
Formerly Utilized Sites Remedial
Action Program (FUSRAP)

Maywood Chemical Company Superfund Site

ADMINISTRATIVE RECORD

Document Number

MISS- 114.



**US Army Corps
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U-715

ORNL/RASA-88/23

HEALTH AND SAFETY RESEARCH DIVISION

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

**RESULTS OF THE RADIOLOGICAL
SURVEY AT 200 STATE ROUTE 17 (MJ035),
MAYWOOD, NEW JERSEY**

R. D. Foley, J. W. Crutcher, R. F. Carrier, and L. M. Floyd

Date of Issue - February 1989

Investigation Team

R. E. Swaja - Measurement Applications and Development Manager
W. D. Cottrell - FUSRAP Project Director
R.D. Foley - Field Survey Supervisor

Survey Team Members

A. C. Butler
M. E. Ward*
W. Winton

*Stone Associates

Work performed by the
MEASUREMENT APPLICATIONS AND DEVELOPMENT GROUP

Prepared by the
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6285
operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U. S. DEPARTMENT OF ENERGY
under Contract No. DE-AC05-84OR21400

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ACKNOWLEDGMENTS

Research for this project was sponsored by the Division of Facility and Site Decommissioning Projects, U.S. Department of Energy, under Contract No. DE-AC05-84OR21400 with Martin Marietta Energy Systems, Inc. The authors wish to acknowledge the support of J. E. Baublitz, Deputy Director, Office of Remedial Action and Waste Technology; J. J. Fiore, Director, Division of Facility and Site Decommissioning Projects; and members of their staff. The authors also appreciate the contributions of B. C. Littleton and L. J. Jeffers of IR&A Publications Office, B. S. Ellis, D. A. Roberts, and T. R. Stewart of the Measurement Applications and Development Group, and M. E. Ward of Don Stone Associates for participation in the collection, analyses, and reporting of data for this survey.

**RESULTS OF THE RADIOLOGICAL
SURVEY AT 200 STATE ROUTE 17 (MJ035),
MAYWOOD, NEW JERSEY***

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 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. Lodi Brook is now located at the southeast boundary of the property whose survey findings are presented in this report.

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 survey discussed in this report is part of that effort and was conducted, at the request of DOE, by members of the Measurement Applications and Development Group of Oak Ridge National Laboratory.

A radiological survey of the commercial property at 200 State Route 17, Maywood, New Jersey, was conducted during 1987. The survey and sampling of the ground surface and subsurface were carried out on September 2, 1987.

SURVEY METHODS

The radiological survey of the property included a gamma scan of the entire property outdoors and collection of surface and subsurface 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. Systematic soil samples were then obtained at randomly selected locations irrespective of gamma exposure rates. In addition, biased soil samples were collected in areas of elevated gamma levels. These survey methods followed the plan outlined in Reference 1. A comprehensive description of the survey methods and instrumentation is presented in *Procedures Manual for the ORNL Radiological Activities (RASA) Program*, Oak Ridge National Laboratory, ORNL/TM-8600 (April 1987).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 surface of the property are given in Fig. 1. Gamma exposure rates over the major portion of the property ranged from 4 to 10 $\mu\text{R}/\text{h}$. Elevated gamma levels were found southeast of the building where the property borders Lodi Brook (15 to 136 $\mu\text{R}/\text{h}$).

Systematic and Biased Soil Samples

Two systematic soil samples (S1A and S1B) and fifteen biased soil samples (B1A-B4E) were taken for radionuclide analyses. The samples were taken at 15-cm

increments from depths of 0 to 30 cm for the systematic samples and 0 to 75 cm for the biased samples. Locations of the samples are shown in Fig. 2, with results of laboratory analyses provided in Table 3. Concentrations of ^{226}Ra and ^{232}Th in the systematic samples ranged from 0.52 to 0.63 pCi/g and from 0.59 to 0.78 pCi/g, respectively. In the biased samples, concentrations ranged from 0.84 to 35 pCi/g for ^{226}Ra and from 3.0 to 390 pCi/g for ^{232}Th . The DOE guideline for ^{226}Ra concentration in surface soil is exceeded in one sample, B1A, and the guideline for subsurface soil is exceeded in one subsurface sample, B4D. Thorium-232 concentrations exceeded the DOE guidelines in all four biased surface samples (B1-4) and in eight of the biased subsurface samples (B1B-D, B3B, and B4B-E).

SIGNIFICANCE OF FINDINGS

Measurements taken at 200 State Route 17 indicate that the property contained radioactive contamination primarily from the ^{232}Th decay chain, with some contamination from ^{226}Ra . These radionuclide distributions are typical of the type of material originating from the processing operations at the MCW. The concentration and extent of ^{232}Th on this property are in excess of the applicable DOE criteria (Table 1). This material was found in the locations shown in Fig. 2 at sample locations B1-4. 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

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TOWNSHIP OF ROCHELLE PARK

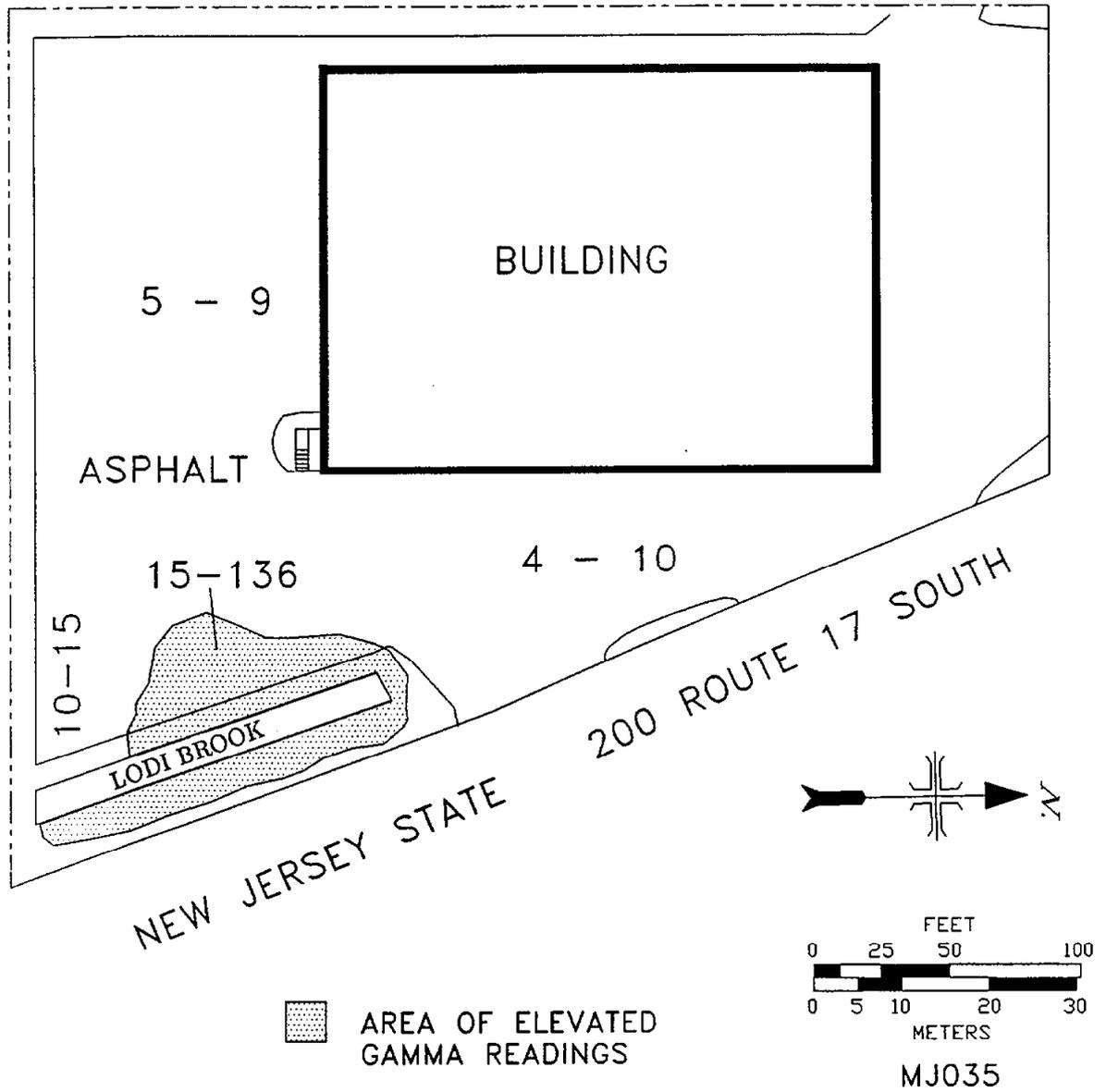


Fig. 1. Gamma radiation levels ($\mu\text{R}/\text{h}$) measured on the surface at 200 State Route 17, Maywood, New Jersey (MJ035).

TOWNSHIP OF ROCHELLE PARK

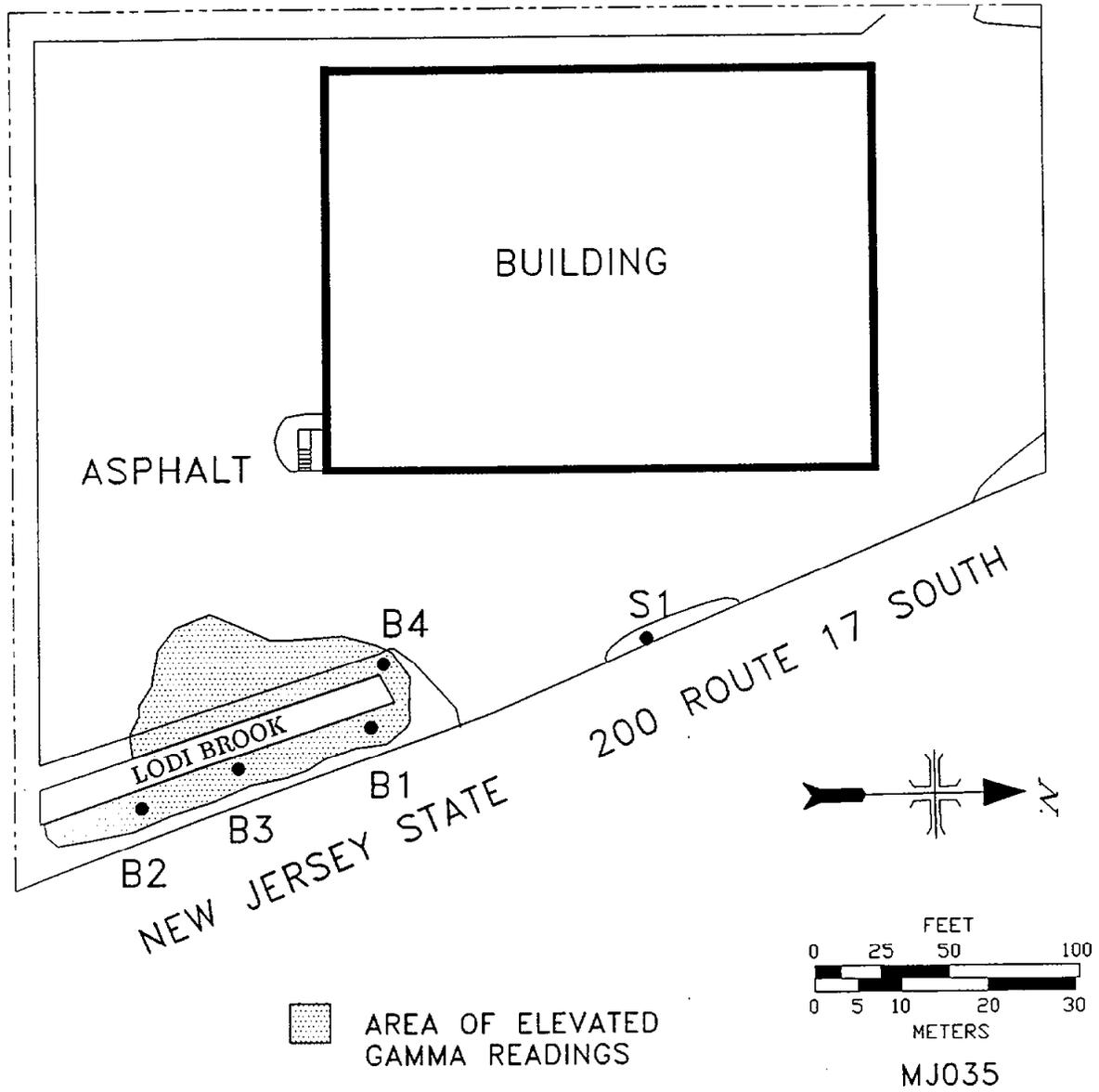


Fig. 2. Diagram showing locations of soil samples taken at 200 State Route 17, Maywood, New Jersey (MJ035).

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

^aReference 3.

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

Type of radiation measurement or sample	Radionuclide 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

^aReference 4.

Table 3. Concentrations of radionuclides in soil at 200 State Rt. 17, Maywood, New Jersey (MJ035)

Sample ^a	Depth (cm)	Radionuclide concentration (pCi/g)	
		²²⁶ Ra ^b	²³² Th ^b
<i>Systematic samples^c</i>			
S1A	0-15	0.52 ± 0.04	0.59 ± 0.06
S1B	15-30	0.63 ± 0.1	0.78 ± 0.2
<i>Biased samples^d</i>			
B1A	0-15	7.3 ± 1	67 ± 1.4
B1B	15-30	5.4 ± 0.9	39 ± 7
B1C	30-45	11 ± 0.5	62 ± 10
B1D	45-60	7.0 ± 0.4	45 ± 8
B2A	0-15	1.4 ± 0.2	9.0 ± 0.8
B2B	15-30	1.2 ± 0.05	5.2 ± 0.5
B2C	30-45	0.84 ± 0.4	3.0 ± 0.6
B3A	0-15	3.2 ± 0.5	45 ± 1
B3B	15-30	6.3 ± 0.7	71 ± 10
B3C	30-45	1.5 ± 0.3	12 ± 0.4
B4A	0-15	4.3 ± 0.4	29 ± 2
B4B	15-30	7.6 ± 0.5	46 ± 2
B4C	30-45	14 ± 1	82 ± 3
B4D	45-60	35 ± 3	390 ± 10
B4E	60-75	6.2 ± 0.3	52 ± 1

^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 grid locations irrespective of gamma exposure.

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

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