063982-13

DOE/OR/20722-157

MO76

Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-81OR20722

RADIOLOGICAL CHARACTERIZATION REPORT FOR THE DeSAUSSURE PROPERTY

Maywood, New Jersey

September 1989

Bechtel National, Inc.

9489-0820.27

063982

Bechtel National, Inc.
Systems Engineers — Constructors

Jackson Plaza Tower
800 Oak Ridge Turnpike
Oak Ridge, Tennessee 37830

Mail Address: P.O. Box 350, Oak Ridge, TN 37831-0350
Telex: 3785873

SEP 29 1989

U.S. Department of Energy
Oak Ridge Operations
Post Office Box 2001
Oak Ridge, Tennessee 37831-8723

Attention: Robert G. Atkin
Technical Services Division

Subject: Bechtel Job No. 14501, FUSRAP Project
DOE Contract No. DE-AC05-81OR20722
Publication of Radiological Characterization Report
for seventeen residential properties, four municipa
properties, and seven commercial properties in
Lodi and Maywood, New Jersey
Code: 7315/WBS: 138

Dear Mr. Atkin:

Enclosed is one copy each of the 28 subject published reports for the properties listed in Attachment 1. These reports incorporate all comments received in this review cycle (CCNs 063165, 063327, 062285, and 061568) and are being published wit approval of Steve Oldham, as reported in CCN 063868.

Also enclosed (as Attachment 2) is a proposed distribution list for these reports. Please send us any changes to the proposed distribution list at your earliest convenience so we may distribute the reports.

BNI would like to express our thanks to Mr. Oldham for his cooperation and efforts to review these drafts in an accelerate manner. His efforts have allowed us to publish these reports o schedule. If you have any questions about these documents, please call me at 576-4718.

Very truly yours,

R C Robertson

R. C. Robertson
Project Manager - FUSRAP

RCR:wfs:1756x
Enclosure: As stated

cc: J. D. Berger, ORAU (w/e)
N. J. Beskid, ANL (w/e)

CONCURRENCE

095	ytt-			

DOE/OR/20722-157

RADIOLOGICAL CHARACTERIZATION REPORT FOR THE DeSAUSSURE PROPERTY MAYWOOD, NEW JERSEY

SEPTEMBER 1989

Prepared for

UNITED STATES DEPARTMENT OF ENERGY

OAK RIDGE OPERATIONS OFFICE

Under Contract No. DE-AC05-81OR20722

By

N. C. Ring, D. J. Whiting, and W. F. Stanley

Bechtel National, Inc.

Oak Ridge, Tennessee

Bechtel Job No. 14501

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

cm	centimeter
cm^2	square centimeter
cpm	counts per minute
dpm	disintegrations per minute
ft	foot
h	hour
in.	inch
km^2	square kilometer
L	liter
L/min	liters per minute
m	meter
m^2	square meter
MeV	million electron volts
μR/h	microroentgens per hour
mi	mile
mi^2	square mile
min	minute
mrad/h	millirad per hour
mrem	millirem
mrem/yr	millirem per year
pCi/g	picocuries per gram
pCi/L	picocuries per liter
WL	working level
yd	yard
yd^3	cubic yard

1.0 INTRODUCTION AND SUMMARY

This section provides a brief description of the history and background of the Maywood site and its vicinity properties. Data obtained from the radiological characterization of this vicinity property are also presented.

1.1 INTRODUCTION

The 1984 Energy and Water Appropriations Act authorized the U.S. Department of Energy (DOE) to conduct a decontamination research and development project at four sites, including the site of the former Maywood Chemical Works (now owned by the Stepan Company) and its vicinity properties. The work is being administered under the Formerly Utilized Sites Remedial Action Program (FUSRAP) under the direction of the DOE Division of Facility and Site Decommissioning Projects. Several residential, commercial, and municipal properties in Maywood, New Jersey, are included in FUSRAP as vicinity properties. Figure 1-1 shows the location of the Maywood vicinity properties in relation to the former Maywood Chemical Works.

The U.S. Government initiated FUSRAP in 1974 to identify, clean up, or otherwise control sites where low-activity radioactive contamination (exceeding current guidelines) remains from the early years of the nation's atomic energy program or from commercial operations that resulted in conditions Congress has mandated that DOE remedy (Ref. 1).

FUSRAP is currently being managed by DOE Oak Ridge Operations. As the Project Management Contractor for FUSRAP, Bechtel National, Inc. (BNI) is responsible to DOE for planning, managing, and implementing FUSRAP.

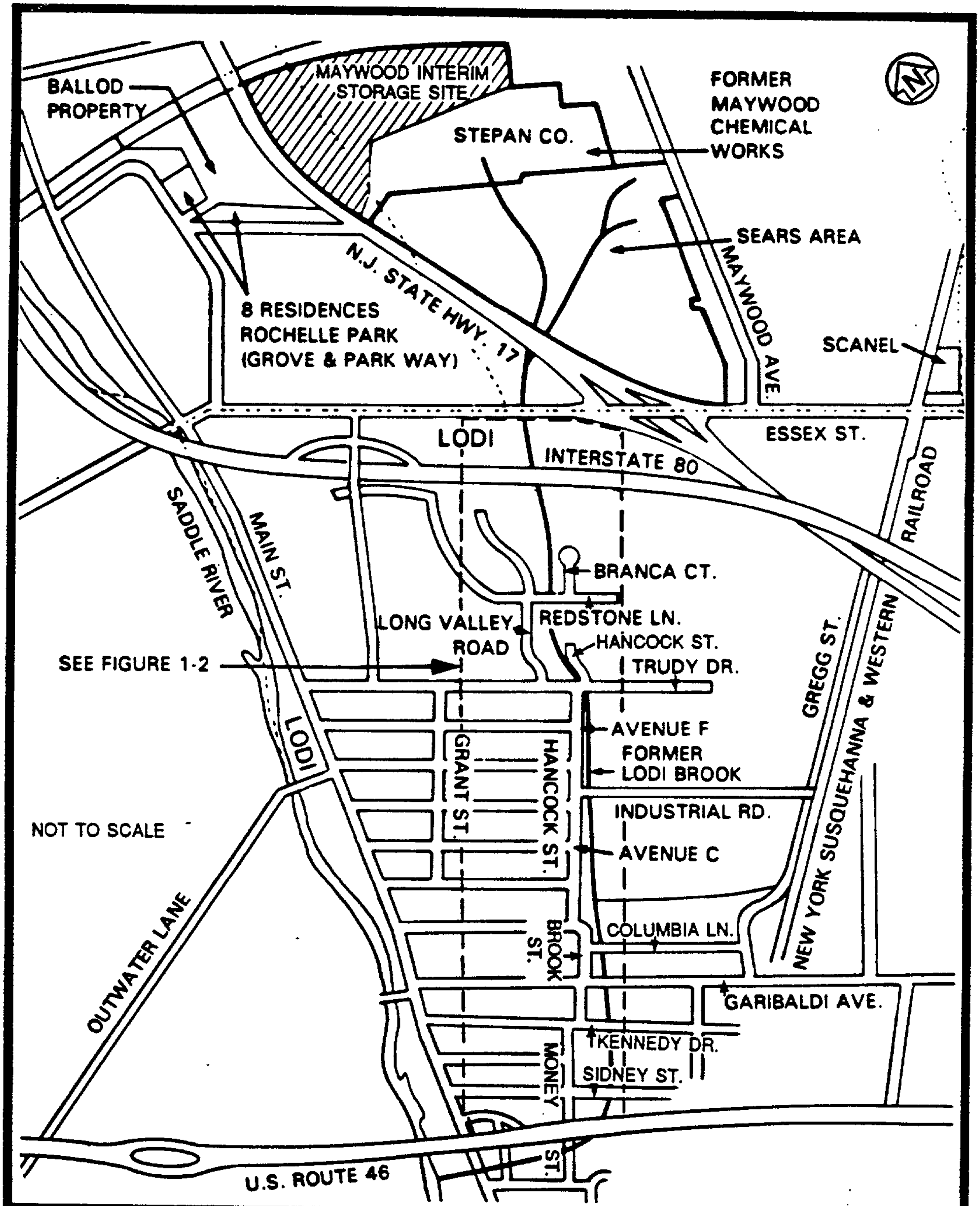

FIGURE 1-1 LOCATION OF LODI VICINITY PROPERTIES

1.2 PURPOSE

The purpose of the 1986 survey performed by BNI was to locate the horizontal and vertical boundaries of radionuclide concentrations exceeding remedial action guidelines.

1.3 SUMMARY

This report details the procedures and results of the radiological characterization of the DeSaussure property (Figure 1-2) in Maywood, New Jersey, which was conducted in June and September 1986. Additional data on this property were obtained in February 1987. Surface soil samples were collected from a drainage ditch located on the Borough of Maywood's right-of-way adjacent to the property in February 1988.

Ultimately, the data generated during the radiological characterization will be used to define the complete scope of remedial action necessary to release the site.

The DeSaussure property is a commercial property situated in a densely populated residential area. Other commercial properties are located adjacent to the property or in close proximity. The property consists of a one-story brick and concrete block building with loading docks. The building is bordered on three sides by grassy areas and on one side by an asphalt-paved parking/loading area. The primary use of the property is for furniture manufacturing.

This characterization confirmed that thorium-232 is the primary radioactive contaminant at this property. Results of surface soil samples collected from the drainage ditch adjacent to the DeSaussure property showed maximum concentrations of thorium-232 and radium-226 to be

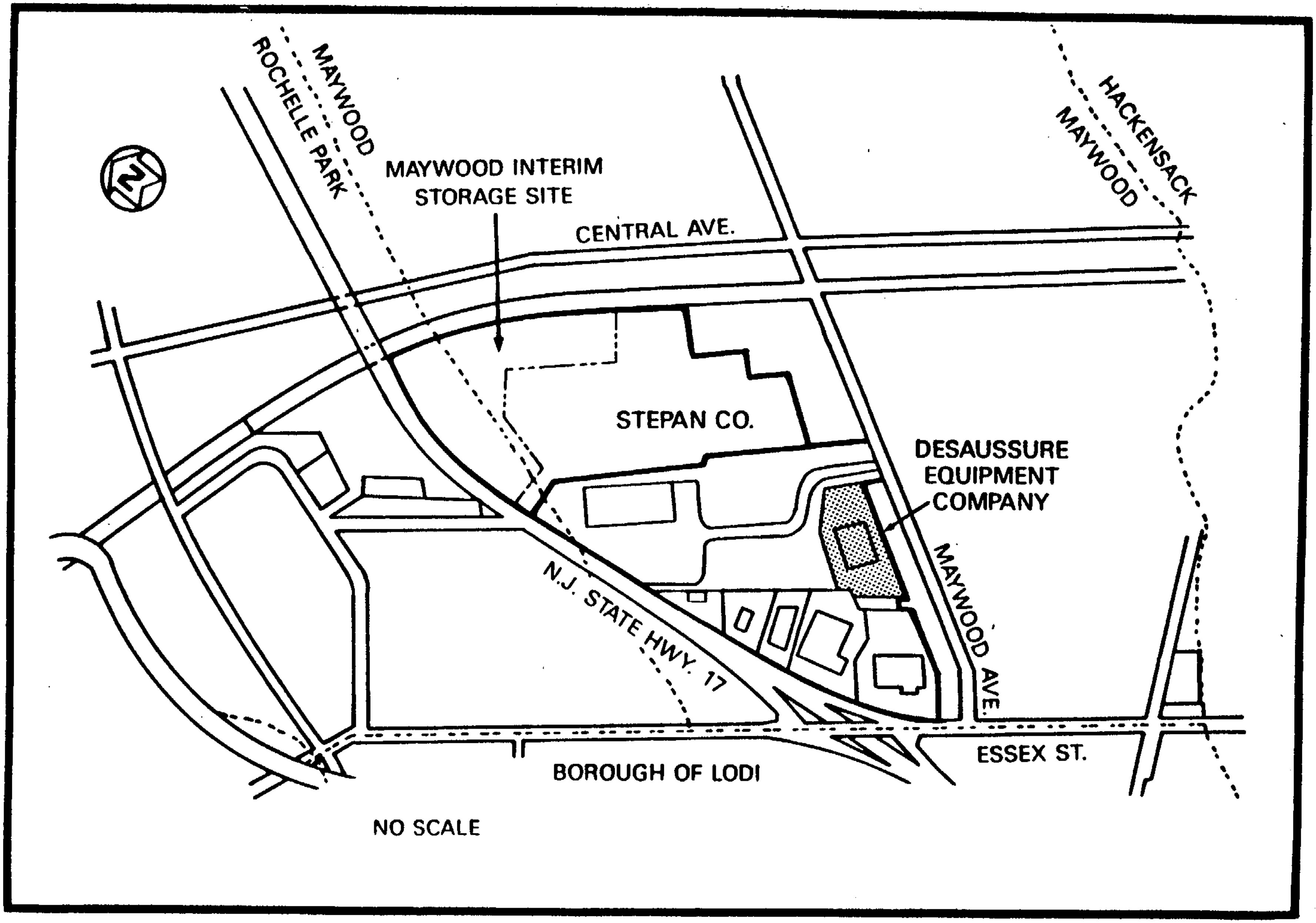

FIGURE 1-2 LOCATION OF THE DESAUSSURE PROPERTY

124.3 and 12.9 pCi/g, respectively. The maximum concentration of uranium-238 in surface soil samples was 80.2 pCi/g.

Subsurface soil sample concentrations ranged from 0.9 to 2.2 pCi/g for thorium-232 and from 0.4 to 1.9 pCi/g for radium-226. The average background level in this area for both radium-226 and thorium-232 is 1.0 pCi/g. The concentrations of uranium-238 in subsurface soil samples were all less than 5.0 pCi/g. Because the major contaminants at the vicinity properties are thorium and radium, the decontamination guidelines provide the appropriate guidance for the cleanup activities. DOE believes that these guidelines are conservative for considering potential adverse health effects that might occur in the future from any residual contamination. The dose contributions from uranium and any other radionuclides not numerically specified in these guidelines are not expected to be significant following decontamination. In addition, the vicinity properties will be decontaminated in a manner so as to reduce future doses to levels that are as low as reasonably achievable (ALARA) (Ref. 2).

Soil analysis data for this property did not indicate surface contamination on the property. However, near-surface measurements indicated the potential for surface contamination along the north and west property boundaries, adjacent to the west side and a portion of the north side of the building, and an isolated area near the east property boundary. Soil analysis of surface soil samples along the drainage ditch adjacent to the southwest corner of the property indicated surface contamination in that area. Subsurface investigation by gamma logging indicated contamination to a depth of 1.83 m (6.0 ft).

Exterior gamma radiation exposure rates ranged from 10 to 146 μR/h, including background. The indoor measurements ranged from 8 to 13 μR/h, including background.

The radon-222 measurements inside the building indicated concentrations of less than 0.3 and 0.5 pCi/L, respectively, which are within the DOE guideline of 3.0 pCi/L.

Measurements for radon progeny (radon and thoron daughters) were not obtained because indoor radon measurements were within the typical background range.

All data tables for this property appear at the end of this report.

1.4 CONCLUSIONS

Evaluation of data collected, analyses performed, and historical documentation reviewed indicates the presence of radiological contamination on the DeSaussure property. There is both surface and subsurface contamination. Subsurface contamination ranges from a depth of 15.2 cm (6.0 in.) to 1.83 m (6.0 ft). The largest area of subsurface contamination is adjacent to the west side of the building, extending beyond the northwest corner and wrapping around that corner to just beyond the midpoint of the north side of the building. The contamination appears to extend along nearly the entire west property boundary and outward from the north side of the building approximately 30.5 m (100 ft). Because of the presence of subsurface contamination adjacent to the building, additional boreholes were attempted inside the building to determine the presence of contamination beneath the building. These attempts were unsuccessful because of the drill reaching refusal at depths of 0.60 m (2.0 ft) to 1.52 m (5.0 ft). Refusal is believed to have resulted from concrete pads buried beneath the western third of the building. Historical information obtained from aerial photographs of the property prior to its development indicate that concrete evaporating ponds were present in this location on the property. The recent addition to the building is in the area above these buried ponds; therefore, their presence offers the most logical explanation for refusal during drilling attempts. Fill material between the building floor/slab and the underlying concrete was not found to be radiologically contaminated. It could not be determined if disturbed soil or fill material beneath the buried concrete pads is contaminated because of drill refusal. There is a high probability that subsurface contamination extends beneath the building and the buried concrete pads in this location.

The presence of subsurface contamination was also indicated along the north property boundary extending westward from the east property boundary to within approximately 4.6 m (15 ft) of the west boundary. This area of the property is forested and adjoins a grassy lawn area that surrounds the immediate foundation of the DeSaussure building on three sides (the south side of the building is adjacent to an asphalt parking/loading area). The total affected area is estimated to be approximately 35 percent of the property. These conclusions are supported by documentation that establishes the presence of the former channel of Lodi Brook in this area. This channel is the suspected transport mechanism for the radiological contamination.

2.0 SITE HISTORY

The Maywood Chemical Works was founded in 1895. The company began processing thorium from monazite sand in 1916 (during World War I) for use in manufacturing gas mantles for various lighting devices. Process wastes from manufacturing operations were pumped to two areas surrounded by earthen dikes on property west of the plant. Subsequently, some of the contaminated wastes migrated onto adjacent and vicinity properties.

In 1928 and again between 1944 and 1946, some of the residues from the processing operations were moved from the company's property and used as mulch and fill in nearby low-lying areas. The fill material consisted of tea and coca leaves mixed with other material resulting from operations at the plant. Some fill material apparently contained thorium process wastes (Ref. 3).

Uncertainty exists as to how the properties in Lodi were contaminated. According to an area resident, fill from an unknown source was brought to Lodi and spread over large portions of the previously low-lying and swampy area. For several reasons, however, a more plausible explanation is that the contamination migrated along a drainage ditch originating on the Maywood Chemical Works property. First, it can be seen from photographs and tax maps of the area that the course of a previously existing stream known as Lodi Brook, which originated at the former Maywood Chemical Works, generally coincides with the path of contamination in Lodi. The brook was subsequently replaced by a storm drain system as the area was developed. Second, samples taken from Lodi properties indicate elevated concentrations of a series of elements known as rare earths. Rare earth elements are typically found in monazite sands, which also contain thorium. This type of sand was feedstock at the Maywood Chemical Works, and elevated levels are known to exist in the by-product of the extraction process. Third, the ratio of thorium to other radionuclides found on these Lodi properties is comparable to the ratio found in contaminated material on other properties in Lodi (Ref. 4). And finally, long-time residents of Lodi recalled chemical odors in and around the brook in Lodi and steam rising off the water. These observations suggest that discharges of contaminants occurred upstream.

The Stepan Chemical Company (now called the Stepan Company) purchased Maywood Chemical Works in 1959. The Stepan Company itself has never been involved in the manufacture or processing of any radioactive materials (Ref. 5).

On the basis of geological information gained as a result of borehole drilling during this characterization, it was determined that the property is relatively flat [total measured relief of 0.82 m (2.7 ft)] and is underlain by fill, two types of soil, and Brunswick sandstone. A brown residual soil is developed on top of red, competent Brunswick sandstone throughout most of the property. A black organic-rich cumulose soil is promoted by the saturated conditions in the drainage areas of the southern section of the property. A heavily overgrown, open drainage ditch in this area transports runoff westward from the south end of the property. This ditch lies on the Borough of Maywood right-of-way. West of the property, the drainage ditch is truncated by a buried drainage system that contains the present-day channel of Lodi Brook.

Fill material on the property is both indigenous and industrial. The indigenous fill is composed of disturbed or transported residual soil; most of the fill material used on the property is of this type. The industrial fill consists mostly of white sand, clay tailings, and animal hides produced by the former Maywood Chemical Works. However, these materials suggest that this industrial waste was not the by-product of processing thorium-rich monazite sand. Another type of artificial fill found on the property is concrete.

2.1 PREVIOUS RADIOLOGICAL SURVEYS

Numerous surveys of the Maywood site and its vicinity properties have been conducted. Among the past surveys, three that are pertinent to this vicinity property are detailed in this section.

January 1981--The Nuclear Regulatory Commission directed that a survey be conducted of the Stepan Company property and its vicinity properties in January 1981. Using the Stepan Company plant as the center, a 10.3-km^2 (4-mi^2) aerial survey was conducted by the EG&G Energy Measurements Group, which identified anomalous concentrations of thorium-232 to the north and south of the Stepan Company property. The Lodi vicinity properties were included in this survey (Ref. 6).

July 1983--NUS Corporation conducted a radiological survey of the Scanel and Sears properties from July 18 to August 9, 1983. This survey included several properties adjacent to the Sears property that are referred to as the Sears vicinity properties. The survey indicated areas requiring further investigation (Ref. 7).

2.2 REMEDIAL ACTION GUIDELINES

Table 2-1 summarizes the DOE guidelines for residual contamination. The thorium-232 and radium-226 limits listed in Table 2-1 will be used to determine the extent of remedial action required at the vicinity properties. DOE developed these guidelines to be consistent with the guidelines established by the U.S. Environmental Protection Agency (EPA) for the Uranium Mill Tailings Remedial Action Program.

TABLE 2-1
SUMMARY OF RESIDUAL CONTAMINATION GUIDELINES

BASIC DOSE LIMITS

The basic limit for the annual radiation dose received by an individual member of the general public is 100 mrem/yr.

SOIL GUIDELINES

Radionuclide	Soil Concentration (pCi/g) Above Background[a,b,c]
Radium-226 Radium-228 Thorium-230 Thorium-232	5 pCi/g when 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

Airborne Radon Decay Products

Generic guidelines for concentrations of airborne radon decay products shall apply to existing occupied or habitable structures on private property that has no radiological restrictions on its use; structures that will be demolished or buried are excluded. The applicable generic guideline (40 CFR 192) is: In any occupied or habitable building, the objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL[d]. In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL. Remedial actions are not required in order to comply with this guideline when there is reasonable assurance that residual radioactive materials are not the cause.

External Gamma Radiation

The average level of gamma radiation inside a building or habitable structure on a site that has no radiological restrictions on its use shall not exceed the background level by more than 20 μR/h.

Indoor/Outdoor Structure Surface Contamination

Radionuclide[f]	Allowable Surface Residual Contamination[e] (dpm/100 cm²) Average[g,h]	Maximum[h,i]	Removable[h,j]
Transuranics, Ra-226, Ra-228, Th-230, Th-228 Pa-231, Ac-227, I-125, I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224 U-232, I-126, I-131, I-133	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay products	5,000 α	15,000 α	1,000 α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000 β - γ	15,000 β - γ	1,000 β - γ

TABLE 2-1 (CONTINUED)

[a]These guidelines take into account ingrowth of radium-226 from thorium-230 and of radium-228 from thorium-232, and assume secular equilibrium. If either thorium-230 and radium-226 or thorium-232 and radium-228 are both present, not in secular equilibrium, the guidelines apply to the higher concentration. If other mixtures of radionuclides occur, the concentrations of individual radionuclides shall be reduced so that 1) the dose for the mixtures will not exceed the basic dose limit, or 2) the sum of ratios of the soil concentration of each radionuclide to the allowable limit for that radionuclide will not exceed 1 ("unity").

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

[c]Localized concentrations in excess of these limits are allowable, provided that the average concentration over a 100-m^2 area does not exceed these limits. In addition, every reasonable effort shall be made to remove any source of radionuclide that exceeds 30 times the appropriate soil limit, regardless of the average concentration in the soil.

[d]A working level (WL) is any combination of short-lived radon decay products in 1 liter of air that will result in the ultimate emission of 1.3 x 105 MeV of potential alpha energy.

[e]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.

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

[g]Measurements of average contamination 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.

[h]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.

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

[j]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. The numbers in this column are maximum amounts.

3.0 HEALTH AND SAFETY PLAN

BNI is responsible for protecting the health of personnel assigned to work at the site. As such, all subcontractors and their personnel were required to comply with the provisions of BNI health and safety requirements and as directed by the on-site BNI Health and Safety Officer.

3.1 SUBCONTRACTOR TRAINING

Before the start of work, all subcontractor personnel attended an orientation session presented by the BNI Health and Safety Officer to explain the nature of the material to be encountered in the work and the personnel monitoring and safety measures that are required.

3.2 SAFETY REQUIREMENTS

Subcontractor personnel complied with the following BNI requirements:

- Bioassay--Subcontractor personnel submitted bioassay samples before or at the beginning of on-site activity, upon completion of the activity, and periodically during site activities as requested by BNI.
- Protective Clothing/Equipment--Subcontractor personnel were required to wear the protective clothing/equipment specified in the subcontract or as directed by the BNI Health and Safety Officer.
- Dosimetry--Subcontractor personnel were required to wear and return daily the dosimeters and monitors issued by BNI.
- Controlled Area Access/Egress--Subcontractor personnel and equipment entering areas where access and egress were controlled for radiation and/or chemical safety purposes were surveyed by the BNI

Health and Safety Officer (or personnel representing BNI) for contamination before leaving those areas.

- Medical Surveillance--Upon written direction from BNI, subcontractor personnel who work in areas where hazardous chemicals might exist were given a baseline and periodic health assessment defined in BNI's Medical Surveillance Program.

Radiation and/or chemical safety surveillance of all activities related to the scope of work was under the direct supervision of personnel representing BNI.

Health and safety-related requirements for all activities involving exposure to radiation, radioactive material, chemicals, and/or chemically contaminated materials and other associated industrial safety hazards are generated in compliance with applicable regulatory requirements and industry-wide standards. Copies of these requirements are located at the BNI project office for use by project personnel.

4.0 CHARACTERIZATION PROCEDURES

A master grid was established by the surveyor. BNI's radiological support subcontractor, Thermo Analytical/Eberline (TMA/E), established a grid on individual properties. The size of the grid blocks was adjusted to characterize each property adequately. The grid origin allows the grid to be reestablished during remedial action and is correlated with the New Jersey state grid system. All data correspond to coordinates on the characterization grid. The grid with the east and north coordinates is shown on all figures included in Sections 4.0 and 5.0 of this report.

4.1 FIELD RADIOLOGICAL CHARACTERIZATION

This section provides a description of the instrumentation and methodologies used to obtain exterior surface and subsurface measurements during radiological characterization of this property.

4.1.1 Measurements Taken and Methods Used

An initial walkover survey was performed using an unshielded gamma scintillation detector [5.0- by 5.0-cm (2- by 2-in.) thallium-activated sodium iodide probe] to identify areas of elevated radionuclide activity. Near-surface gamma measurements taken using a cone-shielded gamma scintillation detector were also used to determine areas of surface contamination. The shielded detector ensured that the majority of the radiation detected by the instrument originated from the ground directly beneath the unit. Shielding against lateral gamma flux, or shine, from nearby areas of contamination minimized potential sources of error in the measurements. The measurements were taken 30.4 cm (12 in.) above the ground at the intersections of

3.0-m (10-ft) grid lines. The shielded detector was calibrated at the Technical Measurements Center (TMC) in Grand Junction, Colorado, to provide a correlation of counts per minute (cpm) to picocuries per gram (pCi/g). This calibration demonstrated that approximately 11,000 cpm corresponds to the DOE guideline of 5 pCi/g plus local average background of 1 pCi/g for thorium-232 in surface soils (Ref. 8).

A subsurface investigation was conducted to determine the depth to which the previously identified surface contamination extended and to locate subsurface contamination where there was no surface manifestation. The subsurface characterization consisted of drilling 24 boreholes (Figure 4-1), using either a 7.6-cm- (3-in.-) or 15.2-cm- (6-in.-) diameter auger bit, and gamma logging them. The boreholes were drilled to depths determined in the field by the radiological and geological support representatives.

The downhole gamma logging technique was used because the procedure can be accomplished in less time than collecting soil samples, and the need for analyzing these samples in a laboratory is eliminated. A 5.0- by 5.0-cm (2- by 2-in.) sodium iodide gamma scintillation detector was used to perform the downhole logging. The instrument was calibrated at TMC where it was determined that a count rate of approximately 40,000 cpm corresponds to the 15-pCi/g subsurface contamination guideline for thorium-232. This relationship has also been corroborated by results from previous characterizations where thorium-232 was found (Ref. 8).

Gamma radiation measurements were taken at 15.2-cm (6-in.) vertical intervals to determine the depth and concentration

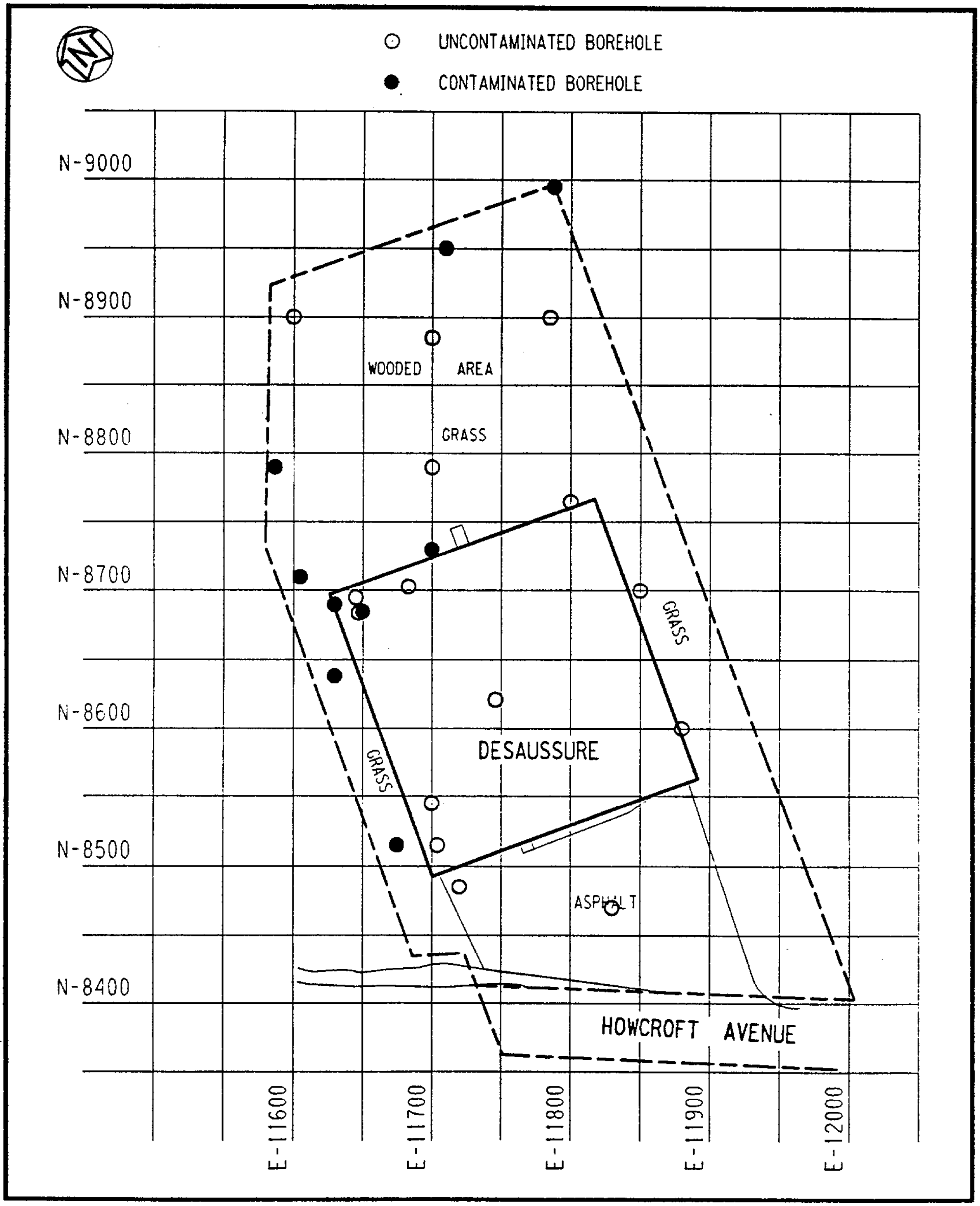

FIGURE 4-1 BOREHOLE LOCATIONS AT DESAUSSURE

M38W9804.DGN

of the contamination. The gamma-logging data were reviewed to identify trends, whether or not concentrations exceeded the guidelines.

4.1.2 Sample Collection and Analysis

To identify surface areas where the level of contamination exceeded the DOE guideline of 5 pCi/g for thorium-232, areas with measurements of more than 11,000 cpm were plotted. Using these data as well as data from previous surveys (Refs. 5, 6, and 7), the locations of biased surface soil samples were selected to better define the limits of contamination. Surface soil samples were taken at six locations (Figure 4-2) and analyzed for thorium-232, uranium-238, and radium-226. Each sample was dried, pulverized, and counted for 10 min using an intrinsic germanium detector housed in a lead counting cave lined with cadmium and copper. The pulse height distribution was sorted using a computer-based, multichannel analyzer. Radionuclide concentrations were determined by comparing the gamma spectrum of each sample with the spectrum of a certified counting standard for the radionuclide of interest.

Subsurface soil samples were collected from two locations (Figure 4-2) using the side-wall sampling method and were analyzed to compare laboratory soil sample results to downhole gamma radiation measurements. A cup or can attached to a steel pipe or wooden stake was inserted into the borehole and used to scrape samples off the side of the borehole at a specified depth. The subsurface soil samples were analyzed for radium-226, uranium-238, and thorium-232 in the same manner as the surface soil samples.

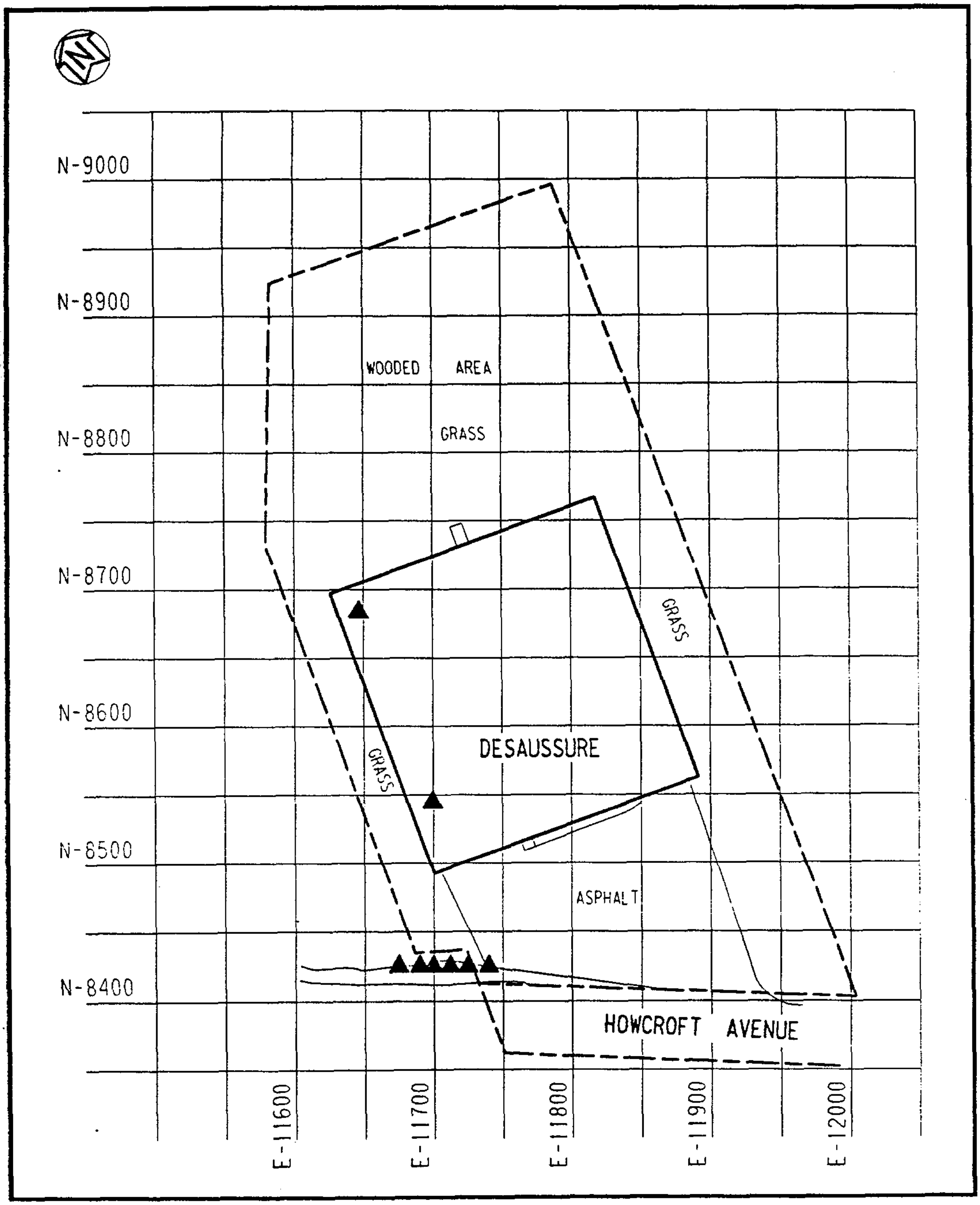

FIGURE 4-2 SURFACE AND SUBSURFACE SOIL SAMPLING LOCATIONS AT DESAUSSURE

M38W9804.DGN

4.2 BUILDING RADIOLOGICAL CHARACTERIZATION

After evaluating previous radiological survey data as well as data from this characterization, it was suspected that contamination might be present under the foundation of the building. A radon measurement was obtained to verify the presence of contaminated material under the building and to estimate potential occupational exposures during future remedial actions.

Indoor radon measurements were made using the Tedlar bag method. Samples were collected by pumping air into a Tedlar bag at a rate of approximately 2 L/min. The air sample was transferred directly into a scintillation cell with an interior coating of zinc sulfide and an end window for viewing the scintillations. Analysis of the sample was simplified by allowing the radon decay products to build up over time. This method allowed all the radon decay products to come into secular equilibrium with the radon. The scintillation cell was placed in contact with a photomultiplier tube, and the scintillations were counted using standard nuclear counting instrumentation.

Measurements for radon progeny (radon and thoron daughters) were not obtained because the indoor radon measurements were within typical background range.

Exterior gamma exposure rate measurements were made at five locations throughout the property grid system and at five location inside the building. To obtain these measurements, either a 5.0- by 5.0-cm (2- by 2-in.) thallium-activated sodium iodide gamma scintillation detector designed to detect gamma radiation only or a pressurized ionization chamber (PIC) was used. Measurement locations are shown in Figure 4-3. The PIC instrument has a response to gamma

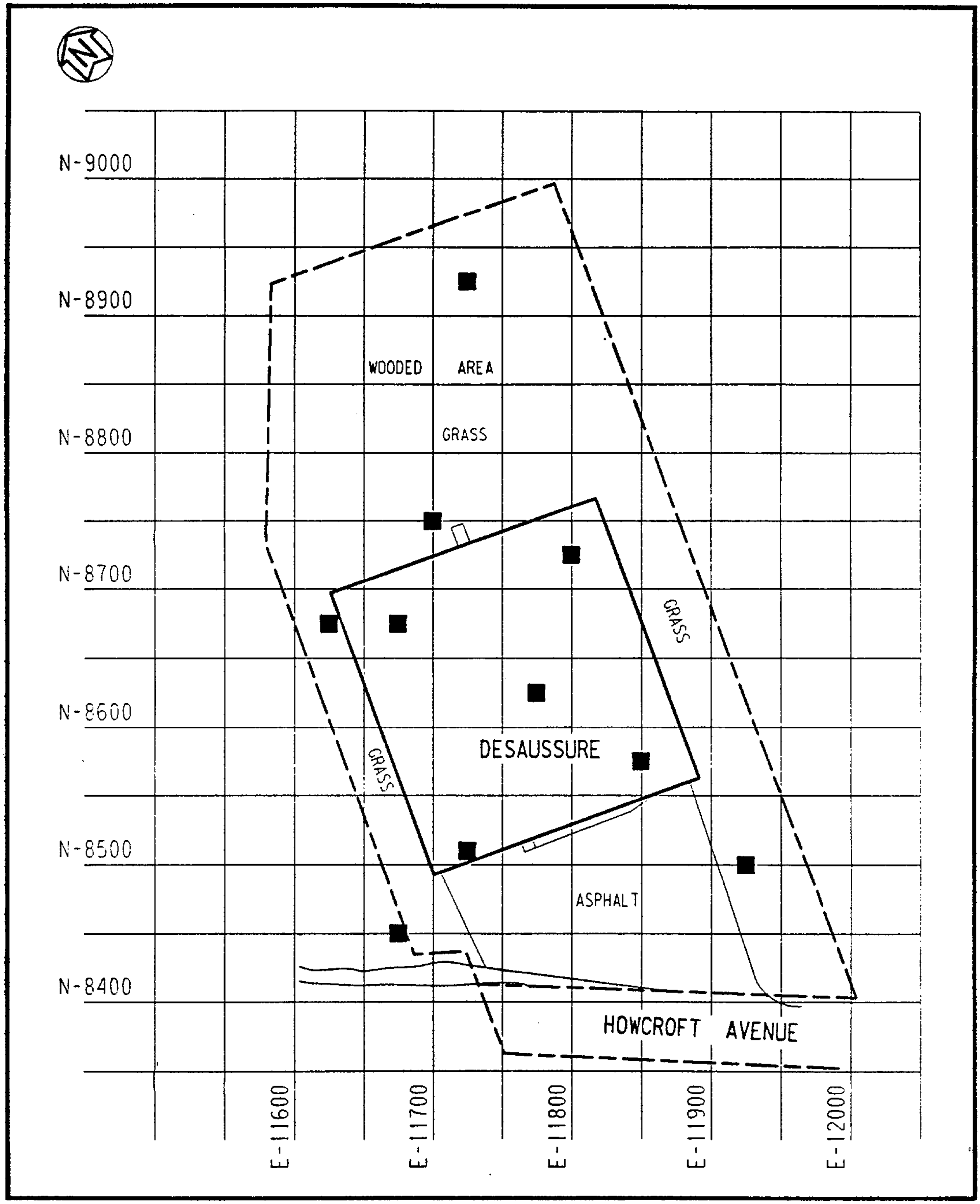

FIGURE 4-3 GAMMA EXPOSURE RATE MEASUREMT LC⁻ˑ˙˙ONS AT DESAUSSURE

M38W9804.DGN

radiation that is proportional to exposure in roentgens. A conversion factor for gamma scintillation to the PIC was established through a correlation of these two measurements at four locations in the vicinity of the property. The unshielded gamma scintillation detector readings were then used to estimate gamma exposure rates for each location. These measurements were taken 1 m (3 ft) above the ground. The locations were determined to be representative of the entire property. Interior measurements are generally obtained with the gamma scintillation instrument rather than the PIC because of its smaller size and the desire to minimize the technician's time inside the building.

5.0 CHARACTERIZATION RESULTS

Radiological characterization results are presented in this section. The data included represent exterior surface and subsurface radiation measurements and interior radiation measurements.

5.1 FIELD RADIOLOGICAL CHARACTERIZATION

Near-surface gamma radiation measurements on the property ranged from 5,000 cpm to approximately 161,000 cpm. The average background level for this area is 5,000 cpm. A measurement of 11,000 cpm is approximately equal to the DOE guideline for thorium-232 of 5 pCi/g above background for surface soil contamination. Using this correlation, the near-surface gamma measurements were used to determine the extent of surface contamination and the basis for selecting the locations of soil samples. Areas of surface contamination are shown in Figure 5-1.

Surface soil samples [depths from 0.0 to 15.2 cm (6.0 in.)] were taken at six locations along an open drainage ditch in the Borough right-of-way adjacent to the property (Figure 4-2). These samples were analyzed for thorium-232, uranium-238, and radium-226. The concentrations in these samples ranged from less than 8.0 to 80.2 pCi/g for uranium-238, from 59.1 to 124.3 pCi/g for thorium-232, and from 5.3 to 12.9 pCi/g for radium-226. Analytical results for surface soils are provided in Table 5-1; these data showed that concentrations of thorium-232 and radium-226 exceeded DOE guidelines (5 pCi/g plus background of 1 pCi/g for surface soils) with a maximum concentrations of 124.3 and 12.9 pCi/g, respectively. Use of the "less than" (<) notation in reporting results indicates that the radionuclide was not present in concentrations that are quantitative with

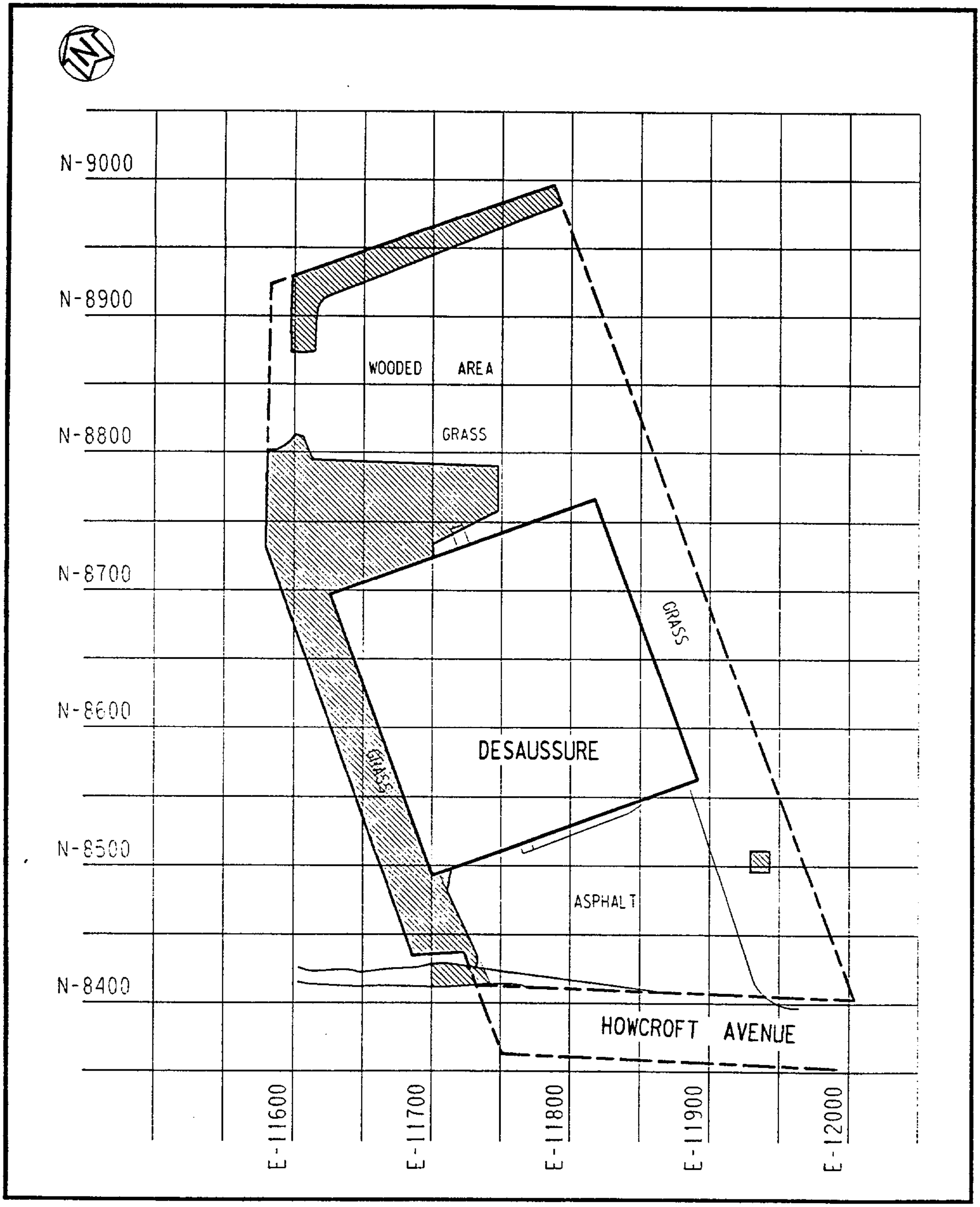

FIGURE 5-1 AREAS OF SURFACE CONTAMINATION AT DESAUSSURE

M3BW9604.DGN

the instruments and techniques used. The "less than" value represents the lower bound of the quantitative capacity of the instrument and technique used. The "less than" value is based on various factors, including the volume, size, and weight of the sample; the type of detector used; the counting time; and the background count rate. The actual concentration of the radionuclide is less than the value indicated. In addition, since radioactive decay is a random process, a correlation between the rate of disintegration and a given radionuclide concentration cannot be precisely established. For this reason, the exact concentration of the radionuclide cannot be determined. As such, each value that can be quantitatively determined has an associated uncertainty term ($\pm$), which represents the amount by which the actual concentration can be expected to differ from the value given in the table. The uncertainty term has an associated confidence level of 95 percent.

Thorium-232, the primary contaminant at the site, is the radionuclide most likely to exceed a specific DOE guideline in soil. Parameters for soil sample analysis were selected to ensure that the thorium-232 would be detected and measured at concentrations well below the lower guideline value of 5 pCi/g in excess of background level. Radionuclides of the uranium series, specifically uranium-238 and radium-226, are also potential contaminants but at lower concentrations than thorium-232. Therefore, these radionuclides (considered secondary contaminants) would not be present in concentrations in excess of guidelines unless thorium-232 was also present in concentrations in excess of its guideline level. Parameters selected for the thorium-232 analyses also provide detection sensitivities for uranium-238 and radium-226 that demonstrate that concentrations of these radionuclides are below guidelines. However, because of the relatively low gamma photon abundance of uranium-238, many of the uranium-238 concentrations were below the detection sensitivity of the analytical procedure; these concentrations are reported in the data tables as "less than" values. To obtain more sensitive readings for the uranium-238 radionuclide with these analytical methods, much longer instrument counting times would be required than were necessary for analysis of thorium-232, the primary contaminant.

Analytical results for subsurface soil samples are given in Table 5-1, and gamma logging data are given in Table 5-2. The results in Table 5-2 showed a range from 2,000 cpm to 382,000 cpm. A measurement of 40,000 cpm is approximately equal to the DOE guideline for subsurface contamination of 15 pCi/g. Analyses of subsurface soil samples indicated uranium-238 concentrations of 5.0 pCi/g, thorium-232 concentrations ranging from 0.9 to 1.3 pCi/g, and radium-226 concentrations ranging from 0.4 to 1.9 pCi/g.

On the basis of near-surface gamma radiation measurements, surface and subsurface soil sample analyses, and downhole gamma logging, contamination on this property is believed to consist primarily of subsurface contamination at depths ranging from 15.2 cm (6.0 in.) to 1.83 m (6.0 ft). The areas of subsurface contamination are shown in Figure 5-2. The subsurface contamination appears to extend beneath the building as well as onto adjacent commercial property.

It is apparent from review of historical documentation (e.g., aerial photographs of the area, interviews with local residents, and previous radiological surveys) that the subsurface contamination on this property lies along the former channel of Lodi Brook and its associated floodplain.

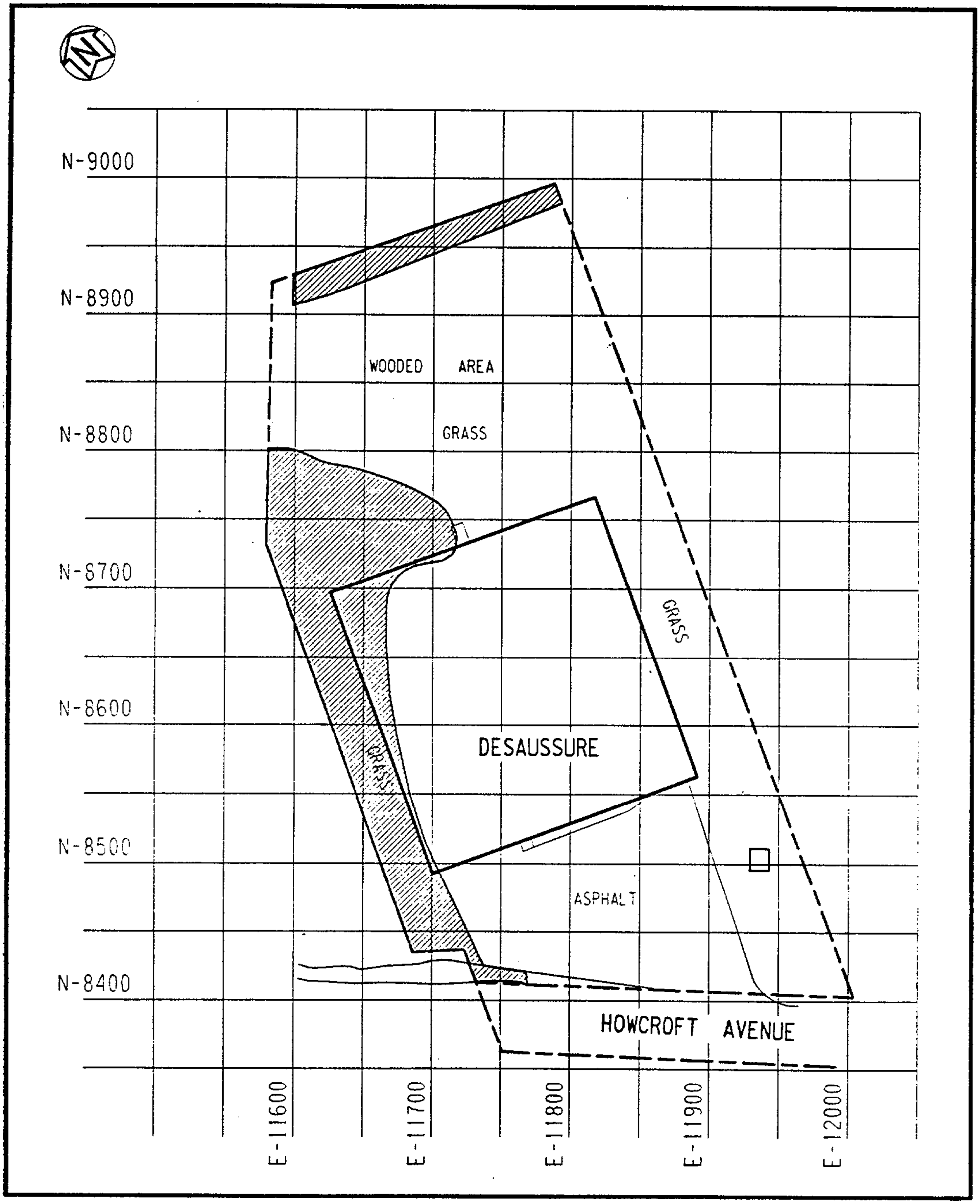

FIGURE 5-2 AREAS OF SUBSURFACE CONTAMINATION AT DESAUSSURE

M38W9604.DGN

The contamination on this property is similar to contamination found on commercial properties in close proximity to this property. It has been established that the Lodi Brook channel through these neighboring properties once occupied locations connecting to those where stream sediments were found at the DeSaussure property. Thus, the elevated gamma readings shown on gamma logs from boreholes drilled on this property serve as further indication of the suspected mechanism of transport for radiological contamination (i.e., stream deposition from Lodi Brook).

The vertical and horizontal limits of contamination as determined by this characterization effort are being evaluated to determine the volume of contaminated material that will require remedial action. To develop this estimate, BNI will consider the location of the contamination, construction techniques, and safety procedures.

5.2 BUILDING RADIOLOGICAL CHARACTERIZATION

Results of indoor radon measurements using the Tedlar bag method indicated concentrations of less than 0.3 and 0.5 pCi/L, respectively. These measurements were substantially less than the applicable DOE guideline of 3.0 pCi/L above guideline (Ref. 9).

Exterior gamma radiation exposure rate measurements ranged from 10 to 146 μR/h, including background. The indoor exposure rate measurements ranged from 8 to 13 μR/h, including background. These results can be found in Table 5-3. Assuming an employee spends 40 hours per week for 50 weeks per year (2,000 hours or 8 hours per day for 5 days per week) inside the building (at an average exposure rate of 10 μR/h) and 5 hours per week for 50 weeks per year (250 hours or 1 hour per day for 5 days per week), outside the building (at an average exposure rate of 49 μR/h), the resulting yearly dose to an individual employee would be 12 mrem above background (after subtracting average background of 9 μR/h; Ref. 10). The DOE guideline is 100 mrem/yr above background.

Based on the above information, the exposure rates and doses are within DOE guidelines. Further, it should be emphasized that natural background exposure rates vary widely across the United States and are often significantly higher than average background for this area.

TABLE 5-1

SURFACE AND SUBSURFACE RADIONUCLIDE CONCENTRATIONS IN SOIL

FOR THE DeSAUSSURE PROPERTY

Coordinates[a] East	Coordinates[a] North	Depth (ft)	Concentration (pCi/g ± 2 sigma) Uranium-238	Radium-226	Thorium-232
11647	8684	0.0 - 1.0	< 5.0	0.4 ± 0.4	1.0 ± 0.6
11647	8684	1.0 - 2.0	< 5.0	0.6 ± 0.4	1.3 ± 0.7
11647	8684	2.0 - 3.0	< 5.0	1.2 ± 0.4	1.6 ± 0.7
11647	8684	3.0 - 4.0	< 5.0	1.9 ± 0.5	0.9 ± 0.5
11675	8425	0.0 - 0.5	< 12.0	5.3 ± 0.8	61.1 ± 4.7
11690	8425	0.0 - 0.5	80.0 ± 15.6	7.2 ± 1.5	102.7 ± 11.8
11700	8425	0.0 - 0.5	< 8.0	5.4 ± 1.4	59.1 ± 11.4
11700	8545	0.0 - 1.0	< 5.0	1.2 ± 0.4	1.5 ± 0.6
11700	8545	1.0 - 2.0	< 5.0	1.2 ± 0.4	2.2 ± 0.6
11712	8425	0.0 - 0.5	< 13.0	12.9 ± 1.6	107.2 ± 14.6
11725	8425	0.0 - 0.5	< 20.0	10.9 ± 1.1	123.3 ± 13.1
11740	8425	0.0 - 0.5	9.3 ± 8.3	10.1 ± 1.0	124.3 ± 18.5

[a]Sampling locations are shown in Figure 4-2.

TABLE 5-2

DOWNHOLE GAMMA LOGGING RESULTS

FOR THE DeSAUSSURE PROPERTY

Coordinates[a]		Depth[b]	Count Rate[c]
East	North	(ft)	(cpm)
11587	8790	0.5	160000
11587	8790	1.0	303000
11587	8790	1.5	138000
11587	8790	2.0	94000
11587	8790	2.5	36000
11587	8790	3.0	15000
11587	8790	3.5	6000
11587	8790	4.0	3000
11587	8790	4.5	5000
11587	8790	5.0	9000
11587	8790	5.5	10000
11587	8790	6.0	10000
11587	8790	6.5	10000
11587	8790	7.0	10000
11587	8790	7.5	10000
11587	8790	8.0	10000
11587	8790	8.5	10000
11587	8790	9.0	10000
11587	8790	9.5	10000
11587	8790	10.0	9000
11587	8790	10.5	9000
11587	8790	11.0	10000
11587	8790	11.5	9000
11587	8790	12.0	9000
11587	8790	12.5	9000
11600	8900	0.5	23000
11600	8900	1.0	28000
11600	8900	1.5	13000
11600	8900	2.0	4000
11600	8900	2.5	3000
11600	8900	3.0	4000
11600	8900	3.5	7000
11600	8900	4.0	10000
11600	8900	4.5	11000
11600	8900	5.0	12000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
11600	8900	5.5	10000
11600	8900	6.0	10000
11600	8900	6.5	10000
11600	8900	7.0	10000
11600	8900	7.5	10000
11600	8900	8.0	10000
11600	8900	8.5	9000
11600	8900	9.0	10000
11600	8900	9.5	10000
11600	8900	10.0	10000
11600	8900	10.5	10000
11600	8900	11.0	10000
11600	8900	11.5	10000
11600	8900	12.0	9000
11600	8900	12.5	10000
11605	8710	0.5	85000
11605	8710	1.0	92000
11605	8710	1.5	146000
11605	8710	2.0	190000
11605	8710	2.5	151000
11605	8710	3.0	171000
11605	8710	3.5	294000
11605	8710	4.0	337000
11605	8710	4.5	382000
11605	8710	5.0	250000
11605	8710	5.5	129000
11605	8710	6.0	38000
11605	8710	6.5	17000
11605	8710	7.0	12000
11605	8710	7.5	11000
11605	8710	8.0	10000
11605	8710	8.5	9000
11605	8710	9.0	9000
11605	8710	9.5	10000
11605	8710	10.0	10000
11605	8710	10.5	10000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
11605	8710	11.0	9000
11605	8710	11.5	9000
11605	8710	12.0	10000
11605	8710	12.5	9000
11605	8710	13.0	8000
11605	8710	13.5	9000
11630	8638	0.5	70000
11630	8638	1.0	103000
11630	8638	1.5	176000
11630	8638	2.0	236000
11630	8638	2.5	253000
11630	8638	3.0	267000
11630	8638	3.5	190000
11630	8638	4.0	49000
11630	8638	4.5	18000
11630	8638	5.0	16000
11630	8638	5.5	19000
11630	8638	6.0	19000
11630	8638	6.5	17000
11630	8638	7.0	15000
11630	8638	7.5	12000
11630	8638	8.0	11000
11630	8638	8.5	10000
11630	8638	9.0	10000
11630	8638	9.5	9000
11630	8638	10.0	9000
11630	8638	10.5	9000
11630	8638	11.0	9000
11630	8638	11.5	9000
11630	8638	12.0	9000
11630	8638	12.5	9000
11630	8638	13.0	9000
11630	8638	13.5	10000
11630	8638	14.0	11000
11630	8638	14.5	10000
11630	8638	15.0	11000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
11630	8685	0.5	48000
11630	8685	1.0	62000
11630	8685	1.5	78000
11630	8685	2.0	99000
11630	8685	2.5	128000
11630	8685	3.0	120000
11630	8685	3.5	58000
11630	8685	4.0	34000
11630	8690	0.5	43000
11630	8690	1.0	54000
11630	8690	1.5	64000
11630	8690	2.0	80000
11630	8690	2.5	67000
11630	8690	3.0	45000
11630	8690	3.5	43000
11630	8690	4.0	29000
11645	8695	0.5	9000
11645	8695	1.0	13000
11645	8695	1.5	15000
11645	8695	2.0	14000
11645	8695	2.5	14000
11645	8695	3.0	15000
11645	8695	3.5	17000
11645	8695	4.0	18000
11647	8684	0.5	10000
11647	8684	1.0	12000
11647	8684	1.5	13000
11647	8684	2.0	12000
11647	8684	2.5	12000
11647	8684	3.0	13000
11647	8684	3.5	13000
11647	8684	4.0	13000
11647	8684	4.5	13000

TABLE 5-2

(continued)

Page 5 of 13

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
11675	8515	0.5	59000
11675	8515	1.0	95000
11675	8515	1.5	106000
11675	8515	2.0	60000
11675	8515	2.5	40000
11675	8515	3.0	30000
11675	8515	3.5	26000
11675	8515	4.0	16000
11675	8515	4.5	14000
11675	8515	5.0	14000
11683	8703	0.5	8000
11683	8703	1.0	10000
11683	8703	1.5	9000
11683	8703	2.0	9000
11683	8703	2.5	9000
11683	8703	3.0	8000
11683	8703	3.5	8000
11683	8703	4.0	8000
11683	8703	4.5	9000
11683	8703	5.0	9000
11683	8703	5.5	9000
11683	8703	6.0	9000
11683	8703	6.5	9000
11700	8545	0.5	8000
11700	8545	1.0	10000
11700	8545	1.5	12000
11700	8545	2.0	13000
11700	8545	2.5	13000
11700	8545	3.0	16000
11700	8730	0.5	140000
11700	8730	1.0	99000
11700	8730	1.5	55000
11700	8730	2.0	23000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
11700	8730	2.5	17000
11700	8730	3.0	13000
11700	8730	3.5	12000
11700	8730	4.0	9000
11700	8730	4.5	8000
11700	8730	5.0	8000
11700	8730	5.5	8000
11700	8730	6.0	8000
11700	8730	6.5	9000
11700	8730	7.0	10000
11700	8730	7.5	10000
11700	8730	8.0	9000
11700	8730	8.5	9000
11700	8730	9.0	9000
11700	8730	9.5	8000
11700	8730	10.0	8000
11700	8730	10.5	8000
11700	8730	11.0	9000
11700	8730	11.5	8000
11700	8730	12.0	8000
11700	8730	12.5	7000
11700	8730	13.0	9000
11700	8730	13.5	8000
11700	8730	14.0	8000
11700	8730	14.5	8000
11700	8790	0.5	10000
11700	8790	1.0	9000
11700	8790	1.5	4000
11700	8790	2.0	3000
11700	8790	2.5	2000
11700	8790	3.0	2000
11700	8790	3.5	3000
11700	8790	4.0	4000
11700	8790	4.5	8000
11700	8790	5.0	10000
11700	8790	5.5	10000

TABLE 5-2

(continued)

Coordinates[a] East	Coordinates[a] North	Depth[b] (ft)	Count Rate[c] (cpm)
11700	8790	6.0	10000
11700	8790	6.5	10000
11700	8790	7.0	9000
11700	8790	7.5	10000
11700	8790	8.0	10000
11700	8790	8.5	9000
11700	8790	9.0	8000
11700	8790	9.5	9000
11700	8790	10.0	9000
11700	8790	10.5	8000
11700	8790	11.0	8000
11700	8790	11.5	8000
11700	8790	12.0	8000
11700	8790	12.5	9000
11700	8790	13.0	11000
11700	8790	13.5	10000
11700	8885	0.5	4000
11700	8885	1.0	1000
11700	8885	1.5	1000
11700	8885	2.0	1000
11700	8885	2.5	2000
11700	8885	3.0	3000
11700	8885	3.5	7000
11700	8885	4.0	10000
11700	8885	4.5	11000
11700	8885	5.0	11000
11700	8885	5.5	10000
11700	8885	6.0	10000
11700	8885	6.5	10000
11700	8885	7.0	11000
11700	8885	7.5	11000
11700	8885	8.0	10000
11700	8885	8.5	9000
11700	8885	9.0	10000
11700	8885	9.5	9000
11700	8885	10.0	9000

TABLE 5-2

(continued)

Page 8 of 13

Coordinates[a] East	Coordinates[a] North	Depth[b] (ft)	Count Rate[c] (cpm)
11700	8885	10.5	8000
11700	8885	11.0	7000
11700	8885	11.5	6000
11700	8885	12.0	7000
11700	8885	12.5	8000
11700	8885	13.0	8000
11700	8885	13.5	8000
11700	8885	14.0	9000
11700	8885	14.5	9000
11704	8515	0.5	9000
11704	8515	1.0	11000
11704	8515	1.5	12000
11704	8515	2.0	12000
11710	8950	0.5	49000
11710	8950	1.0	62000
11710	8950	1.5	105000
11710	8950	2.0	98000
11710	8950	2.5	53000
11710	8950	3.0	27000
11710	8950	3.5	18000
11710	8950	4.0	13000
11710	8950	4.5	11000
11710	8950	5.0	9000
11710	8950	5.5	10000
11710	8950	6.0	9000
11710	8950	6.5	9000
11710	8950	7.0	8000
11710	8950	7.5	8000
11710	8950	8.0	8000
11710	8950	8.5	7000
11720	8485	0.5	10000
11720	8485	1.0	13000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
11720	8485	1.5	13000
11720	8485	2.0	14000
11720	8485	2.5	15000
11720	8485	3.0	15000
11720	8485	3.5	15000
11720	8485	4.0	16000
11720	8485	4.5	15000
11720	8485	5.0	13000
11720	8485	5.5	12000
11720	8485	6.0	11000
11720	8485	6.5	11000
11720	8485	7.0	12000
11720	8485	7.5	12000
11720	8485	8.0	12000
11720	8485	8.5	11000
11720	8485	9.0	13000
11720	8485	9.5	12000
11720	8485	10.0	12000
11746	8621	0.5	8000
11746	8621	1.0	8000
11746	8621	1.5	10000
11746	8621	2.0	11000
11746	8621	2.5	10000
11746	8621	3.0	9000
11746	8621	3.5	9000
11746	8621	4.0	9000
11746	8621	4.5	9000
11746	8621	5.0	10000
11746	8621	5.5	9000
11746	8621	6.0	9000
11746	8621	6.5	8000
11746	8621	7.0	8000
11746	8621	7.5	8000
11785	8900	0.5	4000
11785	8900	1.0	2000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
11785	8900	1.5	2000
11785	8900	2.0	2000
11785	8900	2.5	4000
11785	8900	3.0	7000
11785	8900	3.5	9000
11785	8900	4.0	10000
11785	8900	4.5	10000
11785	8900	5.0	10000
11785	8900	5.5	10000
11785	8900	6.0	10000
11785	8900	6.5	10000
11785	8900	7.0	10000
11785	8900	7.5	10000
11785	8900	8.0	10000
11785	8900	8.5	9000
11785	8900	9.0	10000
11785	8900	9.5	9000
11785	8900	10.0	9000
11785	8900	10.5	11000
11785	8900	11.0	11000
11785	8900	11.5	12000
11785	8900	12.0	12000
11795	8995	0.5	18000
11795	8995	1.0	29000
11795	8995	1.5	41000
11795	8995	2.0	40000
11795	8995	2.5	30000
11795	8995	3.0	21000
11795	8995	3.5	13000
11795	8995	4.0	11000
11795	8995	4.5	10000
11795	8995	5.0	10000
11795	8995	5.5	11000
11795	8995	6.0	11000
11795	8995	6.5	13000
11795	8995	7.0	12000
11795	8995	7.5	12000
11795	8995	8.0	13000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
11800	8765	0.5	9000
11800	8765	1.0	7000
11800	8765	1.5	7000
11800	8765	2.0	9000
11800	8765	2.5	10000
11800	8765	3.0	12000
11800	8765	3.5	9000
11800	8765	4.0	8000
11800	8765	4.5	8000
11800	8765	5.0	6000
11800	8765	5.5	7000
11800	8765	6.0	9000
11800	8765	6.5	10000
11800	8765	7.0	9000
11800	8765	7.5	10000
11800	8765	8.0	10000
11800	8765	8.5	9000
11800	8765	9.0	9000
11800	8765	9.5	9000
11800	8765	10.0	10000
11800	8765	10.5	10000
11800	8765	11.0	10000
11800	8765	11.5	11000
11800	8765	12.0	11000
11800	8765	12.5	10000
11830	8470	0.5	7000
11830	8470	1.0	10000
11830	8470	1.5	11000
11830	8470	2.0	11000
11830	8470	2.5	11000
11830	8470	3.0	12000
11830	8470	3.5	12000
11830	8470	4.0	12000
11830	8470	4.5	13000
11830	8470	5.0	12000
11830	8470	5.5	12000

TABLE 5-2

(continued)

Page 12 of 13

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
11850	8700	0.5	10000
11850	8700	1.0	11000
11850	8700	1.5	12000
11850	8700	2.0	12000
11850	8700	2.5	9000
11850	8700	3.0	9000
11850	8700	3.5	9000
11850	8700	4.0	11000
11850	8700	4.5	11000
11850	8700	5.0	10000
11850	8700	5.5	11000
11850	8700	6.0	11000
11850	8700	6.5	10000
11850	8700	7.0	11000
11850	8700	7.5	11000
11850	8700	8.0	11000
11850	8700	8.5	10000
11850	8700	9.0	10000
11850	8700	9.5	11000
11880	8600	0.5	10000
11880	8600	1.0	11000
11880	8600	1.5	10000
11880	8600	2.0	9000
11880	8600	2.5	8000
11880	8600	3.0	8000
11880	8600	3.5	9000
11880	8600	4.0	9000
11880	8600	4.5	9000
11880	8600	5.0	10000
11880	8600	5.5	10000
11880	8600	6.0	11000
11880	8600	6.5	10000
11880	8600	7.0	9000
11880	8600	7.5	10000
11880	8600	8.0	10000
11880	8600	8.5	10000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
11880	8600	9.0	10000
11880	8600	9.5	9000
11880	8600	10.0	10000
11880	8600	10.5	10000
11880	8600	11.0	10000
11880	8600	11.5	10000
11880	8600	12.0	10000

[a]Borehole locations are shown in Figure 4-1.

[b]The variations in depths of boreholes and corresponding results given in this table are based on the boreholes penetrating the contamination or the drill reaching refusal.

[c]Instrument used was 5.0- by 5.0-cm (2- by 2-in.) thallium-activated sodium iodide gamma scintillation detector.

TABLE 5-3

GAMMA RADIATION EXPOSURE RATES

FOR THE DeSAUSSURE PROPERTY

Coordinates[a] East	North	Rate[b] (μR/h)
Exterior Measurements		
11625	8675	34
11675	8450	146
11700	8750	76
11675	8675	13
11725	8925	10
11925	8500	15
Interior Measurements		
11725	8500	13
11775	8625	10
11800	8575	8
11800	8725	8

[a]Measurement locations are shown in Figure 4-3.

[b]Measurements include background.

REFERENCES

1. U.S. Department of Energy. Description of the Formerly Utilized Sites Remedial Action Program, ORO-777, Oak Ridge, Tenn., September 1980 (as modified by DOE in October 1983).

2. Argonne National Laboratory. Action Description Memorandum, Interim Remedial Actions at Maywood, New Jersey, Argonne, Ill., March 1987.

3. Argonne National Laboratory. Action Description Memorandum, Proposed 1984 Remedial Actions at Maywood, New Jersey, Argonne, Ill., June 8, 1984.

4. Bechtel National, Inc. Post-Remedial Action Report for the Lodi Residential Properties, DOE/OR/20722-89, Oak Ridge, Tenn., August 1986.

5. NUS Corporation. Radiological Study of Maywood Chemical, Maywood, New Jersey, November 1983.

6. EG&G Energy Measurements Group. An Aerial Radiologic Survey of the Stepan Chemical Company and Surrounding Area, Maywood, New Jersey, NRC-8109, Oak Ridge, Tenn., September 1981.

7. NUS Corporation. Radiological Study of Maywood Chemical, Maywood, New Jersey, R-584-11-83-1, November 1983.

8. Thermo Analytical/Eberline. "Technical Review of FUSRAP Instrument Calibrations by Comparison to TMC Calibration Pads," May 1989.

9. U.S. Code of Federal Regulations. 40 CFR 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," Washington, D.C., July 1986.

10. Levin, S. G., R. K. Stoms, E. Kuerze, and W. Huskisson. "Summary of Natural Environmental Gamma Radiation Using a Calibrated Portable Scintillation Counter." Radiological Health Data Report 9:679-695 (1968).