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RESULTS OF THE INDEPENDENT RADIOLOGICAL VERIFICATION SURVEY AT 61 TRUDY DRIVE, LODI, NEW JERSEY (LN003V)

M. G. Yalcintas
C. A. Johnson

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HEALTH AND SAFETY RESEARCH DIVISION

Nuclear and Chemical Waste Programs
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RESULTS OF THE INDEPENDENT RADIOLOGICAL VERIFICATION SURVEY AT 61 TRUDY DRIVE, LODI, NEW JERSEY (LN003V)*

INTRODUCTION

Processing of thorium ores was performed in Maywood, New Jersey, between 1916 and 1956 by the Maywood Chemical Works.[1] During the course of thorium processing the wastes from the operations were pumped to diked areas west of the plant. Additional material was placed in two piles surrounded by earthen dikes. In 1932, Route 17 was built through this disposal area. The Maywood Chemical Works ceased thorium processing in 1956 and subsequently was sold to Stepan Chemical Company in 1959. After 1963, on several occasions wastes were removed from the west side of New Jersey Route 17. This area is now owned by Ballod and Associates. In 1984, the U.S. Department of Energy (DOE) was assigned the responsibility by Congress for the decontamination project involving the site and vicinity properties in Maywood, Rochelle Park, and Lodi, New Jersey, under the Formerly Utilized Sites Remedial Action Program (FUSRAP).

This site, referred to as the Maywood site, had surface and subsurface radionuclide concentrations in excess of the DOE criteria listed in Table 1. It has been identified through radiological assessment procedures by Oak Ridge Associated Universities and Nuclear Safety Associates, Inc.,[1,2] for the purpose of decontamination based on DOE's remedial action objectives. The Maywood site and vicinity properties, which include the residential properties in Lodi, were assigned by DOE to FUSRAP although the contamination at the Maywood site did not result from the Atomic Energy Program. A diagram of the Maywood site and vicinity properties is shown in Fig. 1.

During 1985, Bechtel National, Inc. (BNI), the project management contractor designated by DOE, performed remedial action on this residential property. This remedial action is on one of eight designated properties on Trudy Dr., Hancock St., and Avenues C and F in the Lodi area (Fig. 2). Based on drawings showing the extent of contamination, the property was excavated and the contaminated material transported to the Maywood Interim Storage Site (MISS), adjacent to the Stepan Company plant[3] (see Fig. 1). After removal of all contaminated soil, the property was restored to its original condition. By using a combination of procedures, the contamination was controlled and prevented from spreading to other areas. A post-remedial radiological survey was conducted by BNI to ensure compliance with DOE remedial action guidelines.[4]

The DOE adopted a policy to assign an independent verification contractor to ensure the effectiveness of remedial actions performed within FUSRAP. The Radiological Survey Activities Group of Oak Ridge National Laboratory (ORNL) has been assigned the responsibility for this task at the Maywood site. This report describes the methods and results of that verification.

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*The survey was performed by members of the Radiological Survey Activities Group of the Health and Safety Research Division at Oak Ridge National Laboratory under DOE contract DE-AC05-840R21400 with Martin Marietta Energy Systems, Inc.

From January to June, 1986, ORNL conducted the verification activity for the Maywood vicinity properties, including this location at 61 Trudy Drive, Lodi, located southwest of the Maywood site. A diagram of the property showing the approximate property boundaries and excavated areas is shown in Fig. 3. This location is one in a series of vicinity properties near the Maywood site that was suspected of being radioactively contaminated and that has been surveyed by BNI[3] to identify horizontal and vertical boundaries of radionuclide concentrations exceeding remedial action criteria. (Verification of these properties will be completed in 1986.) A contaminated area of ~60 m^2 that exceeded the guidelines was located in the side yard of the property and was excavated.

PROCEDURES

Objectives

The objective of the verification activities was to confirm (1) that available documentation adequately and accurately describes the post–remedial action radiological conditions of the entire property that is to be certified and (2) that the remedial action reduced contamination levels to within authorized limits.

Document Reviews

Review of the designation/characterization report[3] prepared by BNI indicates that the contaminated area was a shallow deposit of thorium-bearing residues (considered at the time to be nonhazardous organic mulch) that had been removed from the Maywood Chemical Works site and used as fill around the residence. Thus, it was appropriate to designate this property for remedial action.

The post–remedial action report[4] indicates that the area excavated on this property was as identified in the designation report. The post–remedial action survey was performed on this property as described for a generic site in Ref. 5. This survey consists of ground-level beta-gamma measurements, surface gamma measurements, and systematic soil sampling. From the review of the post–remedial action report, it can be concluded that the BNI survey procedure used for this property is satisfactory. All reported ^{238}U, ^{226}Ra, and ^{232}Th soil sample concentrations are below the average guideline limits set by DOE (Table 1).

VERIFICATION SURVEY AND ANALYSIS

Typical background radiation levels for the Maywood, New Jersey, area are presented in Table 2. The data are provided for purposes of comparison with the survey results presented in this section.

All measurements presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations in soil samples.

Gamma Measurements

Results of gamma measurements made by BNI are presented in the confirmatory report (Ref. 4). Gamma scans were conducted using a sodium iodide detector in a walk-over scan of the excavated area, and after all contamination was removed measurements were made with a lead-shielded detector at 10-ft intervals.[4]

One pressurized ionization chamber (PIC) reading was taken at this property by BNI. The results and the location of the reading are presented in the confirmatory report.

Gamma exposure rate measurements were made by ORNL at the ground surface and at 1 m above the surface. Gamma exposure rates ranged from 5 to 8 μR/h (microroentgens* per hour) and averaged 7 μR/h both at 1 m and at the surface.

Soil Sampling

Before backfilling, fifteen soil samples were taken by BNI in the excavated area. The procedures used for soil sample analysis have been described in Ref. 3. Locations of the soil samples are shown in Fig. 4.

The samples were analyzed by BNI to determine the concentrations of ^{238}U, ^{226}Ra, and ^{232}Th in the soil.[4] Concentrations of ^{238}U in the samples ranged from 1.2 to 2.9 pCi/g (picocuries† per gram) and averaged 2.0 pCi/g. Concentrations of ^{226}Ra ranged from 0.4 to 2.2 pCi/g and averaged 1.6 pCi/g. Concentrations of ^{232}Th in the soil samples ranged from 0.7 to 5.4 pCi/g and averaged 2.0 pCi/g. Results of the soil sample analysis are given in Table 3.

CONCLUSION

Measurements of the gamma exposure levels taken from the excavated area before backfilling determined that the exposure rate at 1 m above the ground surface ranged from 5 to 8 μR/h and averaged 7 μR/h. For comparison, the background for the state of New Jersey[7–9] averages ~8 μR/h and ranges from 6 to 11 μR/h based on 1968 measurements. The results of soil radionuclide analyses for ^{238}U, ^{226}Ra, and ^{232}Th show that all soil concentration measurements are within the limits prescribed by DOE radiological guidelines.[10]

Based upon the results of the post–remedial action data and confirmed by the verification survey data, these radiological measurements fall below the limits prescribed by DOE guidelines established for this site. It is concluded that the site successfully meets the DOE remedial action objectives.

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*The roentgen (R) is a unit which was defined for radiation protection purposes for people exposed to penetrating X rays or gamma radiation. A microroentgen (μR) is one millionth of a roentgen. A milliroentgen (mR) is one thousandth of a roentgen or one thousand microroentgens.

†The curie is a unit used to define the radioactivity in a substance and equals that quantity of any radioactive isotope undergoing 2.2×10^{12} disintegrations per minute. The picocurie is one million-millionth of a curie or that amount yielding 2.2 disintegrations per minute.

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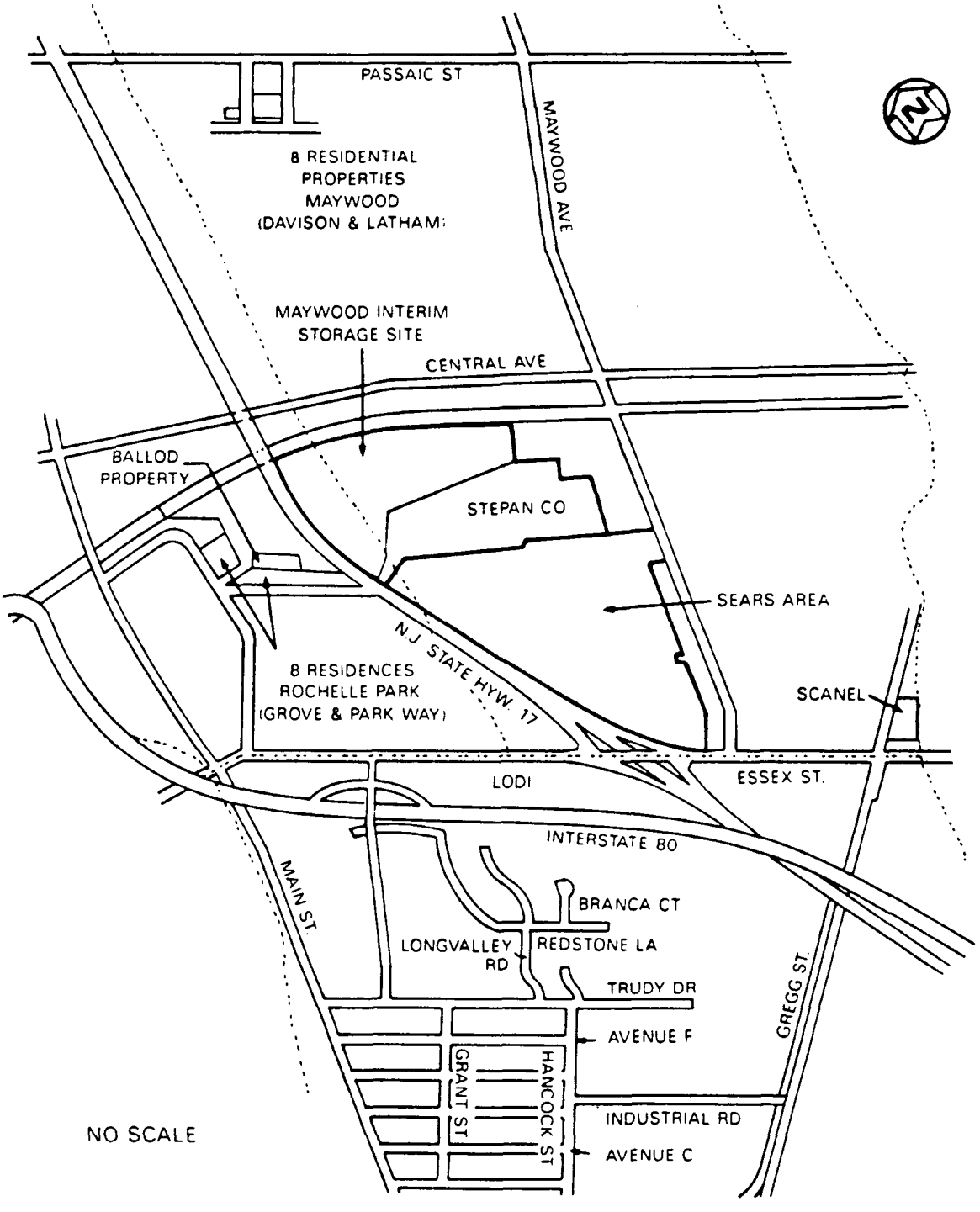

Fig. 1. Location of the Maywood site and vicinity properties in Rochelle Park, Maywood, and Lodi, New Jersey.

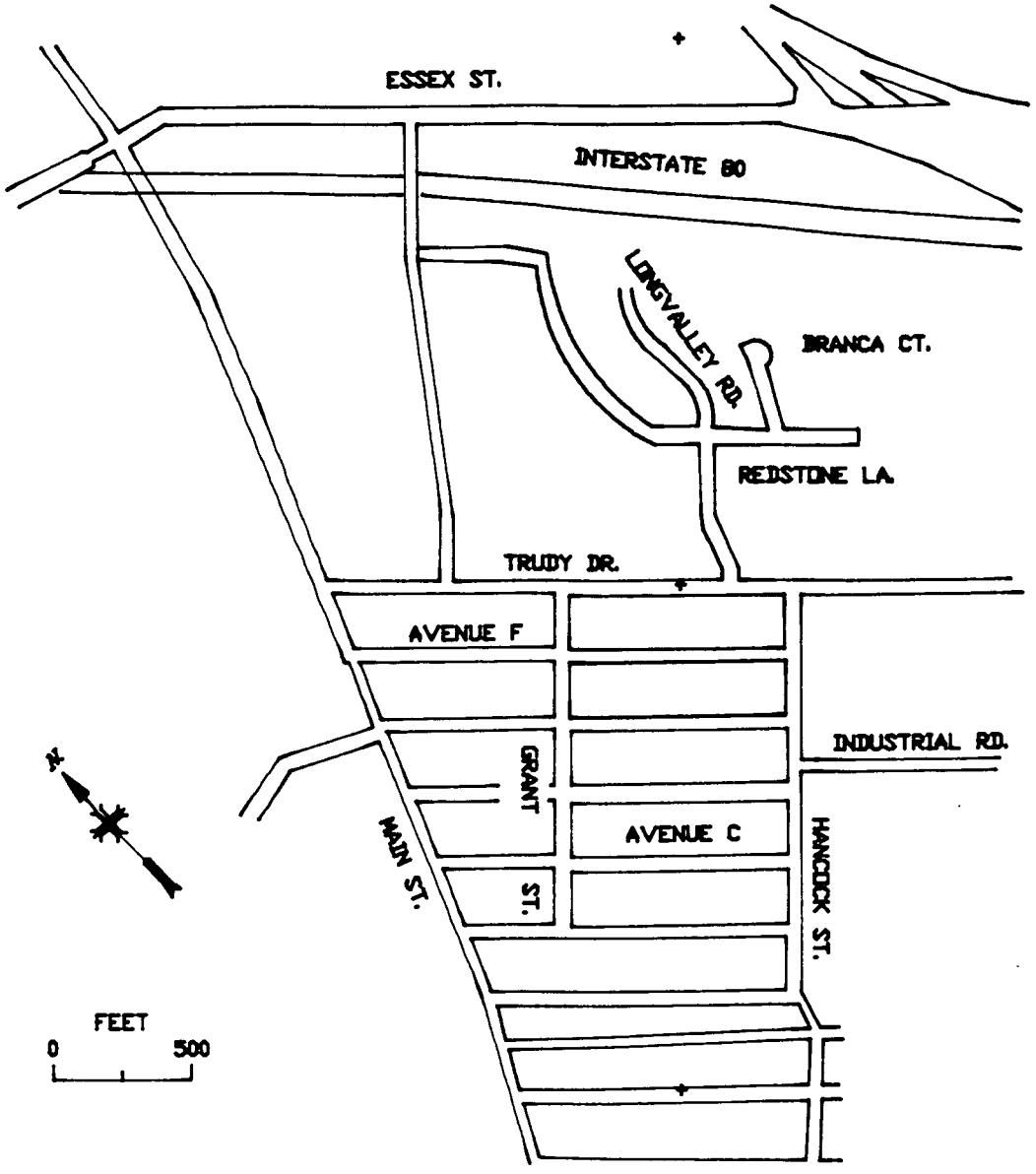

Fig. 2. Vicinity properties in the Lodi, New Jersey, area.

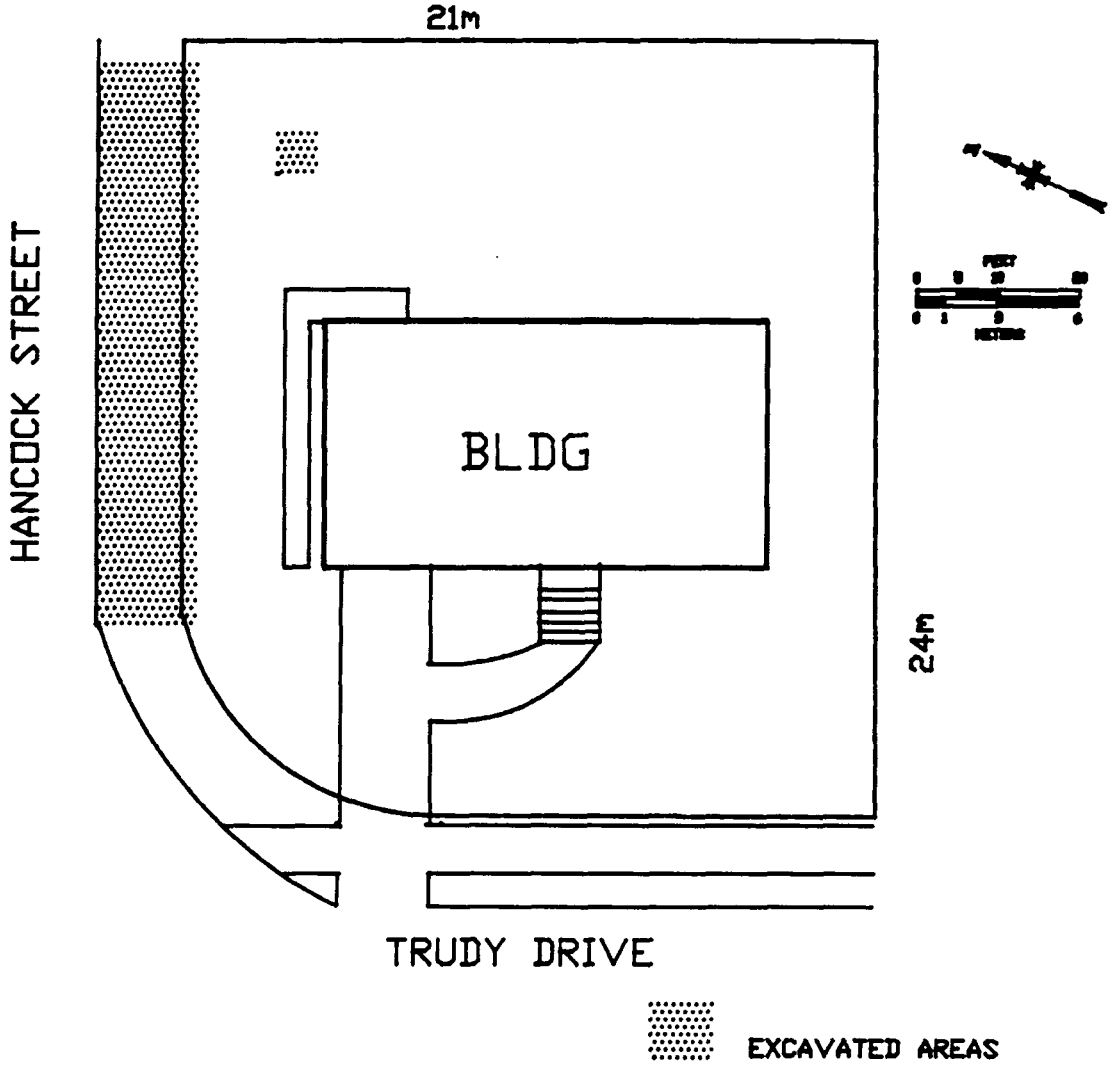

Fig. 3. Diagram showing excavated areas on the property at 61 Trudy Drive, Lodi, New Jersey (LN003V).

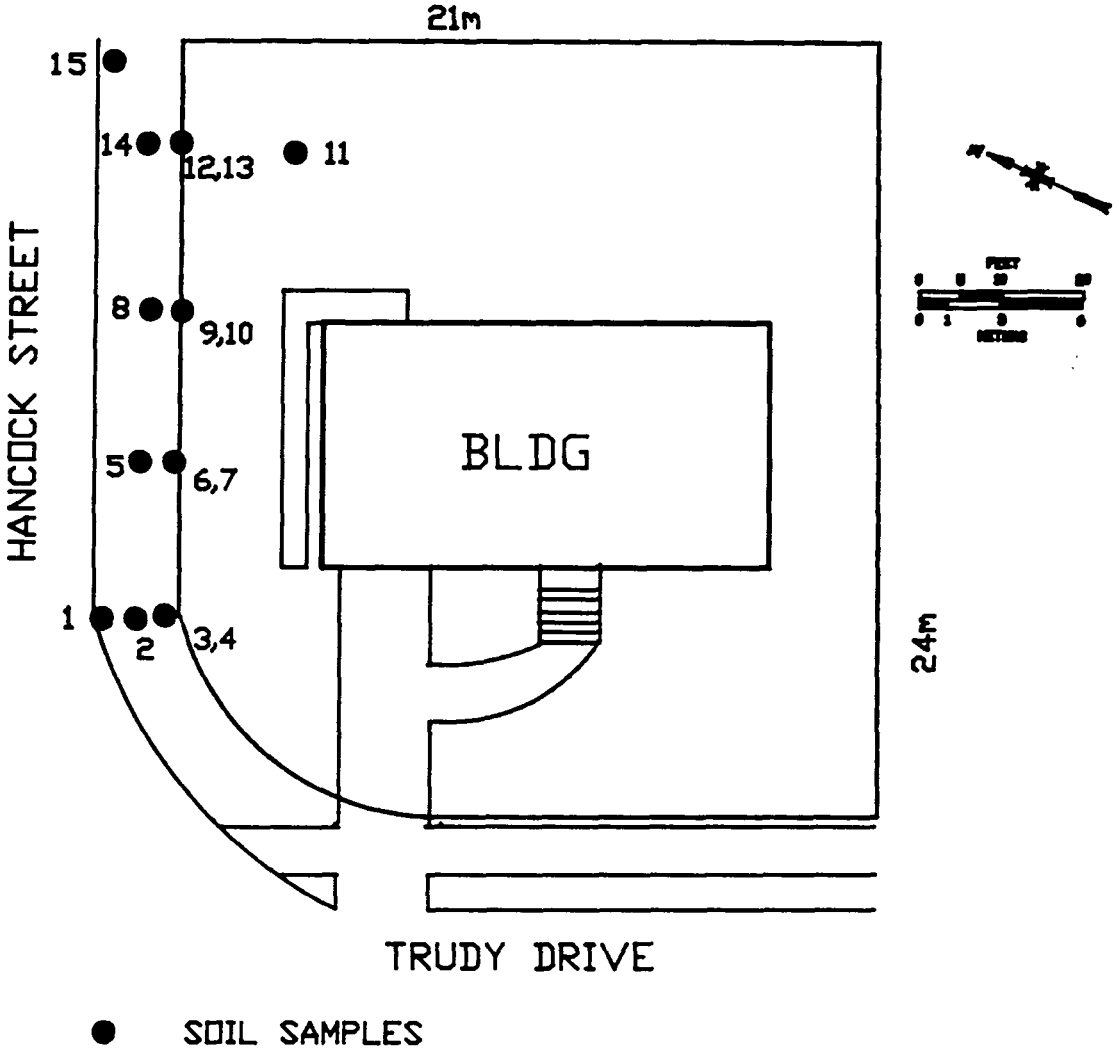

Fig. 4. Locations of soil samples on the property at 61 Trudy Drive, Lodi, New Jersey (LN003V).

Table 1. Summary of residual contamination guidelines for the Maywood, New Jersey, site

Soil (Land) Guidelines (Maximum Limits for Unrestricted Use)

Radionuclide	Soil concentration (pCi/g) above background[a,b]
^{226}Ra ^{228}Ra ^{230}Th ^{232}Th	5 pCi/g, averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over any 15-cm-thick soil layer below the surface layer
Other radionuclides	Soil guidelines will be calculated on a site-specific basis using the DOE manual developed for this use

Structure Guidelines (Maximum Limits for Unrestricted Use)

Indoor Radon Decay Products

For ^{222}Ra and ^{220}Rn concentrations in buildings, the average annual radon decay product concentration (including background) due to uranium or thorium by-products should not exceed 0.02 WL after remedial action. When remedial action has been performed and it would be unreasonably difficult and costly to reduce the level below 0.03 WL, the remedial action may be terminated, and the reasons for termination should be documented. Remedial action shall be undertaken for any building that exceeds an annual average radon decay product concentration (including background) of 0.03 WL.

Indoor Gamma Radiation

The indoor gamma radiation after decontamination shall not exceed 20 microroentgen per hour (20 μR/h) above background in any occupied or habitable building.

Indoor/Outdoor Structure Surface Contamination

Radionuclide[d]	Allowable Surface Residual Contamination[c] (dpm/100 cm^2)		
	Average[e,f]	Maximum[f,g]	Removable[f]
Transuranics, ^{226}Ra, ^{228}Ru, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100	300	20
Natural Th, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	1,000	3,000	200
Natural U, ^{235}U, ^{238}U, and associated decay products	5,000	15,000	1,000

Table 1 (continued)

Indoor/Outdoor Structure Surface Contamination

Radionuclide[d]	Allowable Surface Residual Contamination[c] (dpm/100 cm^2)		
	Average[e,f]	Maximum[f,g]	Removable[f]
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and others noted above	5,000	15,000	1,000

[a]In the event of occurrence of mixtures of radionuclides, the fraction contributed by each radionuclide to its limit shall be determined, and the sum of these fractions shall not exceed 1.

[b]These guidelines represent unrestricted-use residual concentrations above background averaged across any 15-cm-thick layer to any depth and over any contiguous 100-m^2 surface area.

[c]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[d]Where surface contamination by both alpha- and beta-gamma–emitting radionuclides exists, the limits established for alpha- and beta-gamma–emitting radionuclides shall apply independently.

[e]Measurements of average contaminant should not be averaged over more than 1 m^2. For objects of less surface area, the average shall be derived for each such object.

[f]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h at 1 cm and 1.0 mrad/h at 1 cm, respectively, measured through not more than 7 mg/cm^2 of total absorber.

[g]The maximum contamination level applies to an area of not more than 100 cm^2.

Table 2. Background radiation levels in the Maywood, New Jersey, area

Type of radiation measurement or sample	Radiation level or radionuclide concentration	
	Range	Average
Gamma exposure rate at 1 m above floor or ground surface (μR/h)[a]	8–11	9
Concentration of radionuclides in soil (pCi/g)[b]		
^{238}U	0.13–1.4	0.86
^{226}Ra	0.24–1.4	0.87
^{232}Th	0.31–1.5	0.9

[a]Values obtained from 35 locations in the Rochelle Park area.[8]

[b]Soil samples obtained from locations around the Maywood area.[6]

Table 3. Results of soil sample analysis at 61 Trudy Drive, Lodi, New Jersey (LN003V)

Sample[a]	Depth (cm)	Radionuclide concentration (pCi/g ± 1 sigma)		
		^{226}Ra	^{232}Th	^{238}U
01	165–180	1.8	1.8	2.5
02	165–180	1.6	1.9	2.6
03	165–180	1.3	3.5	1.2
04	195–210	1.8	1.5	1.9
05	165–180	1.7	1.6	2.1
06	165–180	2.0	1.8	2.0
07	195–210	1.7	1.7	2.9
08	165–180	1.7	1.6	1.6
09	165–180	1.8	1.5	1.5
10	195–210	1.7	1.6	2.1
11	45–60	0.4	0.7	1.5
12	165–180	2.2	1.7	1.8
13	195–210	1.5	5.4	1.4
14	165–180	1.8	2.7	2.6
15	165–180	1.8	1.3	2.4

[a]Locations of soil samples are shown on Fig. 4.

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