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

RADIOLOGICAL CHARACTERIZATION REPORT FOR THE COMMERCIAL PROPERTY AT 100 HANCOCK STREET

Lodi, New Jersey

September 1989

Bechtel National, Inc.

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RADIOLOGICAL CHARACTERIZATION REPORT FOR THE COMMERCIAL PROPERTY AT 100 HANCOCK STREET 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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063982

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SEP 29 1989

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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)
N. J. Beskid, ANL (w/e)

CONCURRENCE

DOE				

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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.

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.

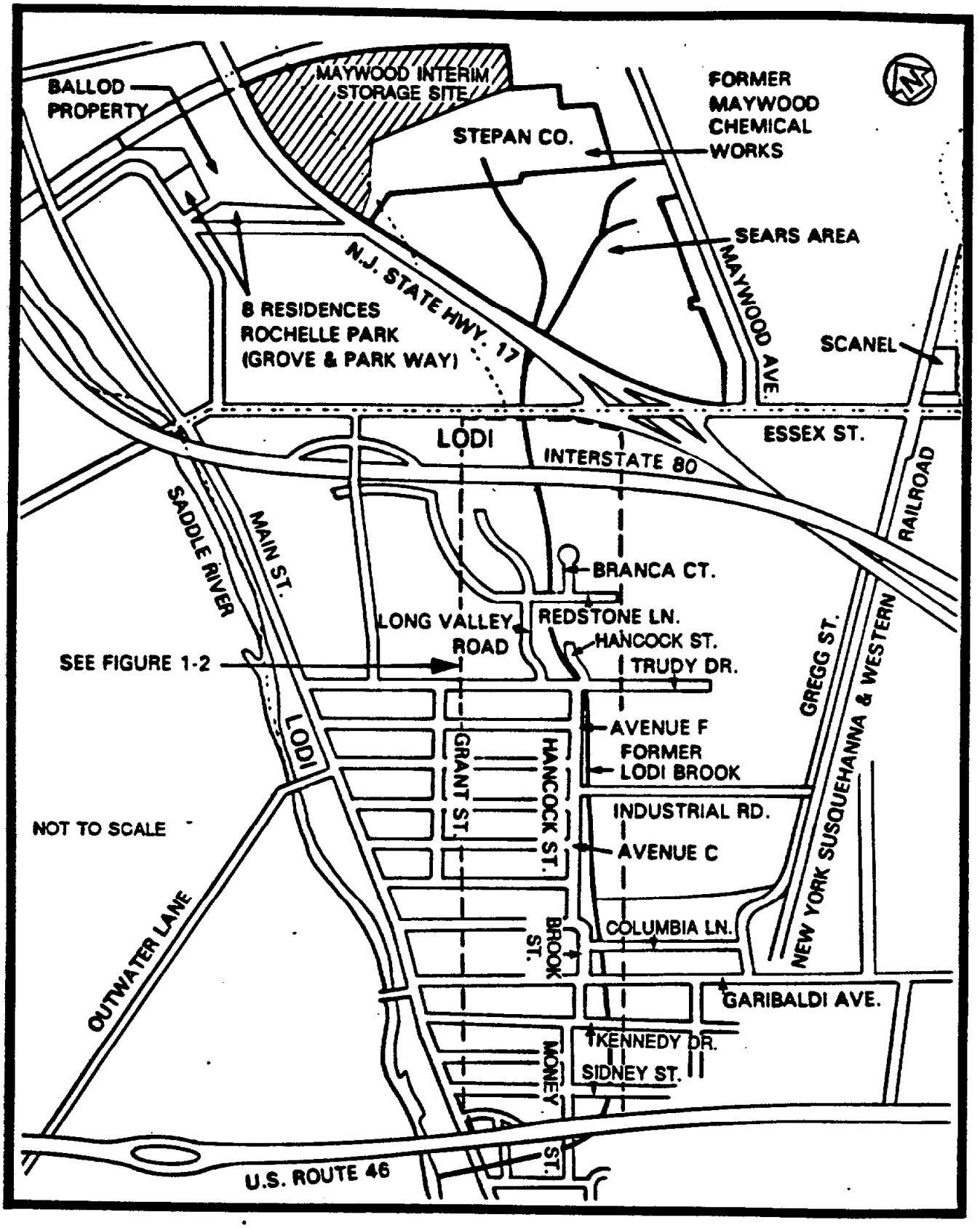

FIGURE 1-1 LOCATION OF LODI VICINITY PROPERTIES

1.2 PURPOSE

The purpose of the 1988 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 100 Hancock Street (Figure 1-2) in Lodi, New Jersey, which was conducted in September 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 property located at 100 Hancock Street is a commercial property that consists of a concrete block building with a grassy area and an asphalt-paved parking lot to the front of the building. Along the eastern side of the building is another grassy area with an inactive railroad spur. The western side of the building is bordered by an asphalt-paved loading area that adjoins another commercial property. The primary use of the property is the distribution of electronic components. The property is situated in a densely populated residential neighborhood; however, other commercial properties are located in close proximity.

This characterization confirmed that thorium-232 is the primary radioactive contaminant at this property. Results of surface soil samples for 100 Hancock Street showed maximum concentrations of thorium-232 and radium-226 to be 8.0 and 1.9 pCi/g, respectively. The maximum concentration of uranium-238 in surface soil samples was 6.7 pCi/g.

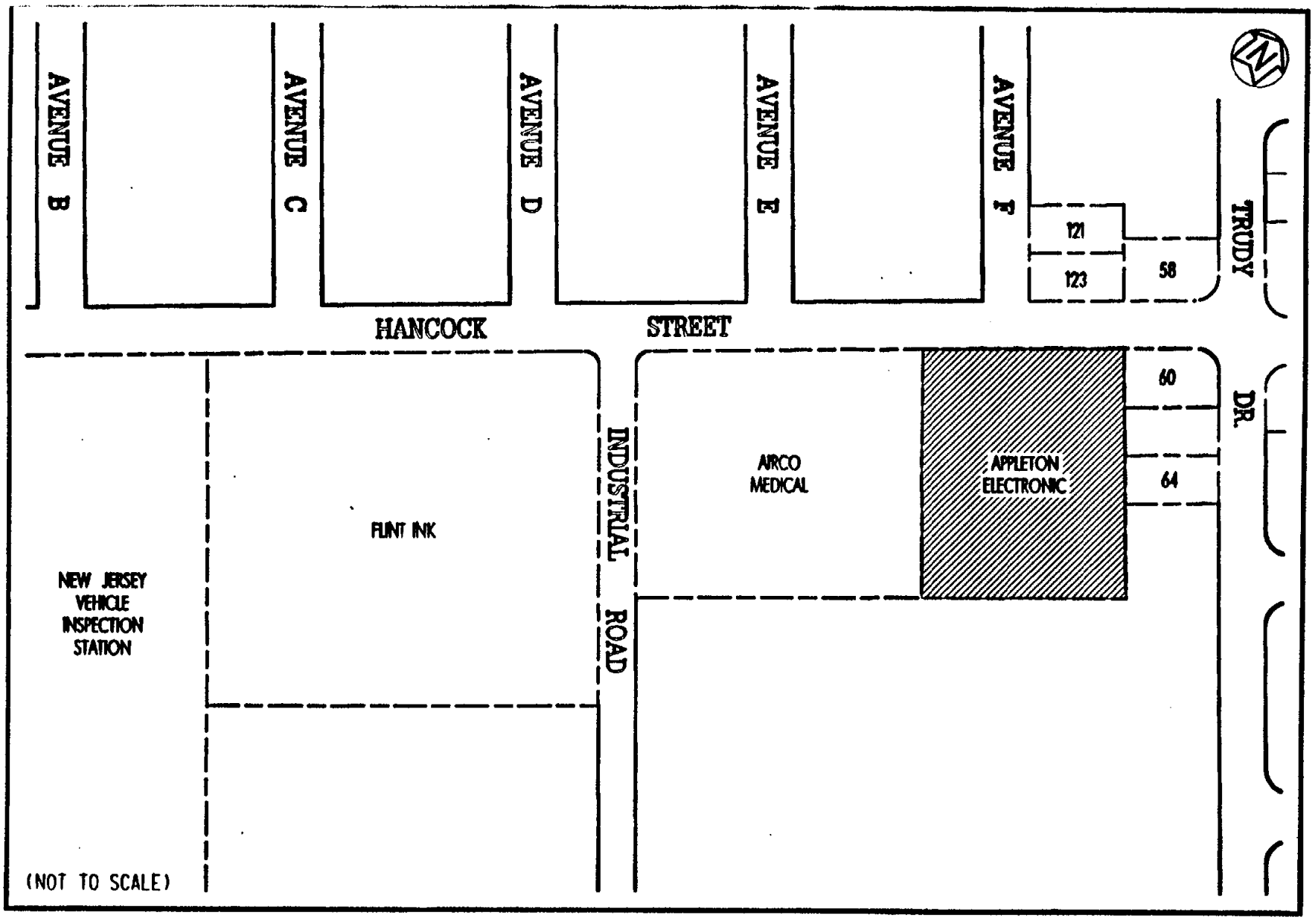

FIGURE 1-2 LOCATION OF 100 HANCOCK STREET

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Subsurface soil sample concentrations ranged from 0.6 to 5.4 pCi/g for thorium-232 and from 0.3 to 2.2 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 0.6 to 7.2 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 indicated surface contamination. Subsurface investigation by gamma logging indicated contamination to a depth of 2.74 m (9.0 ft).

Exterior gamma radiation exposure rates ranged from 5 to 41 μR/h, including background. The indoor measurement showed a rate of 9 μR/h, including background.

The radon-222 measurement inside the building indicated a concentration of 0.7 pCi/L, which is within the DOE guideline of 3.0 pCi/L.

The measurement for radon daughters was 0.001 working level (WL), and the measurement for thoron daughters was 0.001 WL.

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 100 Hancock Street. This contamination is both surface and subsurface contamination. The surface contamination is located in two areas along the eastern boundary of the property in a low-lying, grassy area. One area is near an open culvert that intersects the buried conduit containing the present-day channel of Lodi Brook. The other area is in the southeast corner of the property along the property line. The subsurface contamination ranges from a depth of 1.07 m (3.5 ft) to 2.74 m (9.0 ft). In addition, the contamination appears to extend beneath the building, and there is a high probability that the contamination extends beneath the street in front of the building. The total affected area is estimated to be approximately 40 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.

From review of aerial photographs of the area, it has been determined that the former channel of Lodi Brook was realigned and buried in concrete conduit parallel to Hancock Street on this property. Prior to this realignment, it is suspected that the former channel flowed across the property in a southwesterly direction in the area where the building now stands. Confirmation of this suspicion could not be obtained because of restricted physical access to the

area in question. Indoor boreholes could not be drilled to confirm the presence of contamination because of the small office area and size of equipment needed to accomplish the task.

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).

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).

June 1984--In June 1984, Oak Ridge National Laboratory (ORNL) conducted a "drive-by" survey of Lodi using its

"scanning van." Although not comprehensive, the survey indicated areas requiring further investigation (Ref. 7).

September 1986--At the request of DOE, ORNL conducted radiological surveys of the vicinity properties in Lodi in September 1986 to determine which properties contained radioactive contamination in excess of DOE guidelines and would, therefore, require remedial action (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

Radionuclide[f]	Allowable Surface Residual Contamination[e] (dpm/100 cm²) 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 11 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. 9).

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

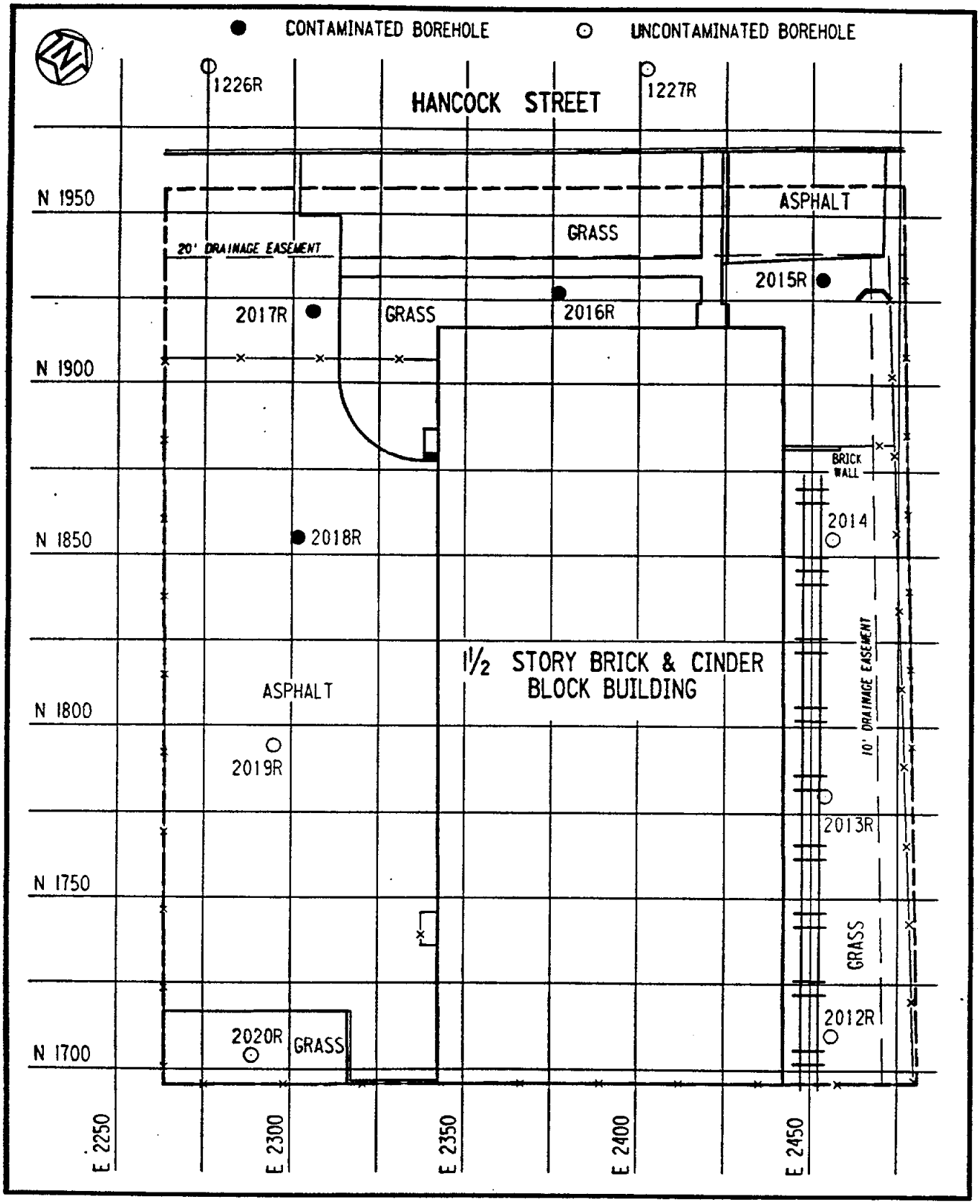

FIGURE 4-1 BOREHOLE LOCATIONS AT 100 HANCOCK STREET

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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, 7, and 8), the locations of biased surface soil samples were selected to better define the limits of contamination. Surface soil samples were taken at 11 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 11 locations (Figure 4-2) using 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 subsurface soil samples were analyzed for radium-226, uranium-238, and thorium-232 in the same manner as the surface soil samples.

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

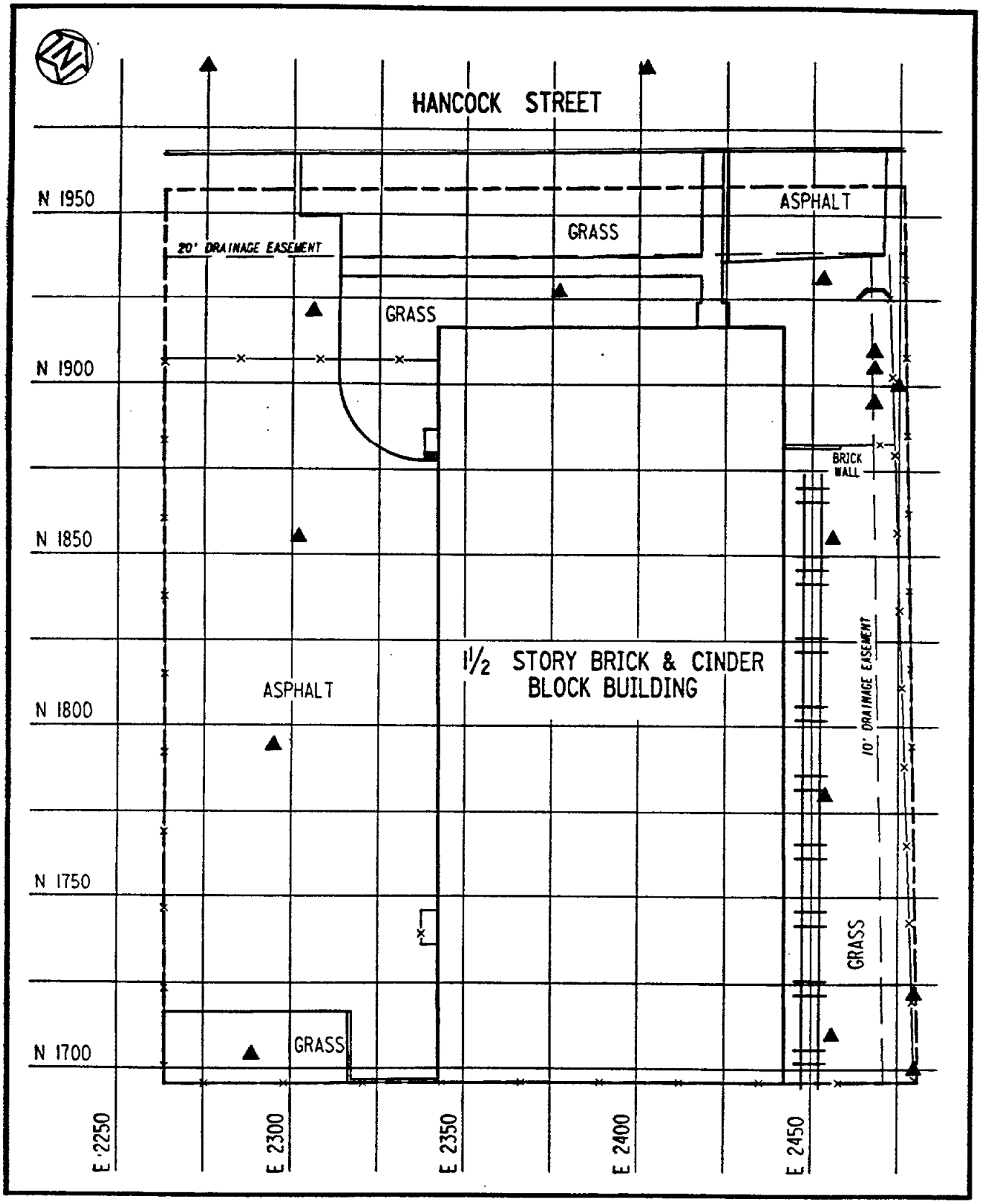

FIGURE 4-2 SURFACE AND SUBSURFACE SOIL SAMPLING LOCATIONS AT 100 HANCOCK STREET

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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.

An indoor radon measurement was 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.

Indoor air samples were also collected to determine a WL for radon and thoron daughters. To measure radon daughters, an air sample was collected for exactly 5 min through a 0.45-micron membrane filter at a rate of 11 L/min for a total sample volume of 55 L. Alpha particle activity on the filter paper was counted 40 to 90 min after sampling. An alpha scintillation detector coupled to a count-rate meter or a digital scaler was used. Measurements for thoron daughters were made using the same method as for radon daughters with the exception of the time between collection of the air sample and counting of the alpha particle activity. In the case of thoron daughters, the sample was allowed to age for at least 5 h after sampling before alpha activity was counted. This elapsed time allowed radon daughters, which may have been present with the thoron daughters, to decay sufficiently so as not to interfere in calculating the WL for thoron daughters.

Exterior gamma exposure rate measurements were made at nine locations throughout the property grid system and at one location inside the office area of 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 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.

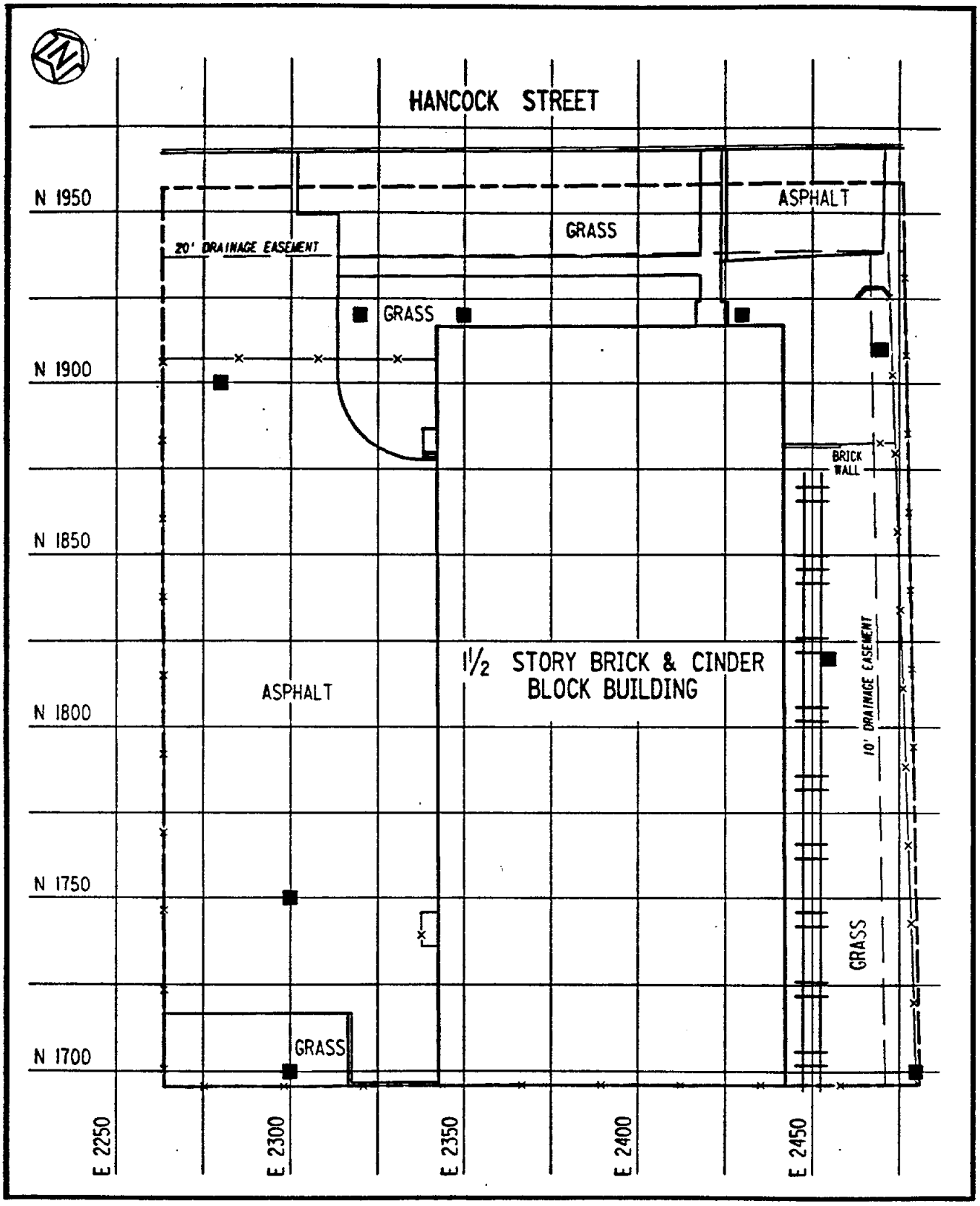

FIGURE 4-3 GAMMA EXPOSURE RATE MEASUREMENT LOCATIONS AT 100 HANCOCK STREET

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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 5,000 cpm to approximately 45,000 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 nine locations on the property and two locations in the street in front of the property (Figure 4-2). These samples were analyzed for thorium-232, uranium-238, and radium-226. The concentrations in these samples ranged from 1.1 to 6.7 pCi/g for uranium-238, from 1.2 to 8.0 pCi/g for thorium-232, and from 0.6 to 1.9 pCi/g for radium-226. Analytical results for surface soils are provided in Table 5-1; these data showed that concentrations of thorium-232 exceeded DOE guidelines (5 pCi/g plus background of 1 pCi/g for surface soils) with a maximum concentration of 8.0 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

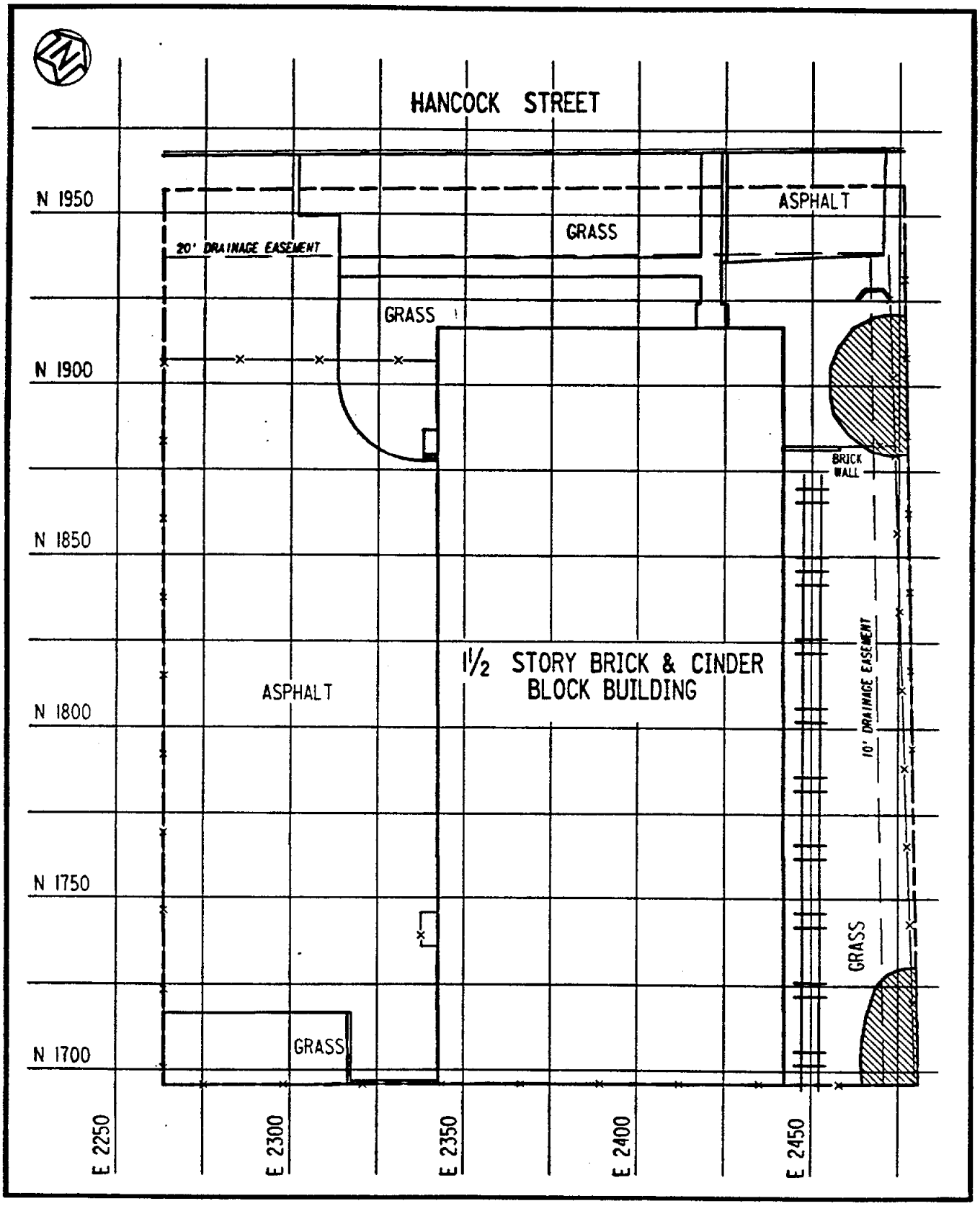

FIGURE 5-1 AREAS OF SURFACE CONTAMINATION AT 100 HANCOCK STREET

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"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 (±), 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 7,000 cpm to 61,000 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 0.6 to 7.2 pCi/g, thorium-232 concentrations ranging from 0.6 to 5.4 pCi/g, and radium-226 concentrations ranging from 0.3 to 2.2 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 1.07 m (3.5 ft) to 2.74 m (9.0 ft). The areas of subsurface contamination are shown in Figure 5-2. The subsurface contamination appears to extend beneath the building as well as into the street in front of the 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.

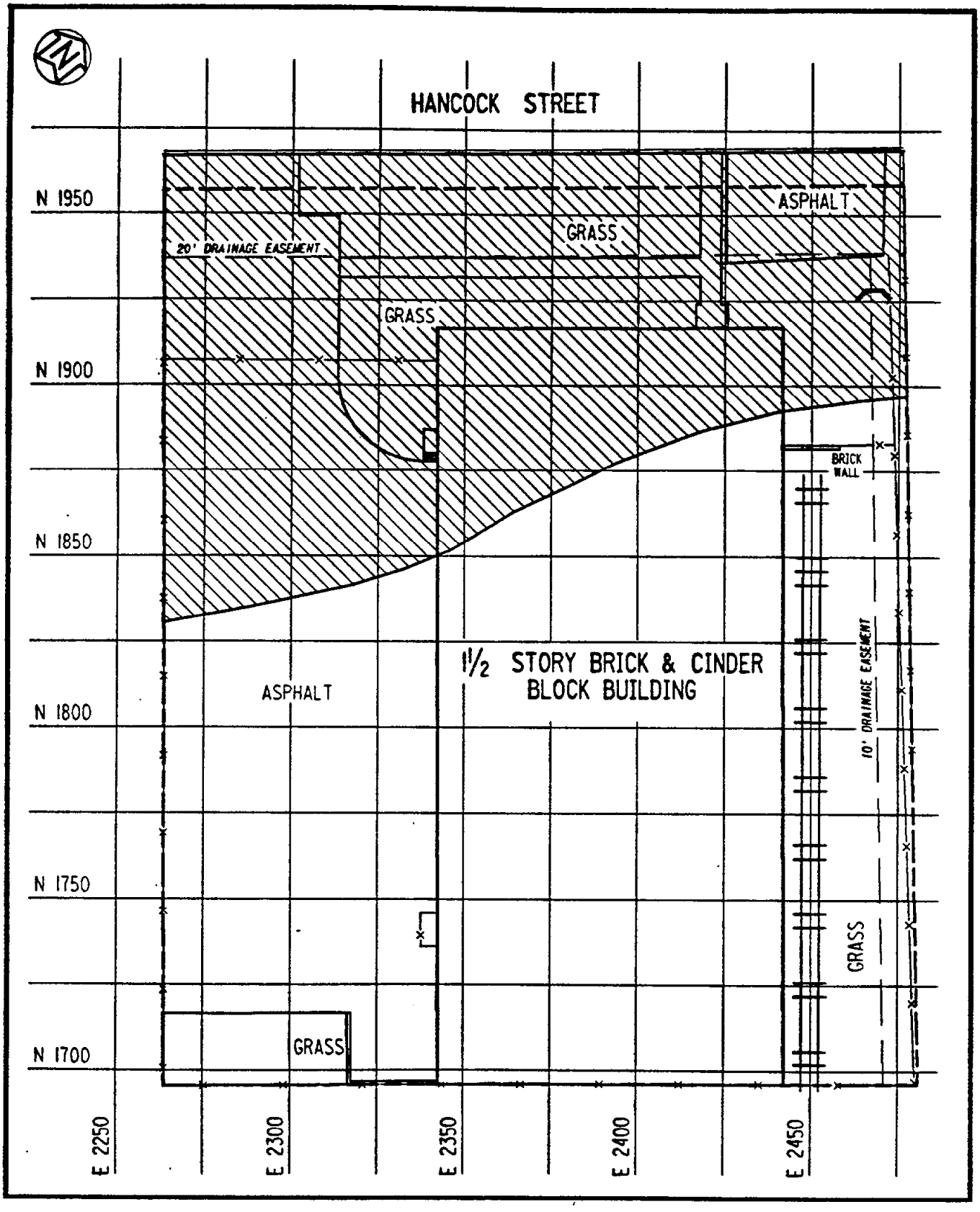

FIGURE 5-2 AREAS OF SUBSURFACE CONTAMINATION AT 100 HANCOCK STREET

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The contamination on the property is similar to contamination found on a residential property and a commercial property in close proximity to it. 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 100 Hancock Street. 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 an indoor radon measurement using the Tedlar bag method indicated a concentration of 0.7 pCi/L. This measurement was substantially less than the applicable DOE guideline of 3.0 pCi/L above background (Ref. 10).

The result of a measurement for radon daughters was 0.001 WL. These results were substantially less than the applicable generic guideline detailed in the Code of Federal Regulations, 40 CFR 192 (Ref. 10), which states that an annual average (or equivalent) radon decay product concentration not exceed 0.02 WL.

The result of a measurement for thoron daughters was 0.001 WL. The generic guideline is more restrictive for radon-222 (radon) than for radon-220 (thoron) according to the National Council on Radiological Protection [see NCRP Report No. 50 (Ref. 11), which was used as the guideline for thoron daughter measurements].

Exterior gamma radiation exposure rate measurements ranged from 5 to 41 μR/h, including background. These results can be found in Table 5-3. Assuming an employee spends 5 hours per week for 50 weeks per year (250 hours or 1 hour per day for 5 days per week) outside the building, the average exterior exposure rate of 16 μR/h would lead to a yearly dose of 2 mrem above background (after subtracting average background of 9 μR/h; Ref. 12).

The indoor exposure rate measurement was 9 μR/h, including background (Table 5-3). The indoor exposure rate does not exceed average background. For comparison, the DOE guideline for indoor exposure rate is 20 μR/h.

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 100 HANCOCK STREET

Coordinates[a] East	Coordinates[a] North	Depth (ft)	Concentration (pCi/g ± 2 sigma) Uranium-238	Radium-226	Thorium-232
2275	1993	0.0 - 0.5	< 4.7	< 1.1	< 1.6
2275	1993	4.0 - 5.0	< 3.4	< 0.7	< 1.2
2275	1993	7.0 - 8.0	< 5.0	< 1.1	< 1.8
2275	1993	8.0 - 10.0	< 2.9	< 0.7	< 1.0
2289	1704	0.0 - 1.0	< 2.0	0.6 ± 0.1	2.1 ± 0.8
2289	1704	1.0 - 2.0	< 2.0	0.6 ± 0.1	< 1.0
2289	1704	2.0 - 3.0	< 2.0	0.6 ± 0.2	1.0 ± 0.2
2289	1704	3.0 - 4.0	< 2.0	< 1.0	< 1.0
2289	1704	4.0 - 5.0	< 2.0	0.5 ± 0.2	1.1 ± 0.2
2289	1704	5.0 - 6.0	< 2.0	< 1.0	< 1.0
2289	1704	6.0 - 7.0	< 1.0	< 1.0	0.7 ± 0.2
2289	1704	7.0 - 8.0	< 2.0	0.6 ± 0.1	< 1.0
2289	1704	8.0 - 9.0	< 1.0	< 1.0	< 1.0
2289	1704	9.0 - 10.0	< 1.0	< 1.0	< 1.0
2289	1704	10.0 - 11.0	< 1.0	< 1.0	< 1.0
2289	1704	11.0 - 12.0	< 1.0	0.4 ± 0.1	0.8 ± 0.7
2295	1794	1.0 - 2.0	< 1.0	0.5 ± 0.1	1.3 ± 0.6
2295	1794	2.0 - 3.0	0.6 ± 0.3	0.5 ± 0.1	1.0 ± 0.1
2295	1794	3.0 - 4.0	< 2.0	0.5 ± 0.1	< 1.0
2295	1794	4.0 - 4.5	< 2.0	< 1.0	1.0 ± 0.5
2295	1794	4.5 - 5.0	< 1.0	0.7 ± 0.1	0.9 ± 0.5
2295	1794	5.0 - 5.5	< 2.0	0.5 ± 0.2	< 1.0
2295	1794	5.5 - 6.0	< 1.0	0.5 ± 0.2	0.9 ± 0.2
2295	1794	6.0 - 6.5	< 2.0	< 1.0	1.0 ± 0.3
2295	1794	6.5 - 7.0	< 1.0	0.5 ± 0.1	0.8 ± 0.3

TABLE 5-1

(continued)

Coordinates[a] East	Coordinates[a] North	Depth (ft)	Concentration (pCi/g ± 2 sigma) Uranium-238	Radium-226	Thorium-232
2295	1794	7.0 - 7.5	< 2.0	0.7 ± 0.2	< 1.0
2295	1794	7.5 - 8.0	< 1.0	0.5 ± 0.1	1.0 ± 0.6
2295	1794	8.0 - 8.5	< 2.0	< 1.0	< 1.0
2295	1794	8.5 - 9.0	< 2.0	0.5 ± 0.1	0.8 ± 0.5
2295	1794	9.0 - 9.5	1.8 ± 1.4	0.5 ± 0.2	0.8 ± 0.3
2295	1794	9.5 - 10.0	< 2.0	0.7 ± 0.1	1.1 ± 0.8
2295	1794	10.0 - 10.5	< 2.0	0.7 ± 0.1	1.2 ± 0.2
2295	1794	10.5 - 11.0	0.7 ± 0.3	0.6 ± 0.1	0.8 ± 0.1
2295	1794	11.0 - 11.5	< 2.0	0.5 ± 0.1	1.0 ± 0.2
2295	1794	11.5 - 12.0	< 2.0	< 1.0	< 1.0
2302	1855	0.5 - 2.0	2.0 ± 1.9	< 1.0	< 1.0
2302	1855	4.0 - 5.0	< 2.0	< 1.0	< 1.0
2302	1855	5.0 - 6.0	< 2.0	0.7 ± 0.2	1.1 ± 0.6
2302	1855	6.0 - 8.0	< 2.0	< 1.0	0.8 ± 0.3
2302	1855	8.0 - 9.0	7.2 ± 3.3	1.7 ± 0.2	3.9 ± 1.2
2302	1855	9.0 - 10.0	< 1.0	0.8 ± 0.1	1.2 ± 0.1
2302	1855	10.0 - 11.0	< 2.0	< 1.0	< 1.0
2302	1855	11.0 - 12.0	< 2.0	< 1.0	< 1.0
2302	1855	12.0 - 13.0	< 2.0	< 1.0	< 1.0
2302	1855	13.0 - 14.0	< 1.0	< 1.0	< 1.0
2306	1921	1.0 - 2.0	0.6 ± 0.2	0.5 ± 0.1	1.1 ± 0.1
2306	1921	2.0 - 3.0	0.7 ± 0.3	0.5 ± 0.1	0.8 ± 0.1
2306	1921	4.0 - 5.0	< 3.0	0.7 ± 0.4	2.0 ± 1.0
2306	1921	7.0 - 8.0	4.4 ± 2.1	0.7 ± 0.2	2.3 ± 0.9
2306	1921	8.0 - 9.0	< 3.0	1.8 ± 0.2	5.4 ± 0.7
2306	1921	9.0 - 10.0	5.3 ± 2.3	1.2 ± 0.2	4.2 ± 0.6

TABLE 5-1

(continued)

Coordinates[a] East	Coordinates[a] North	Depth (ft)	Concentration (pCi/g ± 2 sigma) Uranium-238	Radium-226	Thorium-232
2306	1921	10.0 - 11.0	< 2.0	0.7 ± 0.2	1.3 ± 0.3
2306	1921	11.0 - 12.0	1.6 ± 1.1	0.6 ± 0.1	0.9 ± 0.1
2306	1921	12.0 - 13.0	< 3.0	< 1.0	2.3 ± 0.3
2306	1921	13.0 - 14.0	< 2.0	< 1.0	< 1.0
2377	1927	0.0 - 1.0	< 3.0	< 1.0	1.5 ± 0.6
2377	1927	1.0 - 2.0	< 2.0	< 1.0	1.8 ± 0.2
2377	1927	2.0 - 3.0	< 2.0	0.9 ± 0.2	1.2 ± 0.4
2377	1927	4.0 - 5.0	< 2.0	0.9 ± 0.2	1.2 ± 0.3
2377	1927	5.0 - 6.0	< 1.0	0.6 ± 0.1	0.6 ± 0.2
2377	1927	6.0 - 7.0	< 2.0	0.7 ± 0.1	1.3 ± 0.5
2377	1927	7.0 - 8.0	1.5 ± 1.2	0.9 ± 0.2	1.9 ± 0.2
2377	1927	8.0 - 10.0	2.3 ± 1.6	1.1 ± 0.2	4.5 ± 0.3
2377	1927	10.0 - 11.0	3.1 ± 2.0	1.3 ± 0.1	5.0 ± 0.7
2377	1927	11.0 - 12.0	1.6 ± 1.4	0.7 ± 0.3	1.9 ± 0.5
2377	1927	12.0 - 13.0	1.7 ± 1.2	< 1.0	1.3 ± 0.2
2402	1993	0.0 - 0.5	< 5.0	< 1.1	< 1.4
2402	1993	4.0 - 5.0	< 4.9	< 1.0	< 1.6
2402	1993	9.0 - 10.0	< 4.1	< 1.0	< 1.4
2453	1931	0.0 - 1.0	< 2.0	0.5 ± 0.1	< 1.0
2453	1931	1.0 - 2.0	< 2.0	0.9 ± 0.1	3.0 ± 0.2
2453	1931	2.0 - 3.0	2.8 ± 2.1	< 1.0	2.1 ± 0.4
2453	1931	3.0 - 4.0	< 2.0	0.6 ± 0.1	0.8 ± 0.3
2453	1931	4.0 - 5.0	2.4 ± 0.7	1.2 ± 0.1	5.2 ± 0.2

TABLE 5-1

(continued)

Coordinates[a]		Depth	Concentration (pCi/g ± 2 sigma)		
East	North	(ft)	Uranium-238	Radium-226	Thorium-232
2453	1931	7.0 - 8.0	0.9 ± 0.3	0.8 ± 0.1	2.7 ± 0.3
2453	1931	8.0 - 9.0	< 2.0	< 1.0	1.8 ± 0.3
2453	1931	9.0 - 10.0	< 2.0	< 1.0	< 1.0
2453	1931	10.0 - 11.0	< 1.0	0.5 ± 0.2	0.7 ± 0.1
2453	1931	11.0 - 12.0	< 2.0	< 1.0	< 1.0
2453	1931	12.0 - 13.0	< 1.0	< 1.0	< 1.0
2453	1931	13.0 - 14.0	< 2.0	< 1.0	0.7 ± 0.2
2454	1780	0.0 - 0.5	1.7 ± 0.6	0.8 ± 0.1	1.5 ± 0.3
2454	1780	0.5 - 1.0	< 2.0	0.6 ± 0.1	0.9 ± 0.5
2454	1780	1.0 - 1.5	< 2.0	< 1.0	< 1.0
2454	1780	1.5 - 2.0	< 2.0	0.5 ± 0.1	1.2 ± 0.5
2454	1780	2.0 - 2.5	< 2.0	0.5 ± 0.1	< 1.0
2454	1780	2.5 - 3.0	< 2.0	0.5 ± 0.1	0.6 ± 0.2
2454	1780	3.0 - 3.5	< 2.0	< 1.0	0.8 ± 0.1
2454	1780	3.5 - 4.0	< 1.0	0.4 ± 0.1	0.7 ± 0.3
2454	1780	4.0 - 4.5	< 2.0	< 1.0	< 1.0
2454	1780	4.5 - 5.0	< 1.0	< 1.0	< 1.0
2454	1780	5.0 - 5.5	1.9 ± 1.4	< 1.0	< 1.0
2454	1780	5.5 - 6.0	< 2.0	0.3 ± 0.1	< 1.0
2456	1710	0.0 - 0.5	< 3.0	0.9 ± 0.4	1.8 ± 0.7
2456	1710	0.5 - 1.0	< 2.0	< 1.0	0.8 ± 0.1
2456	1710	1.0 - 1.5	1.1 ± 1.0	0.5 ± 0.1	0.6 ± 0.4
2456	1710	1.5 - 2.0	< 2.0	< 1.0	< 1.0
2456	1710	2.0 - 2.5	1.4 ± 1.3	< 1.0	1.0 ± 0.5
2456	1710	2.5 - 3.0	< 2.0	< 1.0	1.2 ± 0.5
2456	1710	3.0 - 3.5	< 2.0	0.6 ± 0.4	0.8 ± 0.6

TABLE 5-1

(continued)

Coordinates[a] East	Coordinates[a] North	Depth (ft)	Concentration (pCi/g ± 2 sigma) Uranium-238	Radium-226	Thorium-232
2456	1710	3.5 - 4.0	< 2.0	< 1.0	< 1.0
2456	1710	4.0 - 4.5	< 2.0	0.5 ± 0.2	0.7 ± 0.3
2456	1710	4.5 - 5.0	< 2.0	0.3 ± 0.2	0.7 ± 0.2
2456	1710	5.0 - 5.5	< 2.0	< 1.0	< 1.0
2456	1710	5.5 - 6.0	< 2.0	0.5 ± 0.3	1.0 ± 0.4
2456	1855	0.0 - 0.5	1.1 ± 0.4	0.6 ± 0.1	1.2 ± 0.1
2456	1855	0.5 - 1.0	< 2.0	0.6 ± 0.3	1.1 ± 0.4
2456	1855	1.0 - 1.5	< 2.0	< 1.0	1.2 ± 0.6
2456	1855	1.5 - 2.0	5.7 ± 2.3	2.2 ± 0.8	2.4 ± 0.4
2456	1855	2.0 - 2.5	2.3 ± 2.0	1.0 ± 0.3	< 1.0
2456	1855	2.5 - 3.0	< 2.0	0.5 ± 0.4	< 1.0
2456	1855	3.0 - 3.5	1.8 ± 1.4	0.7 ± 0.1	1.2 ± 0.3
2456	1855	3.5 - 4.0	< 2.0	0.6 ± 0.3	1.1 ± 0.1
2456	1855	4.0 - 4.5	< 2.0	0.7 ± 0.2	1.6 ± 0.3
2456	1855	4.5 - 5.0	< 3.0	< 1.0	1.5 ± 0.5
2456	1855	5.0 - 5.5	< 2.0	< 1.0	< 1.0
2456	1855	5.5 - 6.0	< 2.0	0.5 ± 0.1	0.9 ± 0.5
2456	1855	6.0 - 6.5	< 3.0	< 1.0	< 1.0
2456	1855	6.5 - 7.0	< 2.0	0.6 ± 0.1	0.9 ± 0.5
2456	1855	7.0 - 7.5	< 2.0	0.7 ± 0.6	< 1.0
2456	1855	7.5 - 8.0	< 1.0	0.3 ± 0.2	< 1.0

TABLE 5-1

(continued)

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Coordinates[a] East	Coordinates[a] North	Depth (ft)	Concentration (pCi/g ± 2 sigma) Uranium-238	Radium-226	Thorium-232
2468	1895	0.0 - 0.5	3.4 ± 0.7	1.1 ± 0.1	5.2 ± 0.2
2468	1905	0.0 - 0.5	4.0 ± 0.5	1.2 ± 0.1	5.4 ± 0.3
2468	1910	0.0 - 0.5	3.2 ± 0.5	1.0 ± 0.1	5.1 ± 0.1
2475	1900	0.0 - 0.5	< 4.0	1.9 ± 0.2	8.0 ± 0.7
2480	1700	0.0 - 0.5	4.4 ± 2.5	< 1.7	6.6 ± 1.0
2480	1722	0.0 - 0.5	6.7 ± 0.6	1.4 ± 0.1	6.3 ± 0.6

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

TABLE 5-2

(continued)

Page 2 of 7

Coordinates[a] East	Coordinates[a] North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 2020R (continued)			
2289	1704	9.0	7000
2289	1704	9.5	7000
2289	1704	10.0	7000
2289	1704	10.5	6000
2289	1704	11.0	7000
2289	1704	11.5	8000
2289	1704	12.0	10000
Borehole 2019R[d]			
2295	1794	0.5	8000
2295	1794	1.0	12000
2295	1794	1.5	15000
2295	1794	2.0	15000
2295	1794	2.5	13000
2295	1794	3.0	13000
2295	1794	3.5	12000
2295	1794	4.0	12000
2295	1794	4.5	12000
2295	1794	5.0	11000
2295	1794	5.5	11000
2295	1794	6.0	11000
2295	1794	6.5	11000
2295	1794	7.0	11000
2295	1794	7.5	10000
2295	1794	8.0	10000
2295	1794	8.5	10000
2295	1794	9.0	10000
2295	1794	9.5	11000
Borehole 2018R[d]			
2302	1855	0.5	7000
2302	1855	1.0	11000
2302	1855	1.5	13000
2302	1855	2.0	14000
2302	1855	2.5	15000

TABLE 5-2

DOWNHOLE GAMMA LOGGING RESULTS

FOR 100 HANCOCK STREET

Coordinates[a] East	Coordinates[a] North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 1226R[d]			
2275	1993	0.5	5000
2275	1993	1.0	8000
2275	1993	1.5	10000
2275	1993	2.0	11000
2275	1993	2.5	11000
2275	1993	3.0	10000
2275	1993	3.5	10000
2275	1993	4.0	10000
2275	1993	4.5	10000
2275	1993	5.0	10000
2275	1993	5.5	10000
2275	1993	6.0	10000
2275	1993	6.5	11000
2275	1993	7.0	10000
2275	1993	7.5	9000
2275	1993	8.0	10000
Borehole 2020R			
2289	1704	0.5	8000
2289	1704	1.0	12000
2289	1704	1.5	15000
2289	1704	2.0	15000
2289	1704	2.5	13000
2289	1704	3.0	13000
2289	1704	3.5	11000
2289	1704	4.0	10000
2289	1704	4.5	8000
2289	1704	5.0	10000
2289	1704	5.5	11000
2289	1704	6.0	11000
2289	1704	6.5	11000
2289	1704	7.0	10000
2289	1704	7.5	9000
2289	1704	8.0	8000
2289	1704	8.5	8000

TABLE 5-2

(continued)

Coordinates[a] East	Coordinates[a] North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 2018R (continued)[d]			
2302	1855	3.0	18000
2302	1855	3.5	30000
2302	1855	4.0	27000
2302	1855	4.5	19000
2302	1855	5.0	14000
2302	1855	5.5	12000
2302	1855	6.0	10000
Borehole 2017R[d]			
2306	1921	0.5	14000
2306	1921	1.0	15000
2306	1921	1.5	15000
2306	1921	2.0	14000
2306	1921	2.5	15000
2306	1921	3.0	14000
2306	1921	3.5	14000
2306	1921	4.0	16000
2306	1921	4.5	18000
2306	1921	5.0	20000
2306	1921	5.5	20000
2306	1921	6.0	19000
2306	1921	6.5	32000
2306	1921	7.0	42000
2306	1921	7.5	37000
2306	1921	8.0	36000
2306	1921	8.5	61000
2306	1921	9.0	56000
2306	1921	9.5	21000
2306	1921	10.0	14000
2306	1921	10.5	11000
2306	1921	11.0	10000
2306	1921	11.5	9000
2306	1921	12.0	9000

TABLE 5-2

(continued)

Coordinates[a] East	Coordinates[a] North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 2016R[d]			
2377	1927	0.5	12000
2377	1927	1.0	17000
2377	1927	1.5	14000
2377	1927	2.0	15000
2377	1927	2.5	14000
2377	1927	3.0	14000
2377	1927	3.5	14000
2377	1927	4.0	14000
2377	1927	4.5	14000
2377	1927	5.0	13000
2377	1927	5.5	18000
2377	1927	6.0	15000
2377	1927	6.5	32000
2377	1927	7.0	28000
2377	1927	7.5	35000
2377	1927	8.0	39000
2377	1927	8.5	33000
2377	1927	9.0	33000
2377	1927	9.5	29000
2377	1927	10.0	27000
2377	1927	10.5	17000
2377	1927	11.0	18000
2377	1927	11.5	15000
2377	1927	12.0	16000
Borehole 1227R[d]			
2402	1993	0.5	8000
2402	1993	1.0	10000
2402	1993	1.5	10000
2402	1993	2.0	9000
2402	1993	2.5	9000
2402	1993	3.0	9000
2402	1993	3.5	9000
2402	1993	4.0	11000
2402	1993	4.5	11000
2402	1993	5.0	11000
2402	1993	5.5	11000

TABLE 5-2

(continued)

Page 5 of 7

Coordinates[a] East	Coordinates[a] North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 1227R (continued)[d]			
2402	1993	6.0	9000
2402	1993	6.5	9000
2402	1993	7.0	9000
2402	1993	7.5	9000
Borehole 2015R			
2453	1931	0.5	18000
2453	1931	1.0	22000
2453	1931	1.5	21000
2453	1931	2.0	20000
2453	1931	2.5	15000
2453	1931	3.0	14000
2453	1931	3.5	15000
2453	1931	4.0	20000
2453	1931	4.5	25000
2453	1931	5.0	29000
2453	1931	5.5	41000
2453	1931	6.0	35000
2453	1931	6.5	17000
2453	1931	7.0	12000
2453	1931	7.5	10000
2453	1931	8.0	10000
Borehole 2013R			
2454	1780	0.5	8000
2454	1780	1.0	10000
2454	1780	1.5	9000
2454	1780	2.0	11000
2454	1780	2.5	11000
2454	1780	3.0	9000
2454	1780	3.5	9000
2454	1780	4.0	10000
2454	1780	4.5	7000
2454	1780	5.0	8000
2454	1780	5.5	8000

TABLE 5-2

(continued)

Coordinates[a] East	Coordinates[a] North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 2013R (continued)			
2454	1780	6.0	9000
2454	1780	6.5	8000
2454	1780	7.0	9000
2454	1780	7.5	10000
2454	1780	8.0	10000
2454	1780	8.5	10000
2454	1780	9.0	9000
2454	1780	9.5	8000
2454	1780	10.0	8000
Borehole 2012R			
2456	1710	0.5	10000
2456	1710	1.0	11000
2456	1710	1.5	11000
2456	1710	2.0	11000
2456	1710	2.5	10000
2456	1710	3.0	10000
2456	1710	3.5	9000
2456	1710	4.0	9000
2456	1710	4.5	8000
2456	1710	5.0	7000
2456	1710	5.5	8000
2456	1710	6.0	8000
2456	1710	6.5	8000
2456	1710	7.0	8000
2456	1710	7.5	8000
2456	1710	8.0	8000
2456	1710	8.5	9000
2456	1710	9.0	10000
2456	1710	9.5	10000
2456	1710	10.0	11000

TABLE 5-2

(continued)

Coordinates[a] East	Coordinates[a] North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 2014R			
2456	1855	0.5	11000
2456	1855	1.0	15000
2456	1855	1.5	16000
2456	1855	2.0	14000
2456	1855	2.5	12000
2456	1855	3.0	11000
2456	1855	3.5	10000
2456	1855	4.0	10000
2456	1855	4.5	10000
2456	1855	5.0	10000
2456	1855	5.5	10000
2456	1855	6.0	9000
2456	1855	6.5	9000
2456	1855	7.0	8000
2456	1855	7.5	7000
2456	1855	8.0	8000
2456	1855	8.5	9000
2456	1855	9.0	10000
2456	1855	9.5	10000
2456	1855	10.0	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.

[d]Bottom of borehole collapsed.

TABLE 5-3

GAMMA RADIATION EXPOSURE RATES

FOR 100 HANCOCK STREET

Coordinates[a]		Rate[b]
East	North	(μR/h)
2280	1900	5
2300	1700	9
2300	1750	5
2320	1920	13
2350	1920	14
2430	1920	13
2455	1820	8
2470	1910	41
2480	1700	27
Interior of Building		9

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

[b]Measurements include background.

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APPENDIX A
GEOLOGIC DRILL LOGS FOR 100 HANCOCK STREET

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	1226R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
Hancock St. (LODI)	N 1,993 E 2,275	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
12-8-87	12-8-87	E.D.I.	MOBILE B-57	6.5"	10.0		10.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
6.6/69		5			▼ /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 lbs./ 30 in.	NONE	D. Harnish

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	BARREL REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	WATER PRESSURE TESTS: PRESS. P.S.I.	WATER PRESSURE TESTS: TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS	1.5	1.3	20-14-11								0.0 - 4.4 Ft. GRAVEL and Silty GRAVEL FILL (GP, GM).	Borehole advanced 0-10 Ft. using 6.5 in. o.d. hollow-stem auger. Sampled and gamma-logged by TMA-Eberline, Inc.
SS	2.0	1.0	7-13 24-18								0.0-0.9 Ft. Gravel, broken basalt gravel.	
SS	2.0	1.6	26-60-75								0.9-4.0 Ft. Silty gravel, dusky red, angular Brunswick sandstone, basalt and schist gravel; thin layers of organic silt.	
SS	2.0	1.5	33-32 33-29					5			4.0-4.4 Ft. Silt, greenish gray, soft, damp.	0.0-0.5 Ft. Not sampled. Road base.
SS	2.0	1.2	8-9-16 13								4.4 - 10.0 Ft. SILT (ML). Grayish brown (10YR5/2) becoming brown (7.5YR5/4) downward, top has yellowish brown iron-oxide mottling.	
								10			4.4-4.7 Ft. Pieces of reddish brown and dark green silt mixed in.	
											4.4-8.0 Ft. Dry, stiff, crumbly.	ENMET reads >300 ppm with probe at 6 in. in a 10.0 Ft. boring.
											8.0-10.0 Ft. Damp.	
											Bottom of borehole at 10.0 Ft. Borehole backfilled with spoils, 12/8/87.	

Identification and classification of soils by visual examination.

S = SPLIT SPOON; ST = SHELBY TUBE; = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
Hancock St. (LODI)	1226R

GEOLOGIC DRILL LOG

PROJECT: FUSRAP	JOB NO.: 14501-138	SHEET NO.: 1 OF 1	HOLE NO.: 2020R			
SITE: 100 Hancock St. (LODI)	COORDINATES: N 1,704 E 2,289	ANGLE FROM HORIZ: Vertical	BEARING: ------			
BEGUN: 9-2-88	COMPLETED: 9-2-88	DRILLER: EMPIRE SOILS	DRILL MAKE AND MODEL: CME 45B	SIZE: 12"	OVERBURDEN: 12.0	ROCK (FT.):	TOTAL DEPTH: 12.0
CORE RECOVERY (FT./%): 10.6/88	CORE BOXES:	SAMPLES: 6	EL. TOP CASING:	GROUND EL.:	DEPTH/EL. GROUND WATER: ▽ 7.5/ 9/2/88	DEPTH/EL. TOP OF ROCK:	
SAMPLE HAMMER WEIGHT/FALL: 300 lbs./ 24 in.	CASING LEFT IN HOLE: DIA./LENGTH: NONE	LOGGED BY: J. Lord					

TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE "N" BLOWS % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS	2.0	1.6	5-8-12 1S								0.0 - 3.2 Ft. Sandy SILT FILL. Moderate brown (5YR3/4) to dusky red (5R3/4) mixed organic flecks, brick, gravel with a sandy silt loam. Dry, soft, crumbles easily. No cohesion.	Borehole advanced 0-12 Ft. using 12 in. o.d. hollow stem augers. Radiologically sampled and gamma scanned by TMA-Eberline, Inc.
SS	2.0	1.8	8-5-5-6									
SS	2.0	1.2	8-15-15 1S					5			3.2 - 8.0 Ft. Clayey sandy SILT (ML-CL). Light olive gray (5Y5/2) to yellowish gray (5Y7/2). Slightly moist, cohesive, weak thread, no dilatancy. Fines component decreases in amount with depth. 4.0 Ft. Becoming more sandy with depth.	
SS	2.0	2.0	15-15 17-20								7.0 Ft. Unit has graded to a uniform yellowish gray (5Y7/2) silt. Much better sorted; cleaner. Moist to saturated for the last 6". Grades from stiff to runny. Slightly cohesive in the moist upper interval.	7.5 Ft. Groundwater observed. 8.0 Ft. Top of undisturbed soil.
SS	2.0	2.0	3-4-8-9					10			8.0 - 11.8 Ft. Silty SAND (SM). Moderate brown (5YR3/4) medium- to coarse-grained sand. Subangular, poorly sorted with 20% silt. Adhesive due to the moisture. No shear strength. Mixed feldspar and quartz minerals. 11.0 Ft. 2" lense of coarse-grained, well sorted sand.	
SS	2.0	2.0	3-7-8-9								11.8 - 12.0 Ft. Gravelly sandy CLAY (TILL?). Moderate red matrix with feldspar and quartz, poorly sorted gravels and sands. Moist to slightly moist. Crumbles easily.	
											Bottom of borehole at 12.0 Ft. Borehole backfilled with clean spoils, 9/2/88.	Description and classification of soils by visual examination.

S = SPLIT SPOON; ST = SHELBY TUBE; = DENNISON; P = PITCHER; O = OTHER

SITE: 100 Hancock St. (LODI)

HOLE NO.: 2020R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	2019R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
100 Hancock St. (LODI)	N 1,794 E 2,295	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
9-7-88	9-9-88	EMPIRE SOILS	CME 45B	12"	12.0		12.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
11.0/100		6			▽ 6.4/ 9/9/88 ▼ 11.8/ 9/9/88	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
300 lbs./ 24 in.	NONE	J. Lord

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	BARREL REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	WATER PRESSURE TESTS: PRESS. P.S.I.	WATER PRESSURE TESTS: TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE
SS	1.0	1.0	12-8							
SS	2.0	2.0	8-8-7-7							
SS	2.0	2.0	2-2-5-15					5		
SS	2.0	2.0	15-17 14-11							
SS	2.0	2.0	5-7-6-10					10		
SS	2.0	2.0	5-6-7-9							

DESCRIPTION AND CLASSIFICATION

0.0 - 1.0 Ft. ASPHALT & COBBLES.

1.0 - 3.5 Ft. TOPSOIL. Dusky red (5R3/4) to grayish brown (10YR5/6) silty sandy loam. Dry, crumbles with little pressure. Earthy odor, few grass roots and organics. Some medium-grained sand (<10%). Probable FILL.

3.5 - 5.2 Ft. Sandy silty GRAVEL (FILL). Moderate reddish brown (10R4/6). Angular gravel to 0.5 inch, medium-grained sand, and some silt. Poorly sorted, dry to slightly moist. Crumbles easily, slightly cohesive to non-cohesive.

4.9 Ft. Moisture increasing. Some olive gray (5Y4/1) fine silt.

5.2 - 6.8 Ft. Silty SAND (SM). Dark gray (N4) to olive gray (5Y4/1). Stiff, compact, moist, cohesive, but no thread. Fractures easily with weak finger pressure. Sand is subrounded, medium- to coarse-grained, mixed mineralogy.

6.4-6.8 Ft. Saturated. Soft, almost runny.

6.8 - 11.8 Ft. Sandy SILT (ML). Moderate brown (5YR4/4). Stiff, dry, compact, barely cohesive. Crumbles easily. Trace fines.

10.0-11.8 Ft. Increasing plasticity and saturation. Softer. Coarse-grained sand.

11.8 - 12.0 Ft. SAND (SW). Moderate brown (5YR3/4) subangular coarse- to very coarse-grained sand. Saturated. Adhesive due to the moisture. No shear strength. Mixed feldspar and quartz minerals.

Bottom of borehole at 12.0 Ft.
Borehole backfilled with spoils, and top 6" asphalt, 9/9/88.

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

Borehole advanced 0-12 Ft. using 12 in. o.d. hollow stem augers. Radiologically sampled and gamma-logged by TMA-Eberline, Inc.

Groundwater observed at 6.8 and 11.8 ft.
5.2 Ft. Top of undisturbed soil.

Description and classification of soils by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE;) = DENNISON; P = PITCHER; O = OTHER

SITE: 100 Hancock St. (LODI)

HOLE NO.: 2019R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	2018R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
100 Hancock St. (LODI)	N 1,855 E 2,302	Vertical	-------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
8-31-88	9-1-88	EMPIRE SOILS	CME 45B	12"	14.0		14.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
10.2/76		6			▽ 7.5/ 8/31/88	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 lbs./ 30 in.	NONE	J. Lord

DRILL DIAM. AND TYPE	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	WATER PRESSURE TESTS: PRESS. P.S.I.	WATER PRESSURE TESTS: TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS	1.4	1.3	16-9-9								0.0 - 0.7 Ft. ASPHALT. 2 inches of asphalt and 8 inches of limestone cobble base. Not sampled.	Borehole advanced 0-14 Ft. using 12 in. o.d. hollow stem augers. Radiologically sampled and gamma-logged by TMA-Eberline, Inc.
SS	2.0	0.0	11-6-3-3								0.8 - 4.9 Ft. Silty clayey LOAM (FILL).	
SS	2.0	1.7	3-4-17 S0								1.0-4.0(?) Ft. Moderate brown (5YR4/4) matrix with mixed colors and organic flecks. Compressed, cohesive, dry. Crumbles easily. No thread.	
SS	2.0	1.2	6-7-17 10					5			4.0-4.9 Ft. Becoming mixed Moderate brown and dark greenish gray (5G4/1).	Top of undisturbed soil not recognized.
SS	2.0	2.0	15-14 27-17								4.9 - 8.0 Ft. Silty SAND (SM). Moderate yellowish brown (10YR5/4) medium- to coarse-grained, subangular sand with up to 20% organic flecks. Dry. Stiffness increases with depth.	7.5 Ft. Groundwater observed.
SS	2.0	2.0	7-8-10 10					10			6.0-8.0 Ft. Light brown (5YR6/4). Moderately cohesive. Saturated at 6 Ft. for 2 inches. Decreasing moisture thereafter with depth. Weak thread; samples crumble easily.	
SS	2.0	2.0	5-6-4-5								8.0 - 14.0 Ft. SAND (SP). Pale reddish brown (10YR5/4) subrounded, medium- to coarse-grained, mixed mineralolgy of feldspar and quartz. Moist, adhesive, no shear strength. No organics, no depositional structures seen. Moisture decreasing and stiffness increasing with depth.	
											Bottom of borehole at 14.0 Ft. Borehole collapsed to 10.0 Ft. depth upon removal of PVC. Borehole backfilled with grout from 10 to 5 ft., with spoils to 6 inches, and with new asphalt in the top 6 inches, 9/1/88.	Description and classification of soils by visual examination.

S = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: 100 Hancock St. (LODI)

HOLE NO. 2018R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	2017R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
100 Hancock St. (LODI)	N 1,921 E 2,306	Vertical	-------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
9-1-88	9-1-88	EMPIRE SOILS	CME 45B	12"	14.0		14.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
8.3/64		7			▽ 10.0/ 9/1/88	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
300 lbs. / 24 in.	NONE	J. Lord

TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	WATER PRESSURE TESTS: PRESS. P.S.I.	WATER PRESSURE TESTS: TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS	1.0	1.0	10-20								0.0 - 1.0 Ft. ASPHALT. 2 inches of asphalt and 10 inches of limestone cobble base. Not sampled.	Borehole advanced 0-14 Ft. using 12 in. o.d. hollow stem augers.
SS	2.0	0.8	15-12-8-11								1.0 - 9.1 Ft. Silty clayey LOAM (FILL). 1.0-5.0(?) Ft. Dusky brown (5YR2/2) matrix with mixed colors and organic flecks. Compressed, cohesive, dry. Crumbles easily. No thread.	
SS	2.0	0.9	6-6-6-5					5				Radiologically sampled and gamma-logged by Elevated gamma-log at 6.5-10.5 ft. interval.
SS	2.0	0.4	3-6-6-8								5.0-9.1 Ft. Dusky yellowish brown (10YR2/2) sandy clayey silt. Moist. Lots of wood plugs as if the sampler is going through lumber. Bits of brick and leaves.	
SS	2.0	2.0	5-7-8-10								8.0-9.1 Ft. Same but SATURATED.	
SS	2.0	1.2	6-8-9-8					▽ 10			9.1 - 10.2 Ft. Silty SAND (SM). Moderate brown (5YR3/4) medium- to coarse-grained, subangular sand with up to 20% organic flecks. Moisture decreases with depth. Stiffness increases with depth.	9.1 Ft. Top of undisturbed soil. 10.0 Ft. Groundwater observed.
SS	2.0	2.0	4-9-12-8								10.2 - 14.0 Ft. Clayey Silt (ML-CL). Light brown (5YR5/6). Moderately quick dilatancy. Moist, adhesive, soft. No shear strength. Moisture decreases and stiffness increases with depth.	
											Bottom of borehole at 14.0 Ft. Borehole backfilled with grout from 14 to 8 ft., with spoils to 6 inches, and with new asphalt in the top 6 inches, 9/1/88.	Description and classification of soils by visual examination.

S = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: 100 Hancock St. (LODI)

HOLE NO.: 2017R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	2016R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
100 Hancock St. (LODI)	N 1,927 E 2,377	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
8-31-88	8-31-88	EMPIRE SOILS	CME 45B	12"	14.0		14.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
8.8/63		7			▽ 8.0/ 8/31/88	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 lbs./ 30 in.	NONE	J. Lord

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE "N" BLOWS % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	WATER PRESSURE TESTS: PRESS. P.S.I.	WATER PRESSURE TESTS: TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS	2.0	1.3	3-6-6-10								0.0 - 1.3 Ft. TOPSOIL. Dusky red (5R3/4) to grayish brown (10YR5/6) silty sandy loam. Dry, crumbles with little pressure. Earthy odor, few grass roots and organics. Some medium-grained sand (<10%). Probable FILL.	Borehole advanced 0-14 Ft. using 12 in. o.d. hollow stem augers. Radiologically sampled and gamma-logged by TMA-Eberline, Inc.
SS	2.0	0.7	8-8-5-4								1.3 - 2.1 Ft. Sandy SILT (ML). Dusky red (5R3/4) to moderate brown (5YR4/4). Weak cohesion, dry, slightly compacted. Some lenses of poorly sorted sand less than 0.5 in. thick. Sand is moderately rounded quartz.	11.5 Ft. Top of undisturbed soil.
SS	2.0	1.5	2-2-2-1					5				
SS	2.0	1.4	1-1-2-3								2.1 - 8.0 Ft. Clayey SILT (ML-CL). Dusky yellowish brown (10YR2/2), with black organic flecks. Moist throughout the interval. Slow dilatancy, slight plasticity, cohesive. Easily molded but weak thread. Some leaves.	8.0 Ft. Groundwater observed.
SS	2.0	1.1	3-5-8-18									
SS	2.0	2.0	15-9 12-52					10			8.0 - 11.5 Ft. Silty clayey SAND (SP). Grayish red (5R4/2) to moderate brown (5YR4/4). Saturated, and adhesive from the moisture, but no shear strength. Medium-grained sub-rounded sand with silt and clay adhering. Sand is a mix of quartz and feldspars. Some clean sand lenses a few cm. thick.	
SS	2.0	0.8	9-25 8-29								11.5 - 14.0 Ft. Silty clayey GRAVEL (GP). Moderate brown till with pebbles to 2 in. and probably larger. Sub-angular grains and gravel. Slightly moist. Compacted but crumbles easily. Undisturbed Quaternary till?	Elevated gamma-log at 8-11 ft. interval.
											Bottom of hole at 14.0 Ft. Borehole backfilled, 8/31/88, to 6 ft. deep with cement grout, to 6" with spoils and dry cement. Top 6 inches replaced with clean soil and sod.	
												Description and classification of soils by visual examination.

S = SPLIT SPOON; ST = SHELBY TUBE; = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
100 Hancock St. (LODI)	2016R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	1227R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
Hancock St. (LODI)	N 1,993 E 2,402	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
12-8-87	12-8-87	E.D.I.	MOBILE B-57	6.5"	10.0		10.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
6.0/63		5			▽ /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 lbs./ 30 in.	NONE	D. Harnish

TYPE AND DIAM.	SAMP. ADV. / LEN CORE	SAMPLE REC. / CORE REC.	SAMPLE "N" BLOWS / % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	WATER PRESSURE TESTS: PRESS. P.S.I.	WATER PRESSURE TESTS: TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
S	1.5	1.5	12-21-23								0.0 - 4.5 Ft. Silty GRAVEL and Gravelly SILT FILL (GM, GM-ML).	Borehole advanced 0-10 Ft. using 6.5 in. o.d. hollow-stem auger.
S	2.0	0.0	11-26-9 5								0.0-0.8 Ft. Silty gravel, broken basalt gravel.	No sample 0.0-0.5 Ft. Road bed.
S	2.0	1.4	3-6-9 25					5			0.8-2.0 Ft. Gravelly silt, dark reddish brown (5YR3/3), gravel is Brunswick sandstone and basalt, medium stiff.	Sampled and gamma-logged by TMA-Eberline, Inc.
S	2.0	1.7	21-23 28-34								2.0-4.5 Ft. Gravelly silt, gray (10YR6/1), sandy.	2.0-4.0 Ft. Sample from auger flights.
S	2.0	1.6	15-20 26-25					10			4.5 - 6.9 Ft. SILT (ML). Grayish green (5Y7/2) with yellowish brown iron-oxide mottling.	
											6.9 - 7.4 Ft. SILT and SAND (ML, SP). Greenish gray (5Y6/2), fine-grained sand; sand and silt are interbedded in 0.1 ft. layers.	ENMET reads 80 ppm at mouth of 4.0 and 10.0 Ft. deep hole.
											7.4 - 8.0 Ft. SAND (SP). Brown (10YR4/3), fine-grained.	
											8.0 - 10.0 Ft. SILT (ML). Brown (10YR4/3).	
											Bottom of borehole at 10.0 ft. Borehole backfilled with spoils, 12/8/87.	Identification and classification of soils by visual examination.

= SPLIT SPOON; ST = SHELBY TUBE; = DENNISON; P = PITCHER; O = OTHER

SITE: Hancock St. (LODI)

HOLE NO.: 1227R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	2015R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
100 Hancock St. (LODI)	N 1,931 E 2,453	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
9-2-88	9-2-88	EMPIRE SOILS	CME 45B	3"	3.5		8.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
8.0/38		2			/	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
300 lbs. / 24 in.	NONE	J. Lord

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE "N" BLOWS % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	WATER PRESSURE TESTS: PRESS. P.S.I.	WATER PRESSURE TESTS: TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS	2.0	2.0	2-8-12 20								0.0 - 1.3 Ft. TOPSOIL. Dusky red (5R3/4) to grayish brown (10YR5/6) silty sandy loam. Dry, crumbles with little pressure. Earthy odor, few grass roots and organics. Some medium-grained sand (<10%). Probable FILL.	Borehole advanced 0-8 Ft. using 3.0 in. o.d. split-spoon sampler. Radiologically sampled by TMA-Eberline, Inc. No gamma-log.
SS	2.0	1.0	11-12 22-12									
SS	2.0	0.0	4-6-5-7					5			1.3 - 3.5 Ft. Sandy SILT (ML). Dusky red to moderate brown (5YR4/4). Weak cohesion, dry, slightly compacted. Some lenses of poorly sorted sand less than 0.5 in. thick. Sand is moderately rounded quarts.	After 2nd spoon with no recovery, high ppm levels on OVA (>1000), and a 3 in. chunk of concrete in the spoon's mouth, it appeared that a storm drain had been breached at 3.5 ft. However, excavation to 4.5 ft. proved no conduit was present.
SS	2.0	0.0	4-6-6-2								NO SAMPLES from 3.5 Ft. to bottom of boring.	
											Bottom of borehole at 8.0 ft.	
											Borehole and excavation backfilled with spoils on 9/6/88.	

Description and classification of soils by visual examination.

S = SPLIT SPOON; ST = SHELBY TUBE; = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
100 Hancock St. (LODI)	2015R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	2013R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
100 Hancock St. (LODI)	N 1,780 E 2,454	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
9-28-88	9-28-88	EMPIRE SOILS	CME 45B	12"	10.0		10.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
6.0/100		3			▽ 5.0/ 9/28/88	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
300 lbs./ 24 in.	NONE	J. Lord

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE "N" BLOWS % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	WATER PRESSURE TESTS: PRESS. P.S.I.	WATER PRESSURE TESTS: TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS	2.0	2.0	3-4-7-12								0.0 - 1.0 Ft. TOPSOIL. Dusky red (5RS/4) to grayish brown (10YR5/6) silty sandy loam. Dry, crumbles with little pressure. Earthy odor, few grass roots and organics. Some medium-grained sand (<10%). Probable FILL.	Borehole advanced 0-10 Ft. using 12 in. o.d. hollow stem augers.
SS	2.0	2.0	7-12-12 12								1.0 - 2.9 Ft. Silty SAND (SM). Dark yellowish orange (10YR6/6). Very slightly moist to dry. Dense, loose, no odor. Crumbles under pressure. Sand is poorly sorted fine- to coarse-grained.	Radiologically sampled to 6' and gamma-logged to 10' by TMA-Eberline, Inc.
SS	2.0	2.0	5-8-8-11					5			2.6 - 2.9 Ft. Clayey SILT (ML-CL). Light gray (N7) to pale blue (5B6/2). Dense, moist, plastic. Coarsening downwards.	5.0 Ft. Groundwater observed. 6.0 Ft. Top of undisturbed soil.
								10			2.9 - 6.0 Ft. SAND (SP). Moderate yellowish brown (10YR5/4). Medium- to fine-grained sand with 5% silt. Loose, moist, dense, subrounded, adhesive. Undisturbed material.	
											6.0 - 10.0 Ft. Not sampled, but augered to a depth of 10.0 ft. Auger flight samples suggest sand to 10 Ft.	
											Bottom of borehole at 10 Ft. Borehole backfilled with spoils, 9/28/88.	Description and classification of soils by visual examination.

S = SPLIT SPOON; ST = SHELBY TUBE; = DENNISON; P = PITCHER; O = OTHER

SITE: 100 Hancock St. (LODI)

HOLE NO.: 2013R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	2012R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
100 Hancock St. (LODI)	N 1,710 E 2,456	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
9-28-88	9-28-88	EMPIRE SOILS	CME 45B	12"	10.0		10.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
6.0/100		3			▽ 7.2/ 9/28/88	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
300 lbs./ 24 in.	NONE	J. Lord

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE "N" BLOWS % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS	2.0	2.0	15-20 21-20								0.0 - 0.5 Ft. TOPSOIL. Dusky red (5R3/4) to grayish brown (10YR5/6) silty sandy loam. Dry, crumbles with little pressure. Earthy odor, few grass roots and organics. Some mediumgrained sand (<10%). Probable FILL.	Borehole advanced 0-10 Ft. using 12 in. o.d. hollow stem augers.
SS	2.0	2.0	15-17 17-13								0.5 - 5.5 Ft. Silty SAND (SM). Dark yellowish orange (10YR6/6). Very slightly moist to dry. Dense, loose, no odor. Crumbles under pressure. Sand is poorly sorted fine- to coarse-grained. Grades to very coarse-grained at 5.5 Ft. contact.	Radiologically sampled to 6' and gamma-logged to 10' by TMA-Eberline, Inc.
SS	2.0	2.0	13-12-9 7					5			5.5 - 6.0 Ft. Clayey SILT (ML-CL). Moderate reddish brown (10R4/6). Dense, moist to saturated at the contact, plastic. Good thread.	5.5 Ft. Groundwater observed. 5.5 Ft. Top of undisturbed soil.
								10			6.0 - 10.0 Ft. Not sampled, but augered to a depth of 10.0 ft. Auger flight grab samples suggest clayey silt to 6.0 ft. and sand to 10 Ft.	
											Bottom of borehole at 10 ft. Borehole backfilled with spoils, 9/28/88.	

Description and classification of soils by visual examination.

S = SPLIT SPOON; ST = SHELBY TUBE; = DENNISON; P = PITCHER; O = OTHER

SITE: 100 Hancock St. (LODI)

HOLE NO.: 2012R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	2014R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
100 Hancock St. (LODI)	N 1,855 E 2,456	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
9-28-88	9-28-88	EMPIRE SOILS	CME 45B	12"	10.0		10.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
8.0/94		4			▽ 5.5/ 9/28/88	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
300 lbs./ 24 in.	NONE	J. Lord

TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	WATER PRESSURE TESTS: PRESS. P.S.I.	WATER PRESSURE TESTS: TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS	2.0	1.5	2-4-5-3								0.0 - 2.6 Ft. TOPSOIL. Dusky red (5R3/4) to grayish brown (10YR5/6) silty sandy loam. Dry, crumbles with little pressure. Earthy odor, few grass roots and organics. Some medium-grained sand (<10%). Probable FILL.	Borehole advanced 0-10 Ft. using 12 in. o.d. hollow stem augers.
SS	2.0	2.0	4-8-16 20								2.2 Ft. Increasing stiffness and clay content. Cobbles.	
SS	2.0	2.0	30-24 23-20					5			2.6 - 4.0 Ft. Silty SAND (SM). Dark yellowish orange (10YR6/6). Moderate to weak thread, slightly elastic, yet more than 50% sand. Very slightly moist to dry. Dense. Crumbles under pressure.	Radiologically sampled to 8' and gamma-logged to 10' by TMA-Eberline, Inc.
SS	2.0	2.0	13-14 9-10								4.0 - 7.4 Ft. Sandy SILT (ML). Dusky red (5R3/4) to moderate brown (5YR4/4). Weak cohesion, dry. Weak thread, soft, molds easily. Sand is moderately rounded quartz.	7.2 Ft. Groundwater observed. 7.4 Ft. Top of undisturbed soil.
								10			6.0-7.0 Ft. Increasing moisture; decreasing fines. Stiffer, denser.	
											7.4 - 10.0 Ft. SAND (SP). Medium- to coarse-grained multi-colored sand of Qtz. & Fels. grains. Subrounded, saturated. Adhesive, but no shear strength. Well sorted.	
											Bottom of borehole at 10 ft. Borehole backfilled with spoils, 9/28/88.	Gamma-log peak reading of 16,308 cpm at 1.5' deep.
												Description and classification of soils by visual examination.

S = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
100 Hancock St. (LODI)	2014R