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ADMINISTRATIVE RECORD

for the Maywood Site, New Jersey

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RESULTS OF THE RADIOLOGICAL SURVEY AT 9 HANCOCK STREET, LODI, NEW JERSEY (LJ028)

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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, 9 Hancock Street, Lodi, New Jersey (LJ028), was conducted during 1985 and 1986.

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 9 HANCOCK STREET, LODI, NEW JERSEY (LJ028)*

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 feet 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

*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 U.S. DOE contract DE-AC05-840R21400.

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 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 9 Hancock Street, Lodi, New Jersey, was conducted during 1985 and 1986. The survey and sampling of the ground surface were carried out on October 16, 1985, and the follow-up subsurface investigation was performed on September 18, 1986.

SURVEY METHODS

The radiological survey of the property included: (1) a gamma scan of the entire property 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. If the gamma exposure rates were elevated, a biased soil sample was taken at the point showing the highest gamma radiation level. Systematic soil samples were taken at various locations on the property, irrespective of gamma radiation levels. These survey methods followed the plan outlined in Reference 1.

To define the extent of possible subsurface soil contamination, the auger holes were drilled to depths of approximately 2.0 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 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. 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.[4] These data

are provided for comparison with survey results presented in this report. 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 surface of the property are given in Fig. 1. Gamma exposure rates over the major portion of the property ranged from 6-11 μR/h. Exposure rates of 11-13 μR/h were measured on a narrow strip of soil lying along the northeastern wall of the house. These slight elevations in gamma levels are typical of the naturally occurring radioactive substances present in bricks, concrete, granite, and other such materials used in paving and building construction.

Systematic and Biased Soil Samples

Systematic and biased soil samples were taken from various locations on the property for radionuclide analyses. Locations of the systematic (S) and biased (B) samples are shown in Fig. 2, with results of laboratory analyses provided in Table 3. Concentrations of uranium, radium, and thorium in both the systematic and biased samples were within normal background levels for the northern New Jersey area (Table 2).

Auger Hole Soil Samples and Gamma Logging

Varying thicknesses of subsurface soil were sampled from depths of 60 to 185 cm in auger (A) holes which were drilled at 4 separate locations indicated in Fig. 2. The results of analyses of these samples are given in Table 3. Concentrations of ^{226}Ra and ^{232}Th in soil samples from all auger holes ranged from 0.4 to 2.4 and 0.48 to 7.1 pCi/g, respectively. The ^{226}Ra and ^{232}Th concentrations in auger samples ranged from less than normal to approximately 7 times greater than normal background levels for the northern New Jersey area; however, all radionuclide levels auger soil samples were well below applicable DOE guidelines (Table 1).

Gamma logging was performed in each of the 4 auger holes to characterize and further define the extent of possible 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 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 Fig. 3 through Fig. 6.

These profiles indicated concentrations of radionuclides at certain depths to be slightly above background levels. Maximum readings in auger holes 1 through 4 were 1894 cpm, 1442 cpm, 1422 cpm, and 1919 cpm, respectively, at depths from 1.1 to 1.4 m. However, soil sample results (Table 3) showed maximum concentrations of ^{226}Ra and ^{232}Th found at these locations to be 2.4 and 7.1 pCi/g, respectively. These values were well below DOE criteria (Table 1).

SIGNIFICANCE OF FINDINGS

Measurements and results of soil sample analyses taken at 9 Hancock Street indicate the presence of naturally occurring radionuclides in excess of background levels normally encountered in the Lodi, New Jersey area. However, all measurement results were well within applicable DOE guidelines.

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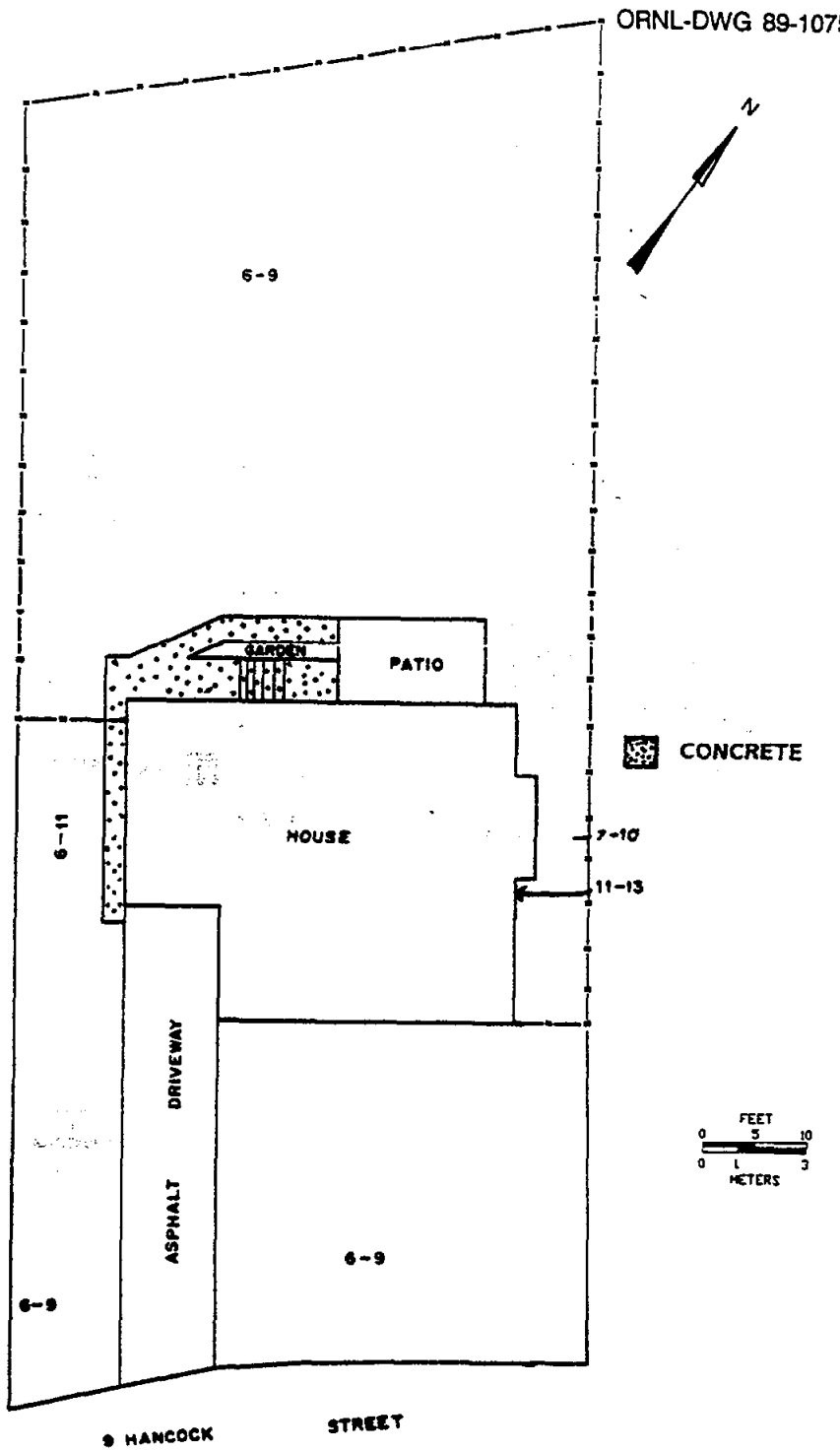

Fig. 1. Gamma radiation levels (μR/h) measured on the surface at 9 Hancock Street, Lodi, New Jersey (LJ028).

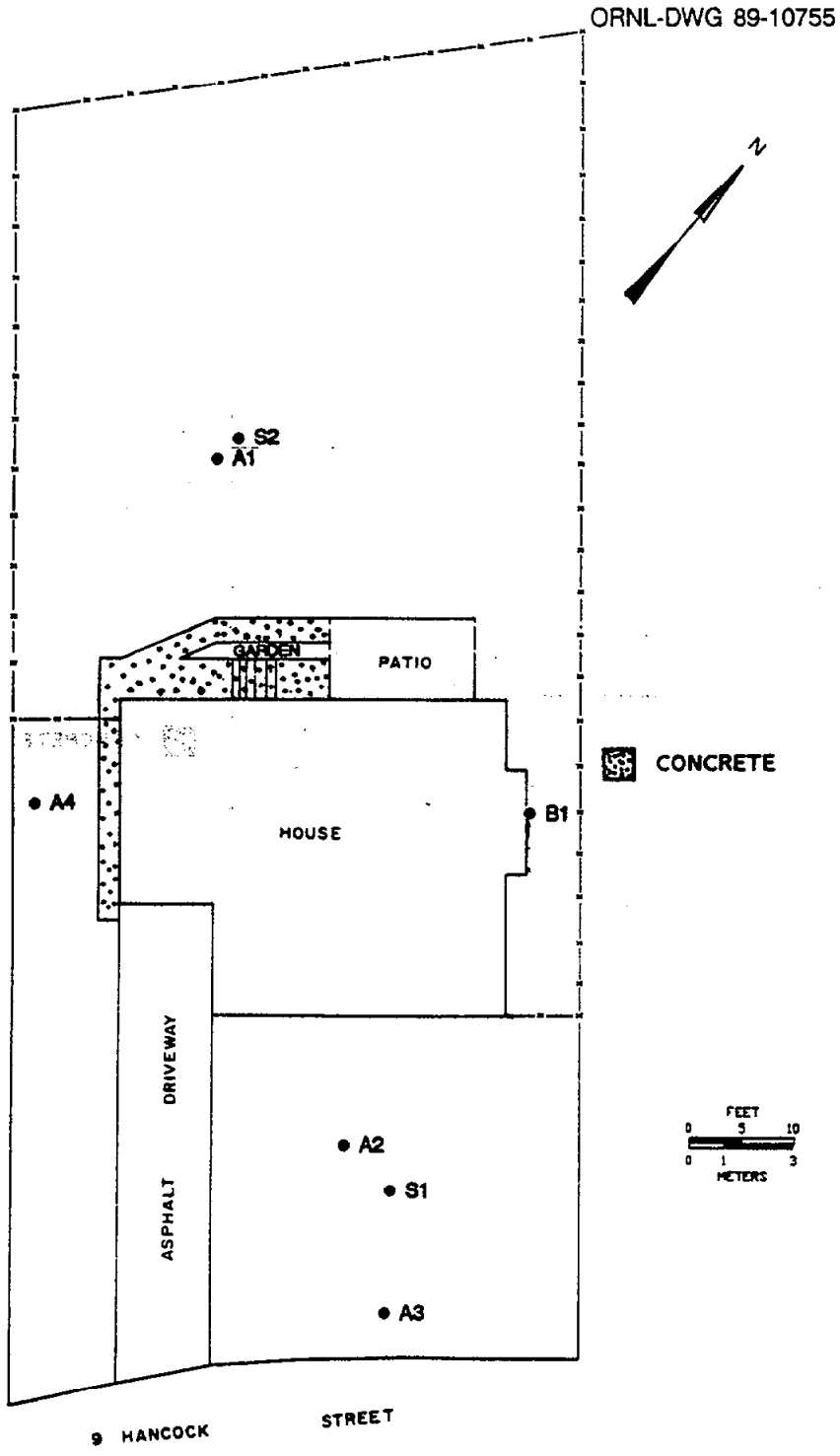

Fig. 2. Diagram showing locations of soil samples taken at 9 Hancock Street, Lodi, New Jersey (LJ028).

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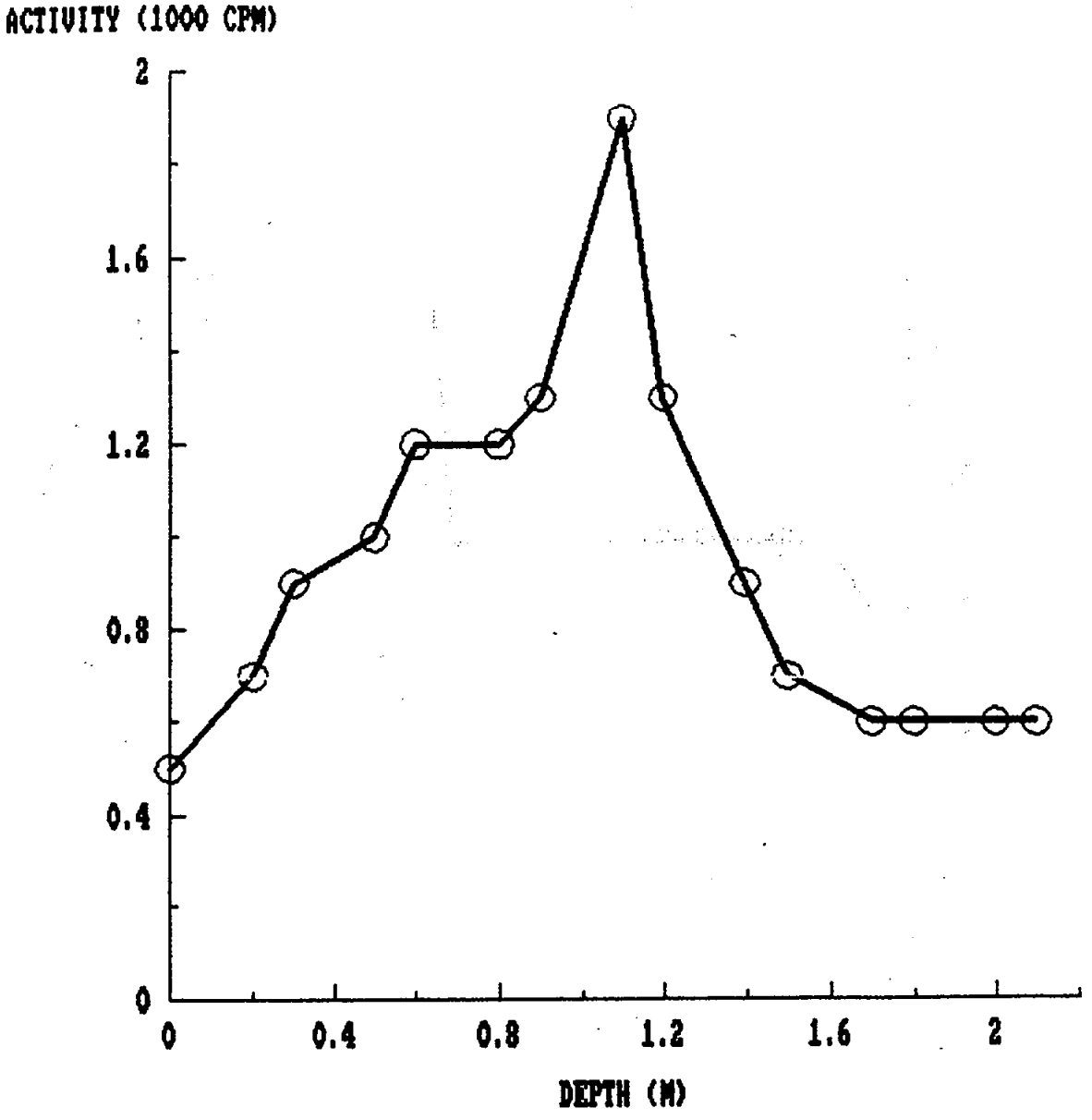

Fig. 3. Gamma profile for auger hole 1 (LJ028A1) at 9 Hancock Street, Lodi, New Jersey.

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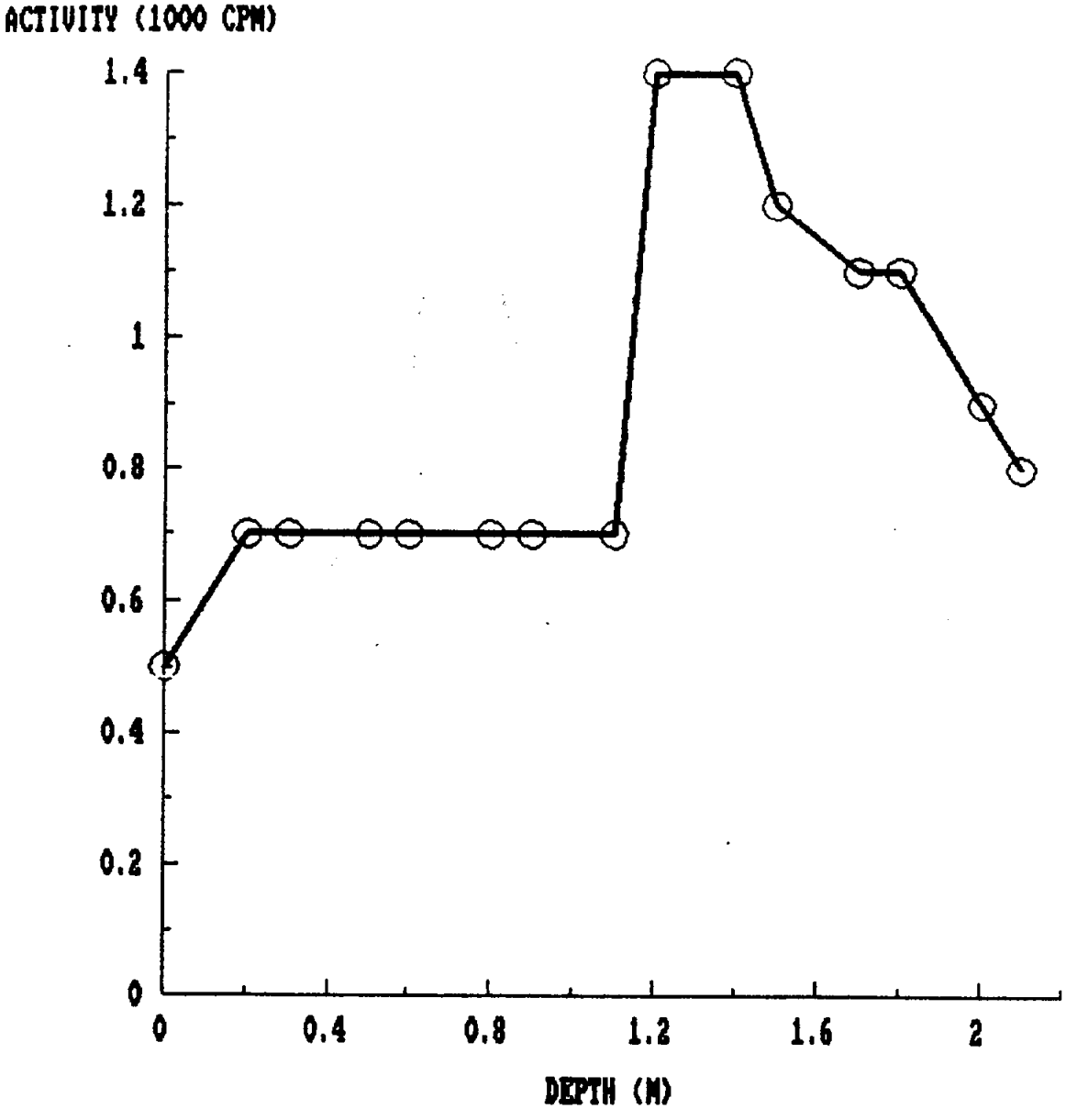

Fig. 4. Gamma profile for auger hole 2 (LJ028A2) at 9 Hancock Street, Lodi, New Jersey.

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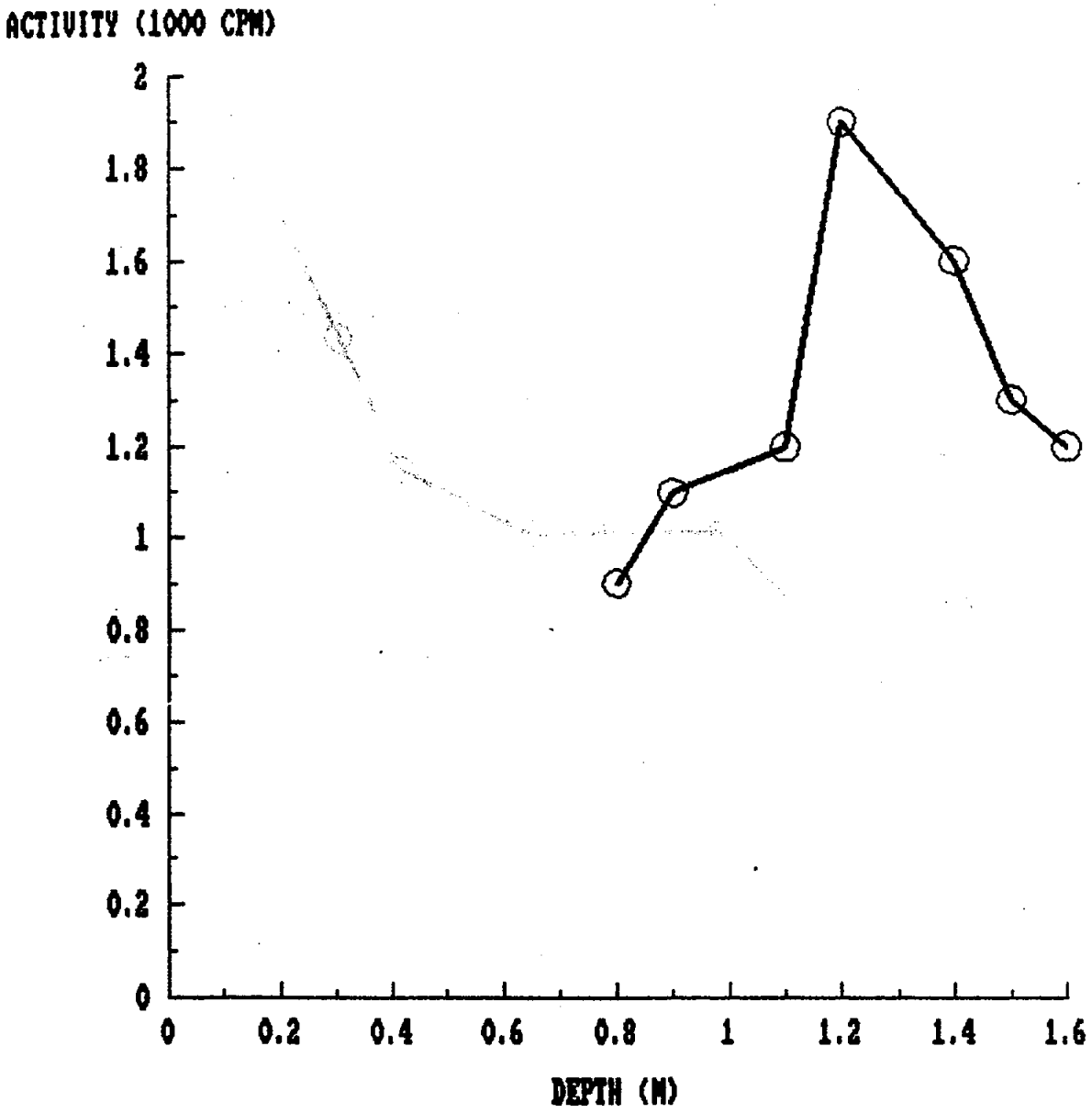

Fig. 6. Gamma profile for auger hole 4 (LJ028A4) at 9 Hancock Street, Lodi, New Jersey.

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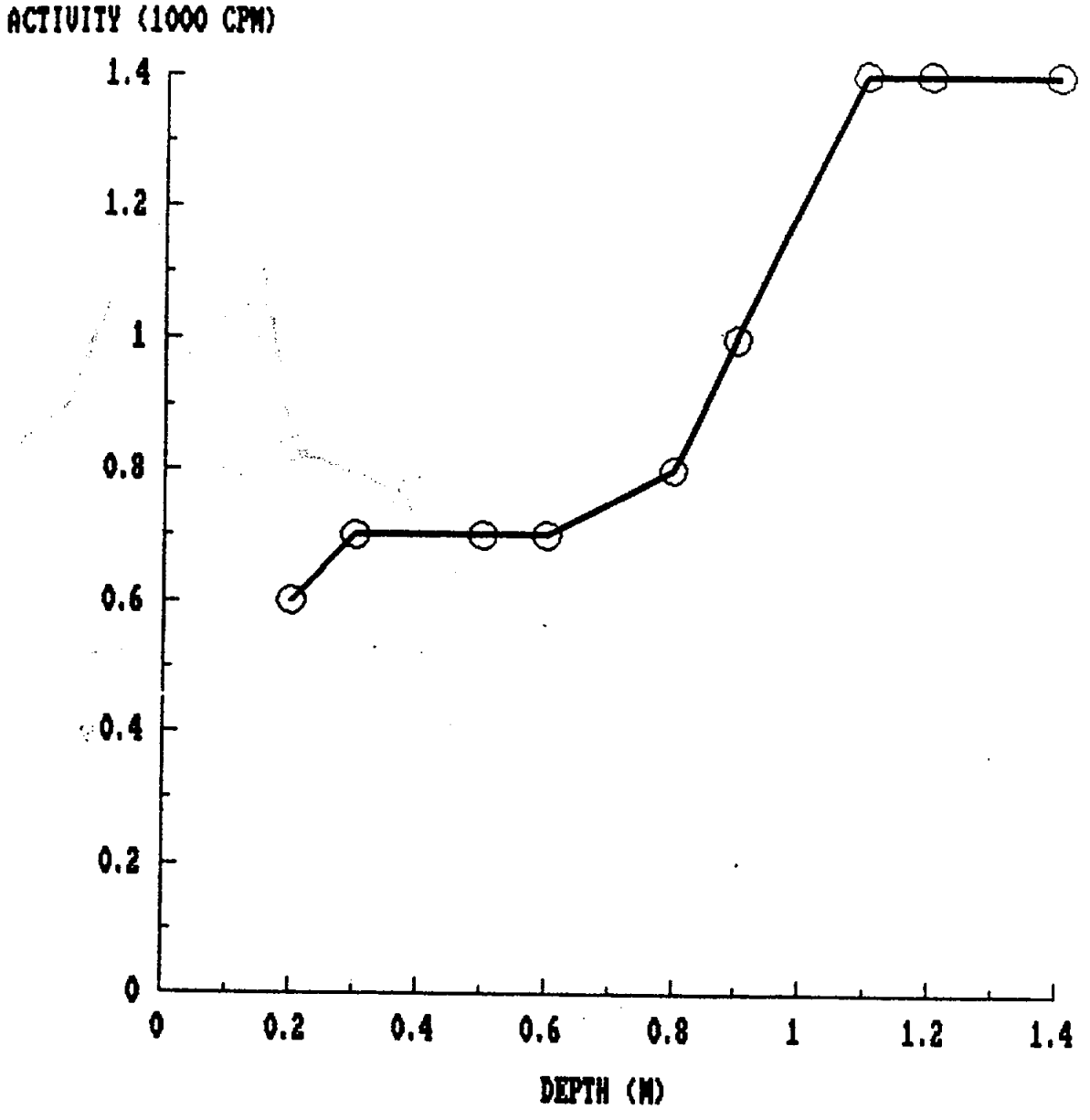

Fig. 5. Gamma profile for auger hole 3 (LJ028A3) at 9 Hancock Street, Lodi, New Jersey.

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

[a]Reference 3.

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

Type of radiation measurement or sample	Radiation level or radionuclide concentration
Gamma exposure at 1 m above ground surface (μR/h)[a]	8
Concentration of radionuclides in soil (pCi/g)	
^{232}Th	0.9[b]
^{238}U	0.9[b]
^{226}Ra	0.9[b]

[a]Reference 4.
[b]Reference 5.

Table 3. Concentrations of radionuclides in soil at 9 Hancock Street, Lodi, New Jersey

Sample[a]	Depth (cm)	Radionuclide concentration (pCi/g)		
		^{226}Ra[b]	^{232}Th[b]	^{238}U[c]
		Systematic samples[d]		
S1	0-15	0.60 ± 0.08	0.70 ± 0.3	0.67
S2	0-15	0.79 ± 0.2	0.97 ± 0.2	0.83
		Biased samples[e]		
B1A	0-15	0.90 ± 0.2	0.88 ± 0.2	0.83
		Auger samples[f]		
A1A	60-90	1.5±0.08	2.7±0.3	[g]
A1B	90-120	1.9±0.1	7.0±0.4	[g]
A1C	120-150	1.2±0.06	1.2±0.1	[g]
A1D	150-185	0.70±0.06	0.92±0.2	[g]
A2A	60-90	0.40±0.03	0.48±0.1	[g]
A2B	120-150	1.9±0.09	2.6±0.4	[g]
A2C	150-185	2.1±0.09	1.8±0.3	[g]
A3A	90-105	0.91±0.03	1.4±0.2	[g]
A3B	105-120	1.9±0.07	3.8±0.2	[g]
A3C	120-135	2.2±0.3	1.8±0.2	[g]
A3D	135-150	2.4±0.07	1.9±0.4	[g]
A3E	150-165	2.1±0.1	1.8±0.1	[g]
A4A	105-120	0.99±0.3	3.0±0.3	[g]
A4B	120-135	1.5±0.08	7.1±0.6	[g]
A4C	135-150	2.0±0.1	1.9±0.1	[g]
A4D	150-170	2.1±0.1	1.8±0.1	[g]

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

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

[c]Total analytical error of measurement results is less than ±5% (95% confidence level).

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

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

[f]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.

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

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