Formerly Utilized Sites Remedial
Action Program (FUSRAP)

Maywood Chemical Company Superfund Site

ADMINISTRATIVE RECORD

Document Number

MISS- 013.

US Army Corps
of Engineers®

063982

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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 municipal
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 with 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 accelerated manner. His efforts have allowed us to publish these reports on schedule. If you have any questions about these documents, please call me at 576-4718.

Very truly yours,

R. C. Robertson
Project Manager - FUSRAP

RCR:wfs:1756x
Enclosure: As stated

cc: J. D. Berger, ORAU (w/e)
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CONCURRENCE

[illegible]	[illegible]			

DOE/OR/20722-178

RADIOLOGICAL CHARACTERIZATION REPORT FOR THE PROPERTY AT INTERSTATE 80 (EASTBOUND RIGHT-OF-WAY) LODI, NEW JERSEY

SEPTEMBER 1989

Prepared for

UNITED STATES DEPARTMENT OF ENERGY

OAK RIDGE OPERATIONS OFFICE

Under Contract No. DE-AC05-81OR20722

By

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Bechtel Job No. 14501

TABLE OF CONTENTS

	Page
List of Figures	iv
List of Tables	iv
Abbreviations	v
1.0 Introduction and Summary	1
1.1 Introduction	1
1.2 Purpose	3
1.3 Summary	3
1.4 Conclusions	6
2.0 Site History	7
2.1 Previous Radiological Surveys	8
2.2 Remedial Action Guidelines	9
3.0 Health and Safety Plan	12
3.1 Subcontractor Training	12
3.2 Safety Requirements	12
4.0 Characterization Procedures	14
4.1 Field Radiological Characterization	14
4.1.1 Measurements Taken and Methods Used	14
4.1.2 Sample Collection and Analysis	17
4.2 Building Radiological Characterization	19
5.0 Characterization Results	21
5.1 Field Radiological Characterization	21
5.2 Building Radiological Characterization	26
References	44

LIST OF FIGURES

Figure	Title	Page
1-1	Location of Lodi Vicinity Properties	2
1-2	Location of Interstate 80 in Lodi, New Jersey	5
4-1	Borehole Locations Along I-80 (Eastbound Right-of-Way)	16
4-2	Surface and Subsurface Soil Sampling Locations at Interstate 80 (Eastbound Right-of-Way)	18
4-3	Gamma Exposure Rate Measurement Locations for I-80 (Eastbound Right-of-Way)	20
5-1	Areas of Surface Contamination Along I-80 (Eastbound Right-of-Way)	22
5-2	Areas of Subsurface Contamination at I-80 (Eastbound Right-of-Way)	25

LIST OF TABLES

Table	Title	Page
2-1	Summary of Residual Contamination Guidelines for the Lodi Vicinity Properties	11
5-1	Surface and Subsurface Radionuclide Concentrations in Soil for Interstate 80 (Eastbound Right-of-Way)	27
5-2	Downhole Gamma Logging Results for Interstate 80 (Eastbound Right-of-Way)	31
5-3	Gamma Radiation Exposure Rates for Interstate 80 (Eastbound Right-of-Way)	43

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 Lodi, New Jersey, are included in FUSRAP as vicinity properties. Figure 1-1 shows the location of the Lodi vicinity properties in relation to the former Maywood Chemical Works. This report addresses the eastbound right-of-way along Interstate 80 where it traverses the Borough of Lodi south of the Maywood Interim Storage Site (MISS) and crosses the path of the former channel of Lodi Brook. This property is not presently included in FUSRAP; however, the westbound right-of-way has been designated for inclusion in FUSRAP based on a survey by the Oak Ridge National Laboratory (ORNL) (Ref. 1).

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

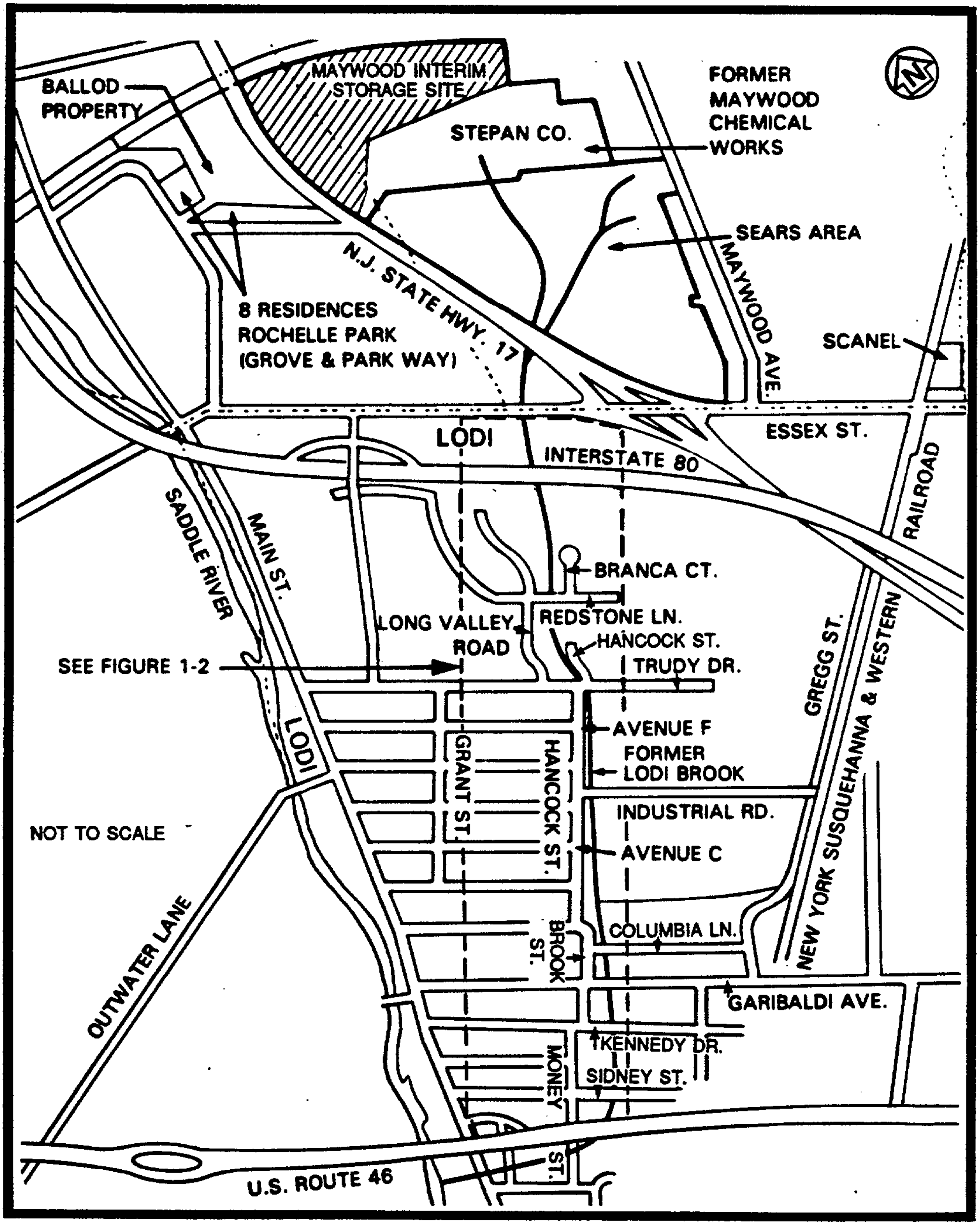

FIGURE 1-1 LOCATION OF LODI VICINITY PROPERTIES

program or from commercial operations that resulted in conditions Congress has mandated that DOE remedy (Ref. 2).

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.

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 property at Interstate 80 (eastbound right-of-way) in Lodi, New Jersey (Figure 1-2), which was conducted from September through December 1986.

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

This characterization confirmed that thorium-232 is the primary radioactive contaminant at this property. Results of surface soil samples for Interstate 80 (eastbound right-of-way) showed maximum concentrations of thorium-232 and radium-226 to be 10.0 and 2.5 pCi/g, respectively. The maximum concentration of uranium-238 in surface soil samples was less than 15.0 pCi/g.

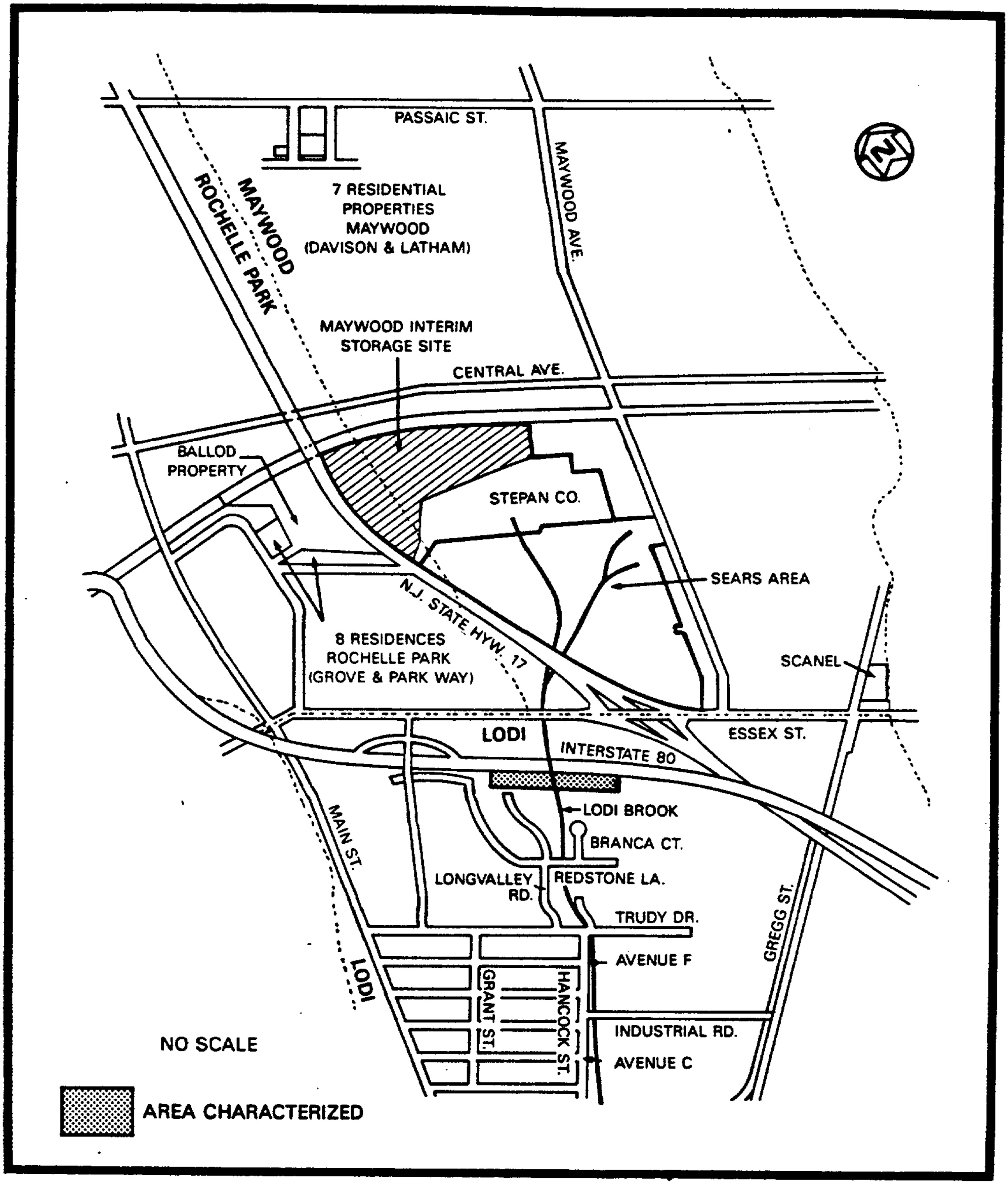

FIGURE 1-2 LOCATION OF INTERSTATE 80 IN LODI, NEW JERSEY

Subsurface soil sample concentrations ranged from 0.8 to 16.0 pCi/g for thorium-232 and from 0.6 to 4.0 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 ranged from less than 4.0 to less than 14.0 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. 3).

Soil analysis data for this property indicated surface contamination. Subsurface investigation by gamma logging indicated contamination to a depth of 1.67 m (5.5 ft).

Exterior gamma radiation exposure rates ranged from 8 to 22 μR/h, including background.

No buildings are present on this property; therefore, indoor radiological characterization was not required.

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 property located at Interstate 80 (eastbound right-of-way). This contamination is both surface and subsurface. Near-surface gamma measurements indicated minimal surface contamination located in areas of surface water migration from the former Lodi Brook channel. These areas were not affected by highway construction or residential backfilling/development activities. The subsurface contamination ranges from a depth of 15.2 cm (6.0 in.) to 1.52 m (5.0 ft). In addition, the bottom of several boreholes collapsed before gamma logging could be completed. There are several locations where the data indicates that the lens of contamination may not have been completely penetrated; therefore, there is a possibility that subsurface contamination may be present at depths greater than 1.52 m (5.0 ft). The contamination appears to extend onto several adjacent residential properties, and there is a high probability that the contamination extends beneath the interstate in a northeasterly direction. The total affected area is estimated to be approximately 13,371 ft^2. 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. 4).

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. 5). 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. 6).

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. 7).

June 1984--In June 1984, ORNL conducted a "drive-by" survey of Lodi using its "scanning van." Although not comprehensive, the survey indicated areas requiring further investigation (Ref. 8).

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

	Allowable Surface Residual Contamination[e] (dpm/100 cm²)		
Radionuclide[f]	Average[g,h]	Maximum[h,i]	Removable[h,i]
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. 9).

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 36 boreholes (Figure 4-1), using either a 7.6-cm- (3-in.-) or 15.2-cm- (6.0-in.-) diameter auger bit, and gamma logging the boreholes. 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. 9).

Gamma radiation measurements were taken at 15.2-cm (6.0-in.) vertical intervals to determine the depth and concentration

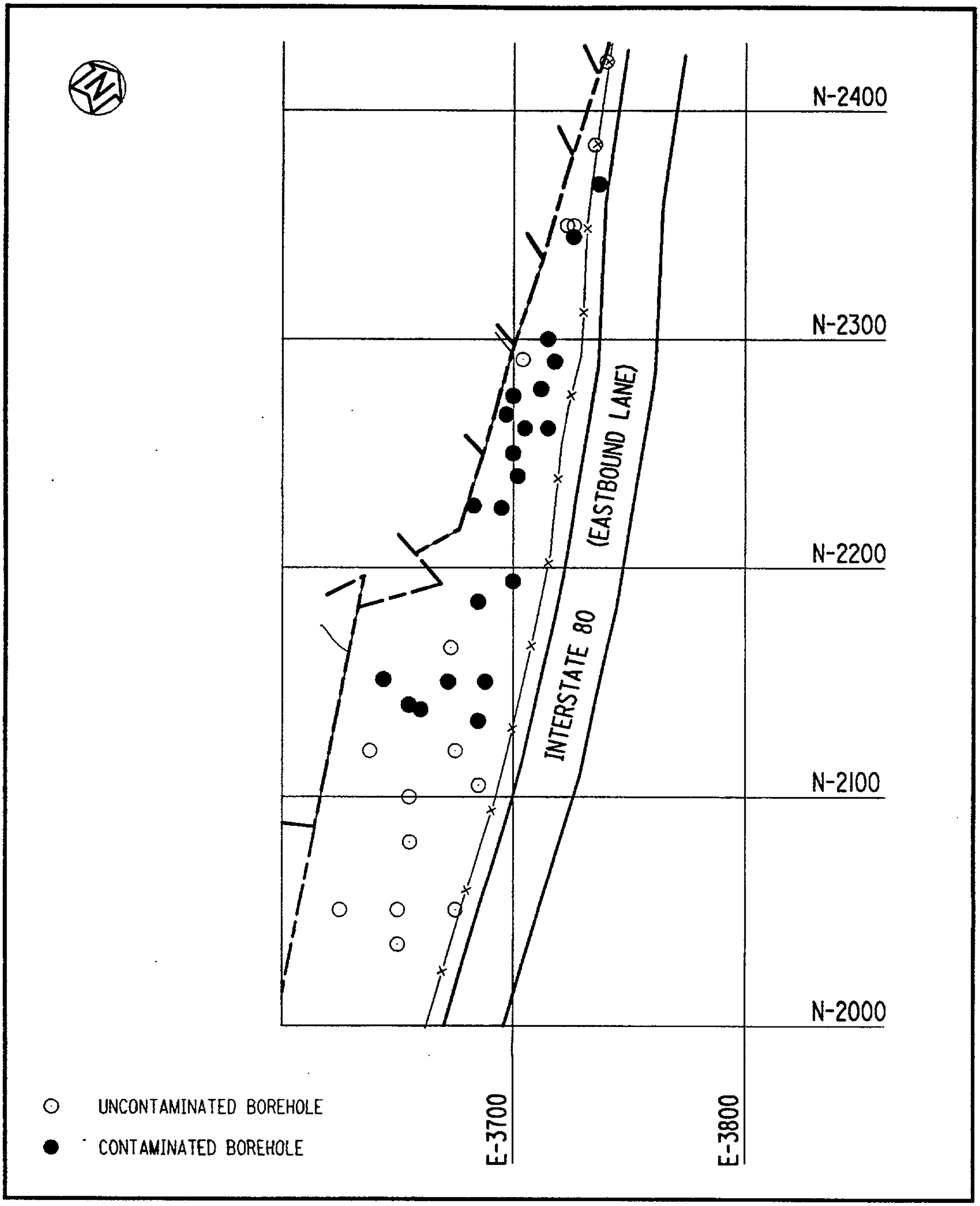

FIGURE 4-1 BOREHOLE LOCATIONS ALONG I-80 (EASTBOUND RIGHT-OF-WAY)

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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 21 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 23 locations (Figure 4-2) using either the side-wall sampling method (i.e., 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) or a 7.6-cm (3.0-in.) outside diameter (O.D.) split-spoon sampler mounted on a tripod or attached to a truck-mounted auger stem. The samples were analyzed to compare laboratory soil sample results to downhole gamma radiation measurements. The subsurface soil samples were analyzed for radium-226, uranium-238, and thorium-232 in the same manner as the surface soil samples.

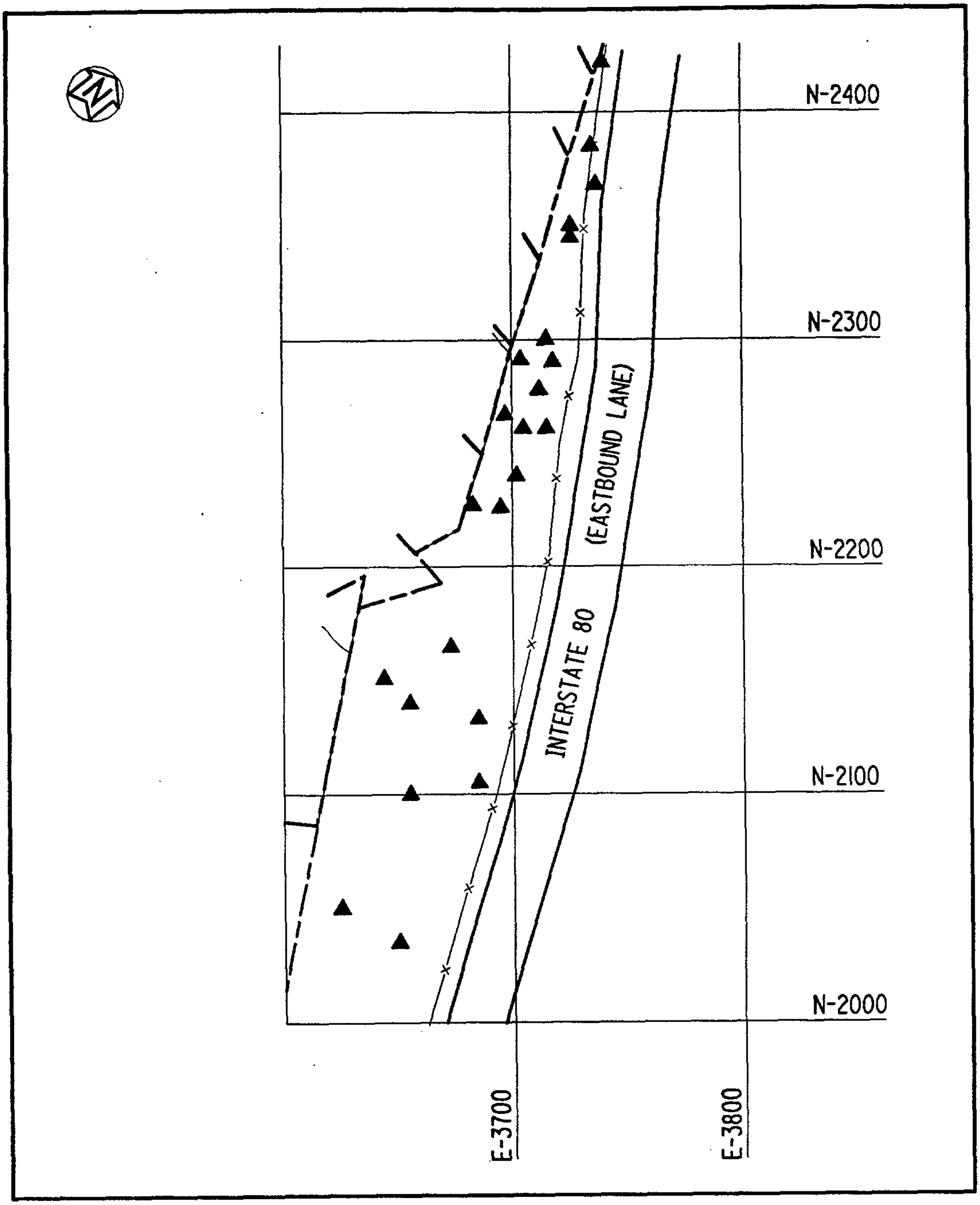

FIGURE 4-2 SURFACE AND SUBSURFACE SOIL SAMPLING LOCATIONS AT INTERSTATE 80 (EASTBOUND RIGHT-OF-WAY)

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4.2 BUILDING RADIOLOGICAL CHARACTERIZATION

No buildings are present on this property; therefore, this element of the radiological characterization activities was not conducted.

Exterior gamma exposure rate measurements were made at nine locations throughout the property grid system. 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 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.

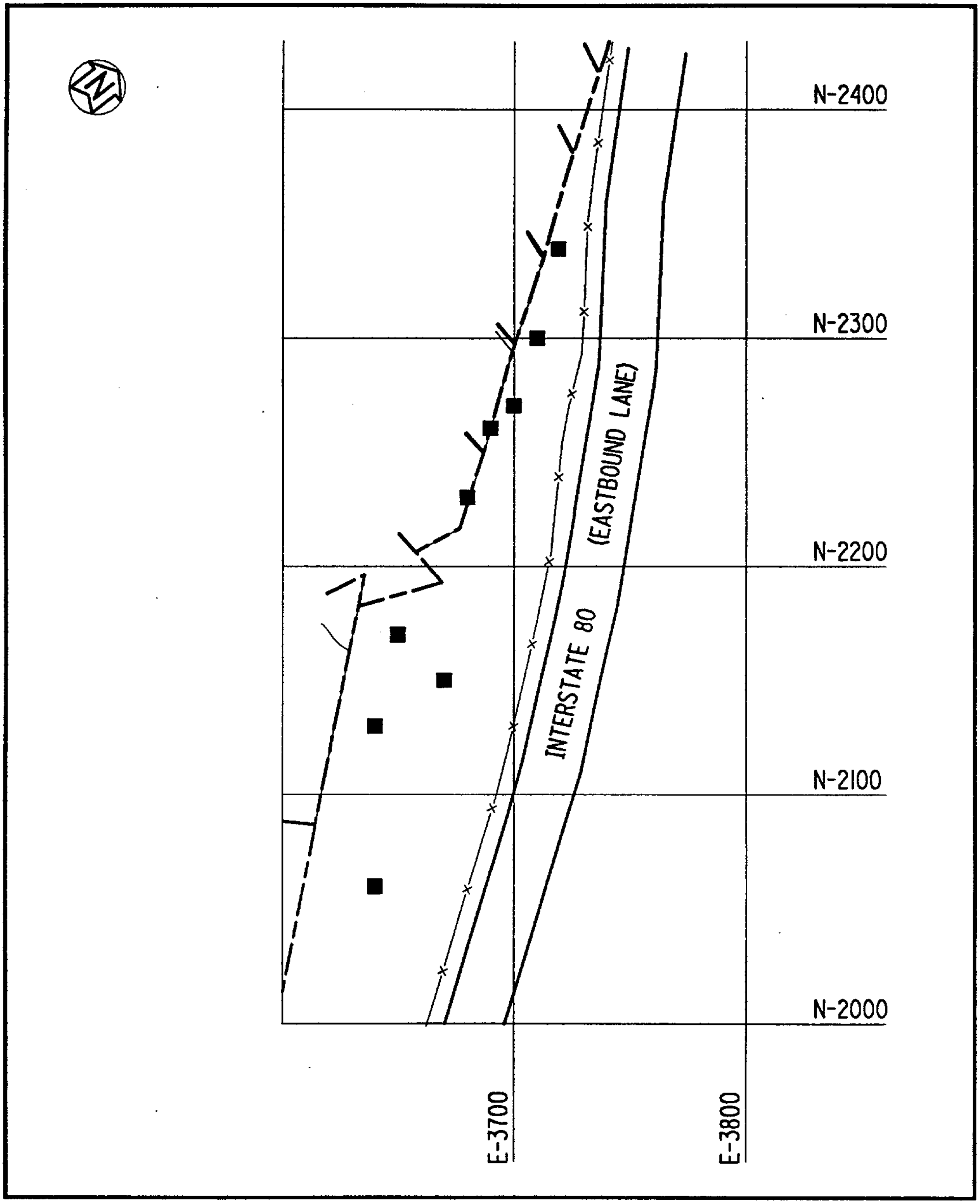

FIGURE 4-3 GAMMA EXPOSURE RATE MEASUREMENT LOCATIONS FOR I-80 (EASTBOUND RIGHT-OF-WAY)

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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 4,000 cpm to approximately 27,000 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 (0.5 in.)] were taken at 21 locations on 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 4.0 to less than 15.0 pCi/g for uranium-238, from less than 1.0 to 10.0 pCi/g for thorium-232, and from less than 1.0 to 2.5 pCi/g for radium-226. Analytical results for surface soils are provided in Table 5-1; these data showed that concentrations of thorium-232 exceeded DOE guidelines (5 pCi/g plus background of 1 pCi/g for surface soils) with a maximum concentration of 10.0 pCi/g. Use of the "less than" (<) notation in reporting results indicates that the radionuclide was not present in concentrations that are quantitative with the instruments and techniques used. The "less than" value represents the lower bound of the

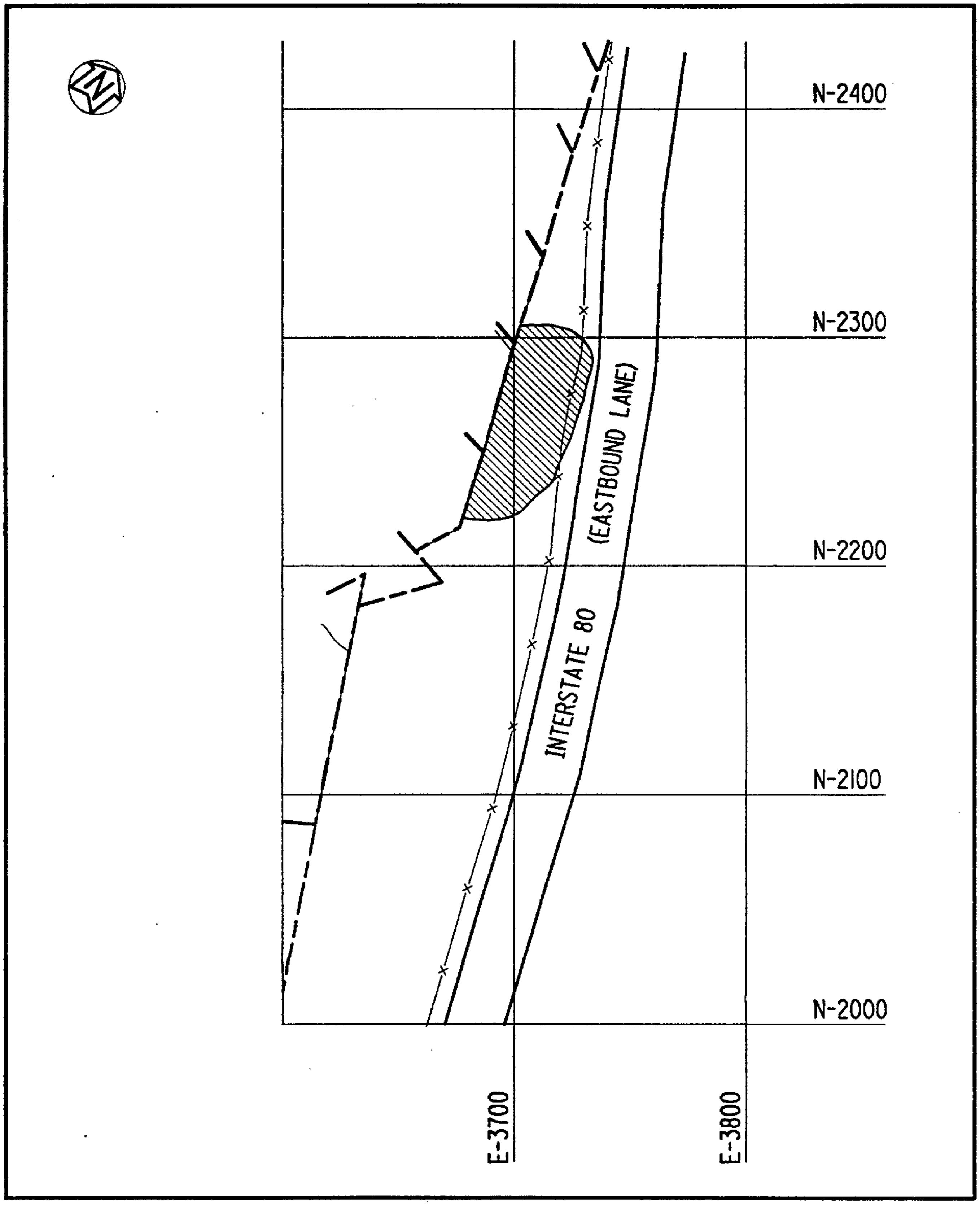

FIGURE 5-1 AREAS OF SURFACE CONTAMINATION ALONG I-80 (EASTBOUND RIGHT-OF-WAY)

M38W9818.DGN

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 8,000 cpm to 293,000 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 ranging from less than 4.0 to less than 14.0 pCi/g, thorium-232 concentrations ranging from 0.8 to 16.0 pCi/g, and radium-226 concentrations ranging from 0.6 to 4.0 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 (0.5 in.) to 1.52 m (5.0 ft). The areas of subsurface contamination are shown in Figure 5-2. The subsurface contamination appears to extend onto several neighboring residential properties and beneath the interstate in a northeasterly direction.

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.

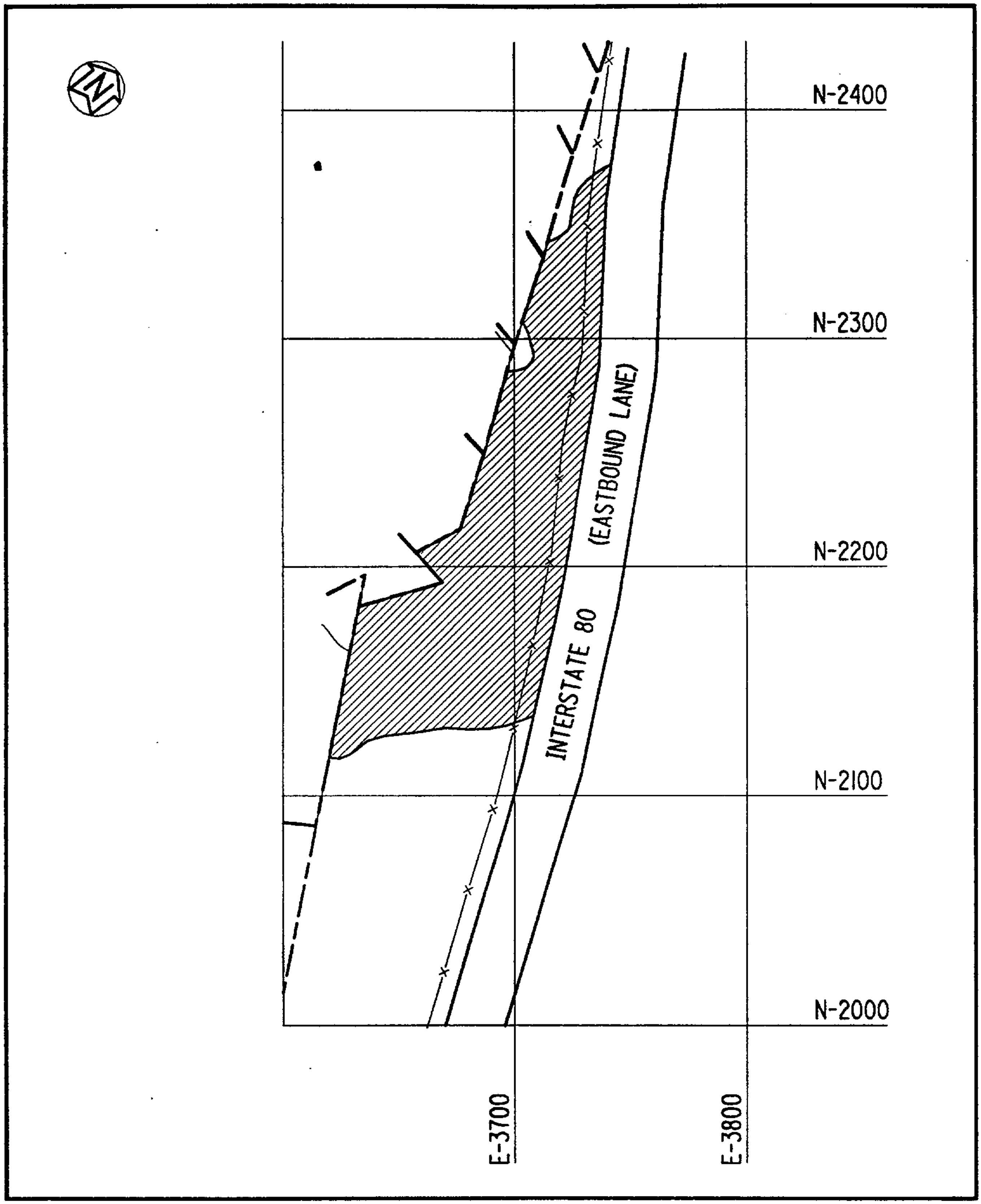

FIGURE 5-2 AREAS OF SUBSURFACE CONTAMINATION AT I-80 (EASTBOUND RIGHT-OF-WAY)

The contamination on this property is similar to contamination found on residential 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 Interstate 80 (eastbound right-of-way). 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

No buildings are present on this property; therefore, this element of the radiological characterization activities was not required.

Exterior gamma radiation exposure rate measurements ranged from 8 to 22 μR/h, including background. These results can be found in Table 5-3. Because the property is not occupied, the most realistic exposure scenario would be a worker on the property to perform maintenance activities. Assuming the worker spends 9 hours per week for 50 weeks per year (450 hours or 9 hours per day for 1 day per week) on the property, the average exterior exposure rate of 14 μR/h would result in a yearly dose of 6 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 at this property 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.

SURFACE AND SUBSURFACE RADIONUCLIDE CONCENTRATIONS IN SOIL

FOR INTERSTATE 80 (EASTBOUND RIGHT-OF-WAY)

Coordinates[a]		Depth	Concentration (pCi/g ± 2 sigma)		
East	North	(ft)	Uranium-238	Radium-226	Thorium-232
3625	2050	1.0 - 1.5	< 7	1.5 ± 0.6	1.2 ± 0.8
3625	2050	3.0 - 3.5	< 5	0.7 ± 0.4	1.6 ± 0.8
3644	2151	0.0 - 0.5	< 7	1.1 ± 0.6	3 ± 1
3644	2151	2.5 - 3.0	< 8	1.0 ± 0.5	4 ± 1
3644	2151	5.5 - 6.0	< 7	0.9 ± 0.4	2.2 ± 0.7
3650	2035	0.0 - 0.5	< 11	1.1 ± 0.5	1.9 ± 0.9
3650	2035	3.0 - 3.5	< 10	1.2 ± 0.5	1.7 ± 0.7
3650	2035	4.0 - 4.5	< 6	1.2 ± 0.5	0.8 ± 0.7
3655	2100	0.0 - 0.5	< 6	1.5 ± 0.6	1 ± 1
3655	2100	1.0 - 1.5	< 10	1.0 ± 0.6	2 ± 1
3655	2100	6.0 - 6.5	< 5	0.9 ± 0.4	1.6 ± 0.7
3655	2140	0.0 - 0.5	< 4	1.0 ± 0.4	< 1
3655	2140	1.0 - 1.5	< 10	2.5 ± 0.8	7 ± 2
3655	2140	4.0 - 4.5	< 5	1.1 ± 0.5	1.2 ± 0.8
3673	2165	0.0 - 0.5	< 13	1.7 ± 0.5	2.0 ± 0.8
3673	2165	1.0 - 1.5	< 5	1.5 ± 0.5	1.6 ± 0.8
3673	2165	3.5 - 4.0	< 9	1.1 ± 0.4	2.4 ± 0.9
3683	2227	0.0 - 0.5	< 9	2.5 ± 0.9	8 ± 2
3683	2227	2.0 - 2.5	< 12	1.7 ± 0.9	7 ± 2

TABLE 5-1

(continued)

Page 2 of 4

Coordinates[a] East	Coordinates[a] North	Depth (ft)	Concentration (pCi/g ± 2 sigma) Uranium-238	Concentration (pCi/g ± 2 sigma) Radium-226	Concentration (pCi/g ± 2 sigma) Thorium-232
3685	2105	0.0 - 0.5	< 12	1.8 ± 0.7	4 ± 1
3685	2105	2.5 - 3.0	< 13	2.3 ± 0.9	7 ± 2
3685	2105	3.0 - 3.5	< 10	0.6 ± 0.6	4 ± 1
3685	2133	1.0 - 1.5	< 6	1.3 ± 0.6	2 ± 1
3685	2133	3.5 - 4.0	< 8	0.8 ± 0.7	2 ± 1
3685	2133	5.5 - 5.5	< 10	1.7 ± 0.5	1.2 ± 0.8
3695	2226	0.0 - 0.5	< 12	1.1 ± 0.6	4 ± 1
3695	2226	1.0 - 1.5	< 11	1.7 ± 0.6	2.7 ± 0.9
3697	2267	0.0 - 0.5	< 6	2.2 ± 0.7	3 ± 1
3697	2267	1.0 - 1.5	< 12	1.1 ± 0.5	2.1 ± 0.9
3697	2267	4.0 - 4.5	< 11	1.3 ± 0.7	2.4 ± 0.8
3702	2240	0.0 - 0.5	< 9	1.1 ± 0.7	10 ± 2
3702	2240	1.5 - 2.0	< 13	3.2 ± 0.8	4 ± 1
3702	2240	3.5 - 4.0	< 11	1.4 ± 0.7	3 ± 1
3704	2291	0.0 - 0.5	< 10	1.4 ± 0.5	3 ± 1
3704	2291	1.0 - 1.5	< 8	1.1 ± 0.4	1.9 ± 0.7
3704	2291	2.0 - 2.5	< 4	1.1 ± 0.5	1.0 ± 0.6
3705	2261	0.0 - 0.5	< 9	1.5 ± 0.8	9 ± 2
3705	2261	2.0 - 2.5	< 14	1.6 ± 0.9	9 ± 2
3705	2261	4.5 - 5.0	< 11	4 ± 1	16 ± 3

TABLE 5-1

(continued)

Coordinates[a] East	Coordinates[a] North	Depth (ft)	Concentration (pCi/g ± 2 sigma) Uranium-238	Concentration (pCi/g ± 2 sigma) Radium-226	Concentration (pCi/g ± 2 sigma) Thorium-232
3712	2278	0.0 - 0.5	< 15	1.5 ± 1.0	10 ± 2
3712	2278	2.5 - 3.0	< 13	1.2 ± 0.8	9 ± 2
3712	2278	3.5 - 4.0	< 8	1.4 ± 0.8	8 ± 2
3715	2261	0.0 - 0.5	< 6	1.7 ± 0.6	2.3 ± 1.0
3715	2261	4.5 - 5.0	< 12	1.2 ± 0.8	4 ± 2
3715	2261	5.5 - 6.0	< 13	1.8 ± 0.9	7 ± 2
3715	2300	0.0 - 0.5	< 10	1.6 ± 0.7	6 ± 1
3715	2300	1.5 - 2.0	< 9	2.2 ± 0.6	4 ± 1
3718	2290	0.0 - 0.5	< 9	1.1 ± 0.8	9 ± 2
3718	2290	3.0 - 3.5	< 12	2.2 ± 0.7	6 ± 2
3718	2290	4.0 - 4.5	< 9	2.1 ± 0.8	6 ± 2
3726	2345	0.0 - 0.5	< 10	1.5 ± 0.6	3 ± 1
3726	2345	2.0 - 2.5	< 8	1.1 ± 0.7	3 ± 1
3726	2345	5.0 - 5.5	< 5	1.8 ± 0.5	1.2 ± 0.8
3726	2350	0.0 - 0.5	< 12	1.1 ± 0.7	4 ± 1
3726	2350	1.0 - 1.5	< 10	2.4 ± 0.8	3 ± 1
3726	2350	4.5 - 5.0	< 7	1.5 ± 0.9	1.5 ± 0.9
3735	2385	0.0 - 0.5	< 5	1.2 ± 0.5	2.0 ± 0.8
3735	2385	1.5 - 2.0	< 11	1.0 ± 0.5	2.1 ± 0.9
3735	2385	4.5 - 5.0	< 8	1.4 ± 0.4	1.0 ± 0.5

TABLE 5-1

(continued)

Coordinates[a]		Depth	Concentration (pCi/g ± 2 sigma)		
East	North	(ft)	Uranium-238	Radium-226	Thorium-232
3737	2368	0.0 - 0.5	< 7	< 1	1.4 ± 0.9
3737	2368	2.0 - 2.5	< 4	0.9 ± 0.5	1.3 ± 0.8
3737	2368	4.0 - 4.5	< 10	1.3 ± 0.5	1.6 ± 0.7
3738	2422	0.0 - 0.5	< 6	1.1 ± 0.5	1.8 ± 0.9
3738	2422	1.0 - 1.5	< 8	1.3 ± 0.5	2.0 ± 0.9
3738	2422	5.5 - 6.0	< 9	< 1	2.0 ± 0.7

[a]Measurement locations are shown in Figure 4-2

TABLE 5-2

DOWNHOLE GAMMA LOGGING RESULTS FOR

INTERSTATE 80 (EASTBOUND RIGHT-OF-WAY)

Coordinates[a] East	Coordinates[a] North	Depth[b] (ft)	Count Rate[c] (cpm)
3625	2050	0.5	11000
3625	2050	1.0	12000
3625	2050	1.5	14000
3625	2050	2.0	14000
3625	2050	2.5	13000
3625	2050	3.0	14000
3625	2050	3.5	14000
3638	2120	0.5	16000
3638	2120	1.0	20000
3638	2120	1.5	19000
3638	2120	2.0	17000
3638	2120	2.5	15000
3638	2120	3.0	14000
3638	2120	3.5	13000
3638	2120	4.0	13000
3638	2120	4.5	13000
3638	2120	5.0	12000
3638	2120	5.5	11000
3638	2120	6.0	10000
3638	2120	6.5	10000
3638	2120	7.0	12000
3644	2151	0.5	32000
3644	2151	1.0	48000
3644	2151	1.5	52000
3644	2151	2.0	57000
3644	2151	2.5	85000
3644	2151	3.0	100000
3644	2151	3.5	59000
3644	2151	4.0	25000

TABLE 5-2

(continued)

Coordinates[a]		Depth[b]	Count Rate[c]
East	North	(ft)	(cpm)
3644	2151	4.5	15000
3644	2151	5.0	12000
3644	2151	5.5	11000
3644	2151	6.0	11000
3644	2151	6.5	12000
3650	2035	0.5	16000
3650	2035	1.0	15000
3650	2035	1.5	12000
3650	2035	2.0	12000
3650	2035	2.5	13000
3650	2035	3.0	14000
3650	2035	3.5	14000
3650	2035	4.0	14000
3650	2035	4.5	16000
3650	2050	0.5	21000
3650	2050	1.0	22000
3650	2050	1.5	19000
3650	2050	2.0	15000
3650	2050	2.5	15000
3650	2050	3.0	14000
3650	2050	3.5	14000
3650	2050	4.0	14000
3650	2050	4.5	15000
3650	2050	5.0	15000
3650	2050	5.5	15000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
3655	2080	0.5	17000
3655	2080	1.0	19000
3655	2080	1.5	20000
3655	2080	2.0	18000
3655	2080	2.5	17000
3655	2080	3.0	14000
3655	2080	3.5	13000
3655	2080	4.0	12000
3655	2080	4.5	12000
3655	2080	5.0	13000
3655	2080	5.5	12000
3655	2100	0.5	21000
3655	2100	1.0	25000
3655	2100	1.5	28000
3655	2100	2.0	24000
3655	2100	2.5	21000
3655	2100	3.0	19000
3655	2100	3.5	16000
3655	2100	4.0	15000
3655	2100	4.5	13000
3655	2100	5.0	14000
3655	2100	5.5	14000
3655	2100	6.0	15000
3655	2100	6.5	14000
3655	2140	0.5	29000
3655	2140	1.0	47000
3655	2140	1.5	73000
3655	2140	2.0	105000
3655	2140	2.5	91000
3655	2140	3.0	68000
3655	2140	3.5	40000
3655	2140	4.0	19000
3655	2140	4.5	12000
3655	2140	5.0	11000
3655	2140	5.5	11000
3655	2140	6.0	9000
3655	2140	6.5	8000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
3660	2138	0.5	21000
3660	2138	1.0	27000
3660	2138	1.5	30000
3660	2138	2.0	27000
3660	2138	2.5	27000
3660	2138	3.0	26000
3660	2138	3.5	24000
3660	2138	4.0	19000
3660	2138	4.5	13000
3660	2138	5.0	10000
3660	2138	5.5	11000
3660	2138	6.0	10000
3660	2138	6.5	10000
3660	2138	7.0	10000
3672	2150	0.5	23000
3672	2150	1.0	29000
3672	2150	1.5	37000
3672	2150	2.0	40000
3672	2150	2.5	45000
3673	2165	0.5	19000
3673	2165	1.0	19000
3673	2165	1.5	20000
3673	2165	2.0	18000
3673	2165	2.5	19000
3673	2165	3.0	15000
3673	2165	3.5	15000
3673	2165	4.0	11000
3673	2165	4.5	11000
3673	2165	5.0	12000
3673	2165	5.5	12000
3673	2165	6.0	11000
3673	2165	6.5	10000
3673	2165	7.0	8000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
3675	2050	0.5	11000
3675	2050	1.0	14000
3675	2050	1.5	13000
3675	2050	2.0	15000
3675	2050	2.5	17000
3675	2050	3.0	15000
3675	2050	3.5	13000
3675	2050	4.0	13000
3675	2050	4.5	13000
3675	2050	5.0	13000
3675	2050	5.5	14000
3675	2050	6.0	14000
3675	2050	6.5	14000
3675	2120	0.5	16000
3675	2120	1.0	23000
3675	2120	1.5	25000
3675	2120	2.0	26000
3675	2120	2.5	26000
3675	2120	3.0	21000
3675	2120	3.5	20000
3675	2120	4.0	17000
3675	2120	4.5	15000
3675	2120	5.0	15000
3675	2120	5.5	13000
3675	2120	6.0	13000
3675	2120	6.5	13000
3675	2120	7.0	12000
3675	2120	7.5	12000
3675	2120	8.0	12000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
3683	2227	0.5	34000
3683	2227	1.0	52000
3683	2227	1.5	61000
3683	2227	2.0	74000
3683	2227	2.5	89000
3683	2227	3.0	55000
3683	2227	3.5	31000
3685	2105	0.5	15000
3685	2105	1.0	18000
3685	2105	1.5	20000
3685	2105	2.0	29000
3685	2105	2.5	34000
3685	2105	3.0	31000
3685	2105	3.5	28000
3685	2133	0.5	12000
3685	2133	1.0	17000
3685	2133	1.5	20000
3685	2133	2.0	17000
3685	2133	2.5	17000
3685	2133	3.0	18000
3685	2133	3.5	20000
3685	2133	4.0	22000
3685	2133	4.5	19000
3685	2133	5.0	15000
3685	2133	5.5	14000
3685	2133	6.0	14000
3685	2185	0.5	38000
3685	2185	1.0	55000
3685	2185	1.5	92000
3685	2185	2.0	135000
3685	2185	2.5	214000
3685	2185	3.0	293000
3685	2185	3.5	190000
3685	2185	4.0	68000
3685	2185	4.5	24000
3685	2185	5.0	14000
3685	2185	5.5	20000
3685	2185	6.0	24000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
3688	2150	0.5	15000
3688	2150	1.0	18000
3688	2150	1.5	18000
3688	2150	2.0	18000
3688	2150	2.5	20000
3688	2150	3.0	26000
3688	2150	3.5	34000
3688	2150	4.0	32000
3688	2150	4.5	19000
3688	2150	5.0	15000
3688	2150	5.5	15000
3688	2150	6.0	13000
3688	2150	6.5	13000
3688	2150	7.0	14000
3695	2226	0.5	18000
3695	2226	1.0	25000
3695	2226	1.5	22000
3695	2226	2.0	15000
3695	2226	2.5	13000
3695	2226	3.0	12000
3695	2226	3.5	13000
3695	2226	4.0	13000
3695	2226	4.5	14000
3697	2267	0.5	35000
3697	2267	1.0	48000
3697	2267	1.5	34000
3697	2267	2.0	22000
3697	2267	2.5	19000
3697	2267	3.0	16000
3697	2267	3.5	14000
3697	2267	4.0	14000
3697	2267	4.5	15000
3700	2194	0.5	12000
3700	2194	1.0	16000
3700	2194	1.5	17000
3700	2194	2.0	18000
3700	2194	2.5	19000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
3700	2194	3.0	19000
3700	2194	3.5	21000
3700	2194	4.0	29000
3700	2194	4.5	47000
3700	2194	5.0	57000
3700	2250	0.5	41000
3700	2250	1.0	62000
3700	2250	1.5	68000
3700	2250	2.0	74000
3700	2250	2.5	101000
3700	2250	3.0	129000
3700	2250	3.5	101000
3700	2250	4.0	105000
3700	2250	4.5	101000
3700	2275	0.5	54000
3700	2275	1.0	82000
3700	2275	1.5	76000
3700	2275	2.0	81000
3700	2275	2.5	84000
3700	2275	3.0	72000
3700	2275	3.5	67000
3700	2275	4.0	72000
3700	2275	4.5	85000
3700	2275	5.0	84000
3702	2240	0.5	29000
3702	2240	1.0	32000
3702	2240	1.5	30000
3702	2240	2.0	37000
3702	2240	2.5	61000
3702	2240	3.0	55000
3702	2240	3.5	32000
3702	2240	4.0	24000

TABLE 5-2

(continued)

Coordinates[a]		Depth[b]	Count Rate[c]
East	North	(ft)	(cpm)
3704	2291	0.5	17000
3704	2291	1.0	26000
3704	2291	1.5	29000
3704	2291	2.0	23000
3704	2291	2.5	18000
3704	2291	3.0	15000
3704	2291	3.5	13000
3705	2261	0.5	30000
3705	2261	1.0	46000
3705	2261	1.5	68000
3705	2261	2.0	69000
3705	2261	2.5	73000
3705	2261	3.0	41000
3705	2261	3.5	39000
3705	2261	4.0	54000
3705	2261	4.5	59000
3705	2261	5.0	62000
3712	2278	0.5	23000
3712	2278	1.0	31000
3712	2278	1.5	38000
3712	2278	2.0	59000
3712	2278	2.5	67000
3712	2278	3.0	59000
3712	2278	3.5	30000
3712	2278	4.0	21000
3715	2261	0.5	15000
3715	2261	1.0	18000
3715	2261	1.5	18000
3715	2261	2.0	18000
3715	2261	2.5	18000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
3715	2300	0.5	37000
3715	2300	1.0	48000
3715	2300	1.5	64000
3715	2300	2.0	66000
3715	2300	2.5	49000
3715	2300	3.0	27000
3715	2300	3.5	19000
3715	2300	4.0	13000
3715	2300	4.5	12000
3715	2300	5.0	12000
3715	2300	5.5	12000
3715	2300	6.0	13000
3715	2300	6.5	14000
3715	2300	7.0	11000
3718	2290	0.5	25000
3718	2290	1.0	36000
3718	2290	1.5	38000
3718	2290	2.0	47000
3718	2290	2.5	64000
3718	2290	3.0	65000
3718	2290	3.5	68000
3718	2290	4.0	50000
3718	2290	4.5	28000
3718	2290	5.0	17000
3718	2290	5.5	12000
3718	2290	6.0	13000
3723	2350	0.5	19000
3723	2350	1.0	25000
3723	2350	1.5	24000
3723	2350	2.0	19000
3723	2350	2.5	16000
3723	2350	3.0	15000
3723	2350	3.5	14000
3723	2350	4.0	13000
3723	2350	4.5	12000
3723	2350	5.0	12000
3723	2350	5.5	11000
3723	2350	6.0	13000
3723	2350	6.5	15000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
3726	2345	0.5	18000
3726	2345	1.0	19000
3726	2345	1.5	28000
3726	2345	2.0	34000
3726	2345	2.5	32000
3726	2345	3.0	34000
3726	2345	3.5	24000
3726	2345	4.0	14000
3726	2345	4.5	12000
3726	2345	5.0	12000
3726	2345	5.5	12000
3726	2350	0.5	20000
3726	2350	1.0	24000
3726	2350	1.5	27000
3726	2350	2.0	22000
3726	2350	2.5	18000
3726	2350	3.0	16000
3726	2350	3.5	15000
3726	2350	4.0	15000
3726	2350	4.5	15000
3726	2350	5.0	14000
3735	2385	0.5	14000
3735	2385	1.0	19000
3735	2385	1.5	21000
3735	2385	2.0	28000
3735	2385	2.5	21000
3735	2385	3.0	15000
3735	2385	3.5	14000
3735	2385	4.0	14000
3735	2385	4.5	13000
3735	2385	5.0	13000
3737	2368	0.5	17000
3737	2368	1.0	17000
3737	2368	1.5	22000
3737	2368	2.0	30000
3737	2368	2.5	29000
3737	2368	3.0	21000
3737	2368	3.5	15000

TABLE 5-2

(continued)

Coordinates[a] East	North	Depth[b] (ft)	Count Rate[c] (cpm)
3737	2368	4.0	13000
3737	2368	4.5	12000
3737	2368	5.0	13000
3737	2368	5.5	14000
3738	2422	0.5	14000
3738	2422	1.0	18000
3738	2422	1.5	18000
3738	2422	2.0	16000
3738	2422	2.5	14000
3738	2422	3.0	14000
3738	2422	3.5	13000
3738	2422	4.0	13000
3738	2422	4.5	12000
3738	2422	5.0	11000
3738	2422	5.5	11000
3738	2422	6.0	12000

[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 INTERSTATE 80

(EASTBOUND RIGHT-OF-WAY)

Coordinates[a]		Rate[b]
East	North	(μR/h)
3640	2060	8
3640	2130	9
3650	2170	22
3670	2150	14
3680	2230	15
3690	2260	18
3700	2270	16
3710	2300	8
3719	2339	17

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

[b]Measurements include background.

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