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Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for the Maywood Site, New Jersey

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HEALTH AND SAFETY RESEARCH DIVISION

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RESULTS OF THE RADIOLOGICAL SURVEY AT 130 WEST CENTRAL AVENUE, MAYWOOD, NEW JERSEY (MJ029)

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ABSTRACT

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid–1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the U.S. Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 130 West Central Avenue, Maywood, New Jersey (MJ029), was conducted during 1987 and 1988.

Some radionuclide measurements were greater than typical background levels in the northern New Jersey area. However, results of the survey demonstrated no radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria.

RESULTS OF THE RADIOLOGICAL SURVEY AT 130 WEST CENTRAL AVENUE, MAYWOOD, NEW JERSEY (MJ029)*

INTRODUCTION

From 1916 to 1956, process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores were generated by the Maywood Chemical Works (MCW), Maywood, New Jersey. During the latter part of this period, MCW supplied rare earth metals and thorium compounds to various government agencies. In the 1940s and 1950s, MCW produced thorium and lithium, under contract, for the Atomic Energy Commission (AEC). These activities ceased in 1956, and, approximately three years later, the 30-acre real estate was purchased by the Stepan Company. The property is located at 100 Hunter Avenue in a highly developed area in Maywood and Rochelle Park, Bergen County, New Jersey.

During the early years of operation, MCW stored wastes and residues in low-lying areas west of the processing facilities. In the early 1930s, these areas were separated from the rest of the property by the construction of New Jersey State Highway 17. The Stepan property, the interim storage facility, and several vicinity properties have been designated for remedial action by the U.S. Department of Energy (DOE).

The waste produced by the thorium extraction process was a sandlike material containing residual amounts of thorium and its decay products, with smaller quantities of uranium and its decay products. During the years 1928 and 1944 to 1946, area residents used these process wastes mixed with tea and cocoa leaves as mulch in their lawns and gardens. In addition, some of the contaminated wastes were apparently eroded from the site into Lodi Brook and carried downstream.

Lodi Brook is a small stream flowing south from Maywood with its headwaters near the Stepan waste storage site. Approximately 150 ft after passing under State Route 17, the stream has been diverted underground through concrete or steel culverts until it merges with the Saddle River in Lodi, New Jersey. Only a small section near Interstate 80 remains uncovered. From the 1940s to the 1970s when the stream was being diverted underground, its course was altered several times. Some of these changes resulted in the movement of contaminated soil to the surface of a few properties, where it is still in evidence. In other instances, the contaminated soil was covered over or mixed with clean fill, leaving no immediate evidence on the surface. Therefore, properties in question may be drilled in search of former streambed material, even in the absence of surface contamination.

As a result of the Energy and Water Appropriations Act of Fiscal Year 1984, the property discussed in this report and properties in its vicinity contaminated with residues from the former MCW were included as a decontamination research and development project under the DOE Formerly Utilized Sites Remedial Action Program. As part of this project, DOE is conducting radiological surveys in the vicinity of the site to identify properties contaminated with residues derived from

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

the MCW. The principal radionuclide of concern is thorium-232. The radiological surveys discussed in this report are part of that effort and were conducted, at the request of DOE, by members of the Measurement Applications and Development Group of the Oak Ridge National Laboratory.

A radiological survey of the private, residential property at 130 West Central Avenue, Maywood, New Jersey, was conducted during 1987 and 1988. The survey and sampling of the ground surface were carried out on April 29, 1987, and the follow-up subsurface investigation was performed on June 1, 1988.

SURVEY METHODS

The radiological survey of the property included: (1) a gamma scan of the entire property surface outdoors, (2) collection of surface and subsurface soil samples, and (3) gamma profiles of auger holes. No indoor survey measurements were performed.

Using a portable gamma scintillation meter, ranges of measurements were recorded for areas of the property surface. Systematic soil samples were taken at various locations on the property, irrespective of gamma radiation levels. To define the extent of possible subsurface soil contamination, auger holes were drilled to depths of approximately 2.4 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. Measurements were usually made at 15– or 30–cm intervals. 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 logs 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. These survey methods followed the plan outlined in Reference 1. A comprehensive description of the survey methods and instrumentation has been presented in another report.[2]

SURVEY RESULTS

Applicable federal guidelines are summarized in Table 1.[3] The normal background radiation levels for the northern New Jersey area are presented in Table 2. These data are provided for comparison with survey results presented in this section. All 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.

Surface Gamma Radiation Levels

Gamma radiation levels measured during a gamma scan of the property surface are given in Fig. 1. Gamma exposure rates over the major portion of the property ranged from 10 to 20 μR/h. The highest gamma levels were found in the backyard on the southern border of the property, ranging from 15 to 37 μR/h. The front

yard measurements ranged from 10 to 15 μR/h. On the southern end of the property, the gamma exposure rate was 37 μR/h near the MCW interim storage pile southwest of the property.

Systematic Soil Samples

Systematic soil samples were taken from various locations on the property for radionuclide analyses. Locations of these samples (S) are shown in Fig. 2, with results of laboratory analyses provided in Table 3. Concentrations of radium and thorium in these samples ranged from 0.77 to 3.0 pCi/g and 0.92 to 10 pCi/g, respectively. The highest thorium concentration was from soil sample S3A, with a value of 10 pCi/g, approximately ten times higher than the normal background level in the northern New Jersey area (Table 2). This value is about 67% of the DOE guideline value of 15 pCi/g for isolated spots of 3 to <10 m^2 (Table 1). When averaged with the thorium concentration in the surrounding soil samples (S2A, S4A, S5A, S6A, and S7A), the level was 5.2 pCi/g. This value is approximately 52% of 10 pCi/g, the guideline value for isolated areas of 10 to 25 square meters (Table 1).

Auger Hole Soil Samples and Gamma Logging

Varying thicknesses of subsurface soil were sampled from depths of 30 to 75 cm in two of the six auger holes (A) drilled at separate locations indicated in Fig. 2. The results of analyses of these samples are given in Table 3 (A). Concentrations of ^{226}Ra in auger soil samples measured 0.71 pCi/g. Concentrations of ^{232}Th and ^{238}U ranged from 0.94 to 1.0 pCi/g, and 1.2 to 1.3 pCi/g, respectively. All values were below DOE criteria (Table 1).

Gamma logging was performed in five of the six auger holes to characterize and further define the extent of possible contamination. Soil conditions in A3 prevented the collection of gamma data, as the hole could not be drilled below 0.5 m. 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 counts per minute (cpm) or greater generally indicate the presence of elevated concentrations of ^{226}Ra and/or ^{232}Th. Data from the gamma profiles of the logged auger holes are graphically represented in Figs. 3 through 7. All readings were near or below 1000 cpm.

SIGNIFICANCE OF FINDINGS

Measurements and results of soil sample analyses taken at 130 West Central Avenue indicate that the property contained no significant radioactive contamination above guideline values. Though elevated gamma radiation levels were found on the property, these readings decreased in a northeasterly direction. The highest radionuclide concentrations were found at sample location S3, as shown in Fig. 2. Under certain conditions, extraneous radiation emanating from a source outside the area of concern will confound measurements in that area. The source of this scattered radiation, or "shine", may be a large quantity of radioactive materials near the area of interest. Some elevated gamma measurements on this site are

therefore considered to be the result of "shine" from the MCW interim storage area just south of the property. In addition, nearly all sample locations had visual signs of coal ash. Coal has a natural uranium/thorium/radium content. When the coal is burned, the radioactive portion is concentrated, accounting for a certain amount of elevation in the radionuclide content of some samples. After radiological assessment of the property and investigation of the coal ash, all soil analyses are considered below DOE criteria.

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2. T. E. Myrick, B. A. Berven, W. D. Cottrell, W. A. Goldsmith, and F. F. Haywood, *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*, Oak Ridge National Laboratory, ORNL/TM-8600 (April 1987).
3. U.S. Department of Energy, *Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites* (Rev. 2, March 1987).
4. T. E. Myrick, B. A. Berven, and F. F. Haywood, *State Background Radiation Levels: Results of Measurements Taken During 1975-1979*, Oak Ridge National Laboratory, ORNL/TM-7343 (November 1981).

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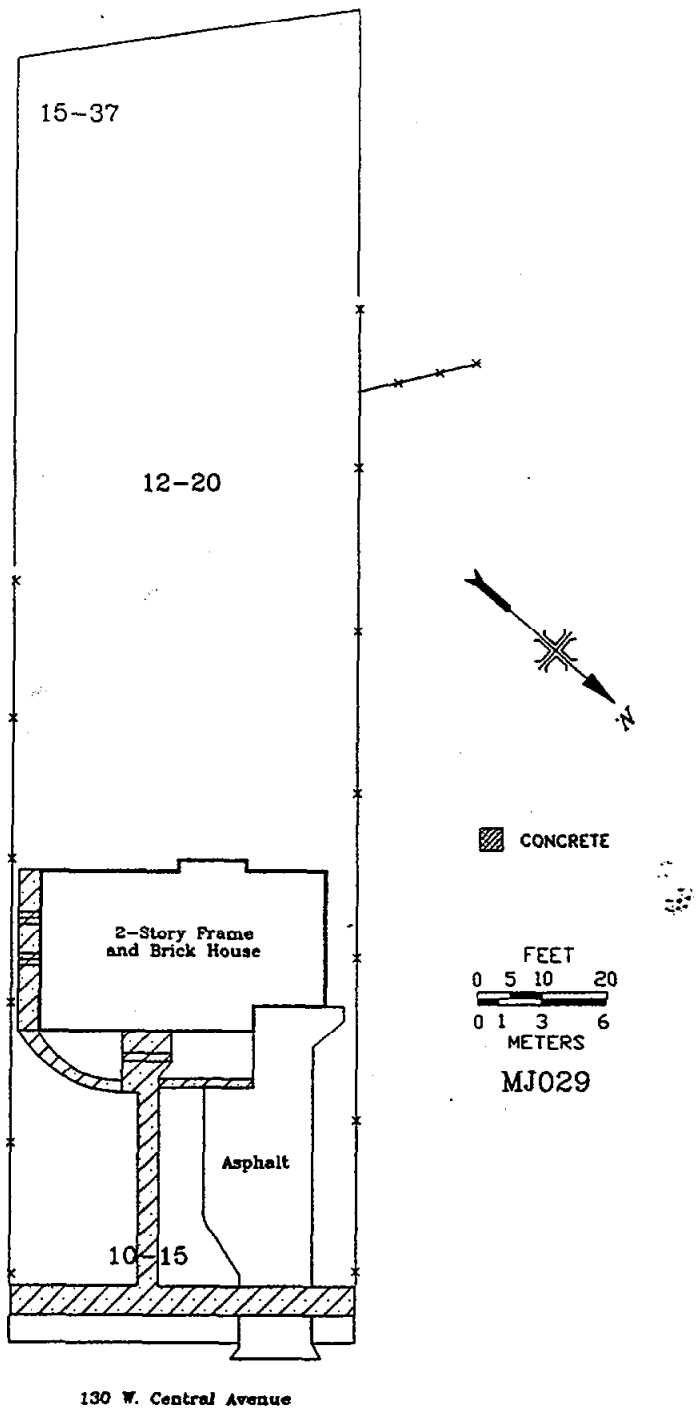

Fig. 1. Gamma radiation levels (μR/h) measured on the surface at 130 West Central Avenue, Maywood, New Jersey (MJ029).

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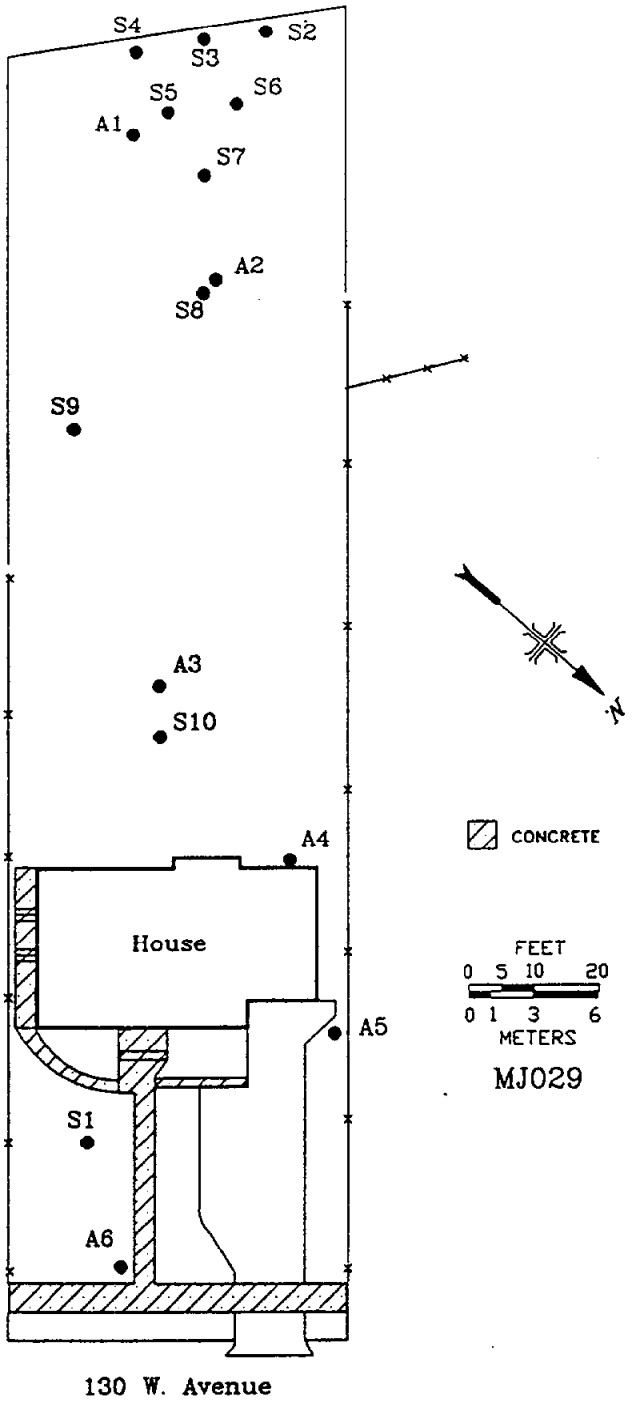

Fig. 2. Diagram showing locations of soil samples taken at 130 West Central Avenue, Maywood, New Jersey (MJ029).

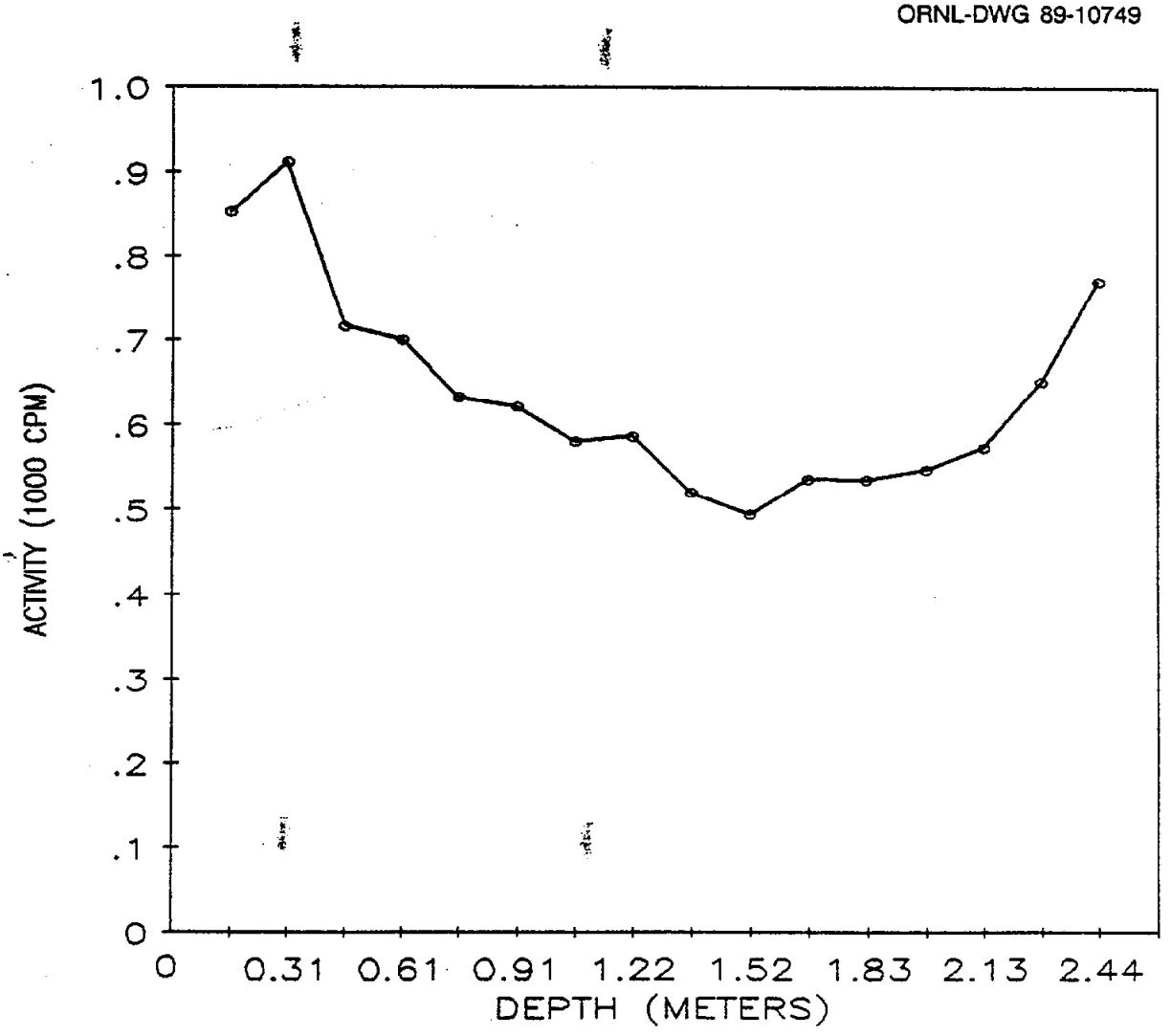

Fig. 3. Gamma profile for auger hole 1 (MJ029A1) at 130 West Central Avenue, Maywood, New Jersey.

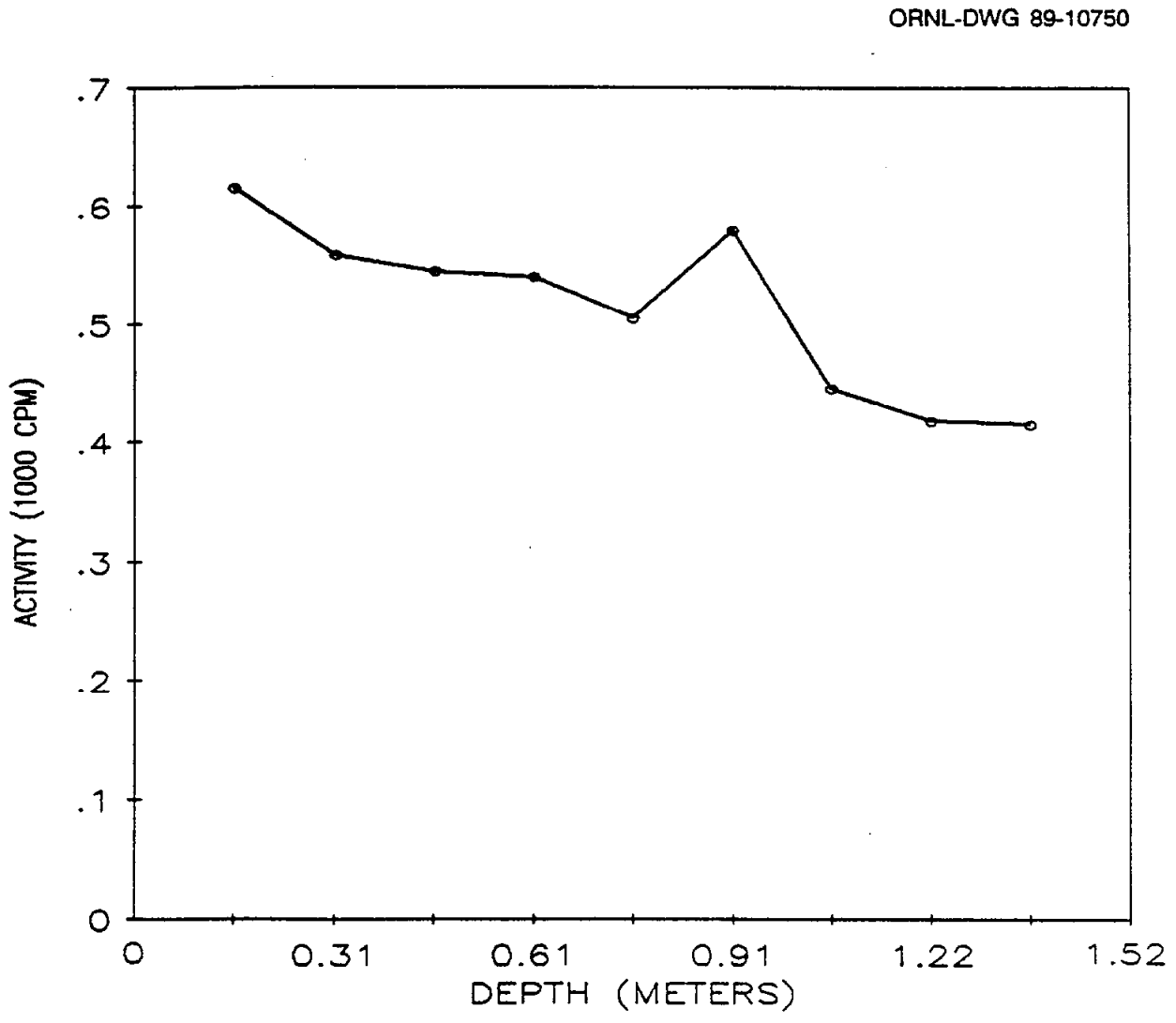

Fig. 4. Gamma profile for auger hole 2 (MJ029A2) at 130 West Central Avenue, Maywood, New Jersey.

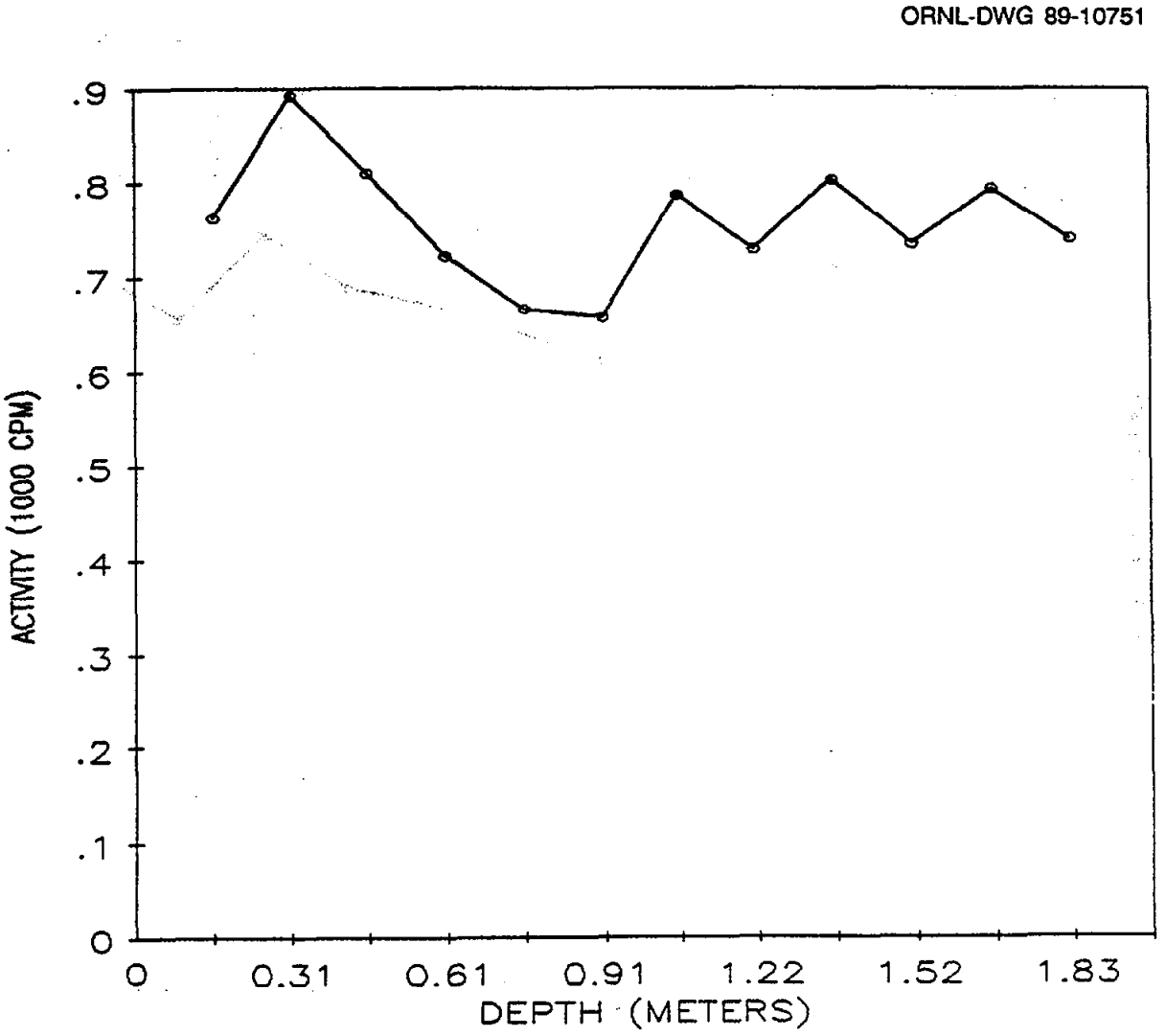

Fig. 5. Gamma profile for auger hole 4 (MJ029A4) at 130 West Central Avenue, Maywood, New Jersey.

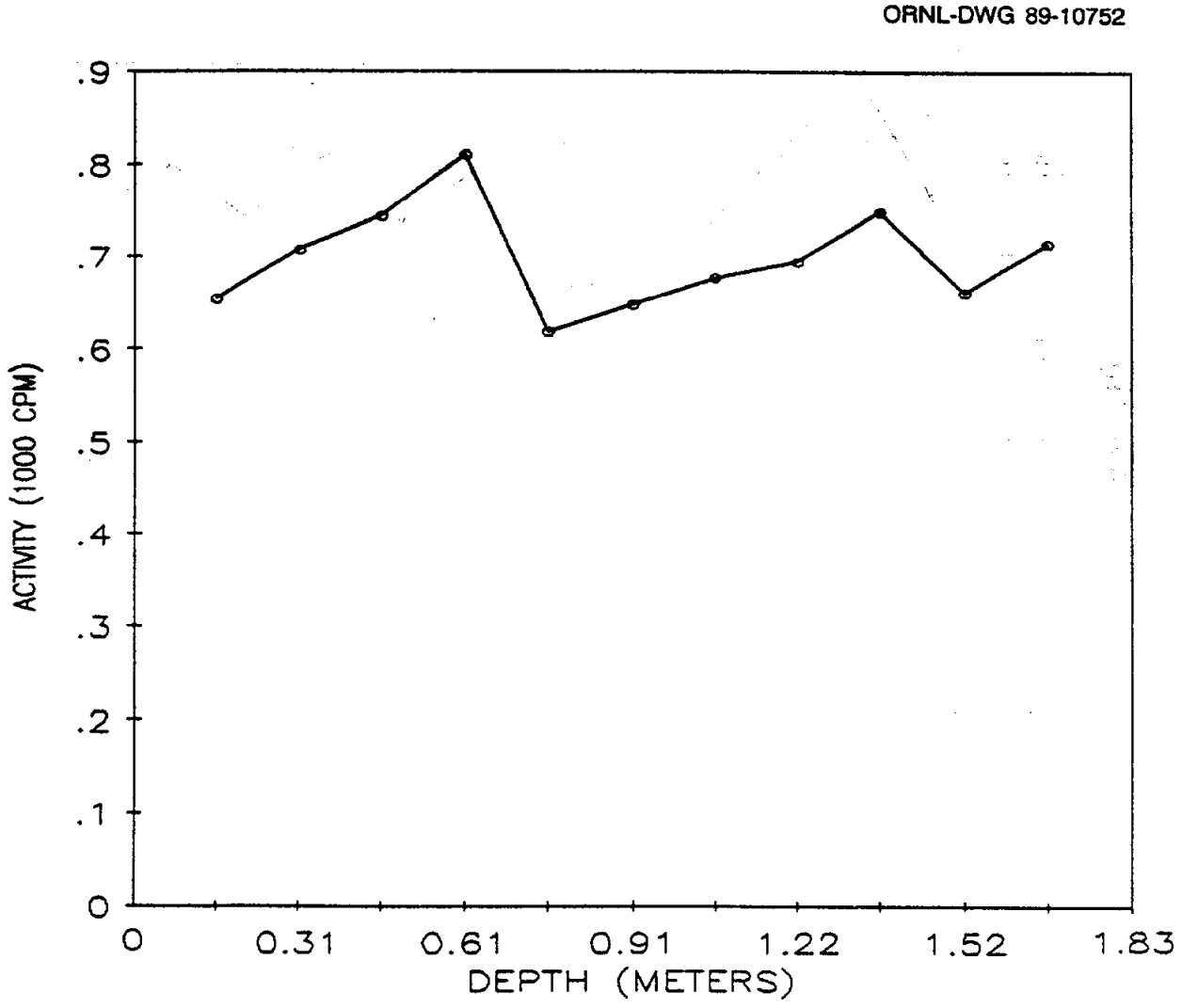

Fig. 6. Gamma profile for auger hole 5 (MJ029A5) at 130 West Central Avenue, Maywood, New Jersey.

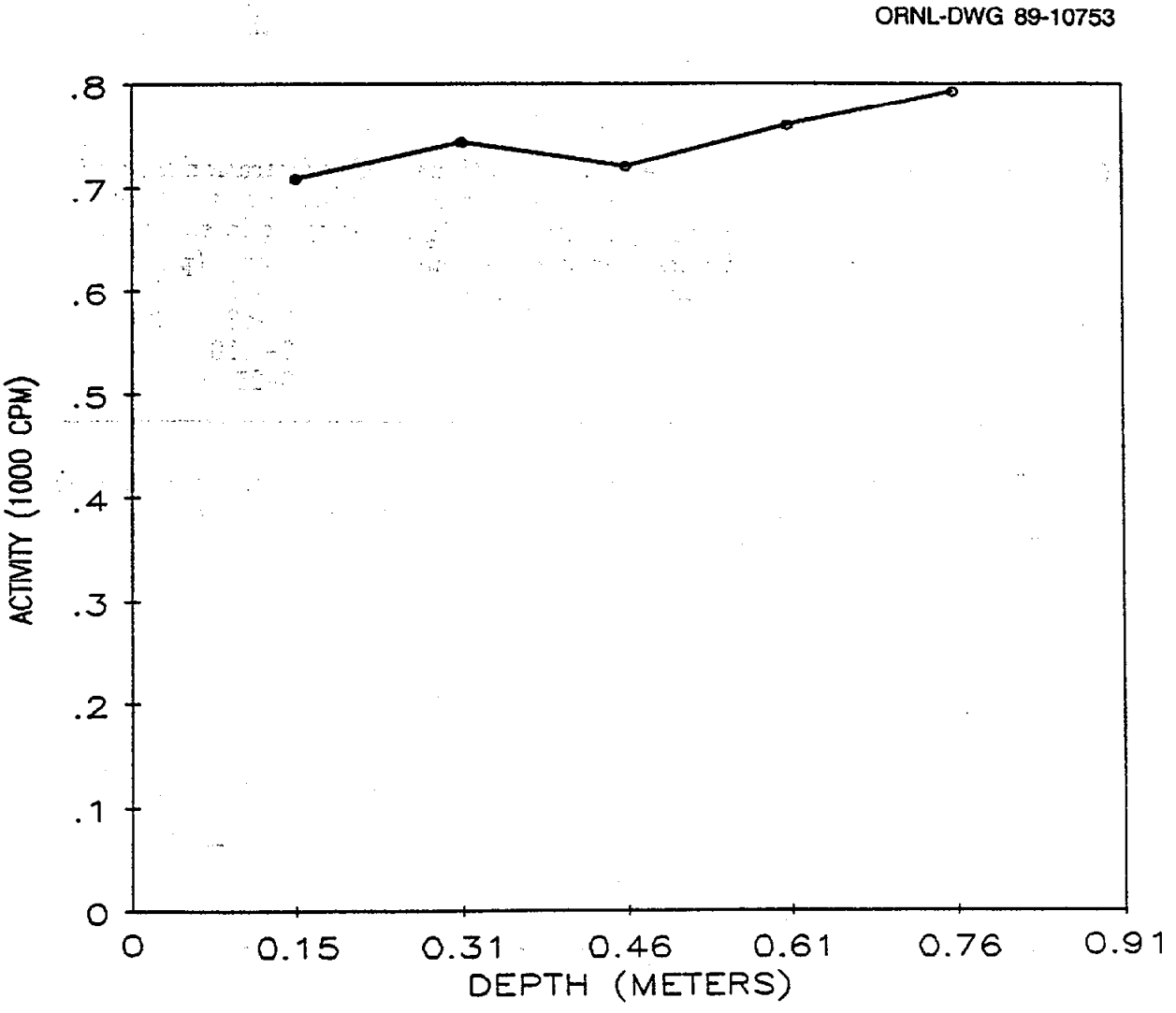

Fig. 7. Gamma profile for auger hole 6 (MJ029A6) at 130 West Central Avenue, Maywood, New Jersey.

Table 1. Applicable guidelines for protection against radiation[a]

Mode of exposure	Exposure conditions	Guideline value
Radionuclide concentrations in soil	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
Guidelines for nonhomogeneous contamination (used in addition to the 100 m^2 guideline)[b]	Applicable to locations meeting the above criterion but ≤ 25 m^2 with significantly elevated concentrations of radionuclides	Concentration limits for application to "hot spots" varying in size as follows: (m^2) (pCi/g)[c] <1 50 1–<3 30 3–<10 15 10–25 10

[a]From Reference 3.

[b]"Every reasonable effort shall be made to identify and remove any source which has a concentration exceeding 30 times the guideline value, irrespective of area."

[c]These guideline values are applicable to surface concentrations of ^{232}Th, ^{230}Th, ^{228}Ra, and ^{226}Ra only; for other radionuclides and subsurface values, see Reference 3.

Table 2. Background radiation levels for the northern New Jersey area

Type of radiation measurement or sample	Radiation level or radionuclide concentration
Concentration of radionuclides in soil (pCi/g)	
^{232}Th	0.9[a]
^{238}U	0.9[a]
^{226}Ra	0.9[a]

[a]Reference 4.

Table 3. Concentrations of radionuclides in soil at 130 West Central Avenue, Maywood, New Jersey (MJ029)

Sample[a]	Depth (cm)	Radionuclide concentration (pCi/g)		
		^{226}Ra[b]	^{232}Th[b]	^{238}U[b]
		Systematic samples[c]		
S1A	0–15	0.92±0.1	1.1 ±0.5	*d*
S1B	15–30	0.77±0.1	1.0 ±0.06	*d*
S2A	0–15	2.2 ±0.3	4.4 ±0.4	*d*
S2B	15–30	2.2 ±0.1	3.0 ±0.1	*d*
S3A	0–15	2.9 ±0.3	10 ±0.7	*d*
S3B	15–30	2.6 ±0.3	5.3 ±0.2	*d*
S3C	30–45	1.3 ±0.05	2.1 ±0.3	*d*
S4A	0–15	2.7 ±0.4	4.0 ±0.3	*d*
S4B	15–30	2.7 ±0.5	3.3 ±0.07	*d*
S4C	30–45	1.5 ±0.08	1.7 ±0.1	*d*
S5A	0–15	2.5 ±0.4	5.0 ±0.2	*d*
S5B	15–30	3.0 ±0.4	3.9 ±0.2	*d*
S5C	30–45	2.1 ±0.3	2.8 ±0.7	*d*
S6A	0–15	1.9 ±0.3	4.6 ±0.2	*d*
S6B	15–30	2.4 ±0.8	4.5 ±0.09	*d*
S7A	0–15	2.1 ±0.1	3.1 ±0.6	*d*
S7B	15–30	2.8 ±0.9	3.6 ±0.8	*d*
S8A	0–15	1.1 ±0.1	1.5 ±0.3	*d*
S8B	15–30	2.1 ±0.2	2.0 ±1	*d*
S9A	0–15	1.0 ±0.07	1.7 ±0.4	*d*
S9B	15–30	1.0 ±0.2	2.0 ±0.2	*d*
S10A	0–15	0.85±0.2	1.1 ±0.2	*d*
S10B	15–30	0.79±0.1	0.92±0.4	*d*
		Auger samples[e]		
A3	30–45	0.71±0.007	0.94±0.01	1.3±0.3
A6	60–75	0.71±0.03	1.0 ±0.03	1.2±0.8

[a]Locations of soil samples are shown on Fig. 2.

[b]Indicated counting error is at the 95% confidence level ($\pm 2\sigma$).

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

[d]Sample was not analyzed for ^{238}U.

[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.

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