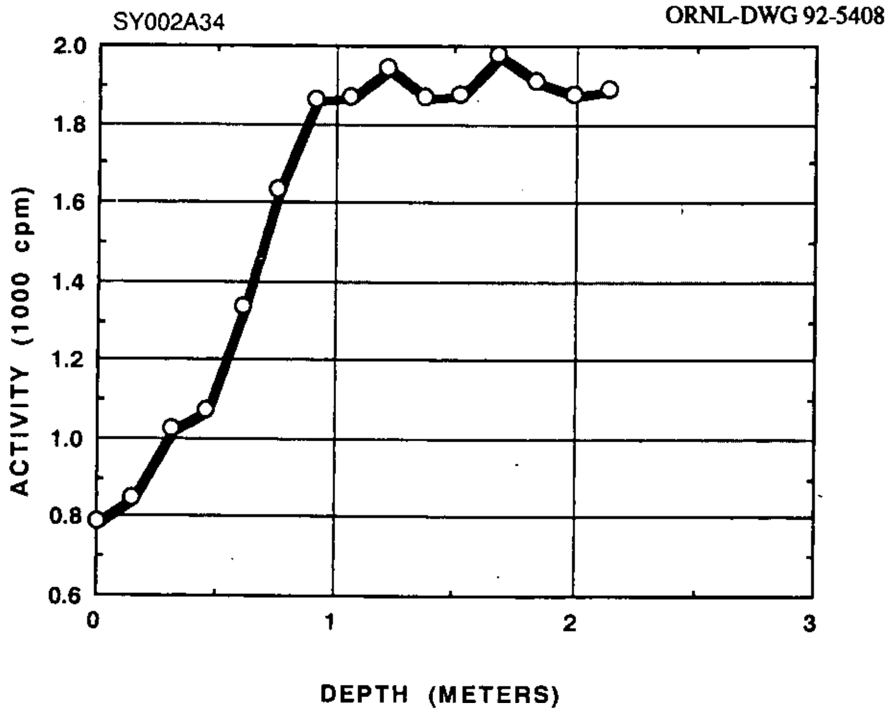

Fig. A.33. Gamma profile of auger hole A034.

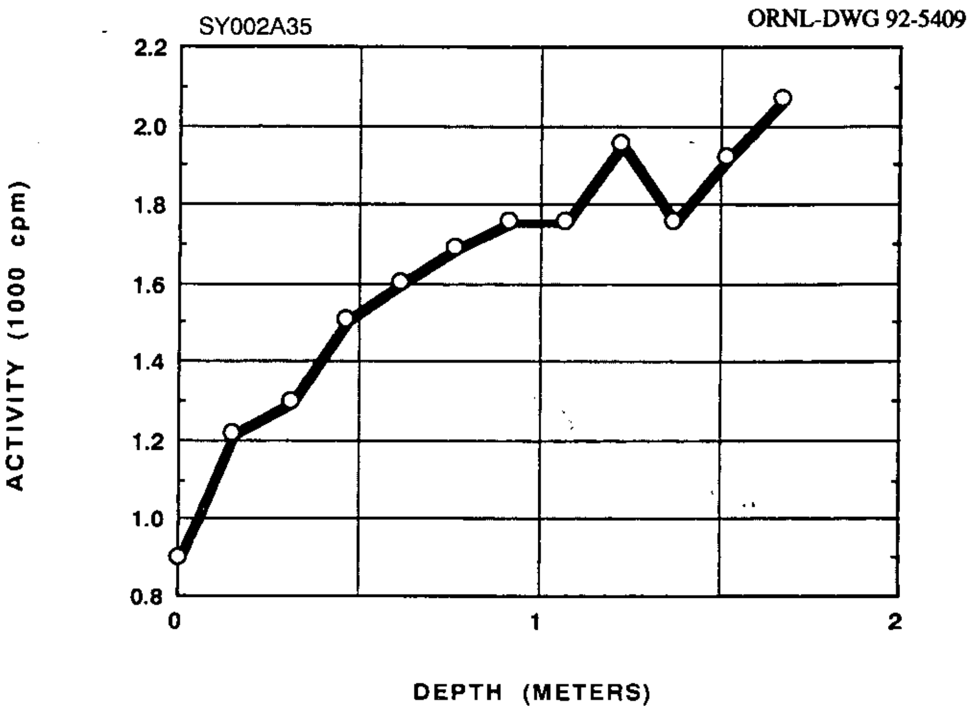

Fig. A.34. Gamma profile of auger hole A035.

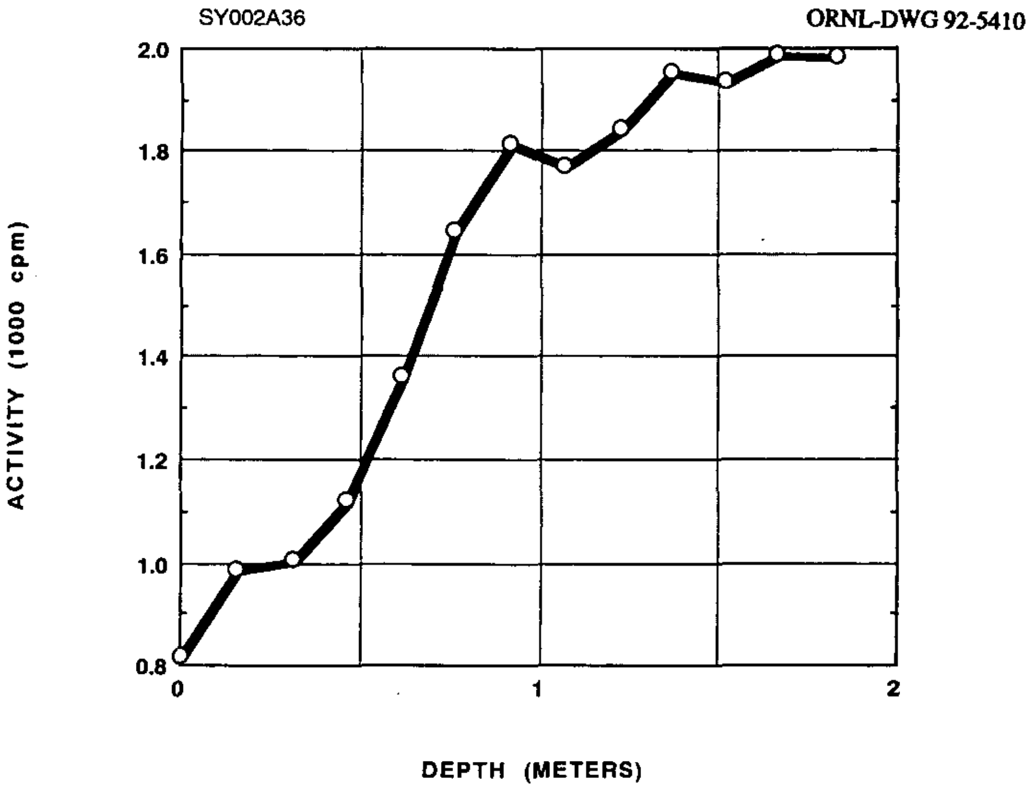

Fig. A.35. Gamma profile of auger hole A036.

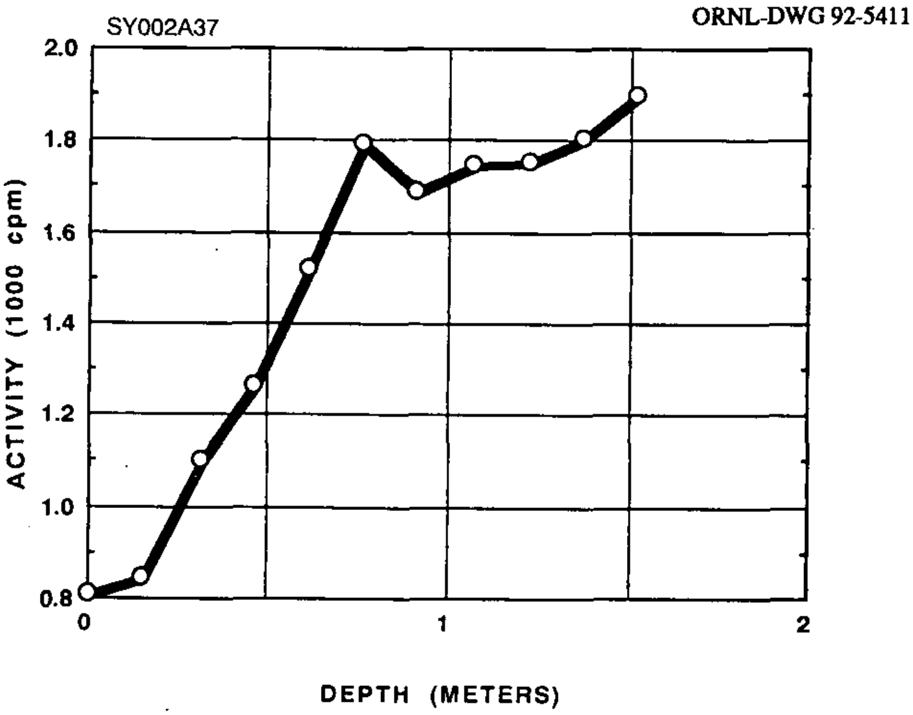

Fig. A.36. Gamma profile of auger hole A037.

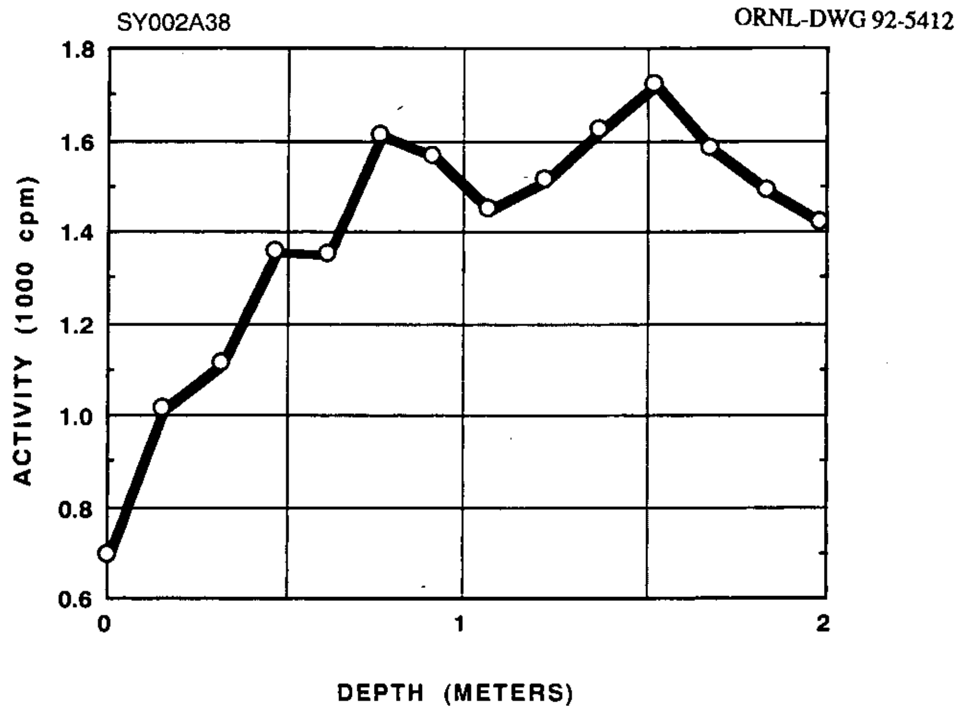

Fig. A.37. Gamma profile of auger hole A038.

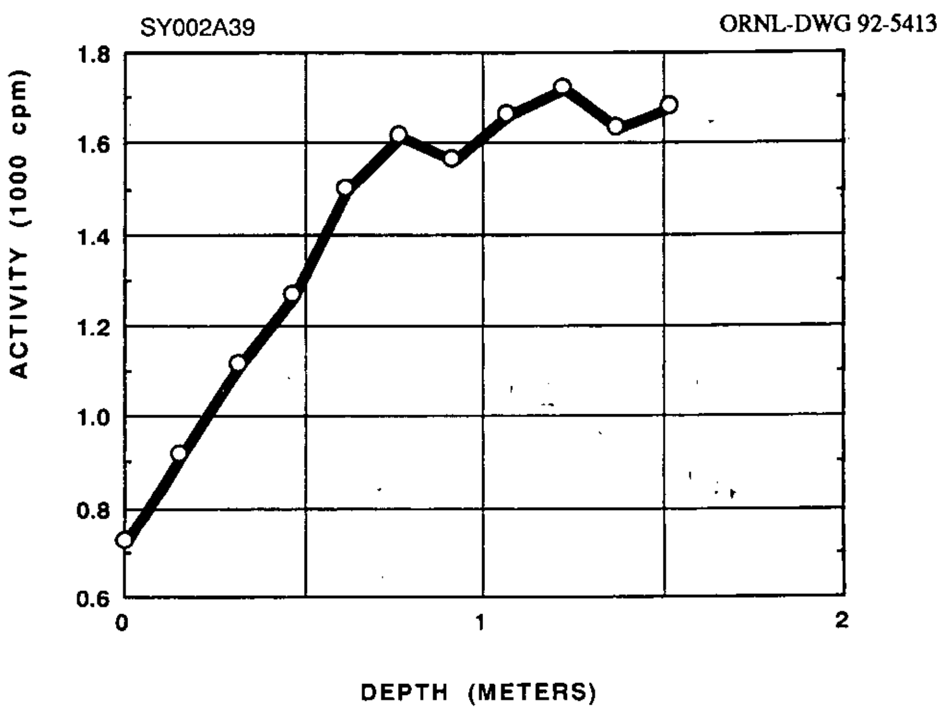

Fig. A.38. Gamma profile of auger hole A039.

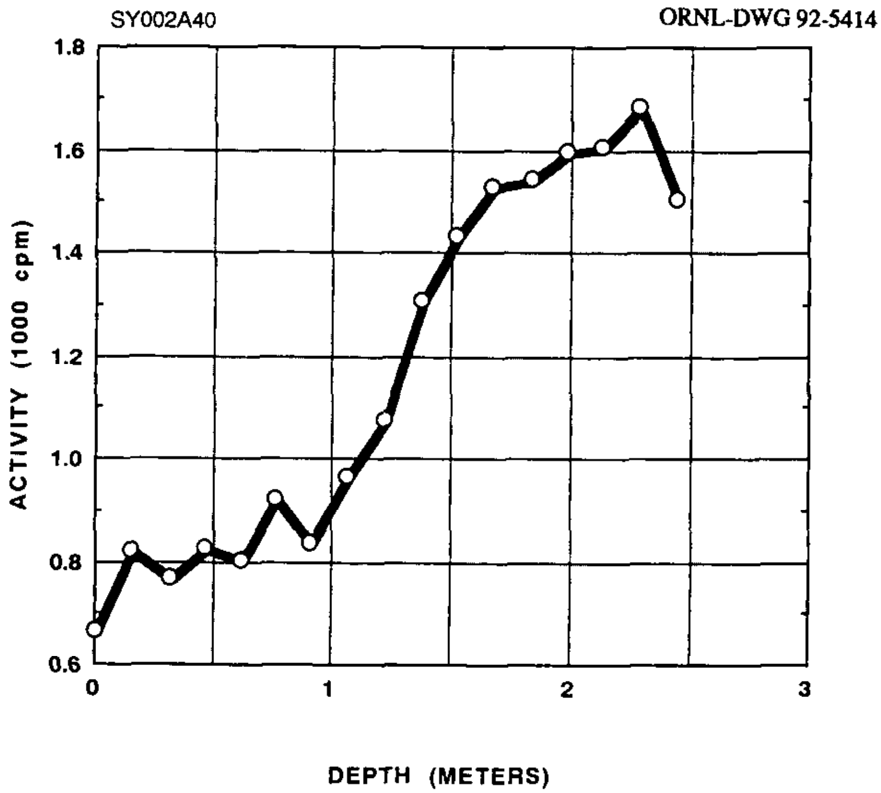

Fig. A.39. Gamma profile of auger hole A040.

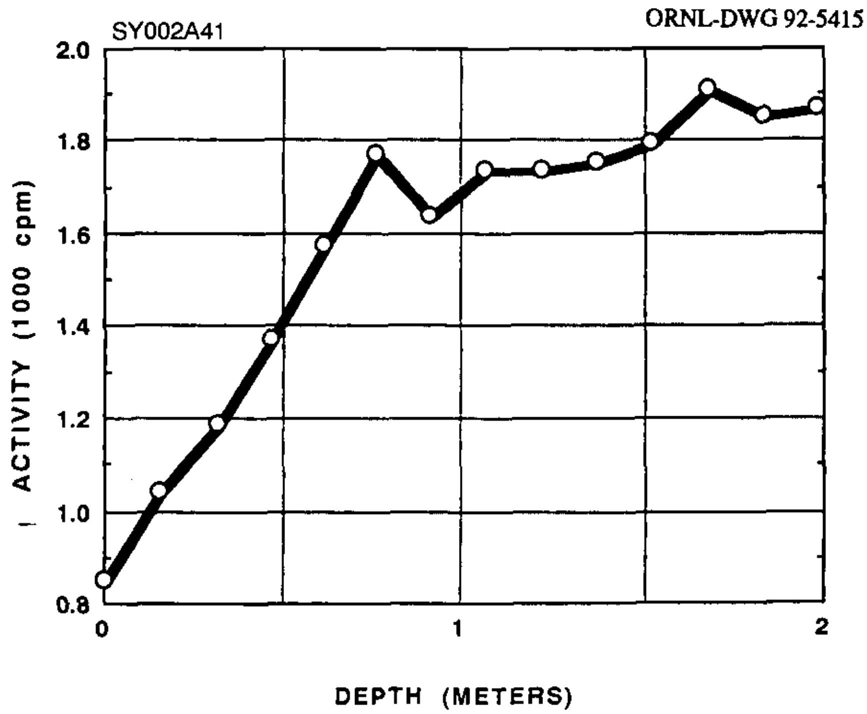

Fig. A.40. Gamma profile of auger hole A041.

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APPENDIX B

AREA OF ELEVATED BERYLLIUM CONCENTRATIONS
AT THE SACANDAGA SITE

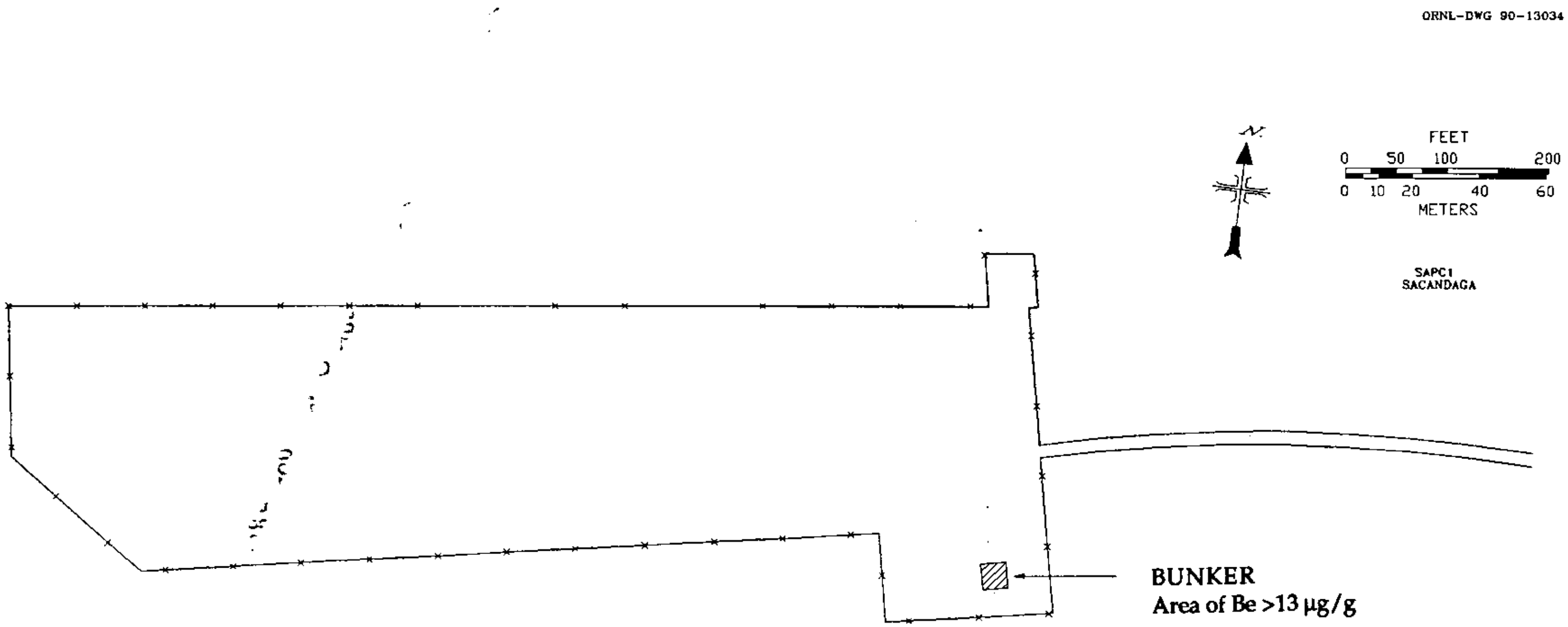

Fig. B.1. Diagram showing the area of beryllium concentrations greater than 13 µg/g on the Sacandaga site (i.e., the concrete bunker).