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**RESULTS OF THE
RADIOLOGICAL SURVEY
AT
108 AVENUE E, LODI,
NEW JERSEY
(LJ084)**

**R. D. Foley
L. M. Floyd**

**ATED BY
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HEALTH AND SAFETY RESEARCH DIVISION

Nuclear and Chemical Waste Programs
(Activity No. AH 10 05 00 0; ONLWCO1)

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AT 108 AVENUE E, LODI,
NEW JERSEY (LJ084)**

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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, 108 Avenue E, Lodi, New Jersey (LJ084), was conducted during 1988.

Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site.

**RESULTS OF THE RADIOLOGICAL SURVEY
AT 108 AVENUE E, LODI,
NEW JERSEY (LJ084)***

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 stream bed 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

*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.

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 108 Avenue E, Lodi, New Jersey, was conducted during 1988. The survey and sampling of the ground surface were carried out on May 9, 1988.

SURVEY METHODS

The radiological survey of the property included: (1) a gamma scan of the entire property outdoors, both at the surface and one meter above the surface and (2) collection of soil samples. No indoor survey measurements were performed.

Using a portable gamma scintillation meter, ranges of measurements were recorded for areas of the property surface and one meter above the surface. If the gamma readings 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. 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.

Gamma Radiation Levels

Gamma radiation levels measured during a gamma scan of the surface of the property are given in Fig. 1, with corresponding measurements one meter above the surface where indicated. Gamma exposure rates over the major portion of the property surface ranged from 5 to 13 $\mu\text{R}/\text{h}$. One-meter readings were between 6 and 11 $\mu\text{R}/\text{h}$, with the 11- $\mu\text{R}/\text{h}$ reading being above the normal background level of 8 $\mu\text{R}/\text{h}$ at one meter for the northern New Jersey area (Table 2). The highest surface readings were in the front yard, ranging from 13 to 21 $\mu\text{R}/\text{h}$, with an isolated spot of 17 $\mu\text{R}/\text{h}$. In the back yard, more isolated spots read 14, 15, and 11 to 15 $\mu\text{R}/\text{h}$ on the western side of the property.

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 radium, thorium, and uranium in these samples ranged from 0.52 to 2.8 pCi/g, 0.71 to 17 pCi/g, and 0.92 to 21 pCi/g, respectively. Biased sample B1A was taken from an area of elevated gamma readings that covered approximately 6 m². The sum of the ²²⁶Ra and ²³²Th concentrations in this sample was 18 pCi/g (corrected for background); this value is 120% of the DOE guideline value of 15 pCi/g for isolated spots of less than 10 m² (Table 1). Sample B2A, however, was taken from a much smaller area of elevated gamma levels (0.5 m²). The sum of radium and thorium concentrations for this sample was 6.8 pCi/g (corrected for background); this value is only about 14% of the DOE guideline value of 50 pCi/g for isolated spots of less than one square meter (Table 1).

SIGNIFICANCE OF FINDINGS

Measurements taken at 108 Avenue E indicate that the property contained radioactive contamination primarily from the ²³²Th and ²³⁸U decay chains, with slight contamination from ²²⁶Ra. These radionuclide distributions are typical of the type of material originating from the MCW site. The concentration and extent of ²³²Th on this property were in excess of the applicable DOE criteria for "hot spots" of less than 10 m² (Table 1). This material was found in the location shown in Fig. 2 at sample station B1, consistent with the elevated gamma radiation measurements in that area. Biased sample B2A did not exceed DOE guidelines for isolated spots of less than one square meter. Based on the results of this radiological assessment, it is recommended that this site be considered for inclusion in the DOE remedial action program.

REFERENCES

1. W. D. Cottrell, ORNL, to A. J. Whitman, DOE/HQ, correspondence, "Radiological Survey of Private Properties in Lodi, New Jersey" (August 15, 1984).
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 (RSA) Program*, Oak Ridge National Laboratory, ORNL/TM-8600 (April 1987).
3. U.S. Department of Energy, *Guidelines for Residual Radioactivity at Formerly Utilized Sites, Remedial Action Program and Remote Surplus Facilities Management Program Sites* (Rev. 2, March 1987).
4. U.S. Department of Energy, *Radiological Survey of the Middlesex Municipal Landfill, Middlesex, New Jersey, DOE/EV-00005/20* (April 1980).
5. T. E. Myrick and B. A. Berven, *State Background Radiation Levels: Results of Measurements Taken During 1975-1979*, Oak Ridge National Laboratory, ORNL/TM-7343 (November 1981).

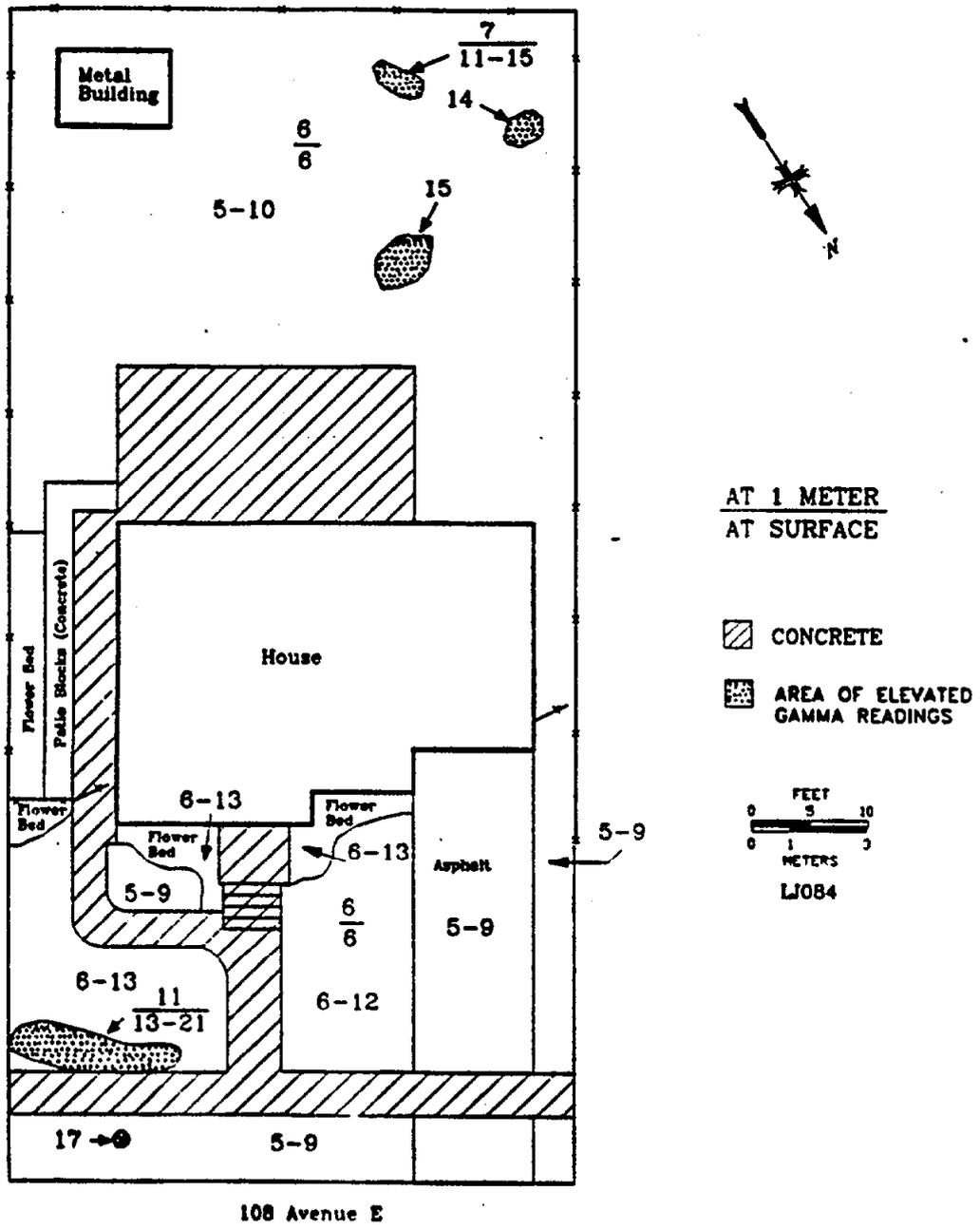


Fig. 1. Gamma radiation levels ($\mu\text{R}/\text{h}$) measured on the surface at 108 Avenue E, Lodi, New Jersey (LJ084), with corresponding measurements one meter above the surface where indicated.

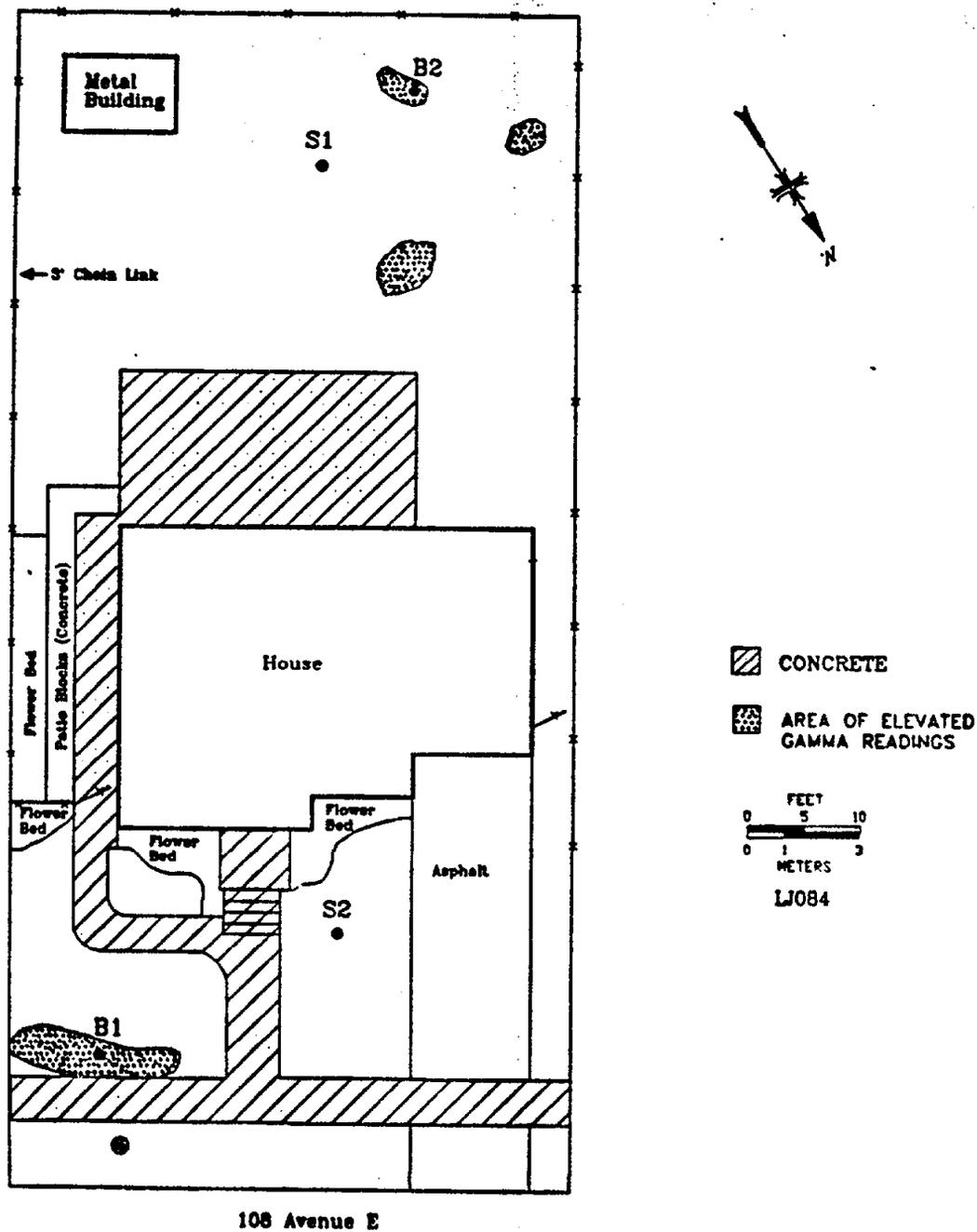


Fig. 2. Diagram showing locations of soil samples taken at 108 Avenue E, Lodi, New Jersey (LJ084).

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

^aReference 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."

^cThese guideline values are applicable to surface concentrations of ²³²Th, ²³⁰Th, ²²⁸Ra, and ²²⁶Ra 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
Gamma exposure at 1 m above ground surface (μR/h)	8 ^a
Concentration of radionuclides in soil (pCi/g)	
²³² Th	0.9 ^b
²³⁸ U	0.9 ^b
²²⁶ Ra	0.9 ^b

^aReference 4.

^bReference 5.

**Table 3. Concentrations of radionuclides in soil at
108 Avenue E, Lodi, New Jersey (LJ084)**

Sample ^a	Depth (cm)	Radionuclide concentration (pCi/g)		
		²²⁶ Ra ^b	²³² Th ^b	²³⁸ U ^b
<i>Systematic samples^c</i>				
S1A	0-15	0.52±0.03	0.71±0.005	0.92±1
S1B	15-30	0.70±0.007	0.91±0.01	1.4 ±0.2
S2A	0-15	0.76±0.007	0.86±0.02	1.1 ±0.5
S2B	15-30	0.65±0.02	0.84±0.03	<1.3
<i>Biased samples^d</i>				
B1A	0-15	2.8 ±0.3	17 ±1	21 ±0.6
B1B	15-30	1.6 ±0.1	8.0 ±0.2	11 ±1
B1C	30-45	0.79±0.03	1.7 ±0.06	<4.8
B2A	0-15	1.3 ±0.1	7.3 ±0.08	8.8 ±1
B2B	15-30	0.87±0.05	2.8 ±0.1	3.7 ±2
B2C	30-45	0.81±0.02	1.3 ±0.04	3.2 ±0.8

^aLocations of soil samples are shown on Fig. 2.

^bIndicated counting error is at the 95% confidence level ($\pm 2\sigma$).

^cSystematic samples are taken at locations irrespective of gamma exposure.

^dBiased samples are taken from areas shown to have elevated gamma exposure rates.

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