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Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for Maywood, New Jersey

U.S. Department of Energy

0489-0613.1

110601

Bechtel

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Job No. 14501, FUSRAP Project
DOE Contract No. DE-AC05-91OR21949
Code: 7310/WBS: 138

NOV 15 1993

U.S. Department of Energy
Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, TN 37831-8723

Attention: Susan M. Cange, Site Manager
Former Sites Restoration Division

Subject: FUSRAP - Maywood Site - Transmittal of WP-IP Ancillary Documents

Dear Ms. Cange:

Enclosed for your use are publication copies of the ancillary documents for the Maywood work plan-implementation plan. Included are two field sampling plans, a quality assurance project plan, a health and safety plan, and a community relations plan. All comments received from reviewers have been incorporated into these documents.

Copies of each of these documents will be placed in the administrative record for the Maywood site.

Sincerely,

M. E. Redmon

M. E. Redmon
Project Manager - FUSRAP

MER:ebs:1346
Enclosure: As stated

ACTION REQ'D	[ ] YES	[X] NO	DUE DATE					
RESPONSE TO CHRON NO.								
☐ FFA	☐ Permit	☐ Milestone	☐ OcR	☐ CCN	☐ CAR	☐ Mid-Yr	☐ Yr-End	☐ Periodic Rpt

DOE/OR/21949-193.6

Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-91OR21949

Field Sampling Plan for the Remedial Investigation/ Feasibility Study-Environmental Impact Statement for the Maywood Interim Storage Site

Maywood, New Jersey

November 1993

DOE/OR/21949-193.6

FIELD SAMPLING PLAN FOR THE REMEDIAL INVESTIGATION/ FEASIBILITY STUDY-ENVIRONMENTAL IMPACT STATEMENT FOR THE MAYWOOD SITE

MAYWOOD, NEW JERSEY

NOVEMBER 1993

Prepared For

United States Department of Energy

Oak Ridge Operations Office

Under Contract No. DE-AC05-91OR21949

By

Bechtel National, Inc.

Oak Ridge, Tennessee

Bechtel Job No. 14501

FOREWORD

This document has been prepared to document the scoping and planning process performed by the U.S. Department of Energy (DOE) to support remedial action activities at the Maywood site, located in northern New Jersey in the boroughs of Maywood and Lodi and the township of Rochelle Park. Remedial action at the Maywood site is being planned as part of DOE's Formerly Utilized Sites Remedial Action Program.

Under the Comprehensive Environmental Response, Compensation, and Liability Act, a remedial investigation/feasibility statement (RI/FS) must be prepared to support the decision-making process for evaluating remedial action alternatives. Consistent with U.S. Environmental Protection Agency guidance for conducting an RI/FS, the work plan (1) contains a summary of information currently known about the Maywood site, (2) presents a conceptual site model that identifies potential routes of human exposure to site contaminants, (3) identifies data gaps, and (4) summarizes the process and proposed studies that will be used to fill the data gaps.

When the work plan identified the data gaps for the Maywood site, other plans were developed to direct field investigations to resolve the data gaps. These plans are the quality assurance project plan, health and safety plan, community relations plan, and field sampling plans. Because the field work is phased, two separate field sampling plans address the field investigations. One field sampling plan directs the field work for the radiological and chemical remedial investigation, and the other directs the geological investigation of the Maywood Interim Storage Site.

The work described in this plan was performed between 1989 and 1991; the plan accurately represents the work that was performed. Authorization was given by DOE to proceed with the work using draft documents due to the lengthy review cycle that was necessary for approval by all agencies involved and the need to use available funding to perform the work. The review is now complete, and the plan has been approved for final publication.

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FIGURES

TABLES

ACRONYMS

AEC	Atomic Energy Commission
ANL	Argonne National Laboratory
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
BNI	Bechtel National, Inc.
CCV	calibration curve verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
DOE	U.S. Department of Energy
EPA	Environmental Protection Agency
FSRD	Former Sites Restoration Division
FUSRAP	Formerly Utilized Sites Remedial Action Program
GC/EC	gas chromatography/electron capture
GC/MS	gas chromatography/mass spectrometry
ICV	initial calibration verification
ICPAES	inductively coupled plasma atomic emission spectrophotometry
MISS	Maywood Interim Storage Site
NEPA	National Environmental Policy Act
NJDEPE	New Jersey Department of Environmental Protection and Energy
NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities

ACRONYMS

(continued)

ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations Office
PCB	polychlorinated biphenyl
PIC	pressurized ionization chamber
RCRA	Resource Conservation and Recovery Act
RI/FS-EIS	remedial investigation/feasibility study environmental impact statement
SHSO	site health and safety officer
TC	toxicity characteristic
TCL	Target Compound List
TCLP	toxicity characteristics leaching procedure
TMA/E	Thermo Analytical/Eberline
TPH	total petroleum hydrocarbons
USGS	U.S. Geological Survey
WL	working level
VOC	volatile organic compound

UNITS OF MEASURE

cm	centimeter
cpm	counts per minute
dpm	disintegrations per minute
ft	foot
g	gram
gal	gallon
ha	hectare
in.	inch
kg	kilogram
km	kilometer
L	liter
lb	pound
m	meter
mg	milligram
mi	mile
min	minute
msl	mean sea level
s	second
μCi	microcurie
μg	microgram
pCi	picocurie
yd	yard

1.0 INTRODUCTION

In 1974, the Atomic Energy Commission (AEC), a predecessor agency to the U.S. Department of Energy (DOE), instituted the Formerly Utilized Sites Remedial Action Program (FUSRAP), a program now managed by DOE. The objective of FUSRAP is to identify and clean up or otherwise control sites where residual radioactive contamination (exceeding current guidelines) remains from activities carried out under contract to the Manhattan Engineer District and AEC. In addition to these sites, the U.S. Congress authorized DOE to undertake remedial actions at four other sites where commercial operations had radioactively contaminated the environment. One of these four sites is located in Maywood, New Jersey.

Former Maywood Chemical Works operations in Maywood have resulted in contamination of numerous properties in Maywood, Rochelle Park, and Lodi, including the property previously owned by Maywood Chemical Works (now owned by the Stepan Company); the DOE-owned property referred to as the Maywood Interim Storage Site (MISS); and residential, commercial, and governmental vicinity properties. To organize and segment the investigation and remedial actions at these properties, DOE has grouped them into four operable units:

- Stepan Company property
- MISS property
- Residential properties
- Commercial and governmental properties

The Maywood site comprises these four operable units.

To select a corrective action to be implemented at the Maywood site, DOE is preparing a remedial investigation/feasibility study-environmental impact statement (RI/FS-EIS). This process is described in detail in the Work Plan-Implementation Plan for the Remedial Investigation/Feasibility Study-Environmental Impact Statement for the Maywood Site.

Maywood, New Jersey (ANL/BNI 1992). In general, the RI/FS-EIS process consists of conducting field investigations to determine the nature and extent of contamination (remedial investigation), then performing studies to assess relative merits and impacts of possible remedial action alternatives (feasibility study-environmental impact statement).

The RI/FS-EIS work at the Maywood site will be accomplished in accordance with the following plans:

- Work plan-implementation plan
- Sampling and analysis plan
- Health and safety plan
- Community relations plan

The sampling and analysis plan consists of the field sampling plans and the quality assurance project plan. This field sampling plan will direct the field work for the radiological and chemical remedial investigation. A separate field sampling plan addresses the geological investigation of MISS.

1.1 SITE CHARACTERIZATION RATIONALE

DOE's responsibilities are different for MISS than for the other three operable units. Because MISS is DOE-owned, DOE is responsible for remedial action for all radioactive and chemical contaminants on or migrating from MISS. Based on the congressional assignment of the Maywood site to DOE, DOE is responsible for remediation of only the contaminants on the other three operable units that are associated with thorium processing operations at the Maywood Chemical Works. The contaminants for which DOE has responsibility include radionuclides and any chemicals used in the thorium processing operations.

The remedial investigation field activities described in this plan are intended to accomplish a complete characterization of the Maywood site (Stepan Company property, DOE-owned MISS property, residential vicinity properties, and commercial/governmental vicinity properties) with respect to DOE responsibilities. Information from previous investigations of the site (a summary of which is presented in Section 2.4 of the work plan-implementation plan) has been used to the extent possible. However, many of these investigations were conducted several years ago, and some were not intended to define the areal extent of contamination or to evaluate potential migration pathways. These investigations were often conducted to identify potential contaminants and potential areas of contamination rather than a spectrum of suspected contaminants.

Given the nature of the previous surveys, the limited data collected, and the considerable amount of time elapsed since the studies were conducted, it appears that the most effective characterization approach is to use the historical data only for the following purposes:

- To identify the locations of suspected contaminated areas on properties that have been designated for inclusion in FUSRAP

- To institute a comprehensive remedial investigation program to satisfy the data requirements of the Comprehensive Environmental Response, Compensation, and Liability Act/National Environmental Policy Act (CERCLA/NEPA) process

Section 2.0 of this report identifies the objectives of the remedial investigation activities and the technical approach for achieving them.

1.2 ORGANIZATION AND RESPONSIBILITIES

1.2.1 Project Organization

FUSRAP is conducted as a team effort with multiple organizations responsible for its implementation. DOE is responsible for the overall implementation of FUSRAP. DOE-Headquarters provides oversight and coordination. DOE-Headquarters contracts Oak Ridge Associated Universities (ORAU) and Oak Ridge National Laboratory (ORNL) to designate sites and properties for FUSRAP. These two organizations also provide independent verification of the successful completion of remedial action leading to elimination of properties from FUSRAP.

The DOE-Oak Ridge Operations Office (ORO) manages day-to-day FUSRAP activities. DOE-ORO has contracted Bechtel National, Inc. (BNI) and Argonne National Laboratory (ANL) to assist in the performance of FUSRAP activities. BNI serves as project management contractor for FUSRAP. ANL serves in an independent role as environmental compliance contractor. ORNL is also contracted by DOE-ORO to act as a technical support contractor.

The remedial action process for the Maywood site will be conducted based on the project management structure currently in effect for the overall FUSRAP program (Figure 1-1). The flow of the remedial action process is shown in Figure 1-2. This figure also indicates the organization responsible for each step in the process.

1.2.2 Coordination and Responsibilities for Field Work

As project management contractor for FUSRAP, BNI provides management of and support to the remedial investigation field activities. Management and support will include all activities necessary to implement the field work delineated in the remedial investigation plans. Typically, these activities include development and procurement of subcontract services; development, implementation, and overview of plans; collection and review of data including sampling results, quality assurance/quality control submittals, and sample tracking and custody; technical guidance to onsite personnel; report preparation; cost management; and schedule control.

The BNI program manager is responsible to DOE for the successful completion of all aspects of the work. The program manager is supported by project managers and representatives from engineering, construction, environmental health and safety, procurement, operations, quality assurance, project administration, community relations, and project controls. The responsibilities of the project manager and each group are as follows.

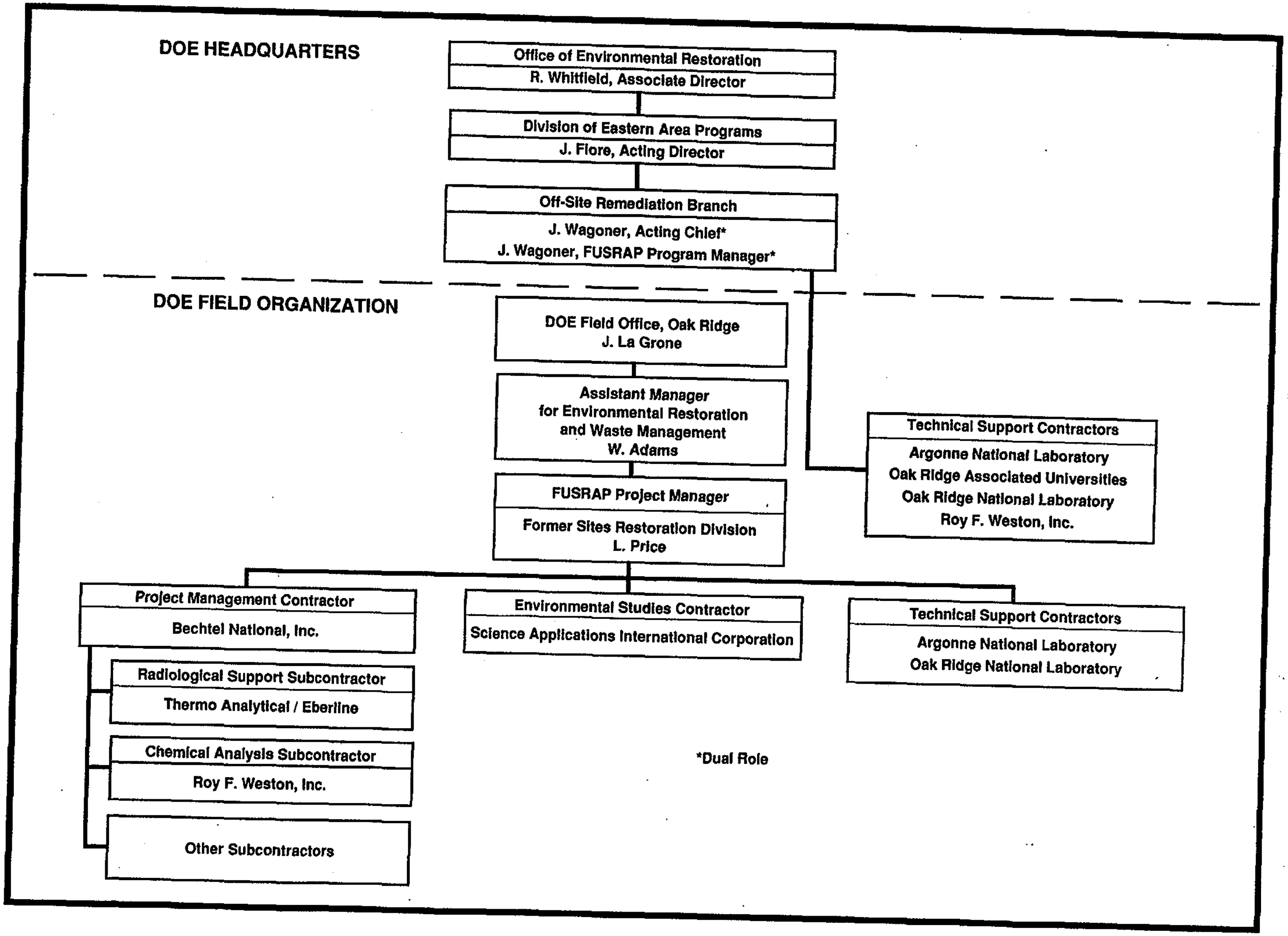

Figure 1-1
Project Organization

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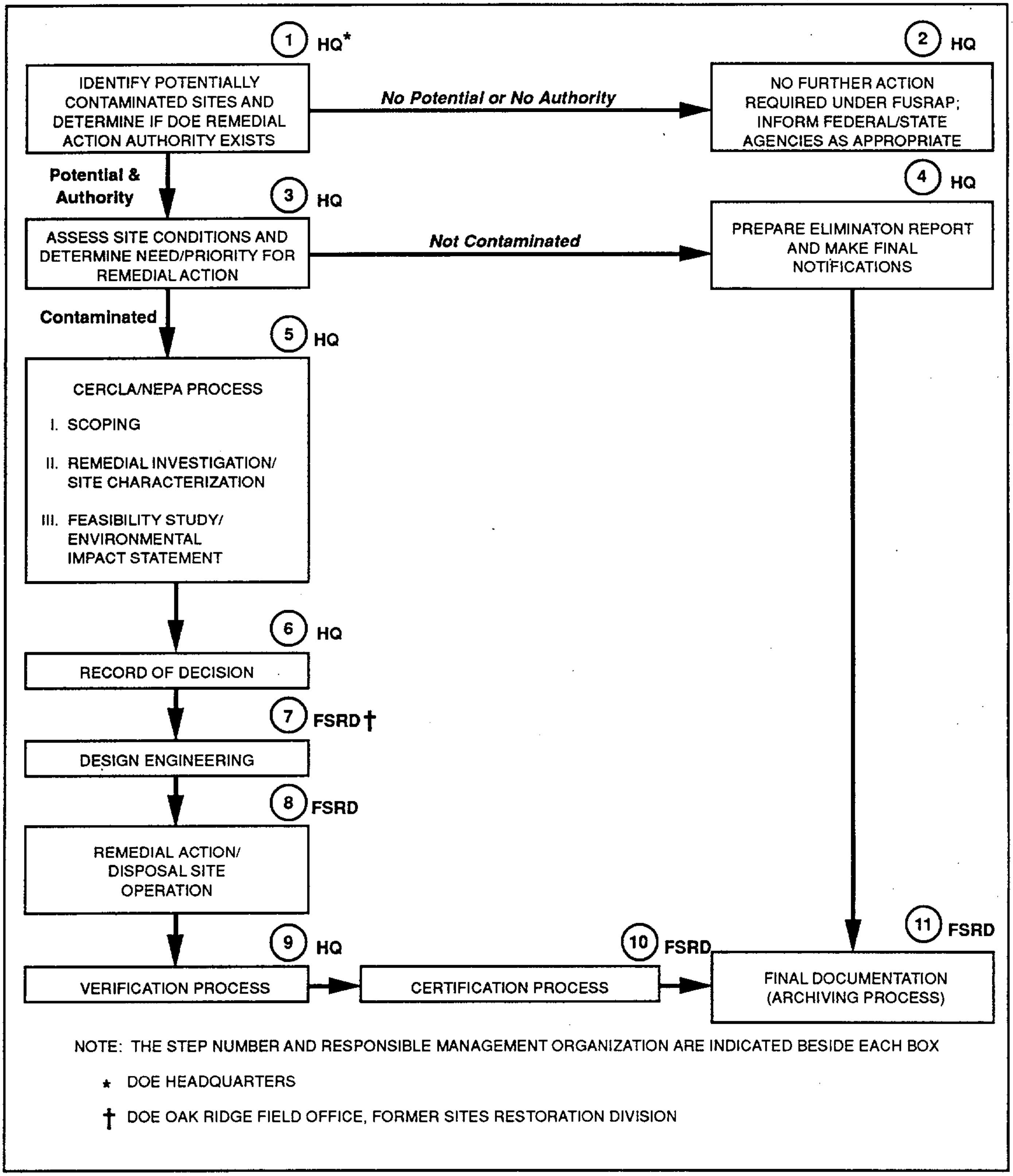

Figure 1-2
Project Coordination and Responsibility Matrix

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Project manager

- Implements overall guidance provided by BNI program manager on a site-specific basis

- Interfaces directly with DOE-ORO site managers to implement DOE directions on a site-specific basis

- Manages a team of BNI technical professionals from each of the disciplines described below to accomplish the goals of the DOE site managers and BNI program manager for each site

Engineering

- Develops bid packages and technical specifications needed to subcontract remedial investigation work

- Performs engineering studies in support of the environmental compliance contractor to evaluate data and assess remedial action alternatives

- Provides field engineering services to monitor onsite work and modify technical specifications as required

Construction

- Reviews all site plans for constructibility
- Monitors subcontract status (cost, completion, etc.)
- Provides a site superintendent to administer subcontracts for onsite activities

Environmental health and safety

- Develops plans, objectives, and documentation; manages and evaluates chemical and radiological data obtained during remedial investigation activities

- Manages radiological and chemical analysis support subcontracts

- Provides technical group leader to support onsite remedial investigation efforts

- Coordinates and evaluates all health and safety matters

- Provides a site health and safety officer (SHSO)

Procurement

- Identifies bidders for subcontract work
- Coordinates subcontract bid and award process
- Manages revisions to subcontracts

Site operations

- Performs site maintenance work
- Provides site security
- Manages local purchasing of equipment and supplies
- Provides year-round onsite support, including collection of environmental samples

Quality assurance

- Evaluates implementation of quality assurance project plan
- Audits quality assurance system and performance
- Conducts periodic reviews of program plans

Project controls

- Provides cost and schedule support, including budgeting, monitoring, variance analysis, and trend analysis

Project administration

- Provides administrative services such as document control, mail distribution, and reproduction

- Provides document editing services

Community relations

- Conducts community relations planning and prepares community relations plan
- Coordinates community relations activities

Onsite management of remedial investigation activities is accomplished through the organizational structure shown in Figure 1-3. Responsibilities of each onsite position are as follows.

Site superintendent

The site superintendent is responsible to the BNI project manager for day-to-day operations at the site and directs activities of the technical group leader, field engineer, and site operations personnel.

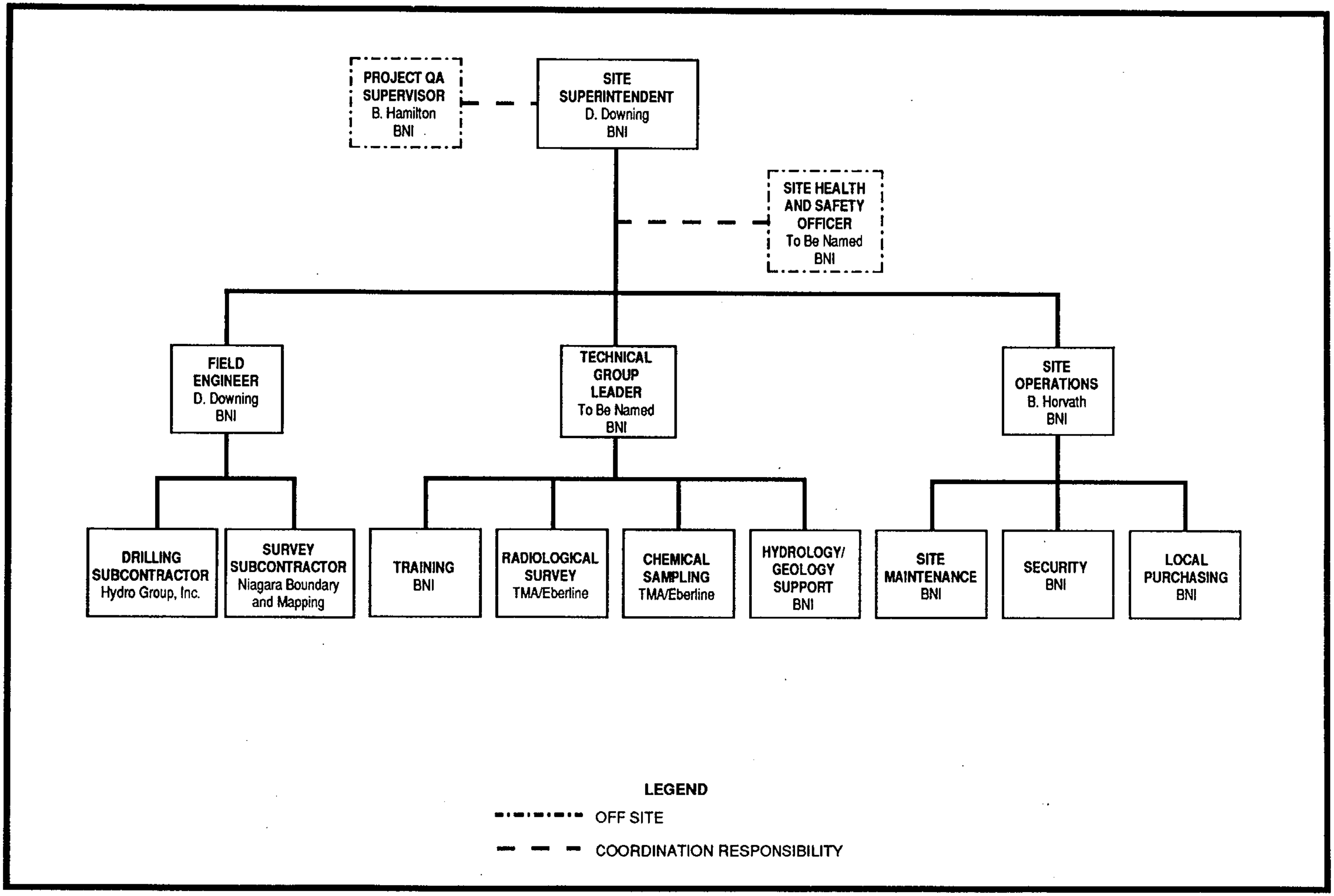

Figure 1-3
Onsite Organization

Technical group leader

The technical group leader is responsible for accomplishing the goals of the remedial investigation. All BNI or subcontractor personnel providing training, radiological survey services, chemical sampling, and geological/hydrological support to the remedial investigation activities will report to the technical group leader. The technical group leader will coordinate daily activities with the field engineer to ensure support of subcontractor activities with sampling activities.

Field engineer

The field engineer will administer all subcontractor activities (excluding radiological and chemical support), including daily work assignments, completion of subcontract management documentation, quality assurance/quality control verification, and cost management. The field engineer must work with the technical group leader to ensure coordination of subcontractor and sampling activities.

Site operations personnel

Site operations personnel are responsible for site maintenance and security and for purchasing local supplies and equipment. Site operations personnel coordinate purchases with both the technical group leader and the field engineer to ensure that the needs of the remedial investigation activities are met.

Site health and safety officer

The SHSO is responsible for the administration and implementation of all health and safety matters that may adversely affect the health and well-being of the general public or site personnel. While onsite, the SHSO will work directly with the site superintendent or his designee to coordinate all matters related to health and safety. The SHSO has the authority to implement corrective measures or to stop work to ensure the health and safety of site personnel.

Project quality assurance supervisor

The project quality assurance supervisor conducts audits in the field (typically semiannually) to ensure implementation of the field sampling plan and the health and safety plan. Audits and surveillances are also conducted of the way the BNI environmental monitoring team handles and analyzes sample data after receipt of data from the laboratories. The project quality assurance supervisor reports the results of audits and surveillances and evaluation of the effectiveness of the quality assurance/quality control program to BNI management and conducts audits of subcontractors who have a direct bearing on the results and effectiveness of the field sampling plan and health and safety plan. All quality assurance/quality control program procedures and instructions are submitted to the project quality assurance supervisor for review and signoff before they are issued.

This onsite organization provides well-defined responsibilities for each group and allows the site superintendent to make decisions based on input from each group. However, depending on the level of effort at a particular site, individuals within the organization may be assigned multiple responsibilities. When activities are under way at a specific site, the names and telephone numbers of individuals in the positions shown in Figure 1-3 will be posted in a conspicuous location at the site.

1.3 SITE DESCRIPTION

The Maywood site is in a highly developed area of northeastern New Jersey in the boroughs of Maywood and Lodi and the township of Rochelle Park. It is located approximately 20 km (12 mi) north-northeast of New York City and 21 km (13 mi) northeast of Newark, New Jersey. The population density of this area is approximately 10,000 people per square mile. The Maywood site includes the former Maywood Chemical Works property (now owned by the Stepan Company), the DOE-owned MISS, and several residential, commercial, and governmental vicinity properties. Figure 1-4 shows the location of the Maywood site.

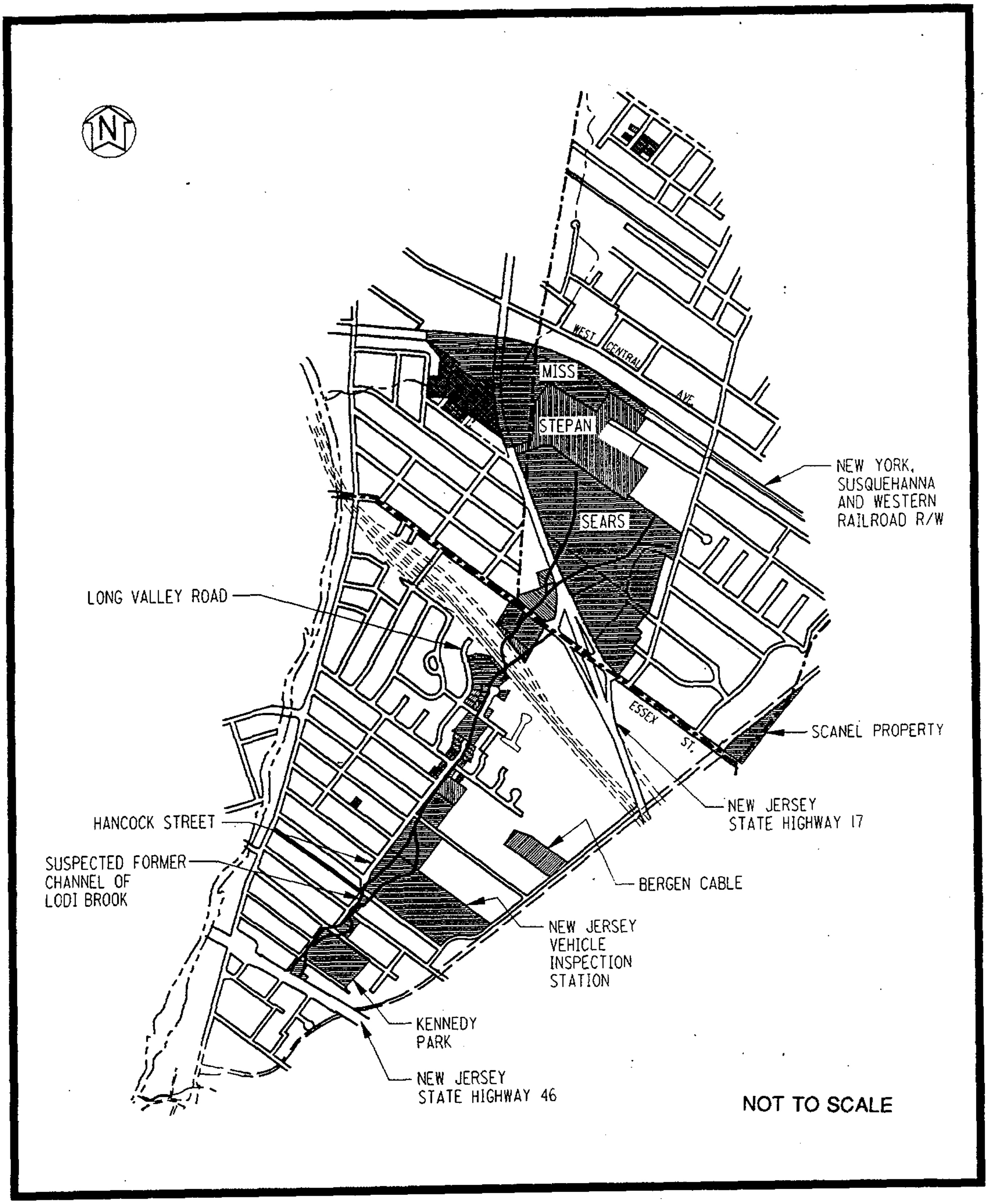

Figure 1-4
Regional Setting of the Maywood Site

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1.3.1 Stepan Company Property

The Stepan Company is located at 100 West Hunter Avenue in the borough of Maywood, Bergen County, New Jersey. The property covers 7.4 ha (18.2 acres) and is relatively flat. The topography of the property has been modified into a series of terraces to accommodate construction of the operating facility. Topographic relief from the highest terrace at the north side to the lowest terrace at the south side of the property is about 7.6 m (25 ft). Approximately two-thirds of the property contains buildings, some of which are in or near locations where the Maywood Chemical Works thorium processing operations occurred. The property (excluding the main office and parking area) is enclosed by a chain-link fence.

Land use in the vicinity of the Stepan Company property is industrial, commercial, and residential. West Hunter Avenue is lined with several small businesses, as is a portion of nearby Maywood Avenue. The area across Maywood Avenue from the Stepan Company property is predominantly residential. To the north and northeast, the property is bordered by a New York, Susquehanna, and Western Railroad line and numerous residential properties. Various commercial properties and MISS border the Stepan Company property to the south and southwest.

1.3.2 Maywood Interim Storage Site

MISS is a 4.7-ha (11.7-acre) fenced lot that was once part of a 12.1-ha (30-acre) property owned by Maywood Chemical Works. MISS contains an interim waste storage pile, two buildings (Building 76 and a pumphouse), temporary office trailers, a reservoir, and two rail spurs. It is bounded on the west by New Jersey Route 17, on the north by a New York, Susquehanna, and Western Railroad line, and on the south and east by commercial and industrial properties. Residential properties are located north of the railroad line and within 274 m (300 yd) to the north of MISS. The topography of MISS is generally flat, ranging in elevation from approximately 15.2 to 20.4 m (51 to 67 ft) above mean sea level (msl). The highest elevations are in the northeastern portion of the property. Small mounds and ditches occur; these are the result of process waste stored by Maywood Chemical Works. At least two partially buried structures remain from these waste operations.

The interim storage pile at MISS occupies approximately 0.81 ha (2 acres) and contains about 27,000 m^3 (35,000 yd^3) of contaminated soils and materials from removal actions conducted on vicinity properties near the Maywood site.

1.3.3 Vicinity Properties

Several residential, commercial, and governmental vicinity properties in the boroughs of Maywood and Lodi and the township of Rochelle Park are known to have been radioactively contaminated from operations at the Maywood Chemical Works. These properties were identified by DOE through surveys performed by ORNL. For the purposes of this investigation, the vicinity properties are segmented into two operable units: residential properties and commercial/governmental properties. In Rochelle Park, these properties include nine residential properties on Grove Avenue and Park Way (eight have been completely decontaminated; a small portion of the ninth has not been decontaminated). Maywood properties include 13 commercial properties, part of the New Jersey Route 17 embankment, a vacant lot, and approximately 10 residential properties. Eight Maywood properties have been decontaminated. In Lodi, these properties include 50 residential, commercial, and governmental properties on Trudy Drive, Hancock Street, Branca Court, Long Valley Road, Essex Street, Redstone Lane, Columbia Lane, Garibaldi Avenue, Kennedy Drive, Sidney Street, and Avenues B, C, E, and F. Eight Lodi properties have been decontaminated.

1.4 SITE HISTORY

Maywood Chemical Works was constructed in 1895. In 1916, the plant began extracting thorium and rare earths from monazite sand for use in manufacturing industrial products such as mantles for gas lanterns. The manufacturing process included the production of mantle-grade thorium nitrate (Harris 1951) from monazite sands and various lithium compounds, especially lithium hydroxide and lithium chloride (NRC 1981). The manufacturing process included the production of thorium nitrate from monazite sand for gas mantles (from 1916 to 1954) and later (between 1954 and possibly 1959) as a product suitable for purification to Atomic Energy Commission (AEC) reactor-grade levels (NRC 1981). Thorium extraction stopped in 1956, but thorium processing of stockpiled material continued until 1959. The process may have been modified for AEC products because rare earth impurities were essential for brilliance in gas mantles but would be detriments in reactor-grade materials. This change may be inferred from memos written in the early 1950s that referred to the use of oxalic acid in the extraction process; oxalic acid is an expensive material, not cost-effective in the production of lower-grade mantle material.

Maywood Chemical Works also produced rare earths, detergents, alkaloids, essential oils, and lithiated compounds, including lithium chloride and lithium hydroxide. Lithium wastes were believed to have been disposed of in diked areas on the property. In addition, a variety of other inorganic and organic chemicals have been identified in soils and groundwater at MISS. The primary radioactive contaminant at the Maywood site is thorium-232 and its associated daughter products, with lesser amounts of the uranium-238 decay chain (BNI 1987a). In addition, other chemical constituents have been identified in soils and groundwater at MISS (BNI 1986, 1987b, and 1989; Ebasco 1987, 1988).

The following description of the process used to produce mantle-grade thorium nitrate at Maywood Chemical Works is based on correspondence regarding plant operations and on a reconstruction of the chemical processes (Heatherton 1951; Jones 1987; Albert 1966; Eister 1974; Stokinger 1981).

The process began with monazite sand from 23-kg (50-lb) sacks being dumped into a steam-jacketed tank or sulfating mill and digested with hot sulfuric acid for several hours. The resultant pasty mass was diluted with water to dissolve the thorium, uranium, and rare earths. This left unreacted monazite, silica, rutile, and zircon. The mixture was then vacuum filtered. The filtrate was evaporated, separating the uranium and rare earths from the thorium sulfate solution. Reagents, perhaps oxalic acid (NRC 1981), were added to the thorium sulfate solution to form thorium oxalates, which were precipitated and removed by vacuum filtration to produce a cake. Additional steps in the process involved redissolving the thorium oxalate and precipitating it as a hydroxide. During finishing, thorium hydroxide was dissolved with nitric acid in large silica dishes and subsequently evaporated until crystallization was complete. The remaining thorium salt was hand-ground and packaged in 19-L (5-gal) bottles. The primary chemicals used in the extraction process are thought to have included sulfuric acid, nitric acid, ammonium hydroxide, oxalic acid, and ammonium oxalate.

The slurry, containing process waste from the thorium processing operations, was pumped into two areas surrounded by earthen dikes on property west of the plant (Cole 1981). In 1932, the disposal areas were separated from the plant and partially covered by the construction of Route 17.

Some of the process wastes were removed for use as mulch and fill on nearby properties, thereby contaminating those properties with radioactive thorium (Mata 1984). Although the fill consisted primarily of tea and coca leaves from other Maywood Chemical Works processes, it apparently included some of the thorium-processing wastes.

Additional waste apparently migrated off the property via natural drainage associated with the former Lodi Brook. Historical photographs and maps indicate that the former course of the brook, which originated on the Maywood Chemical Works property, generally coincides with the distribution of contaminated properties in the borough of Lodi. Most of the open stream channel in Lodi has been replaced by a subsurface storm drain system.

In 1954, AEC issued License R-103 to Maywood Chemical Works, thereby allowing it to continue to possess, process, and distribute radioactive materials under the authority of the Atomic Energy Act of 1954. Maywood Chemical Works stopped processing thorium in 1956 after approximately 40 years of production. The property was subsequently sold to the Stepan Company in 1959.

In 1961, the Stepan Company was issued an AEC radioactive materials license (STC-1333). Based on AEC inspections and information related to the property on the west side of Route 17 (now known as the Ballod property), Stepan agreed to take certain corrective actions, although the Stepan Company did not process and has never processed radioactive materials at the Ballod property. Stepan began to clean up residual thorium wastes in 1963. Residues and tailings on the property west of Route 17 were partially stabilized at that time. In 1966, 6,391 m^3 (8,400 yd^3) of contaminated material was removed from the property west of Route 17 and buried on the Stepan property at burial site 1 (Figure 1-5); that area is now covered with grass. In 1967, an additional 1,570 m^3 (2,053 yd^3) of material was removed from the same general area and buried on the Stepan property at burial site 2, which is now a parking lot (Figure 1-5). In 1968, Stepan obtained permission from AEC to transfer an additional 6,575 m^3 (8,600 yd^3) of waste from the area west of Route 17 and buried it on burial site 3, where a warehouse was later constructed (Figure 1-5). During that same year, AEC conducted a survey of the area west of Route 17 and certified it for use without radiological restrictions. At the time of the survey, AEC was apparently not aware of contaminated waste materials still present in the northeast corner of the property. In 1968, this portion of the Stepan property was sold to a private citizen who later sold it (in the 1970s) to Ballod Associates (Cole 1981).

The presence of radioactive materials in the northeast corner of the Ballod property was discovered in 1980, after a private citizen reported the discovery of radioactive contamination near Route 17 to the New Jersey Department of Environmental Protection and Energy (NJDEPE). A survey of the area (Route 17, Ballod property, and Stepan property) conducted by NJDEPE identified the contaminants as thorium-232 and radium-226. The Nuclear Regulatory Commission (NRC) was notified of the results and undertook additional surveys from November 1980 to January 1981; these surveys confirmed high concentrations of thorium-232 in soil samples collected from both the Stepan and Ballod properties (NRC 1981). Accordingly, NRC requested a comprehensive survey of the area.

In January 1981, EG&G Energy Measurements Group conducted an aerial radiological survey of the Stepan property and surrounding properties (EG&G 1981). The survey, which covered a 10-km^2 (3.9-mi^2) area, indicated contamination not only on the Stepan and Ballod

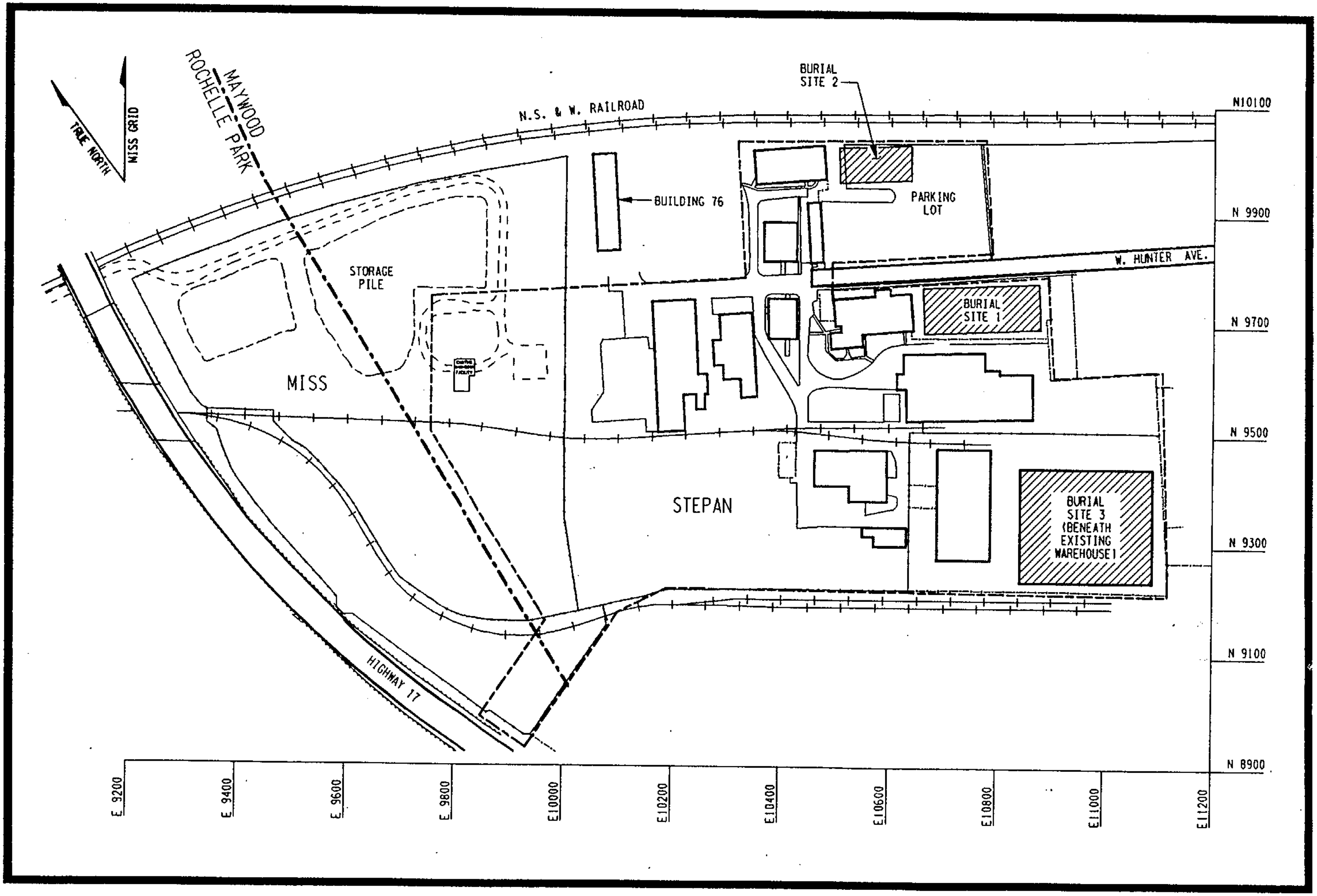

Figure 1-5
Burial Site Locations on the Stepan Company Property

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properties, but also in areas to the north and south of the Ballod property. During February 1981, ORAU performed a separate radiological ground survey of the Ballod property (Cole 1981); the results of this survey eventually led to designation of the property for remedial action under FUSRAP (Coffman 1983). An additional radiological survey of the Stepan and Ballod properties (commissioned by the Stepan Company) was conducted in June with similar findings (Morton 1982).

By enacting the Energy and Water Development Appropriations Act of 1984, Congress authorized DOE to undertake a decontamination research and development project at the Maywood site. The site was assigned to FUSRAP, and DOE negotiated access to a 4.7-ha (11.7-acre) portion of the Stepan property for use as an interim storage facility for contaminated materials that were to be removed from vicinity properties. This area is now known as MISS. A detailed description of these contaminated materials as FUSRAP waste is provided in Section 1.4.2 of the work plan-implementation plan. In late 1983, DOE instructed ORNL and BNI to begin surveying properties in the vicinity of the former Maywood Chemical Works. In 1984 and 1985, DOE conducted removal actions from 26 properties and placed the waste in temporary storage at MISS. In September 1985, ownership of MISS was transferred to DOE.

Further details of the Maywood site description and history can be found in the work plan-implementation plan.

1.5 SUMMARY OF EXISTING DATA AND DATA REQUIREMENTS

Based on the historical information available for the Maywood site, the radionuclides of concern for the site are the thorium-232 and uranium-238 decay chains. Less information is available concerning chemical contaminants. Specific data and data requirements for each of the four operable units are summarized below.

1.5.1 Stepan Company Property

- Gamma exposure rate measurements inside the buildings and most outdoor areas are available; these measurements will be confirmed.

- Limited surface and subsurface soil concentration data are available for thorium-232, radium-226, and uranium-238. Additional surface and subsurface soil concentrations are needed for these radionuclides to establish vertical and horizontal boundaries of contamination.

- Limited measurements for fixed and removable contamination within buildings do not indicate that contamination levels exceed applicable guidelines. These measurements will be confirmed.

- The land surface has been altered considerably during the period of processing operations and since the operations ceased. Damming of creeks and berming were used to create retention ponds for process wastes. Buried wastes were excavated and relocated to new burial areas on the property. In some cases, buildings were constructed above these new burial areas.

- The surface water flow pattern on the property is completely controlled by regrading during construction of the facilities. Runoff has been increased by paving and roofing areas. All runoff is directed to storm drains via culverts or channels.

- The property is located on a relatively thin layer of glacial debris and residual soil. Locally, bedrock (Brunswick formation) may have been exposed during site regrading or in excavations for individual structures at the site.

1.5.2 Maywood Interim Storage Site

- Surface and subsurface soil concentration data are available for thorium-232, radium-226, and uranium-238.

- Surface water data for total uranium, thorium-232, and radium-226 are available.

- Chemical data and groundwater data for total uranium, thorium-232, and radium-226 are available from the ongoing environmental monitoring program. Additional data will be collected to confirm that no chemical contamination is migrating from MISS.

- Radon and thoron data are available from the ongoing environmental monitoring program.

- Removable and fixed surface contamination data for Building 76 and the pumphouse will be collected.

- Radioactive waste stored in the pile was removed from 26 vicinity properties during 1984 and 1985. The waste is primarily soil and building materials. Sampling will be conducted to collect representative samples of the waste; appropriate analyses will be performed.

- No data are available regarding chemical characteristics of the wastes stored in the pile. Limited chemical information exists for MISS. Sampling activities will be conducted to collect representative samples of the waste; appropriate analyses will be performed.

1.5.3 Vicinity Properties

- Gamma exposure rate measurements are available for several buildings and many outdoor areas. Additional measurements will be taken on uncharacterized properties.

- Surface and subsurface soil concentration data for thorium-232, radium-226, and uranium-238 have been obtained for properties where characterization activities are complete. Additional data concerning concentrations of these contaminants in surface and subsurface soil will be obtained for designated properties that have not been characterized.

- Substantial contamination appears to have occurred as a result of stream/sediment deposition and flooding of low-lying areas during periods of heavy rainfall. Sediment sampling has been performed at four locations along the open portions of Lodi Brook downstream of MISS. Analyses for several radiological contaminants of concern were performed, and results did not indicate that contaminant migration is occurring as a result of these transport mechanisms. Because the majority of Lodi Brook is currently contained within a concrete conduit, contaminant migration is not thought to occur via these pathways. Therefore, additional sediment sampling will be performed only to verify these results.

- Indoor air sampling for radon and thoron has been performed at the properties where characterization is complete.

- Groundwater data are available for MISS and the Stepan property, and limited data are available for some of the vicinity properties. A well canvass was performed in March and April 1989 to locate wells that draw from the aquifer beneath the Maywood site and users of these wells. The results of that canvass are the subject of a separate report.

1.5.4 Resolution of Additional Data Gaps

Section 3.6.5 of the work plan-implementation plan identifies data gaps that needed to be filled to obtain the information essential to assess risk and plan effective remediation. Some of these data gaps were discussed in Sections 1.5.1 through 1.5.3 of this field sampling plan; the following methodologies will be used to address the remaining data gaps.

- As an initial phased procedure (to reduce the scope of laboratory analyses), a limited number of soil samples will be submitted for full radioisotopic analyses. Based on these results, it may be possible to fill data gaps without further direct sampling. Isotopic ratios in the limited sampling results will be applied to the data as a whole or, if necessary, theoretical upper limits will be calculated.

- If not directly available from site surveys, local and subregional background data for radionuclides in soils will be used. Equilibrium of decay chains and natural abundances will be assumed.

- Background data for radon-222 and radon-220 in soils and groundwater will not be acquired unless soil gas or groundwater treatments are instituted.

- To address the elevated total uranium in well MISS-5A, the latest data for new adjacent well MISS-5A-1 will be reviewed first, as will the characteristics of MISS-5A. If necessary, upgradient wells MISS-2A and MISS-3A will be used as background. As a last resort, a background well will be drilled offsite.

- Background radiological data for surface water may not be needed, but, if required, data from upgradient locations will be used as background.

- A literature search will be conducted to investigate and confirm the reliability of radon-220 sampling with alpha track detectors. Radon flux measurements will be made at MISS to comply with provisions of the Clean Air Act.

- Long-term sampling for radon within buildings will be performed when radon grab sampling or subsurface soil sampling indicates contamination.

- A well canvass has already identified the locations of wells and the purposes for which they are used. These data will be held in reserve to plan additional groundwater field sampling should the necessity arise.

2.0 REMEDIAL INVESTIGATION APPROACH

Additional data to be collected during the remedial investigation have been identified based on results of detailed study of existing reports, preliminary identification of applicable or relevant and appropriate requirements and contaminants of concern, development of a conceptual site model, and preliminary identification of remedial action alternatives described in the work plan-implementation plan. These remedial investigation data will provide a better understanding of the site and allow evaluation of remedial action alternatives.

The following sections delineate the data requirements for each of the four operable units at the Maywood site. The sections also describe the technical approach that will be implemented to meet the data requirements.

2.1 DATA REQUIREMENTS FOR STEPAN COMPANY PROPERTY

To date, DOE has conducted no investigations of the Stepan property; therefore, the data requirements are comprehensive. Specific objectives are described below:

- Objective 1: Determine extent of radioactive surface contamination
- Objective 2: Determine horizontal and vertical boundaries of radioactive subsurface contamination
- Objective 3: Identify chemical contaminants resulting from thorium-232 processing operations
- Objective 4: Determine whether hazardous waste is mixed with radioactive waste
- Objective 5: Determine whether relocated and reburied process wastes have migrated from burial areas
- Objective 6: Confirm measurements obtained during previous surveys for fixed and removable contamination within buildings
- Objective 7: Confirm gamma exposure rate measurements obtained during previous surveys within buildings and outdoor areas

The following sections present the technical approach that will be used to fulfill the data requirements at the Stepan Company property.

2.1.1 Objective 1: Determine Extent of Radioactive Surface Contamination

Before radiological characterization begins, a civil survey of the property will be conducted to identify and map the locations of all buildings, aboveground utilities, streets, major vegetation, and property boundaries. A grid system will be established by the surveyor, using a grid origin correlated to the New Jersey State Plane Coordinate System. The grid origin allows the grid to be reestablished during future response actions. The civil surveyor will then establish a 15.2-m (50-ft) grid system over the property by marking the intersections of grid lines. All data collected during the remedial investigation will be tied to coordinates on the characterization grid. The grid, with the east and north coordinates given, is shown on all figures in Sections 2.1 through 2.4.

An initial near-surface walkover gamma survey will be performed on the property using a 2- x 2-in. sodium iodide, thallium-activated [NaI(Tl probe)] unshielded gamma scintillation detector to identify areas of elevated gamma-emitting radionuclide activity. The NaI(Tl) crystal is coupled to a photomultiplier tube, and the entire probe is connected to a scaler. The surveyor holds the gamma detector several inches above the ground surface and slowly moves the detector back and forth while walking forward. The surveyor will be a health physics technician who will map each area where the meter registers radiation levels in excess of 10,000 cpm (twice the background level for the Maywood area).

Areas where measurements are greater than twice the normal background count rate will then be resurveyed with a cone-shielded gamma scintillation detector held 30.4 cm (12 in.) above the ground surface. The average background level for this area is 5,000 cpm; this background value will be confirmed. The cone-shielded detector ensures that the majority of the radiation detected by the instrument originates from the ground directly beneath the unit. Shielding against lateral gamma flux, or "shine," from nearby areas of contamination minimizes potential sources of error in the measurements. The shielded detectors are calibrated at the DOE Technical Measurements Center in Grand Junction, Colorado, to provide a correlation of counts per minute with picocuries per gram. This calibration has demonstrated that approximately 11,000 cpm on the cone-shielded detector corresponds to the DOE guideline of 5 pCi/g plus local average background of 1 pCi/g for thorium-232 in surface soils (TMA/E 1989).

Using the data collected from the walkover and cone-shielded surveys, as well as data from historical surveys (Mata 1984; Cole 1981; EG&G 1981; Coffman 1983; Morton 1981), the locations of biased surface soil samples will be selected. These biased samples will be used to confirm the extent of surface contamination, as mapped by the surface walkover gamma survey, by providing laboratory measurements of the radionuclide concentrations.

Surface soil samples will be collected for radiological analysis according to the procedures outlined in the quality assurance project plan. The samples will be analyzed for thorium-232, uranium-238, and radium-226 by gamma spectroscopy at the Thermo Analytical/Eberline (TMA/E) radiological analysis laboratories in Albuquerque, New Mexico, and Oak Ridge, Tennessee. TMA/E is subcontracted by BNI for all radiological support services, including laboratory analysis and field health physics technician support. The gamma spectroscopy technique uses characteristic radiation energies of each radioactive isotope to determine the concentration of that radionuclide in the soil sample. In some cases, the concentration of a radionuclide is inferred from radiation emitted by its decay products. This the technique is conservative because it can only overestimate the concentration of the parent radionuclide. Gamma spectroscopy is more cost-effective than direct measurement of each radionuclide; however, 5 percent of the samples will be analyzed for all radium and thorium isotopes.

Counting times for gamma spectroscopy will be selected to detect thorium-232 concentrations to near background levels. Uranium-238 and radium-226 concentrations will also be reported; however, because of the relatively low gamma-photon abundance of uranium-238, many of the uranium-238 concentrations will be below the detection sensitivity for the analytical procedure. To obtain more sensitive readings for uranium-238 with these analytical methods, much longer instrument counting times would be required than are necessary for analysis of thorium-232. Counting times will be adjusted to maximize the uranium sensitivity while maintaining cost-effectiveness.

2.1.2 Objective 2: Determine Horizontal and Vertical Boundaries of Radioactive Subsurface Contamination

A subsurface investigation will be conducted using the established grid system to determine the depth to which the previously identified surface contamination extends. The investigation will also locate subsurface contamination where there is no surface manifestation.

The subsurface investigation will consist of drilling approximately 75 boreholes using either a 3-in.- or 6-in.-diameter auger bit (Figure 2-1). Results of near-surface gamma walkover surveys may be used to select locations of biased boreholes during subsurface investigations. Based on the relative insolubility of the radionuclides present in the ores processed by Maywood Chemical Works, the binding properties of the soil, and results of DOE's previous characterization of properties contaminated as a result of thorium-232 processing, it is unlikely that contamination has migrated into undisturbed (natural) soil. However, all boreholes will be drilled 0.6 m (2 ft) into undisturbed soil. The field geologist will determine when this depth is reached.

Grid lines and estimated borehole locations are shown in Figure 2-1. In each borehole, a shielded, sodium-iodide gamma scintillation detector will be used to perform downhole gamma logging. The instrument is calibrated at the Technical Measurements Center, where it has been determined that a count rate of approximately 40,000 cpm corresponds to the subsurface contamination guideline for thorium-232 of 15 pCi/g. This relationship has been corroborated by results from previous characterizations where thorium-232 was found (TMA/E 1989). The downhole gamma logging technique is used because the procedure can be accomplished in less time than collection and analysis of soil samples, and it provides an immediate indication of the approximate location of subsurface contamination. Gamma radiation measurements will be taken at 15.2-cm (6-in.) intervals to approximate the depth and concentration of the contamination and to determine which soil samples will be analyzed.

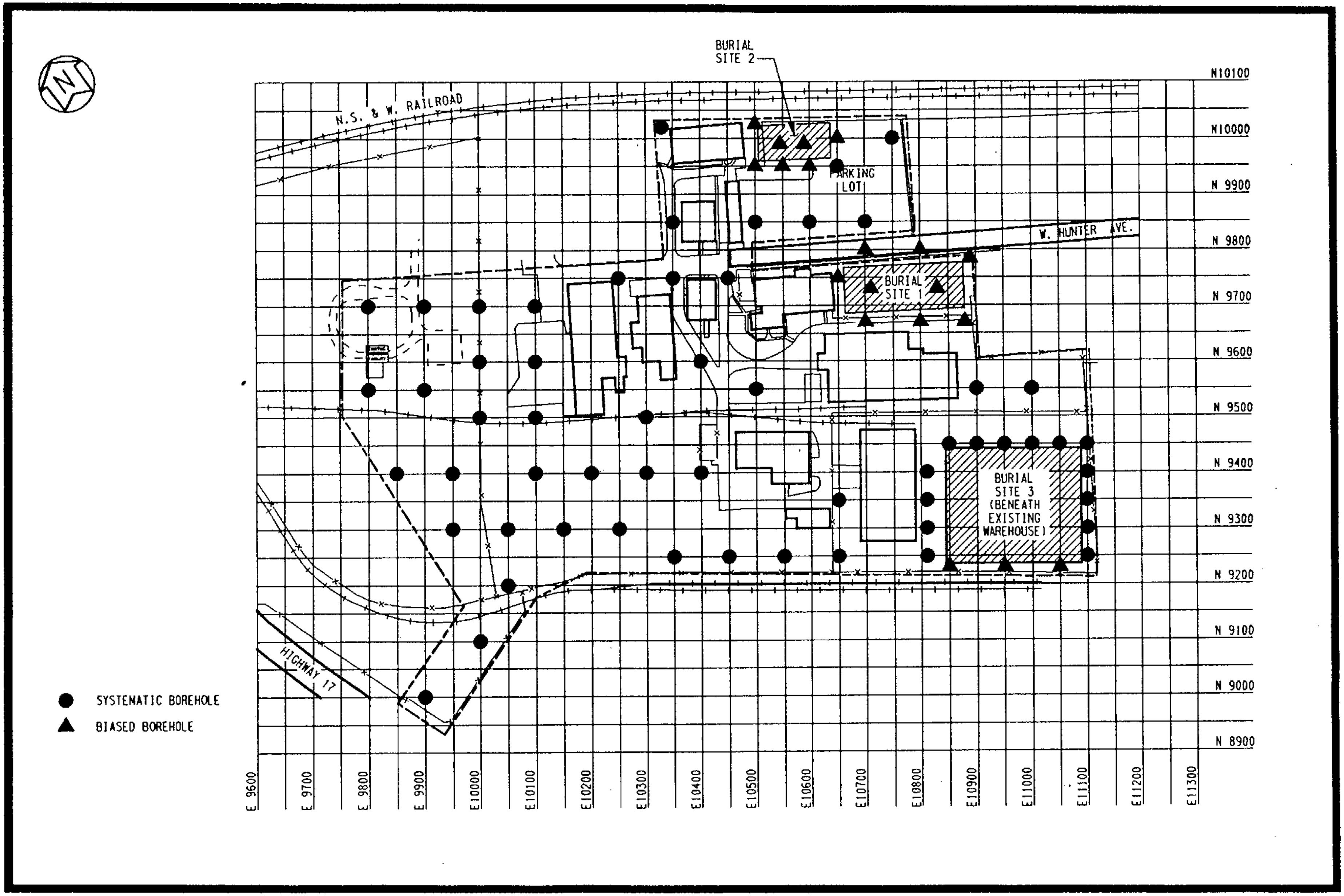

Figure 2-1
Proposed Borehole Locations on the Stepan Company Property

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In addition to downhole gamma logging, continuous soil sampling will be conducted in each borehole. Samples will be collected at 30.4-cm (12-in.) intervals from a depth of 15.2 cm (6 in.) until undisturbed soil has been penetrated 0.6 m (2 ft). It is estimated that an average of three samples from each borehole will be analyzed for thorium-232, radium-226, and uranium-238 in the same manner as the surface soil samples. Data from the analyzed samples will provide information to confirm the horizontal and vertical boundaries of subsurface contamination on the Stepan property as determined by the gamma logging. The remaining samples collected will be archived, to be available if future analyses are required.

2.1.3 Objective 3: Identify Chemical Contaminants Resulting from Thorium-232 Processing Operations

Full-scale chemical characterization of the Stepan property will be accomplished during a separate but concurrent RI/FS conducted by the Stepan Company under an Environmental Protection Agency (EPA) consent order. Therefore, only limited chemical sampling will be conducted by BNI to determine the presence of chemical contaminants that can be traced from the thorium-232 processing and may be mixed with radioactive waste.

To identify the presence of these chemical contaminants, 5 percent of selected radiological boreholes will be sampled at specific intervals above and below the radioactively contaminated zones. Approximately two 0.6-m (2-ft) intervals will be sampled per selected borehole. Locations of boreholes to be sampled for chemical contaminants will be selected by the field sampling team after radioactively contaminated areas are identified because the thorium-232 processing chemical contaminants would likely be collocated with the radioactive wastes. Samples obtained from areas identified as not radioactively contaminated will also be analyzed for chemical contaminants.

All samples will be analyzed for metals that may have been present in the original ores; mobile ions such as phosphate, chloride, and nitrate that could stem from the ore processing; and additional parameters described in Section 4.0, Table 4-1. If any hazardous chemicals related to thorium-232 processing that require corrective action are found, the horizontal and vertical boundaries of chemical contamination may need to be determined in a subsequent remedial investigation phase. Data collected by BNI will be compared with data available from the RI/FS conducted for EPA, and additional field sampling will be planned if necessary.

2.1.4 Objective 4: Determine Whether Hazardous Waste is Mixed with Radioactive Waste

Information must be obtained regarding the presence of hazardous waste mixed with radioactive waste on the Stepan property to determine appropriate final disposition of the radioactive waste, as described in Section 2.1.2. DOE must determine whether any hazardous constituents are present that require corrective action or that may be regulated by the State of New Jersey. NJDEPE is responsible for managing the Resource Conservation and Recovery Act (RCRA) compliance program for New Jersey. Therefore, 5 percent of all samples collected from within radioactively contaminated areas will be collected in sufficient volume to allow for the following chemical analyses: toxicity characteristics leaching procedure (TCLP) metals, corrosivity, reactivity, total polychlorinated biphenyls (PCBs), sulfide and cyanide reactivity, and total petroleum hydrocarbons (TPH). If any sample exceeds 1,000 ppm TPH, that sample will be screened for EPA priority pollutants. In addition, these samples will be analyzed for TCLP organics and volatile and semivolatile organics. These parameters have been coordinated with NJDEPE to ensure that the State has adequate data to classify the wastes. The field sampling team will identify the samples to be chemically analyzed.

2.1.5 Objective 5: Determine Whether Relocated and Reburied Process Wastes Have Migrated from Burial Areas

To determine whether relocated and reburied wastes have migrated from the new burial areas, boreholes (a subset of the 75 boreholes described in Section 2.1.2) will be drilled around the perimeter of each burial area at 7.6- to 15.2-m (25- to 50-ft) intervals (Figure 2-1). The locations of these boreholes may be adjusted by the field sampling team (with prior concurrence by the technical group leader) as needed, depending on accessibility and size of the burial areas. Within accessible burial areas, boreholes will be drilled a minimum of 0.6 m (2 ft) into undisturbed soil (as determined by the field geologist). Continuous sampling will be conducted in each borehole with soil samples collected at 0.3-m (1-ft) increments. Radiological analyses will be conducted on approximately three samples per borehole as described in Section 2.1.2. Five percent of the boreholes will be analyzed for chemical parameters as discussed in Section 4.0. These boreholes will also be gamma logged to provide supporting data for determining radiological conditions surrounding the burial areas. Gamma logging will be accomplished in the manner described in Section 2.1.2. Samples for analysis will be determined by the field sampling team.

2.1.6 Objective 6: Verify Presence of Fixed and Removable Contamination Within Buildings

Smear samples will be collected from biased locations by wiping an area of about 100 cm^2 (15.5 $in.^2$) with appropriate smear paper. The smears will be counted at the TMA/E laboratory for gross alpha and gross beta activity. If significant activity (exceeding DOE guidelines, see Appendix A of the work plan-implementation plan) is detected, the isotopes present will be determined if possible.

Fixed contamination levels will be spot-checked with hand-held alpha and beta detectors. Locations will be biased to confirm or negate the findings of historical surveys. Where possible, surveying will be conducted beneath painted, coated, wet, or dirty surfaces because these conditions may mask contamination. Data from these samples and survey measurements will be evaluated and compared with measurements obtained during previous surveys to accurately define the areas of fixed or removable contamination.

2.1.7 Objective 7: Verify Gamma Exposure Rate Measurements From Previous Surveys

Indoor and outdoor gamma exposure rate measurements will be taken to determine whether measurements obtained during previous surveys are representative of locations sampled.

Approximately two to four gamma exposure rate measurements will be obtained in each building where access is permitted. Exact locations will be determined by the field sampling team and will be shown in the remedial investigation report. Indoor measurements will be collected using either an NaI(Tl) gamma scintillation detector, designed to detect gamma radiation only, or a pressurized ionization chamber (PIC). The PIC instrument has a response to gamma radiation that is proportional to exposure in roentgens.

A factor for converting gamma scintillation measurements to PIC measurements was established by correlating these two measurements at four locations during previous characterization activities at properties in the vicinity of the Stepan property. The measurements were taken 1 m (3 ft) above the ground in locations determined to be representative of the properties sampled. The unshielded gamma scintillation detector readings were then used to estimate gamma exposure rates for each location. This correlation will be confirmed before the exposure rate measurements are made in 1990. Interior measurements are generally obtained with the gamma scintillation detector rather than the PIC because use of the smaller instrument minimizes interruption of ongoing operations.

Approximately ten exterior gamma exposure rate measurements will be obtained using the PIC instrument on the Stepan property. Data from these measurements and from interior measurements will be compared with data obtained during previous surveys to determine whether locations sampled are representative of the property.

2.2 DATA REQUIREMENTS FOR MISS

The following data objectives have been identified for MISS. This information must be obtained in order to understand the extent of contamination at MISS:

- Objective 1: Determine whether waste in the storage pile contains RCRA-hazardous waste and determine average concentrations of radioactive waste in the pile

- Objective 2: Determine presence/identity of chemical contaminants in onsite soil

- Objective 3: Determine whether chemical contaminants are migrating from MISS via surface water, sediment, or groundwater

- Objective 4: If chemical contaminants are present that require corrective action, assess the extent of the contamination

- Objective 5: Perform radon flux measurements for compliance with the Clean Air Act and quantify residual radioactive contamination on structural surfaces in Building 76

The following sections present the technical approach that will be used to collect data required to fill existing data gaps in characterizing MISS.

2.2.1 Objective 1: Determine Whether Waste in the Storage Pile Contains RCRA-Hazardous Waste and Determine Average Concentrations of Radioactive Waste in the Pile

To determine the final disposition of the radioactive waste currently in the interim storage pile, the presence or absence of chemical constituents that may be regulated under RCRA must be investigated. Because EPA has delegated authority to manage the RCRA compliance program to NJDEPE, classification of the waste is the responsibility of NJDEPE. To ensure that adequate data will be collected to allow NJDEPE to classify the waste, DOE and NJDEPE have agreed on the sampling program described in this section (Atkin 1989; Kaup 1989). To allow NJDEPE to determine whether the interim storage pile contains hazardous waste, the samples collected should be representative of the contained waste. For this reason, a systematic sampling approach was selected. The pile will be marked with a 15.2-m (50-ft) grid, and boreholes will be drilled near each grid intersection. Considering that the pile occupies approximately 0.81 ha (2 acres), sampling on a 50-ft grid results in placement of 37 boreholes (Figure 2-2). Boreholes will be drilled at the intersections of the grid lines to the degree possible; however, some adjustment is allowable based on field

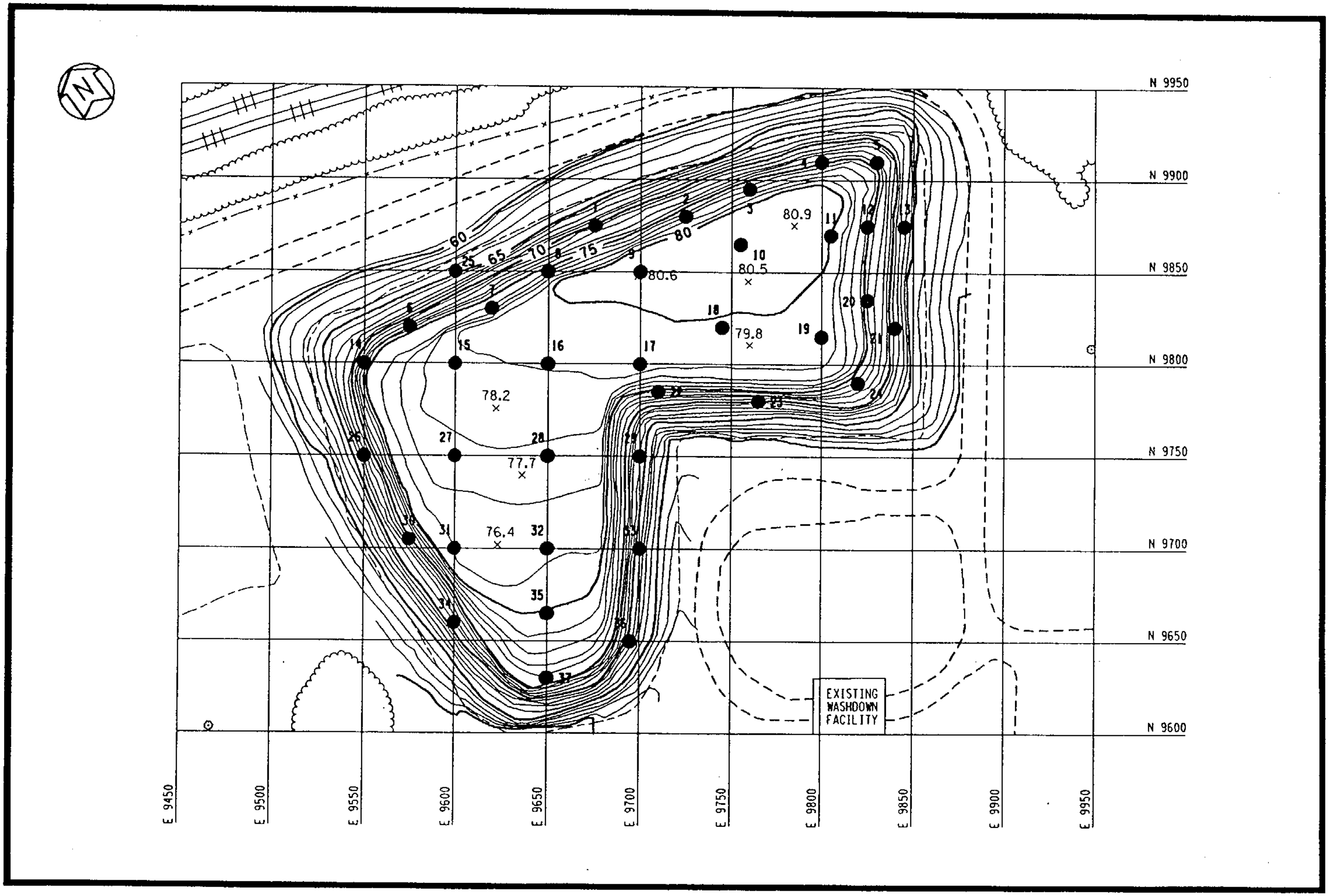

Figure 2-2
Proposed Borehole Locations at the MISS Pile

conditions. Borehole locations may be moved up to 3 m (10 ft) at the discretion of the field sampling team; moves greater than 3 m (10 ft) require notification of the technical group leader. Reasons for relocating boreholes may include moves to ensure stable footing for the drill rig, to avoid obstructions in the pile, and to avoid precarious drilling locations along sloped edges.

Drilling depth at each location will differ because of the variable height of the pile and the underlying leachate collection system. The average height of the pile is 5.5 m (18 ft). Extreme caution must be exercised to avoid puncturing the impermeable liner beneath the pile. This liner was placed on a sand layer to provide a smooth base and is also covered with sand that is sloped to drain leachate from the waste.

Table 2-1 shows the depth to which each borehole will be drilled. These depths were selected to ensure that as much waste is sampled as possible while allowing an adequate safety margin at the bottom of the borehole to protect the liner. Side slopes are also considered in selecting the depths.

Each borehole will be sampled continuously from top to bottom to the degree possible. Waste extracted from the borehole will be composited into one sample representative of the entire depth of the borehole, and the sample will be analyzed for radiological constituents. Additionally, waste extracted from the borehole will be composited into samples representative of a 0.9-m (3-ft) depth interval for chemical analyses. For boreholes at the top of the pile, six samples per borehole will be taken. All samples collected will be analyzed for TCLP metals, total PCBs, sulfide and cyanide reactivity, and TPH. Should any sample exceed 1,000 ppm TPH, that sample will be screened for EPA priority pollutants. Septum-sealed vials will be filled with material for volatile organic compound (VOC) analysis from each discrete interval before the composite sample is obtained. Based on TPH results, the VOC vials can then be submitted to the laboratory for analysis.

Table 2-1

Borehole Locations and Depths at MISS

Location Number[a]	Coordinate East	Coordinate North	Maximum Drill Depth (ft)	Sample Depth[b] (ft)
P-1	9675	9875	10	
P-2	9725	9880	11	
P-3	9760	9895	12	6, 12
P-4	9800	9910	10	4
P-5	9830	9910	9	8
P-6	9575	9820	11	
P-7	9620	9830	15	
P-8	9650	9850	15	12
P-9	9700	9850	19	
P-10	9755	9865	18	4
P-11	9805	9870	16	9
P-12	9825	9875	11	
P-13	9845	9875	5	
P-14	9550	9800	12	
P-15	9600	9800	17	
P-16	9650	9800	19	5
P-17	9700	9800	19	
P-18	9745	9820	18	
P-19	9800	9815	17	
P-20	9825	9835	11	
P-21	9840	9820	7	3
P-22	9710	9785	15	10
P-23	9765	9780	8	
P-24	9820	9790	12	10
P-25	9600	9850	4	
P-26	9550	9750	8	3
P-27	9600	9750	8	3
P-28	9650	9750	17	
P-29	9700	9750	7	4
P-30	9575	9705	10	8
P-31	9600	9700	17	6
P-32	9650	9700	17	
P-33	9700	9700	7	4
P-34	9600	9660	8	3, 8
P-35	9650	9665	18	12
P-36	9695	9650	8	2
P-37	9650	9630	15	

Table 2-1

(continued)

[a]Locations are shown in Figure 2-2.

[b]These depths are for samples that will be collected and analyzed for TCLP organics and corrosivity. Ten percent of the samples collected will be analyzed. Samples will be collected in 0.9-m (3-ft) intervals.

In addition to these analyses, 10 percent of all samples will be analyzed for TCLP organics and corrosivity. The samples to be analyzed for these additional parameters are also listed in Table 2-1. The sample depths were selected using a random sequence to select the borehole and then the depth.

To the extent practicable, boreholes will be drilled vertically. Boreholes on the side slopes may be drilled from the top of the pile and angled to intersect the location shown in Figure 2-2. For any angle drilling, depth should be adjusted so the angled boreholes reach the same overall depth that vertically drilled boreholes would reach.

Immediately following drilling of each borehole, each penetration of the pile cover will be repaired by gluing a patch over the borehole. The adequacy of the patches will be verified by the BNI site superintendent.

2.2.2 Objective 2: Determine Presence/Identity of Chemical Contaminants in Onsite Soil

Under CERCLA requirements, DOE is responsible for all chemical contamination at MISS. To date, only limited information has been collected with regard to chemical constituents present on the property. DOE must determine whether waste exhibiting RCRA characteristics is present; DOE is not aware of the disposal of any RCRA-listed waste at MISS. Additionally, DOE must determine whether any hazardous constituents are present that require corrective action or that may be regulated by NJDEPE. To accomplish these goals, chemical characterization of the overburden at MISS was planned based on a review of available data (Bechtel 1986; Bechtel 1987a,b; Bechtel 1988; Ebasco 1987; Ebasco 1986).

The limited chemical characterization performed by BNI in 1986 revealed some volatile and semivolatile chemical constituents in MISS soil; however, concentrations were typically low, and some problems were encountered with laboratory quality assurance/quality control.

To reevaluate these historic results, 34 boreholes will be placed at the locations shown in Figure 2-3 and listed in Table 2-2. Each borehole will be drilled 0.6 m (2 ft) into undisturbed soil, as determined by the field geologist. If bedrock is the first undisturbed soil encountered, drilling will stop at bedrock.

Because most areas of MISS are radioactively contaminated, these boreholes will be in known areas of radioactive contamination (Bechtel 1987a). Treatment alternatives for radioactive materials are extremely limited; therefore, cleanup of the radioactive waste present on MISS will likely involve some form of excavation. For this reason, the information needed for the radioactively contaminated zone concerns the RCRA characteristics. To obtain this information, a composite sample over the depth of the radioactive waste will be collected and analyzed for RCRA characteristics.

In addition, to obtain more detailed information on chemicals present in the radioactive waste, 17 discrete samples will be collected and analyzed for Target Compound List (TCL) compounds. This information is needed for risk assessment and worker health protection. Fifty percent of the boreholes will have a discrete-interval sample collected, at random depths, for TCL analysis. Table 2-3 shows the locations and depths for these samples. These boreholes and the sampling depths will be determined using a random number generator. Soil samples will be collected from the center of each discrete interval sampled in each borehole and placed in septum-sealed vials for potential VOC analysis. The VOC analysis will be performed on any sample having greater than 1,000 ppm TPH. After the discrete sample is collected, the remaining soil in each borehole will be composited by field personnel in accordance with the procedures outlined in Section 6.1.2 of this plan. The composite samples will be composited over the entire depth of the borehole and analyzed for RCRA characteristics (toxicity, sulfide and cyanide reactivity, corrosivity), TPH, and total PCBs. The zone of radioactive contamination in MISS onsite soil will be determined from previous characterization data and by gamma logging conducted in the field as described in Section 2.1.2.

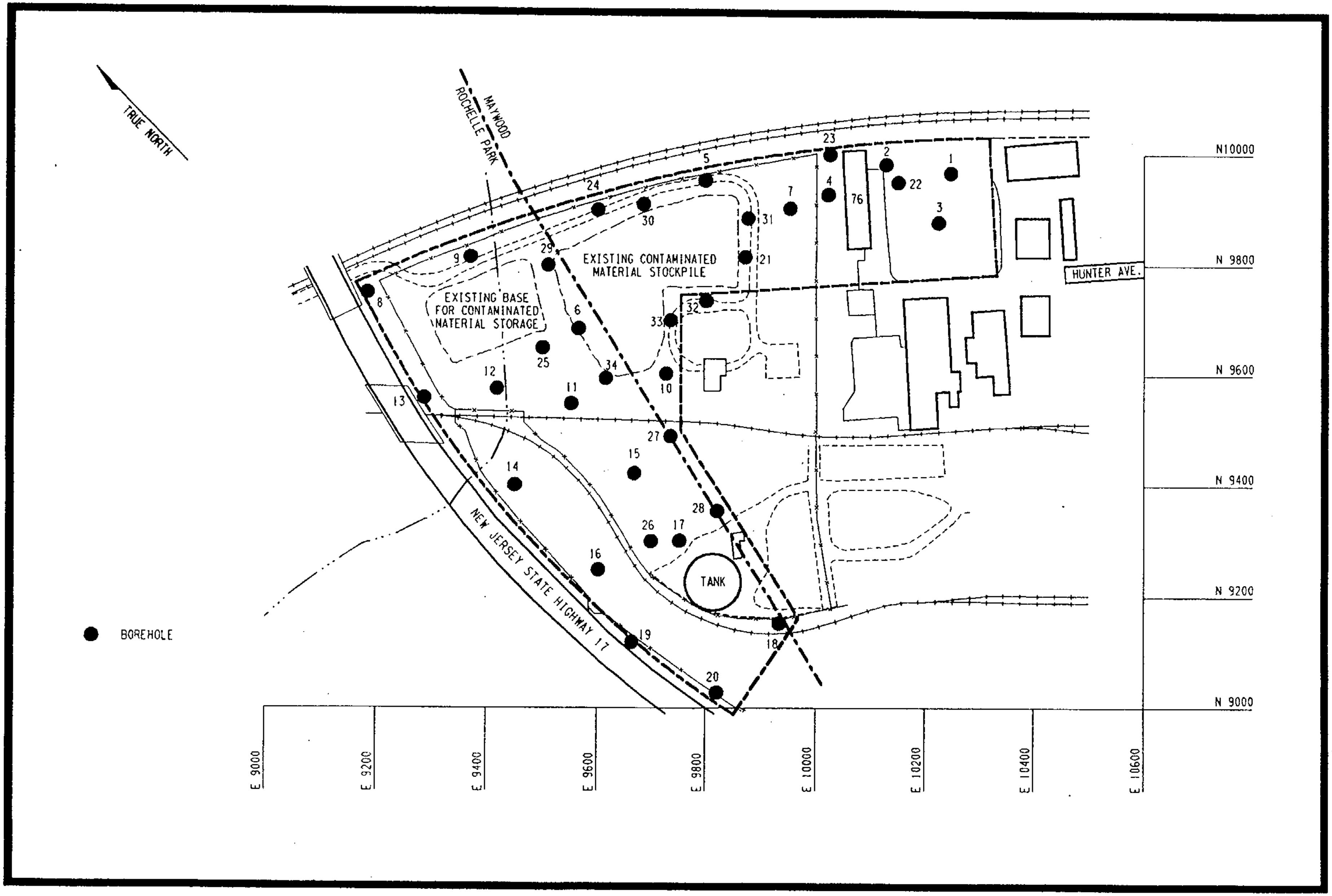

Figure 2-3
Proposed Onsite Borehole Locations at MISS

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Table 2-2

Locations and Depths of Chemical Boreholes at MISS

Borehole Number[a]	Grid Coordinate East	Grid Coordinate North	Estimated Depth of Borehole (ft)	Estimated Depth of Radioactive Contamination (ft)	TCLP Sample Depth (ft)	TCL/TAL Sample Depth (ft)	TCL/TAL RCRA Characteristic Sample Depth (ft)
1	10246	9967	12	9.0	2-4	4-6	10-12
2	10128	9982	12	9.0	8-10	4-6	10-12
3	10224	9878	12	9.0	6-8	0-2	10-12
4	10022	9928	15	11.0	8-10	6-8	12-14
5	9798	9953	20	4.5	2-4	0-2	16-18
6	9565	9685	13	Surface	0-2		10-12
7	9951	9903	18	Surface	0-2		14-16
8	9183	9750	22	11.0	10-12	0-2	18-20
9	9370	9815	14	6.5	2-4		10-12
10	9727	9603	7	Surface	0-2		4-6
11	9552	9549	14	6.5	4-6		10-12
12	9419	9576	16	13.5	12-14	10-12	14-16
13	9287	9559	17	13.5	12-14		14-16
14	9451	9402	15	10.0	2-4		12-14
15	9669	9423	16	11.0	6-8		12-14
16	9602	9249	17	12.5	10-12		14-16
17	9752	9301	15	9.0	0-2		12-14
18	9933	9153	10	2.5	0-2		8-10
19	9665	9119	13	4.5	2-4		6-8
20	9820	9028	14	4.5	2-4	0-2	8-10
21	9870	9815	15	8.0	4-6	6-8	10-12
22	10150	9950	15	7.0	6-8	4-6	10-12
23	10025	10000	15	8.0	6-8	0-2	12-14
24	9600	9900	15	8.0	4-6	4-6	10-12

Table 2-2

(continued)

Borehole Number[a]	Grid Coordinate East	North	Estimated Depth of Borehole (ft)	Estimated Depth of Radioactive Contamination (ft)	TCLP Sample Depth (ft)	TCL/TAL Sample Depth (ft)	TCL/TAL RCRA Characteristic Sample Depth (ft)
25	9500	9650	15	7.0	2-4		10-12
26	9700	9300	15	8.0	6-8	0-2	12-14
27	9735	9490	15	7.0	2-4	4-6	12-14
28	9820	9355	15	8.0	6-8		10-12
29	9510	9800	15	7.0	6-8	0-2	12-14
30	9685	9910	15	8.0	6-8	4-6	10-12
31	9875	9885	15	10.0	8-10	10-12	12-14
32	9800	9735	15	3.0	0-2		4-6
33	9735	9700	15	3.0	2-4		4-6
34	9615	9595	15	5.0	2-4		6-8

[a]Borehole locations are shown in Figure 2-3.

Table 2-3

Discrete Sampling Intervals to be Analyzed for

TCL Compounds in Onsite Soils

Borehole Number	Grid Coordinate East	Grid Coordinate North	Discrete Sample Interval (ft)
1	10246	9967	4 - 6
2	10128	9982	4 - 6
3	10224	9878	0 - 2
4	10022	9928	6 - 8
5	9798	9953	0 - 2
8	9951	9903	0 - 2
12	9419	9576	10 - 12
20	9820	9028	0 - 2
21	10250	9950	6 - 8
22	10150	9950	4 - 6
23	10025	10000	0 - 2
24	9500	9650	4 - 6
26	9700	9300	0 - 2
27	9735	9490	4 - 6
29	9800	9735	0 - 2
30	9685	9910	4 - 6
31	9875	9985	10 - 12

Each of the 34 boreholes will be advanced a minimum of 0.6 m (2 ft) beyond the depth of radioactive contamination (Table 2-2). A discrete sample from each borehole will be collected below the zone of radioactive contamination and analyzed for TCL compounds. Results from these samples will help determine whether chemical contamination is present on the DOE-owned MISS outside the known boundaries of radioactive contamination.

2.2.3 Objective 3: Determine Whether Chemical Contaminants Are Migrating from MISS via Surface Water, Sediment, or Groundwater

Transport of contaminants by the current surface water flow system at MISS will be evaluated with 10 surface water/sediment samples collected from all drainages leaving or entering MISS. Because there are no existing surface water drainages on MISS, it is anticipated that flowing runoff present after a heavy rainfall may be sampled, provided sufficient quantities are available for sample analysis. These locations will be selected by the field sampling team.

In addition, the presence of radioactive and chemical contaminants in Westerley Brook both upstream and downstream of MISS will be determined, as will the effects of these contaminants on the Saddle River. An evaluation of the quality of drainage water at the southwest corner of the property adjacent to the Sears property and an assessment of sediment transport of contaminants at each surface water monitoring location will be made.

Sediment samples will be collected at each of the surface water sampling locations to determine the potential presence of contaminants and their availability for particulate transport. Sediment samples will also be collected downstream of the point where Westerley Brook discharges from the pipe that conveys it beneath the MISS property; emphasis will be on the area where Westerley Brook joins the Saddle River. This area is expected to contain deposits of sediments that typically occur at the confluence of a fast-moving stream with a slow-moving river.

Surface water/sediment samples will be analyzed for metals, lithium, lanthanides, mobile ions, and indicator parameters. Section 5.0 presents a description of sample collection and handling procedures.

Half of each surface water sample will be filtered before preservation. The unfiltered aliquot will be analyzed for the substances discussed in Section 3.0, Table 3-1. If concentrations that exceed the local background range for the Maywood area are detected in the unfiltered aliquot, the filtered sample will be analyzed to evaluate the particulate and solute transport pathways.

To investigate potential migration of chemical contaminants from MISS via groundwater, existing wells will be sampled for additional parameters. Approximately 10 wells will be selected; groundwater taken from these wells will be analyzed for mobile ions, lanthanides, metals, and lithium. These wells, which are a part of the existing environmental monitoring program, will represent upgradient and downgradient conditions to allow comparison and calculation of contributions of chemicals from MISS. The existing groundwater program monitors for radionuclides, volatile and semivolatile compounds, and indicator parameters.

2.2.4 Objective 4: Investigate Extent of Chemical Contamination

Section 2.2.2 describes a sampling program designed to identify chemical contaminants at MISS. If any hazardous chemicals that require corrective action are found, the horizontal and vertical boundaries of chemical contamination may need to be substantiated. Due to the time required for laboratory chemical analyses, this determination may require an additional phase of field sampling.

2.2.5 Objective 5: Obtain Radon Flux Measurements for Compliance with the Clean Air Act and Quantify Residual Contamination on Structural Surfaces in Building 76

The magnitude of the radon and thoron source terms can be determined by measuring the respective emanation rates from the ground surface. Radon flux data will be taken from measurements required for compliance with radionuclide provisions of the Clean Air Act. Thoron flux data will also be taken, for informational purposes, and all data will be reported in the remedial investigation report.

Flux rate measurements are made by placing charcoal canisters on the ground for a 24-hour period. The canisters are then collected and the amount of radon and thoron collected can be determined by gamma spectroscopy. When the concentration is known, the emanation rate can be calculated because the surface area of the canister and the collecting times are known.

When the radon and thoron emanation rates are measured, computer modeling can be used to calculate ambient air concentrations of these two radionuclides at various locations. To check the computer model, five grab samples will be collected at various distances and directions from MISS.

These grab samples will be collected using short-term, high-volume air samplers that will draw a known air volume into a Tedlar bag. Samples will be collected and analyzed as described in Section 2.1.8.

The grab samples will be collected during the period in which the MISS flux rate measurements are being taken. The time of day and atmospheric conditions will be recorded, including average estimated wind speed, turbulence, wind direction, temperature, and sky conditions (e.g., overcast, sunny, partly cloudy). These conditions and the measured concentrations can be used as input to the computer model for verification.

The objective of the building survey is only to determine whether radioactivity exceeding guidelines exists on building surfaces; precise boundaries of contamination are not intended to be determined during this investigation. Previous experience within FUSRAP has shown it to be more practical to perform final building surveys immediately before remedial action, especially in facilities where the potential for changing uses and operations could alter the nature and extent of surface contamination. This survey is only intended to identify general areas of contamination and determine gross levels of radioactivity on building surfaces. Therefore, various surfaces of Building 76 (floors, walls, and ceilings) will be spot-checked for residual radioactivity.

In some portions of Building 76, samples may be collected and analyzed for uranium-238, radium-226, and thorium-232. These samples will be collected from horizontal surfaces such as window ledges, overhead beams, and floors where surface deposit buildup is observed. The analytical results will aid in determining major contaminants in the building and in determining the appropriate surface criteria for the structure.

2.3 DATA REQUIREMENTS FOR RESIDENTIAL VICINITY PROPERTIES

Residential vicinity properties contaminated with radioactive materials have been identified by ORNL. Most of these properties have been characterized; however, seven remain to be thoroughly investigated. For these seven properties, the following objectives exist:

- Objective 1: Determine extent of radioactive surface contamination
- Objective 2: Determine horizontal and vertical boundaries of radioactive subsurface contamination
- Objective 3: Investigate the potential presence of chemical contamination associated with thorium-232 processing operations
- Objective 4: Determine mechanisms of contaminant transport
- Objective 5: Determine gamma exposure rate measurements

The following subsections provide an overview of the technical approach that will be used to fill existing data gaps at the residential vicinity properties.

2.3.1 Objective 1: Determine Extent of Radioactive Surface Contamination

A civil survey delineating property boundaries and the locations of all structures, aboveground utilities, driveways, streets, and major vegetation will be obtained for each residential property before characterization. A master grid will be established by the surveyor using a grid origin correlated with the New Jersey State Plane Coordinate System. The grid origin will allow the grid to be reestablished during removal action. TMA/E will establish the characterization grid on individual properties. These grid coordinates may vary depending on the location of the property (i.e., grids for the boroughs of Maywood and Lodi may differ because separate characterization grids are used for each borough). The size of the grid blocks for residential properties is typically 7.6 m (25 ft) but may be adjusted by the field sampling team to adequately characterize each property. All data correspond to coordinates on the characterization grid. The grid, with east and north coordinates, is shown on all figures included in Sections 2.1 through 2.4 of this plan.

An initial near-surface walkover survey will be performed to identify areas of elevated radionuclide activity. Near-surface gamma measurements will also be taken using a cone-shielded gamma scintillation detector in all locations identified during the walkover survey where measurements were greater than twice background. The average background level for this area is 5,000 cpm.

To identify surface areas where the level of contamination exceeds the DOE guideline of 5 pCi/g for thorium-232, areas with measurements of more than 11,000 cpm will be plotted. These data will be used to determine the locations for biased surface soil samples. These biased samples and samples collected systematically at 7.6-m (25-ft) intervals where the grid lines intersect will be used to determine the extent of surface contamination. These samples will be analyzed for thorium-232, radium-226, and uranium-238.

2.3.2 Objective 2: Determine Horizontal and Vertical Boundaries of Radioactive Subsurface Contamination

A subsurface investigation, using the established grid system, will be conducted to determine the depth to which the previously identified radioactive surface contamination extends. The investigation will also be used to locate subsurface contamination where there is no surface manifestation.

The subsurface investigation will consist of drilling systematic and biased boreholes on each property (Figures 2-4 through 2-10), using either a 3-in.- or 6-in.-diameter auger bit. Locations of biased boreholes will be determined by near-surface walkover gamma survey and cone-shielded measurements. All boreholes will be drilled to undisturbed soil (as determined by the field geologist) and gamma logged to provide supporting data on radiological conditions at each property. Drilling to undisturbed soil ensures that any lens of contamination encountered will be completely penetrated. Gamma radiation measurements will be taken in the boreholes at 15.2-cm (6-in.) intervals to identify the depth and concentration of the contamination.

In addition to downhole gamma logging each borehole, continuous soil sampling will be conducted. Samples will be collected at 30.4-cm (1-ft) intervals from depths of 15.2 cm (6 in.) until undisturbed soil is reached. It is estimated that three samples from each borehole will be analyzed for thorium-232, radium-226, and uranium-238. Analysis will be performed in the same manner as for surface soil samples. The remaining samples will be archived for future analysis, should it be required. Data from the analyzed samples will provide information for determination of the horizontal and vertical boundaries of subsurface contamination on each property. If contamination is found at a property boundary, adjacent properties may need to be investigated to determine the extent of contamination.

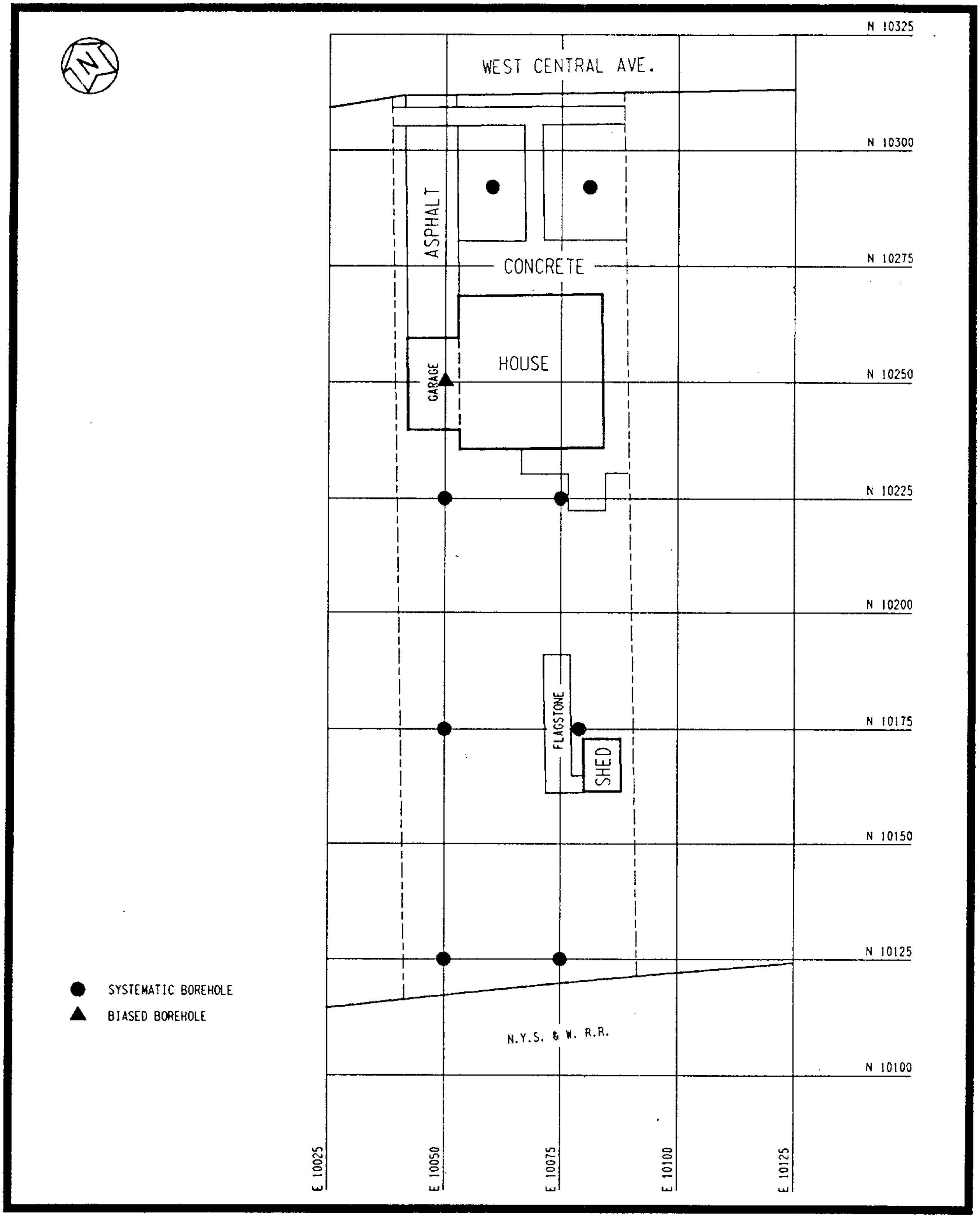

Figure 2-4
Proposed Borehole Locations at
136 West Central Avenue, Maywood, New Jersey

138F035.DGN

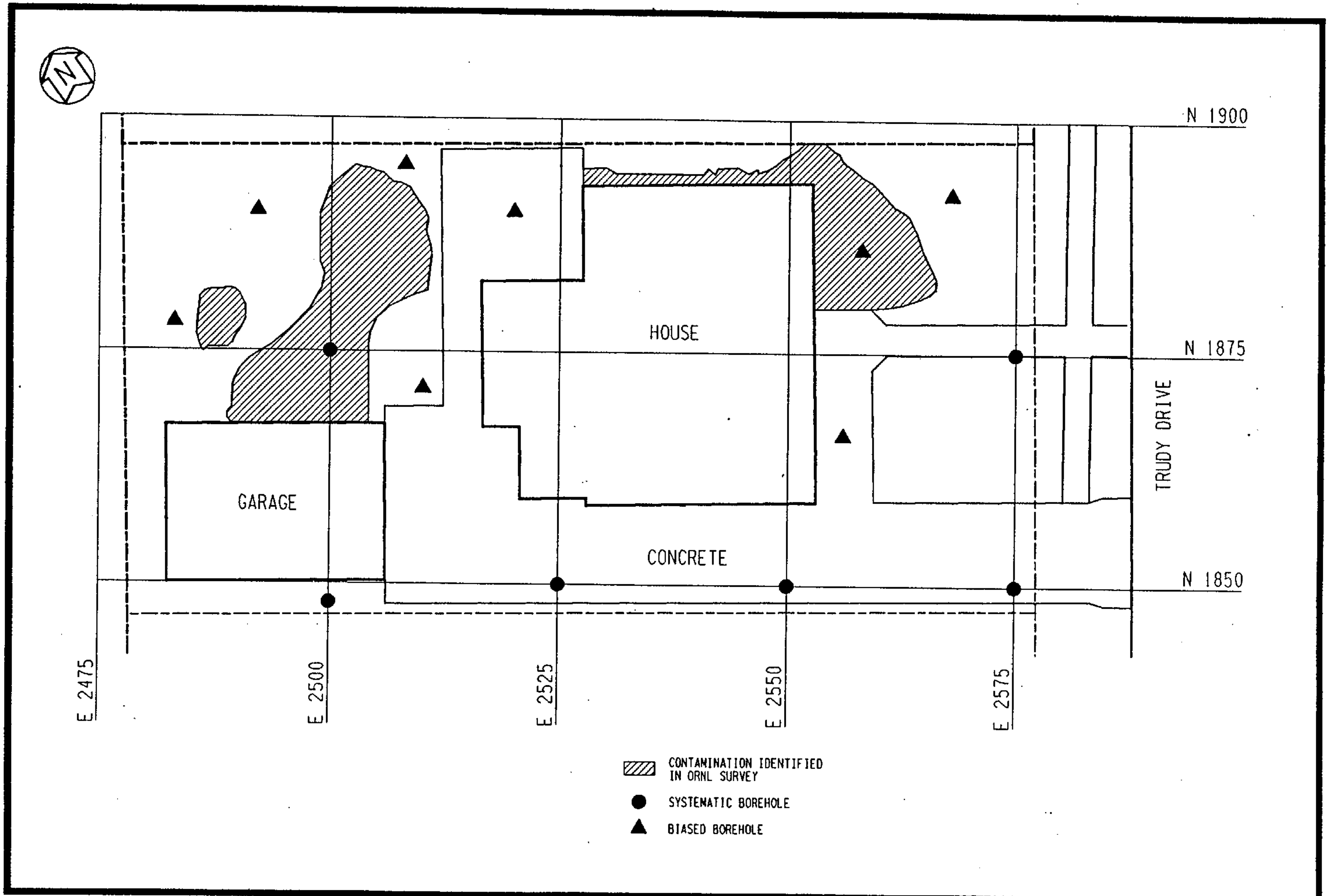

Figure 2-5
Proposed Borehole Locations at 62 Trudy Drive, Lodi, New Jersey

138F036.DGN

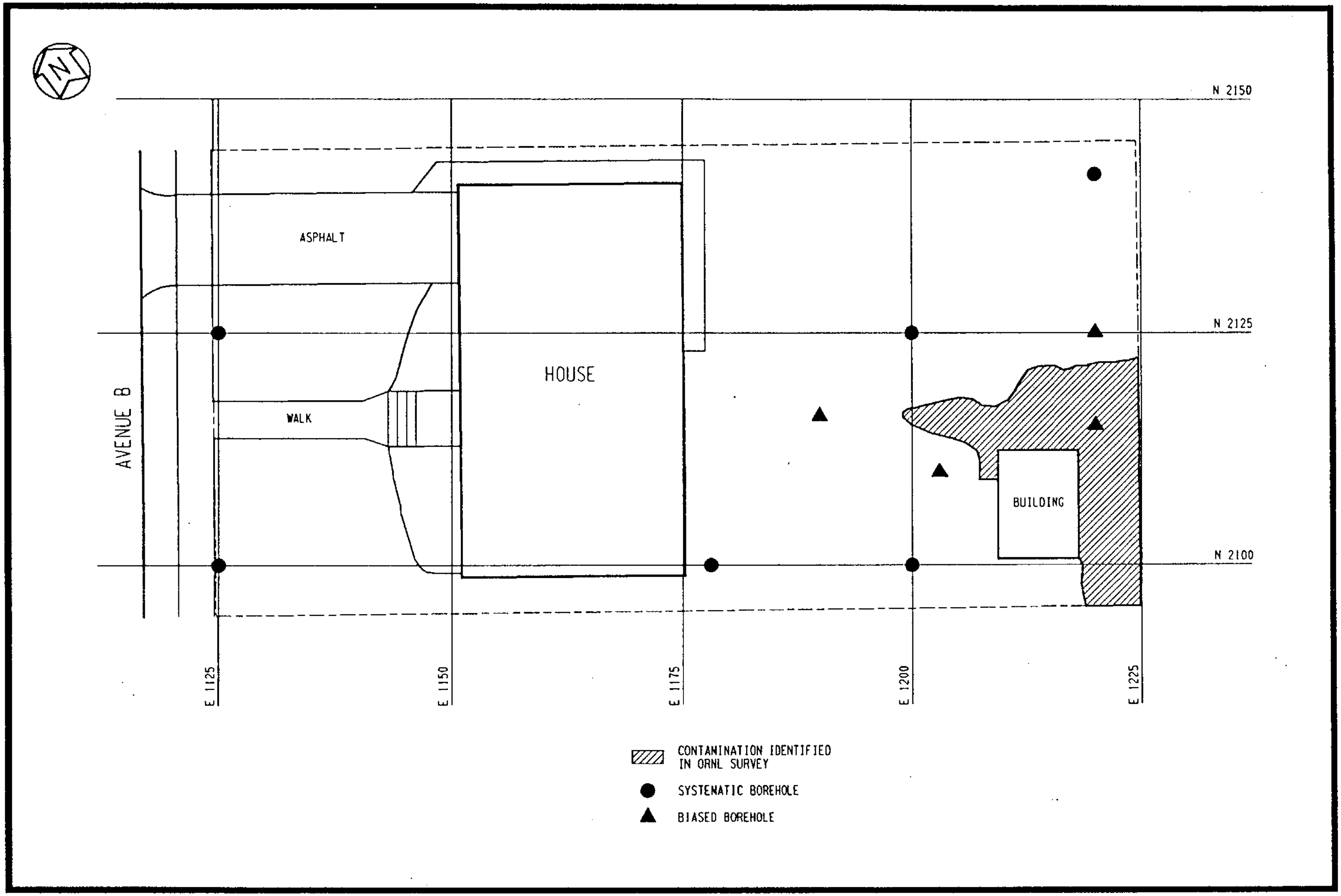

Figure 2-6
Proposed Borehole Locations at 79 Avenue B, Lodi, New Jersey

138F038.DGN

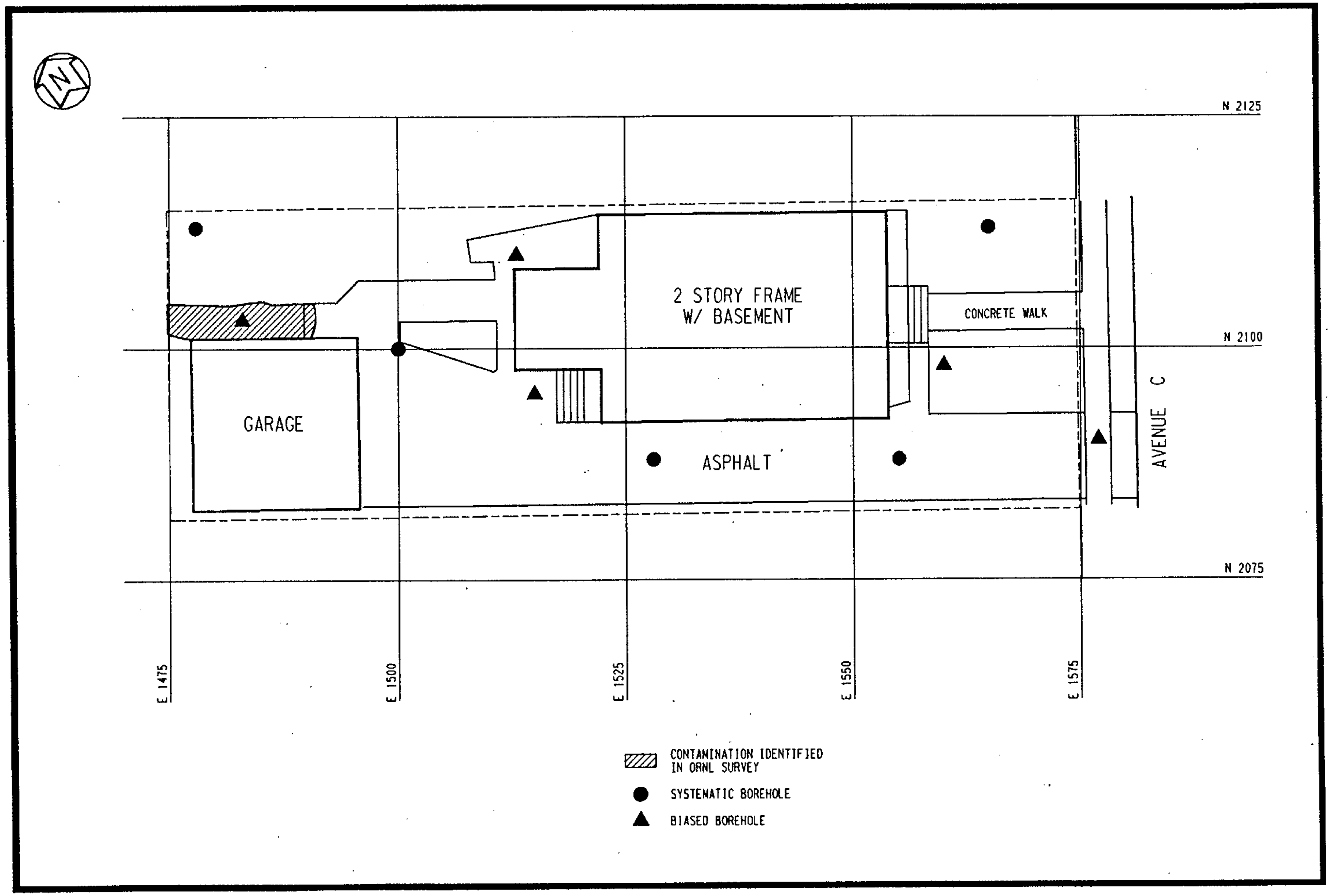

Figure 2-7
Proposed Borehole Locations at 90 Avenue C, Lodi, New Jersey

138F042.DGN

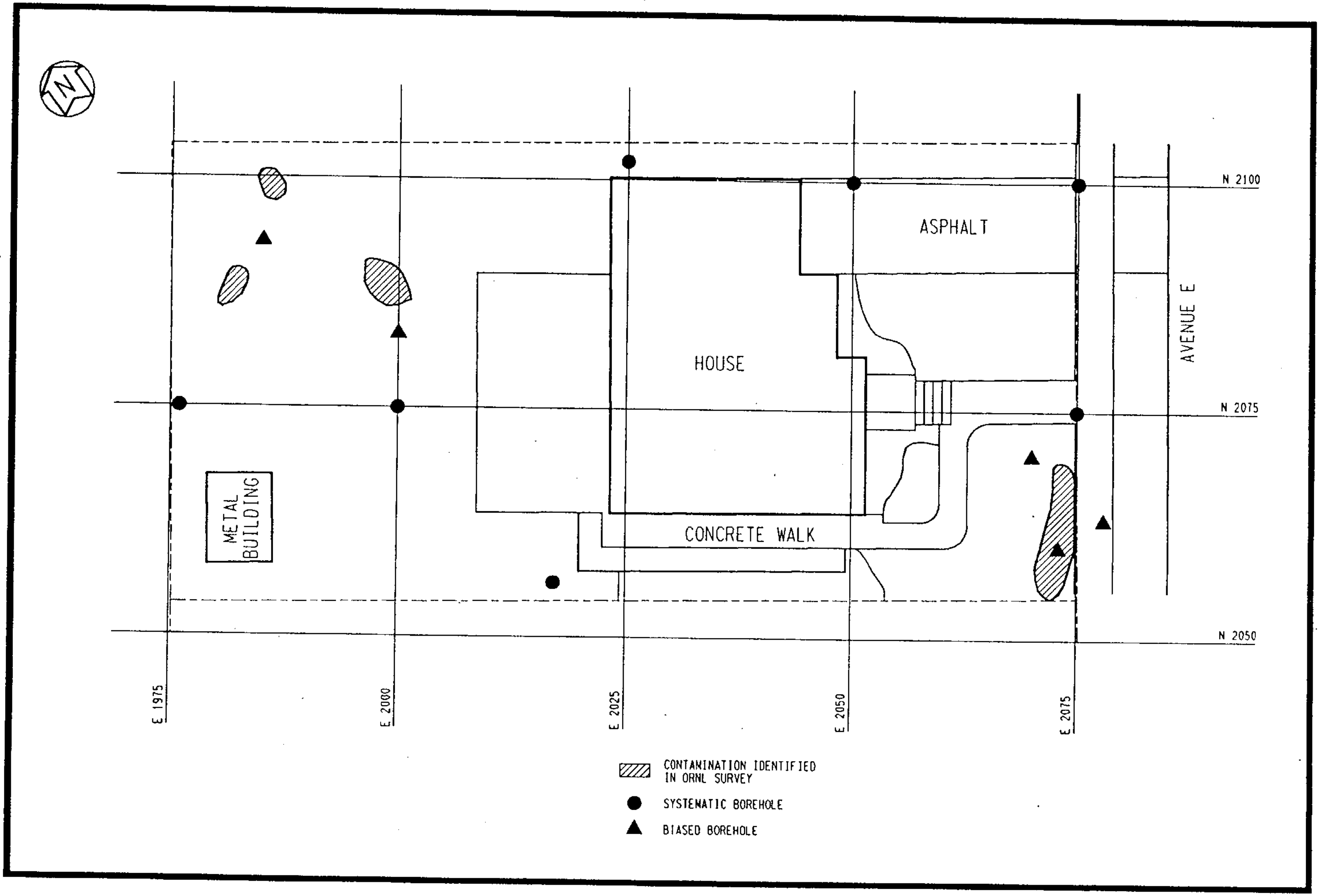

Figure 2-8
Proposed Borehole Locations at 108 Avenue E, Lodi, New Jersey

138F039.DGN

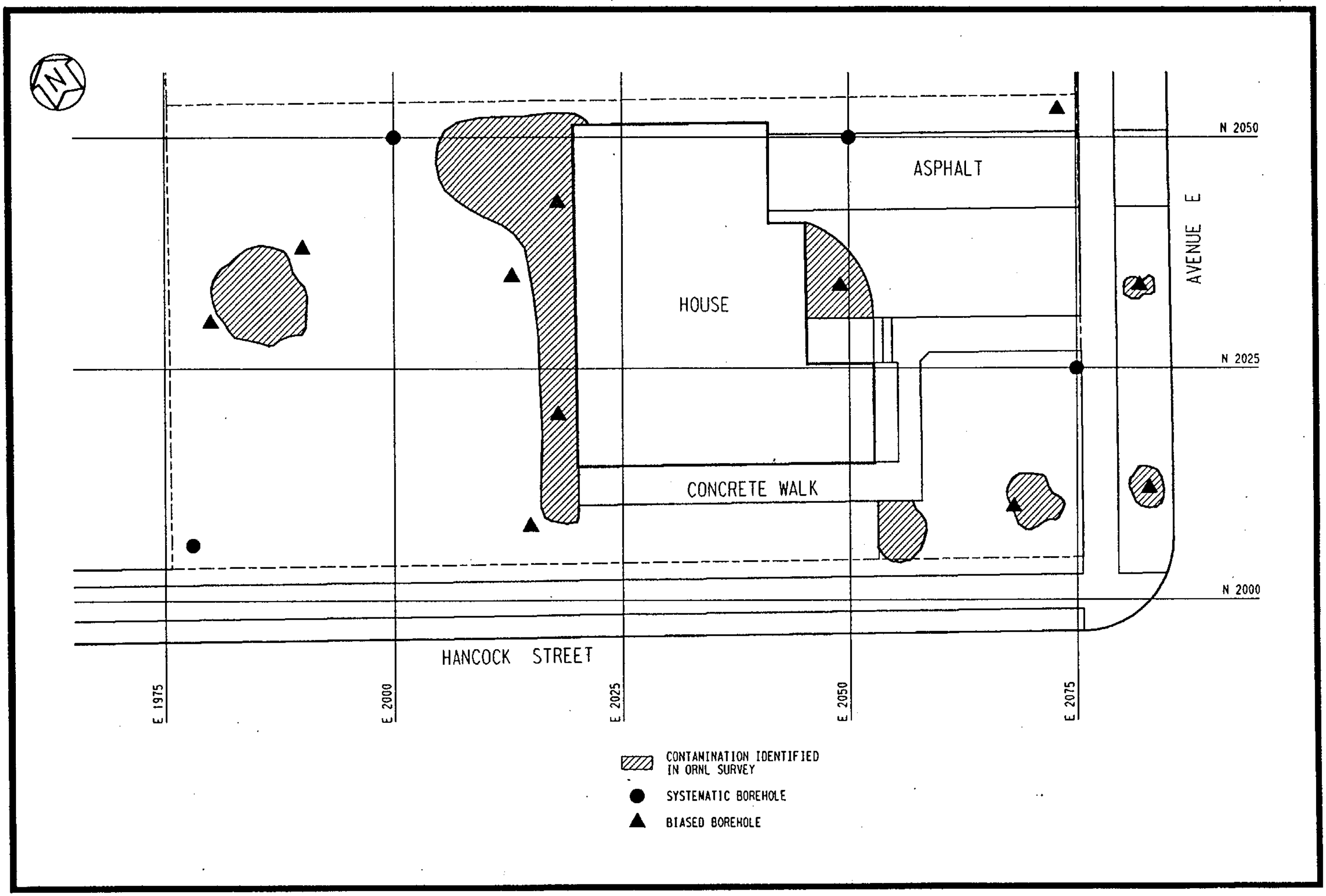

Figure 2-9
Proposed Borehole Locations at 112 Avenue E, Lodi, New Jersey

138F040.DGN

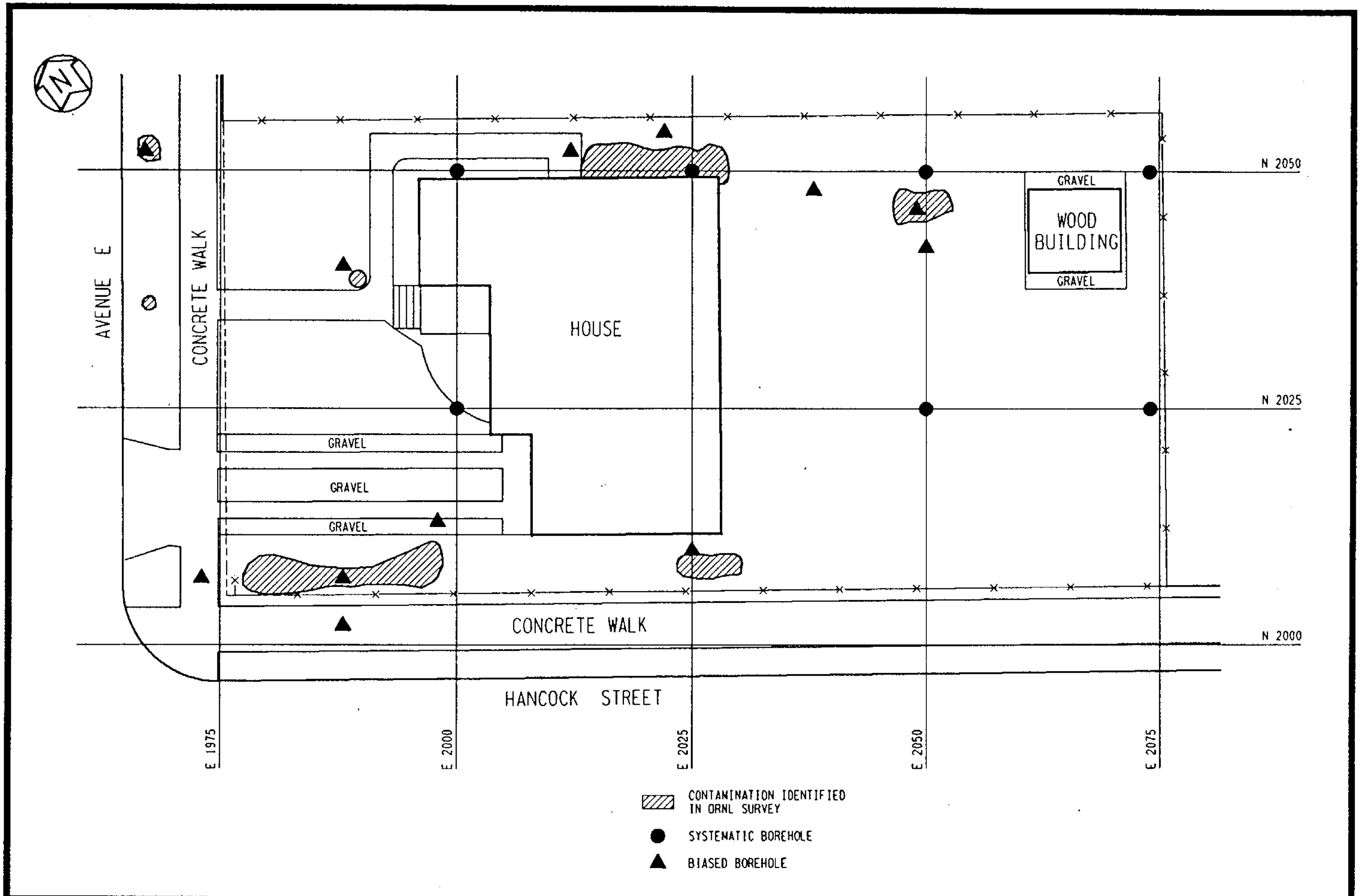

Figure 2-10
Proposed Borehole Locations at 113 Avenue E, Lodi, New Jersey

138F041.DGN

2.3.3 Objective 3: Investigate the Potential Presence of Chemical Contamination

Limited chemical characterization of the residential properties will be conducted to identify the presence of chemical contaminants associated with the thorium processing operations, and to determine whether chemical contamination is collocated with radioactive contamination. Biased boreholes drilled for the radiological characterization will be sampled at specified intervals above, within, and below the radioactive contamination for chemical analysis. Approximately three 0.6-m (2-ft) intervals will be sampled per borehole. Five percent of all samples collected will be analyzed for metals, mobile ions, lanthanides, TCLP metals, reactivity, corrosivity, TPH, and total PCBs. Additionally, 10 percent of these samples will be analyzed for TCLP organics. If any hazardous chemicals that require corrective action are found, the horizontal and vertical boundaries of chemical contamination will need to be determined by additional phases of remedial investigation work.

2.3.4 Objective 4: Determine Mechanisms of Contaminant Transport

It is important to identify the mechanism by which contamination was transported onto the residential properties because the transport mechanism provides information on the expected contaminant distribution in the soil. Biased boreholes will be drilled in areas where the former channel of Lodi Brook is believed to have existed to further confirm that contaminated materials were transported by the brook. Stream channel sediments that might be present in these boreholes will be identified by the field geologist. Soil samples will be collected from these boreholes and analyzed for radiological and chemical parameters identified in Table 4-1.

2.3.5 Objective 5: Determine Gamma Exposure Rate Measurements

Interior and exterior gamma exposure rate measurements will be obtained at each property using the methodology and instrumentation outlined in the Stepan property technical approach (Section 2.1.6). Two interior and six exterior measurements are planned for each property to obtain sufficient data to determine exposure rates for occupants of the residence.

2.4 DATA REQUIREMENTS FOR COMMERCIAL/GOVERNMENTAL VICINITY PROPERTIES

ORNL has identified numerous nonresidential properties that were contaminated by thorium processing operations. Although many of these properties have been characterized, four properties remain to be investigated to meet the following objectives:

- Objective 1: Determine extent of radioactive surface contamination
- Objective 2: Determine horizontal and vertical boundaries of radioactive subsurface contamination
- Objective 3: Investigate the potential presence of chemical contamination associated with thorium-232 processing operations
- Objective 4: Determine mechanisms of contaminant transport
- Objective 5: Determine gamma exposure rate measurements

The technical approach that will be used to fulfill the existing data objectives for the commercial/governmental vicinity properties is identical to that to be used for the residential vicinity properties. However, commercial/governmental properties are generally larger, and the size of the grid blocks is usually 15.2 m (50 ft). Grid block size may be altered by the field sampling team as needed for adequate characterization.

The number of boreholes and radon and exposure rate measurements may be adjusted to adequately investigate the properties. Figures 2-11 through 2-14 illustrate the suggested borehole locations. In addition, sediment samples will be collected along any exposed areas of Lodi Brook and will be analyzed for the radiological and chemical parameters identified in Table 4-1.

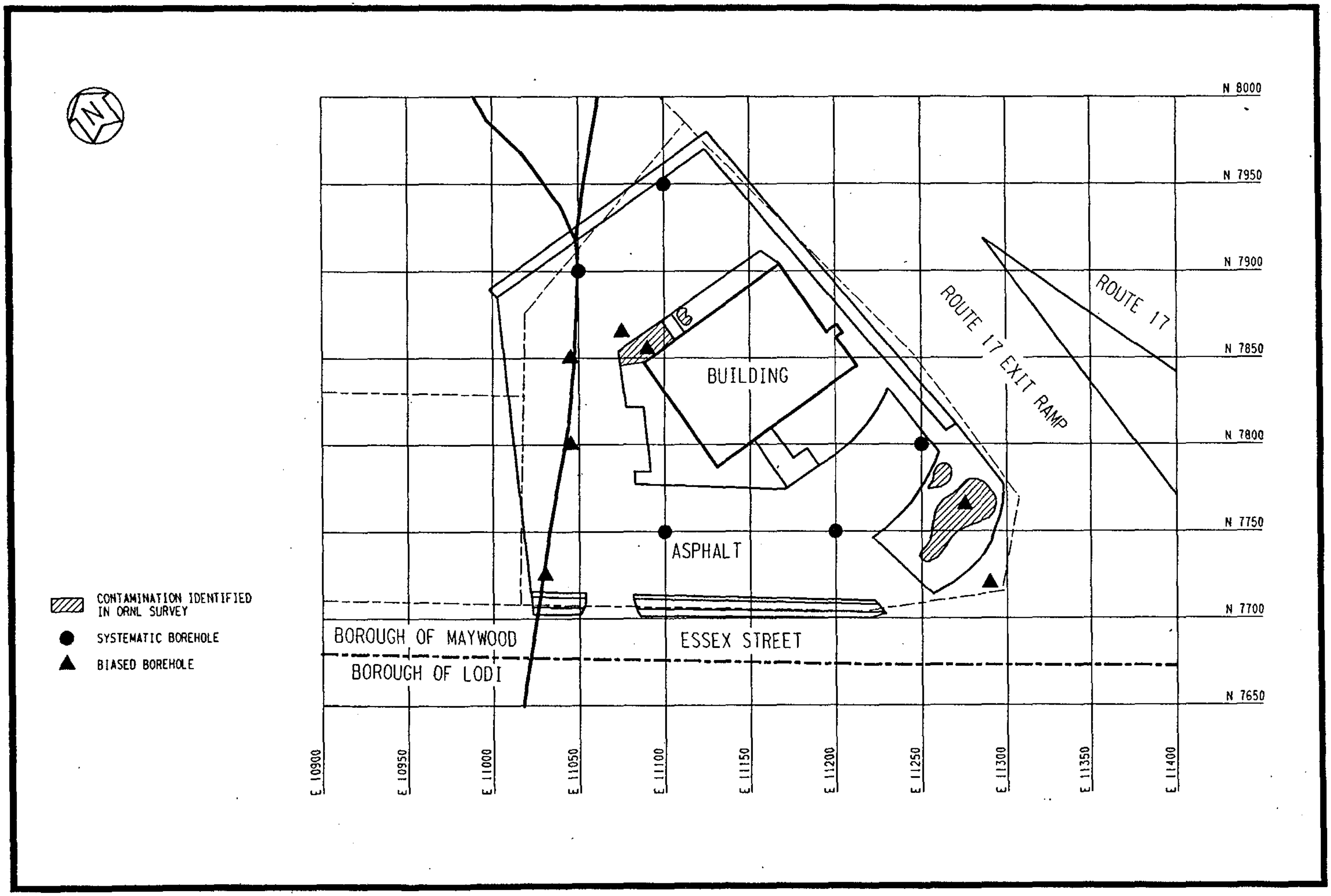

Figure 2-11
Proposed Borehole Locations at Muscarelle Associates Property, Maywood, New Jersey

138F034.DGN

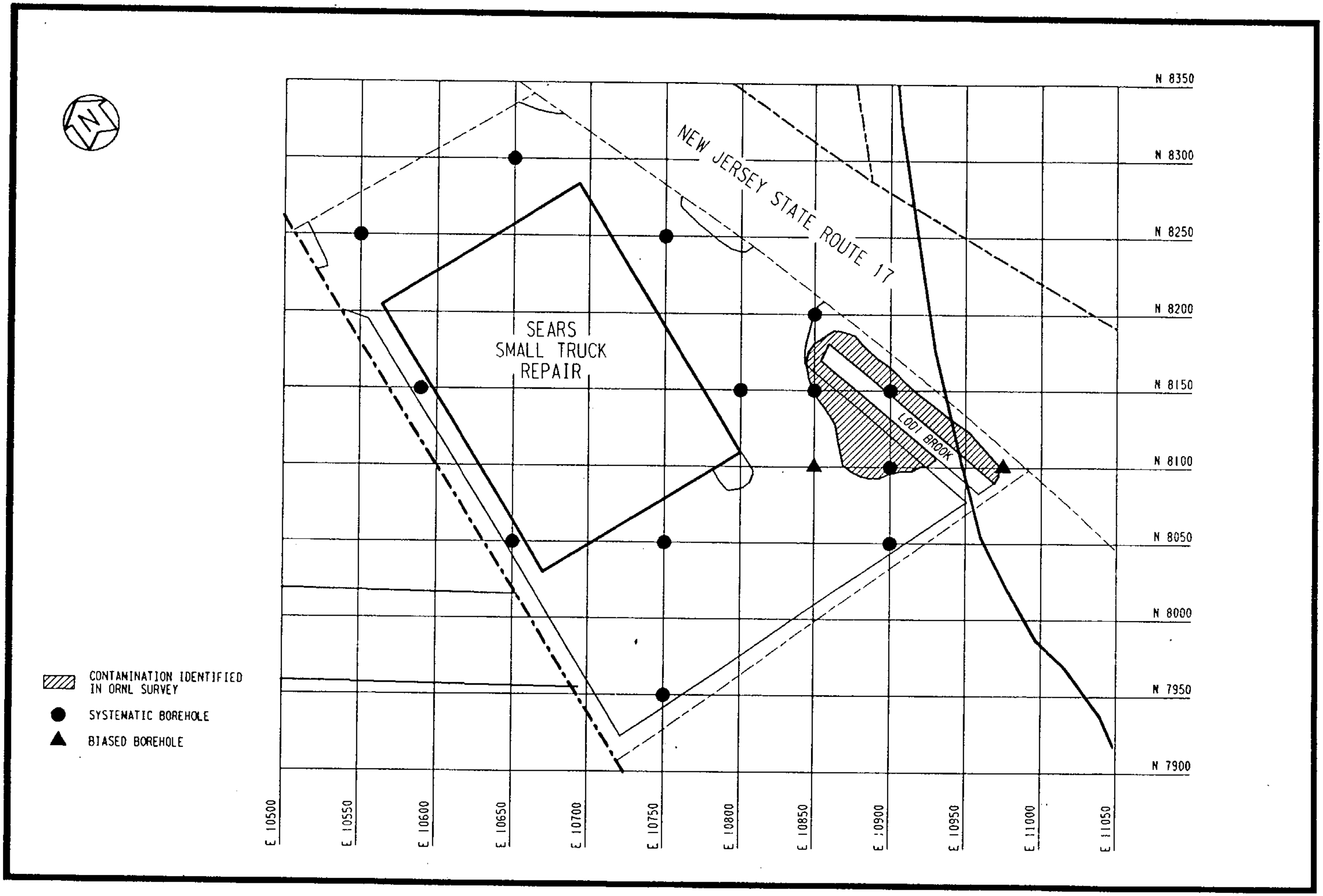

Figure 2-12
Proposed Borehole Locations at 200 State Route 17,
Maywood, New Jersey

138F032.DGN

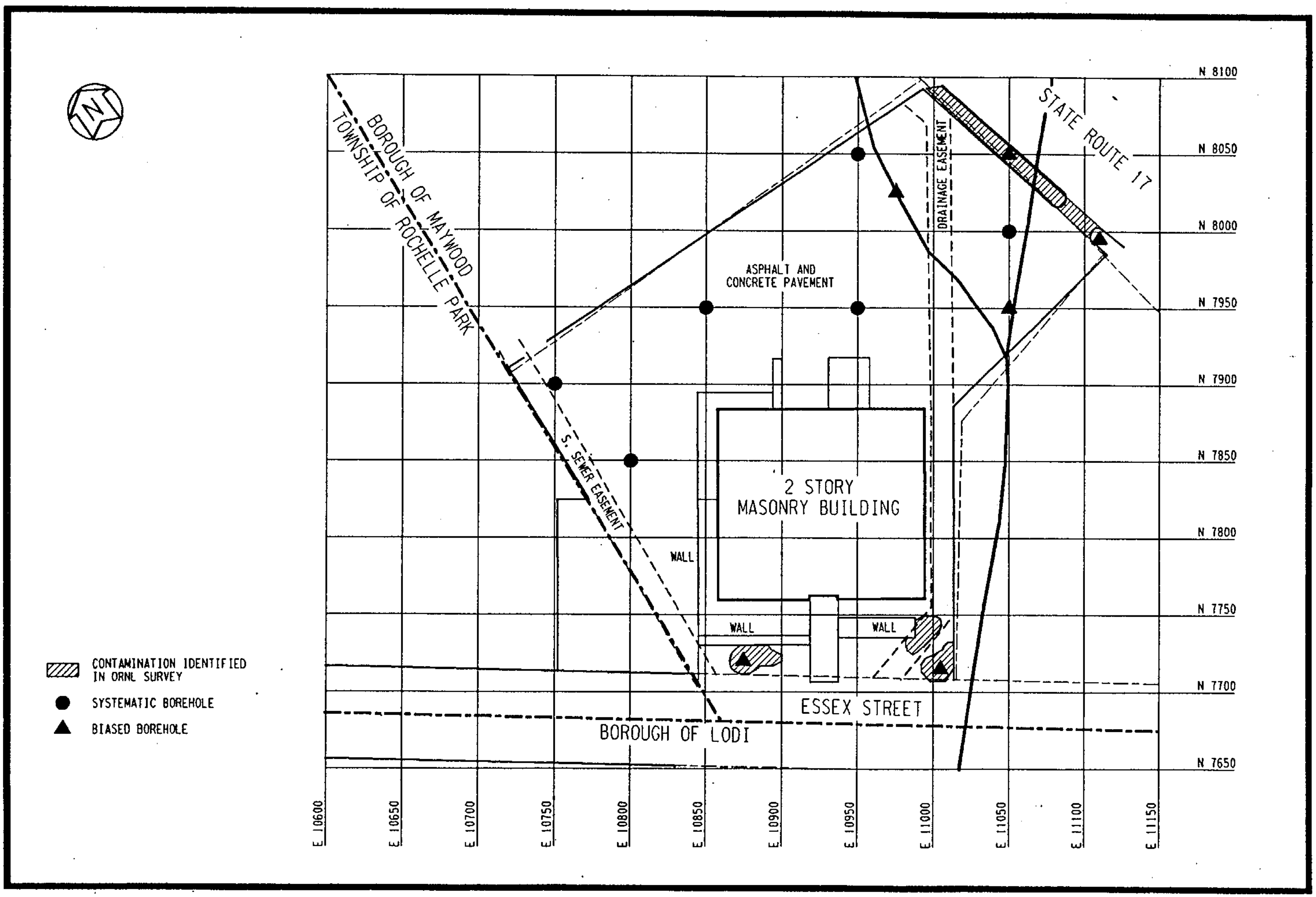

Figure 2-13
Proposed Borehole Locations at National Community Bank,
113 Essex Street, Maywood, New Jersey

138F033.DGN

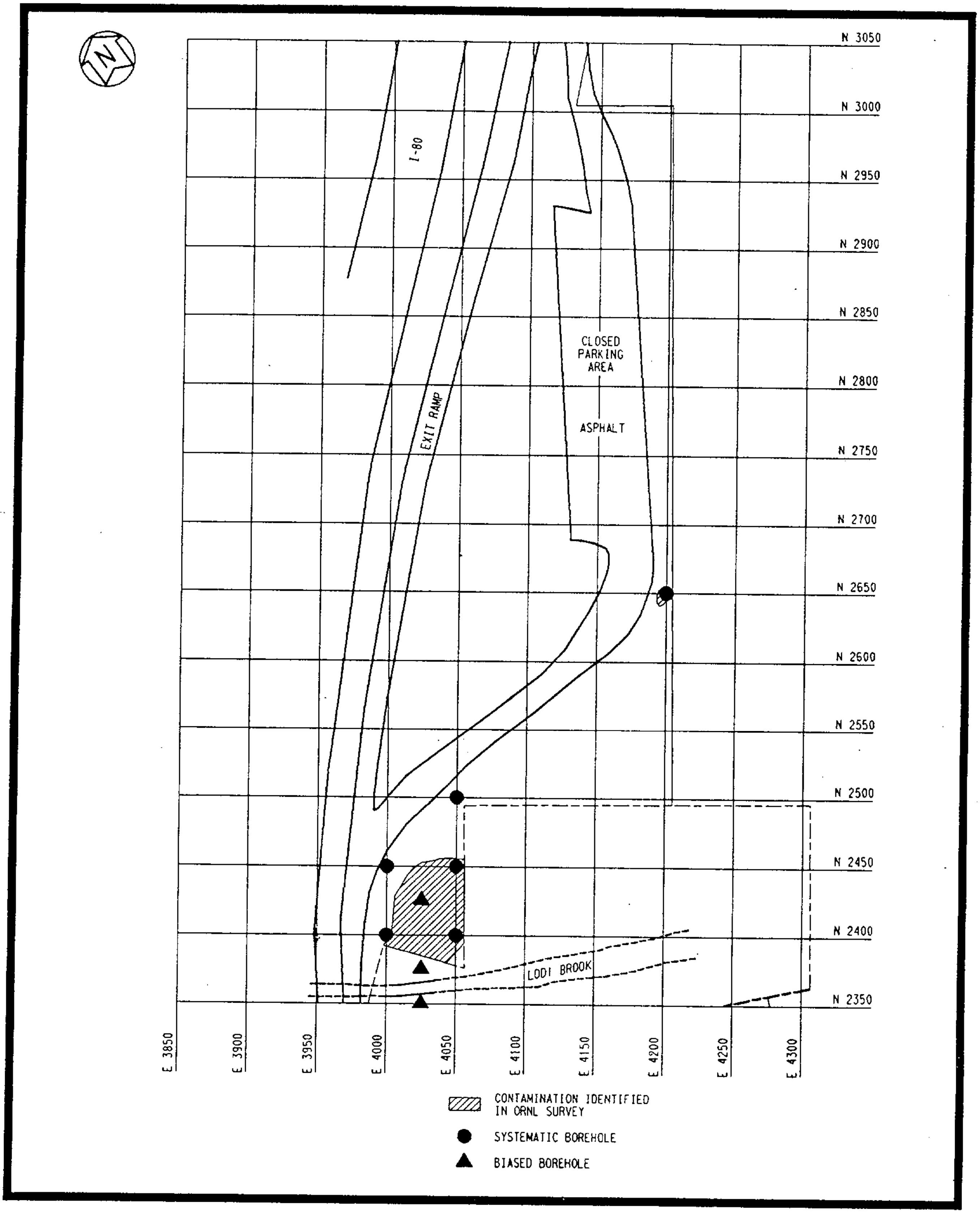

Figure 2-14
Proposed Borehole Locations at Interstate 80,
North Right-of-Way at Lodi Brook,
Lodi, New Jersey

138F037.DGN

3.0 SAMPLE TYPES AND MEASUREMENTS

Section 2.0 describes the data requirements for each operable unit and outlines the technical approach that will be used to resolve the requirements during the remedial investigation field activities. Table 3-1 summarizes the types of samples that will be collected and analyzed from each medium. Table 3-2 indicates the volumes of samples needed to allow the laboratories to perform the analyses.

In general, six different types of samples will be collected during the remedial investigation: soil, air, groundwater, surface water, filtered surface water, and sediment. All types of samples will be collected using methodologies compatible with A Compendium of Superfund Field Operations Methods (EPA 1987a). In addition, smear samples and direct radiation measurements will be collected from various structural surfaces in selected buildings at the Stepan property.

Analyses to be performed on each type of sample vary for each operable unit because of the differing data needs. The six categories of analysis include radiological parameters, metals that may have been present in or added to the original thorium-232 source materials, mobile ions potentially related to the thorium-232 processing operations, organic contaminants that may have been introduced over the years but are not related to thorium-232 processing operations, hazardous waste determinations, and miscellaneous chemical indicator parameters.

Table 3-l

Analytical Parameters for Various Media

Parameter	Soil	Ground-water	Surface Water	Filtered Surface Water	Sediment	Air
Radiological						
Isotopic uranium	O	--	--	--	--	--
Isotopic thorium	O	--	--	--	--	--
Isotopic radium	O	--	--	--	--	--
Thorium-232	O	O	--	--	O	--
Radium-226	O	O	--	--	O	--
Uranium-238	O	O	--	--	O	--
Radon	--	--	--	--	--	O
Thoron	--	--	--	--	--	O
Metals						
ICPAES[a,b]	O	O	O	X	O	--
Lithium	O	O	O	X	O	--
Lanthanides	O	O	O	O	O	--
Mobile Ions						
Phosphate	O	O	O	X	O	--
Chloride	O	O	O	X	O	--
Nitrate	O	O	O	X	O	--
Organics						
Volatile organics	O	--	--	--	--	--
Semivolatile organics	O	--	--	--	--	--
Hazardous Waste						
TCLP metals[c]	O	--	--	--	--	--
TCLP organics	O	--	--	--	--	--
Corrosivity	O	--	--	--	--	--
Reactivity	O	--	--	--	--	--
TPH[d]	O	--	--	--	--	--
Total PCBs[e]	O	--	--	--	--	--

Table 3-1

(continued)

Parameter	Soil	Ground-water	Surface Water	Filtered Surface Water	Sediment	Air
<u>Engineering and Geotechnical</u>						
Gradation/ hydrometer	O	--	--	--	O	--
Cation exchange capacity	O	--	--	--	O	--
Distribution coefficient	O	--	--	--	O	--
Atterberg limits	O	--	--	--	--	--
Specific gravity	O	--	--	--	--	--
Unit weight (wet/dry)	O	--	--	--	--	--
Moisture content	O	--	--	--	--	--
Centrifugal moisture equivalent	O	--	--	--	--	--
<u>Miscellaneous Indicators</u>						
Temperature	--	--	O	--	--	--
pH	--	--	O	--	--	--
Specific conductance	--	--	O	--	--	--
Dissolved oxygen	--	--	O	--	--	--

O - Analysis required.
X - Analysis is contingent on other results.
-- - Analysis not required.

[a]Includes aluminum, antimony, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, potassium, silver, sodium, vanadium, and zinc. Analyses for arsenic, selenium, thallium, and lead are by furnace atomic absorption.

[b]ICPAES - inductively coupled plasma atomic emission spectrophotometry.

[c]TCLP - toxicity characteristics leaching procedure.

[d]TPH - total petroleum hydrocarbons.

[e]PCBs - polychlorinated biphenyls.

Table 3-2

Sample Volume/Weight

Parameter	Medium: Soil/ Sediment (g)	Medium: Water (ml)
Radiological[a]	500	1,000
Metals[a]	200	200
Mobile ions	100	1,000
Miscellaneous analyses[b]	50	50
Organics[b]		
Volatiles	50	40
Semivolatiles	100	1,000
Hazardous wastes[c]	200	4,000

[a]Water samples will be acidified to pH <2. Metal analyses will include inductively coupled plasma atomic emission spectrophotometry, metals, lithium, and lanthanides. Air sampling for radon will require a minimum volume of 2 L of filtered air collected in a gas sampling bag, or charcoal canisters exposed for 24 hours. Radon daughter samples will be collected on 0.45-micron filters with a minimum sample volume of 10 L. Airborne particulate samples will be collected on glass fiber filters and have a minimum sample volume of 5×10^5 ml for lapel samplers and 2×10^6 ml for high-volume area samples.

[b]Soil and water samples will be cooled to 4°C.

[c]Includes toxicity characteristics leaching procedure (TCLP) metals, TCLP organics, reactivity, corrosivity, total petroleum hydrocarbons, and polychlorinated biphenyls.

4.0 SAMPLING FREQUENCY

The sampling frequency specified in this plan is a one-time field sampling effort. However, depending on analytical results, additional field work may be necessary to refine understanding of site conditions.

Sampling frequency to be implemented in this one-time remedial investigation effort varies for each operable unit, as described in Section 2.0. Table 4-1 summarizes the planned sampling for each operable unit.

Table 4-1

Sampling Frequency

Operable Unit/Medium	Planned Activity	Approximate Number of Samples/Measurements	Analyses[a]	Data Quality Level
Stepan				
Soil	Identify surface radioactive contamination with walkover surveys	Not Applicable	Not Applicable	II
	Collect surface soil samples to confirm walkover results	50	Th-232, Ra-226, U-238	III
	Drill ≈ 75 boreholes and collect subsurface soil samples to define subsurface radioactive contamination	225	Th-232, Ra-226, U-238	III
	Determine presence of Th-232 process waste	8	TCLP metals, corrosivity, lithium, reactivity, metals, lanthanides, TPH, mobile ions, total PCBs, TCLP organics, volatile organics, semivolatile organics	III/IV
	Determine presence of mixed waste	11	TCLP metals, corrosivity, lithium, reactivity, metals, lanthanides, TPH, mobile ions, total PCBs, TCLP organics, volatile organics, semivolatile organics	III/IV
	Determine whether wastes have migrated from burial areas	8	TCLP metals, corrosivity, lithium, reactivity, metals, lanthanides, TPH, mobile ions, total PCBs, TCLP organics, volatile organics, semivolatile organics	III/IV

Table 4-1

(continued)

Operable Unit/Medium	Planned Activity	Approximate Number of Samples/Measurements	Analyses[a]	Data Quality Level
Smears	Collect smear samples, take direct readings in buildings to confirm presence of fixed and removable radioactive contamination	500	Gross alpha and gross beta	III
Direct Radiation	Obtain exposure rate measurements for direct gamma radiation	25	Gamma exposure rate	II
<u>MISS</u>				
Soil	Drill 37 holes in storage pile to determine presence of hazardous waste	170	TCLP metals, reactivity, TPH, total PCBs	III
		37	U-238, Ra-226, Th-232	
		20	TCLP organics, corrosivity	III
	Drill 34 holes onsite to determine mixed waste within known areas of radioactive contamination	34	RCRA characteristics, TPH, total PCBs	III
	Determine presence of Th-232 chemical process contaminants within areas of radioactive contamination	17	TCL/TAL	III/IV
	Collect discrete samples from beneath areas of known radioactive contamination	34	TCL/TAL, RCRA characteristics	III/IV

Table 4-1

(continued)

Operable Unit/Medium	Planned Activity	Approximate Number of Samples/Measurements	Analyses[a]	Data Quality Level
Surface Water	Collect upstream and downstream water samples to determine migration of hazardous materials	10	Metals, lithium, lanthanides, mobile ions, indicator analysis (see Table 3-1)	III/IV
Sediments	Collect upstream and downstream sediments to determine migration of hazardous materials	10	Same as surface water (except indicator analysis)	III/IV
Groundwater	Collect upgradient and downgradient samples from site for Th-232 process wastes, migration from MISS	10	Mobile ions, lanthanides, metals, lithium	III/IV
Air	Collect radon flux samples for compliance with Clean Air Act	20	Radon/thoron flux rates from pile and MISS	III
		5	Radon/thoron grab samples	III
Building 76	Collect data for fixed and removable radioactive surface contamination	100	Direct field measurement	III
Residential/Commercial/ Governmental Vicinity Properties				
Soil	Identify surface radiological contamination with walkover surveys	Not Applicable	Not Applicable	II
	Collect surface soil samples to confirm walkover results	300	Th-232, Ra-226, U-238	III

Table 4-1

(continued)

Operable Unit/Medium	Planned Activity	Approximate Number of Samples/Measurements	Analyses[a]	Data Quality Level
	Drill ≈ 10 to 15 boreholes per property (≈ 140 total) and collect subsurface soil samples to define subsurface radiological contamination	420	Th-232, Ra-226, U-238	III
	Determine presence of mixed waste, Th-232 process waste	21	TCLP metals, reactivity, corrosivity, TPH, metals, mobile ions, total PCBs, lanthanides	III/IV
		2	TCLP organics	III
Sediments	Collect sediment samples from open areas of Lodi Brook (downstream) to confirm that no contaminant migration is occurring from MISS	8	Th-232, Ra-226, U-238, metals, lithium, lanthanides, mobile ions	III/IV
Direct Radiation	Obtain gamma exposure rate measurements	30	Direct gamma radiation	II

[a]TCLP - toxicity characteristics leaching procedure; TPH - total petroleum hydrocarbons; PCB - polychlorinated biphenyls; RCRA - Resource Conservation and Recovery Act; TCL - Target Compound List.

5.0 ANALYTICAL PROCEDURES

This section describes acceptable analytical methods and protocols and quality assurance/quality control requirements for the remedial investigation. The requirements are stated to ensure defensibility and integrity of the analytical data to DOE, peer reviewers, and regulatory agencies. These methods were selected for their ability to detect the maximum number of parameters and meet the required detection limits. The quality assurance project plan provides greater detail on the quality assurance/quality control requirements and checks. As described in the work plan-implementation plan, these controls are intended to achieve the equivalent of Level II to IV quality.

5.1 ANALYTICAL METHODS

Procedures for analyzing for chemical and radiological parameters are shown in Tables 5-1 and 5-2 of this plan and Tables 3-1 and 3-2 of the quality assurance project plan. The published detection limits for each method (where appropriate) and method reference numbers are also included. The technical requirements for analyses are based on guidelines and standards developed by EPA and other sources. The chemical analysis laboratory will follow the protocol of the EPA Contract Laboratory Program (CLP) (EPA 1986). Because this program does not address radiological analysis, the radiological laboratory will adhere to laboratory procedures developed by Environmental Measurements Laboratory-300 (EML-300) and EPA methods (EPA-600/ 4-80-032), and quality assurance/quality control checks will be used to monitor performance as appropriate. In addition, analysis for radon and radon daughters in air samples will be in accordance with EML-300 methods (Rn-01 modified for radon), modified Kuznets method (radon daughters), and R. L. Rock procedure (thorium daughters).

Table 5-1

Analytical Methods for Water

Page 1 of 2

Parameter	Analytical Technique	EPA Method No.	Published Method Detection Limit
Total uranium	Fluorometric	Uranium-01[a,b]	0.1 pCi/L[c]
Isotopic thorium	Alpha spectroscopy	Thorium-03[a,b]	0.5 pCi/L[c]
Radium-226	Emanation spectrometry	Radium-03[a,b]	0.1 pCi/L[c]
Radium-228	Liquid beta scintillation	904.0	1.0 pCi/L[c]
Metals[d,e,f]	ICPAES[g]	200.7-CLP-M	Varies
Arsenic[e]	Furnace AA	206.2-CLP-M	0.01 mg/L
Lead[e]	Furnace AA	239.2-CLP-M	0.005 mg/L
Selenium[e]	Furnace AA	270.2-CLP-M	0.005 mg/L
Thallium[e]	Furnace AA	279.2-CLP-M	0.01 mg/L
pH[h]	Electrometric	150.1	--
Chloride	Colorimetric	325.2	1 mg/L
Phosphate	Colorimetric	365.2	0.02 mg/L
Nitrate	Ion chromatography	353.1	0.3 mg/L
Specific conductance[h]	Electrometric	120.1	1 μmho/cm
Dissolved oxygen[h]	Membrane electrode	360.1	--
Temperature[h]	Thermometric	170.1	--

Table 5-1

(continued)

[a]Thermo Analytical/Eberline uses laboratory procedures developed by Environmental Measurements Laboratory (EML).

[b]Modified EML procedure to accommodate the water matrix.

[c]Detection is dependent upon sample volume, detector efficiency, etc.

[d]Includes aluminum, antimony, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lithium, magnesium, manganese, molybdenum, nickel, potassium, silver, sodium, vanadium, zinc, and lanthanides. Arsenic, selenium, thallium, and lead analyses are by furnace atomic absorption (AA).

[e]Samples are prepared for analysis in accordance withprocedures outlined in Exhibit D of the CLP-statement of work for inorganicsanalysis (EPA 1988b).

[f]For boron, lithium, molybdenum, and lanthanides, which are not standard CLP analyses, interference corrections are determined and reported, calibration standards are prepared and a calibration curve determined, initial calibration verification (ICV) and calibration curve verification standards are prepared at a midrange concentration, and a laboratory control sample is prepared by digesting the ICV standard.

[g]ICPAES - Inductively coupled plasma atomic emission spectrophotometry.

[h]Indicator analysis.

Table 5-2
Methods for Analysis of Soil and Sediment

Page 1 of 2

Parameter[a]	Analytical Technique[b]	EPA Method No.
Isotopic uranium	Radiochemical	U-04[c]
Isotopic thorium	Radiochemical	Th-03[d]
Isotopic radium	Radiochemical	Ra-07
Uranium-238	Gamma spectrometry	C-02[c]
Radium-226	Gamma spectrometry	C-02[c]
Thorium-232	Gamma spectrometry	C-02[c]
Metals[e,f]	ICPAES	200.7-CLP-M
Arsenic[f]	Furnace AA	206.2-CLP-M
Lead[f]	Furnace AA	239.2-CLP-M
Selenium[f]	Furnace AA	270.2-CLP-M
Thallium[f]	Furnace AA	279.2-CLP-M
Volatile organics	GC/MS	CLP-SOW[g]
Semivolatile organics	GC/MS	CLP-SOW[g]
Nitrate	Hydrazine reduction	353.1
Chloride	Titrimetric	925.1
Phosphate	Colorimetric	365.2
TCLP	Various	1311
Corrosivity	Electrometric	9045
Reactivity	Titration	9010 & 9030
TPH	Infrared (IR) spectrophotometry	9073
PCBs	GC/EC	CLP-SOW[g]

Table 5-2

(continued)

[a]TCLP - toxicity characteristics leaching procedure; TPH - total petroleum hydrocarbons; PCBs - polychlorinated biphenyls.

[b]ICPAES - Inductively coupled plasma atomic emission spectrophotometry; furnace AA - furnace atomic absorption; GC/MS - gas chromatography/mass spectrometry; GC/EC - gas chromatography/electron capture.

[c]TMA/E uses laboratory procedures developed by Environmental Measurements Laboratory-300 (EML-300).

[d]Modified EML procedure to accommodate the matrix.

[e]Includes aluminum, antimony, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lithium, magnesium, manganese, molybdenum, nickel, potassium, silver, sodium, vanadium, zinc, and lanthanides.

[f]Soil samples are prepared for analysis in accordance with procedures outlined in Exhibit D of the CLP-statement of work for inorganics analysis (EPA 1988b).

[g]Analysis is conducted in accordance with the procedures outlined in Exhibit D of the CLP-statement of work for organics analysis (EPA 1988c).

5.2 SAMPLE HANDLING AND PRESERVATION

Surface water samples will be collected from each sampling location. A 1.5-L aliquot of the surface water sample will be filtered through a 0.45-micron filter for metals analysis. Water samples will be preserved as indicated in Table 5-3. All samples will be stored at 4°C after collection and during transport to the laboratory.

For soil and sediment samples, approximately 1.5 kg and 500 g of the sample, respectively, will be collected at each sampling location. All samples will be stored at 4°C after collection and during transport to the laboratory.

5.3 QUALITY CONTROL

Quality assurance/quality control activities are described in detail in the quality assurance project plan. The plan describes the blanks, splits, duplicates, and other quality control samples required to measure field and laboratory performance. In addition, quality assurance/quality control activities for radiological field measurements and sampling procedures are described in the procedures manual used by TMA/E personnel, including procedures on instrument response checks, calibration confirmation, duplicate sampling/ surveys, and data review required to measure field and laboratory performance.

5.4 REPORTING

All data from each sample batch will be reported. Analytes will be reported using the International Union of Pure and Applied Chemistry system of chemical nomenclature (and if differing, the applicable Federal Register nomenclature for CERCLA) and Chemical Abstract Number. Reported analyses for aqueous samples will be in milligrams/liter (mg/L), micrograms/liter (μg/L), or microcuries/milliliter (μCi/ml); solid sample analytical results will be reported in milligrams/gram (mg/g), micrograms/gram (μg/g), or picocuries/gram (pCi/g).

Table 5-3

Preservatives, Containers, and Maximum Holding Times[a,b,c,d]

Analyte	Matrix/ Treatment[e]	Container	Quantity/Size of Bottles	Maximum Holding Time
Metals[f]	Water/adjust to pH <2 with HNO_3	Polyethylene	1/1 L	180 days
	Soil and sediment	Glass	1/250-ml wide-mouth jar	180 days
TC[g] Metals	Liquid waste/ unpreserved	Polyethylene or glass, amber	1/1-L polyethylene or 950-ml jar	see Table 4-3
	Soil and sediment	Glass, amber	1/950-ml jar	see Table 4-3
TC - VOA	Liquid waste/ unpreserved		2/40-ml VOA	see Table 4-3
	Soil and sediment		1/125-ml VOA	see Table 4-3
TC-BNAE/Pest./Herb.	Water/ unpreserved	Glass, amber	3/950-ml jar	see Table 4-3
	Soil and sediment	Glass, amber	1/950-ml jar	see Table 4-3
Total petroleum hydrocarbons	Soil	Glass, clear	1/125-ml wide-mouth jar	28 days
Dissolved oxygen, pH, and temperature	Water	Polyethylene or glass	1/500-ml wide-mouth jar	Onsite analysis
Specific conductance	Water	Polyethylene or glass	1/500-ml jar	Onsite analysis
Nitrate, phosphate, chloride	Water	Polyethylene	1/500-ml jar	NO_3 - 48 hours, PO_3 - 48 hours, Cl - 28 days
	Soil and sediment	Glass	1/250-ml jar	None

Table 5-3

(continued)

Analyte	Matrix/ Treatment[e]	Container	Quantity/Size of Bottles	Maximum Holding Time
Volatile organics	Soil	Glass vial with Teflon septum	2/120-ml wide-mouth vials	10 days
	Water	Glass vial with Teflon septum	2/40-ml vials	10 days
Semivolatile organics and total PCBs[h]	Soil	Glass, amber	1/500-ml wide-mouth jar	10 days for extractions/ 40 days after extraction
Alpha spectrometry	Soil	Polyethylene	1/500-ml wide-mouth jar	6 months
Gamma spectrometry	Soil	Polyethylene	1/500-ml wide-mouth jar	6 months

[a]American Public Health Association, Standard Methods for the Examination of Water and Wastewater, 17th edition, 1989.

[b]American Society for Testing and Materials, 1985 Annual Book of ASTM Standards, Section 11, Volume 11.02, "Water and Environmental Technology," 1985.

[c]All bottles shipped to the site by Weston for chemical sample collection will be new, certified precleaned bottles purchased from Eagle Pitcher. Analytical results for each bottle shipment are available upon request from Eagle Pitcher.

[d]Holding times for CLP analyses are measured from validated time of sample receipt (VTSR) at the lab. All other holding times are measured from time of collection.

[e]All samples will be shipped to the laboratory at 4°C.

[f]Metals analysis includes inductively coupled plasma atomic emission spectrophotometry, lithium, and lanthanides.

[g]TCLP - toxicity characteristics leaching procedure.

[h]Triple volume is required for QC analyses.

Air sampling data will be reported in the following units: airborne particulate, gross alpha/beta, and isotopic analyses will be in microcuries/milliliter (μCi/ml); ambient radon will be in picocuries/liter (pCi/L); radon and thoron daughters in working levels (WL); radon flux will be in picocuries/square meter/second (pCi/m^2/s). Smear sample data analyzed by gross alpha/beta techniques will be reported in disintegrations per minute/100 square centimeters (dpm/100 cm^2) or total dpm, whichever is applicable.

5.5 SAMPLE HANDLING, PACKAGING, AND SHIPPING

The samples will be packed in vermiculite to minimize the potential for breakage and will be shipped to the laboratory for analysis. Samples will be shipped, on ice if necessary, by priority mail on the same day they are taken. Chain of custody and sample handling will be conducted in accordance with the quality assurance project plan and the EPA User's Guide to the Contract Laboratory Program (EPA 1987b).

Due to the low levels of radioactivity present at MISS, no special radiological controls or labeling are necessary to package and ship these samples.

6.0 OPERATING PLAN

The scope of the operating plan includes the field activities required to fulfill the data requirements. The objective is to identify the subcontract packages, field and analytical support, BNI support, documentation, technical specifications, and project instructions. The following sections address the major elements of the operating plan for the Maywood site.

6.1 SAMPLING

All sampling performed as part of this remedial investigation will be conducted in accordance with guidance provided in A Compendium of Superfund Field Operations Methods (EPA 1987a). General practices are outlined below.

6.1.1 Presampling Activities

Before any field activities begin, activities conducted in the home office will include assembling and training the field remedial investigation team (as described in Section 1.2) and procuring subcontracted services. TMA/E and Roy F. Weston Analytical Laboratories are subcontractors on FUSRAP. The drilling subcontractor procured for this work is Hydro Group, Inc. Civil surveying will be provided by Niagara Boundary and Mapping. A readiness review will be conducted to ensure that all activities are properly planned and coordinated.

Before the start of remedial investigation sampling, an access agreement will be negotiated with each property owner to grant DOE permission to enter the property and also to protect the interests of the property owner. Next, the civil surveyor will perform a survey of each property to be investigated. During this survey, property boundaries will be determined and staked and a drawing will be prepared showing legal boundaries, buildings, significant surface features (e.g., concrete, gravel), and major vegetation (with estimated value). These drawings will be submitted to BNI as early as practicable to allow their use in planning for the remedial investigation activities. The civil surveyor will also establish the grid system just before the commencement of field work by staking and marking intersections of perpendicular grid lines. The surveyor may also spot precise locations of boreholes.

Approximately ten days before field sampling is to begin, all subcontractors will mobilize at the site. Mobilization entails the arrival of all personnel (BNI site superintendent, field engineers, geologists, technical group leader, operations supervisor, TMA/E technicians, and drilling personnel); receiving all equipment and instruments; ordering sampling containers; stocking personal protective equipment; initial checkouts/calibrations; notifications to the communities and officials; final field training; and setup/testing of the decontamination facility. All personnel must demonstrate that they have met the medical qualifications for working on a hazardous waste site. Forty hours of health and safety training will be given for members of this crew not previously trained (see the health and safety plan for details). Following site-specific training, field sampling can begin.

Before field work begins each day, the technical group leader will review the characterization plans for the day and coordinate activities with the various subcontractors, including the driller and the radiological support subcontractor (TMA/E). The technical group leader will identify the samples to be collected by referring to Section 2.0 of this plan.

Sample collection bottles ordered for the planned activities will be selected and provided to the sampling team with chain-of-custody forms. Proper sampling and decontamination procedures for the analyses required will be reviewed with the team. Decontamination techniques are included in Appendix A to this field sampling plan.

All field instrumentation will be cross-checked and/or calibrated daily to ensure accurate field operation.

6.1.2 Sampling Activities

Surface and subsurface soil samples will typically be collected by the drilling subcontractor using techniques specified in the subcontract package and summarized in

Appendix A. For radiological and chemical sampling, split-spoon sampling or Central Mine Equipment sampling is adequate to provide unmixed samples that retain their vertical distribution. After the driller withdraws the sample from the ground, TMA/E sampling personnel will open the split barrel and withdraw the sample. For volatile organic samples, TMA/E sampling personnel will fill two 40-ml vials per sample immediately upon retrieval of the split spoon. The remaining contents will then be homogenized (mixed) in a decontaminated stainless steel pan with a decontaminated stainless steel spoon, using the coring and quartering method. The samples will then be packaged for shipment to either TMA/E or Weston laboratories. This procedure will be followed for all samples collected for analytical parameters shown in Table 5-2.

Particulate sampling for airborne radiological contaminants will be conducted using flow-calibrated, high-volume samplers and lapel samplers. Samples may be collected on glass fiber filter media or in gas sampling bags, as required by the analytical technique. Air samplers will be placed on individual workers for occupational exposure information or as area monitors for environmental compliance data. Minimum sample volumes will be 5×10^5 ml for lapel samplers and 2×10^6 ml for high-volume area samplers.

Air sampling for radon will require a minimum sample volume of 2 L of filtered air collected in a gas sampling bag or charcoal canisters exposed for 24 hours. Radon daughter sampling will be conducted with a minimum sample volume of 10 L collected on 0.45-micron filters.

Measurements will be performed on equipment and structural surfaces inside buildings to determine levels of fixed and transferable radioactive contamination. Measurements are made as required to adequately characterize equipment and structures or release them for use with no radiological restrictions. Measurements for fixed contamination will be performed using hand-held detectors (thin-window Geiger-Mueller detectors for beta/gamma activity and scintillation detectors for alpha activity) at contact as required. Measurements by these instruments will be converted to dpm/100 cm^2 and documented on appropriate survey forms.

Surveys for transferable contamination will be conducted to determine levels of removable/transferable contamination on equipment and structural surfaces inside buildings for characterization or release for use with no radiological restrictions. Smear samples will be collected by wiping an area of 100 cm^2 (15.5 in^2) with a 50-mm cloth, using moderate pressure to obtain transferable fractions. The smear will then be counted in an alpha scintillation counter and a beta/gamma counter. Data will be converted to dpm/100 cm^2.

All surface water samples for chemical analyses will be collected at the designated locations by immersing sample bottles until completely filled. The bottles will then be sealed with the supplied cap, wiped dry, and labeled. For metals analyses, a 1.5-L sample will be collected and then filtered through a 0.45-micron membrane filter. The filtered sample will be preserved by lowering the pH to <2 with nitric acid (HNO_3). Samples for mobile ions and miscellaneous indicators (Table 3-1) will be collected individually and kept at 4°C until analysis.

Sediment samples will be collected with a garden trowel. Samples will not be collected from dry streams or ditches. Only the top 0.63 cm (0.25 in.) of sediment covering approximately 1 m^2 (10.7 ft^2) will be collected. Rocks, gravel, and hard-bottom material will not be collected. At each location, approximately 1.5 kg (3.3 lb) of sediment will be scooped into a polyethylene bag. After excess water is drained, the bag will be secured with a twist tie, labeled, and placed in a paint-type can which is also labeled. Sediment samples will be stored at 4°C until they are prepared for analysis. Sample preparation entails dewatering, drying at 98°C, pulverizing to less than 80-mesh, and homogenizing the sediment.

Before groundwater samples are collected for chemical analyses, each well to be sampled will be purged of three well casing volumes of water using a gasoline-driven centrifugal pump or a Teflon bailer. The polyethylene pump suction line and Teflon bailer are both cleaned by scrubbing with an Alconox solution followed by three rinses of fresh Alconox solution and three rinses of deionized water prior to insertion into the wells.

Groundwater samples will be obtained using a Teflon bailer. Samples for radiological and metals analyses are preserved by lowering the pH to <2 with reagent grade HNO^3. Mobile ion samples are stored at 4°C until analysis.

TMA/E sampling personnel have been trained to avoid compromising the integrity of the samples. This includes proper decontamination of sampling equipment (Appendix A), sample handling and packaging, preservation, and shipment. Chain of custody from collection through shipment is maintained by the sampling team; custody from shipment through analysis is maintained by the analytical laboratory.

6.1.3 Postsampling Activities

All boreholes drilled for sampling will be backfilled and closed as discussed in Appendix A. In all cases, care will be taken to avoid creating a preferential pathway through which surface water may infiltrate the waste and reach groundwater. All areas disturbed will be restored to original condition.

All equipment and personnel entering a controlled area will be radiologically surveyed and decontaminated (as necessary) before leaving the area. Release limits will be the same as FUSRAP surface contamination guidelines for release for use with no radiological restrictions. The limits for thorium-232 will be used.

All field notes, chain-of-custody records, drawings, and files created during field activities will be forwarded to the BNI Oak Ridge office and entered into the project document control center. The document control center will retain the records in a computerized database system until the end of FUSRAP, at which time the records will be transferred to DOE.

Sample analysis results returned from the radiological and chemical laboratories will also be submitted through the project document control center. The document control center will retain the originals and submit copies of the data to the environmental health and safety department for verification and evaluation.

Data verification activities conducted by environmental health and safety personnel are described in the quality assurance project plan. These activities include checking data completeness and quality assurance/quality control sample results. When these checks are complete and the validity of the results is verified, data are released for evaluation and use.

6.2 SITE-SPECIFIC FEATURES

Known property features and utilities that will affect the field program will be drawn on a plot plan and issued with all subcontract packages. Locations of underground utilities will be determined by the local utility companies.

6.3 HEALTH AND SAFETY

The Maywood site health and safety plan will be in effect during all field activities.

6.4 LABORATORY PHASING

Because holding times for radiological analyses are long, laboratory phasing of samples at the TMA/E laboratory will not be necessary. Advance notification of the sample loading for the Weston laboratory will allow adequate time for the laboratory to phase samples for analysis within holding times indicated in Table 5-3. The mechanism for ensuring early notification of Weston is described in the quality assurance project plan.

6.5 FIELD NOTES AND DOCUMENTATION

Geologists and sampling crews will keep indelible ink records of their field activities in bound field notebooks. Geologists' notes will include, at a minimum, descriptions of each stratum encountered, soil sample collection data (e.g., depth, type), depths of stratum changes, measurements of water levels during drilling, industrial hygiene measurements taken during drilling (e.g., Enmet readings, lower explosive limit measurements, Draeger tube test results), permeability test data, installation details for monitoring wells, grouting details for boreholes, and any other observations made (including water loss zones, drilling character, odor). These notes will be transferred to a geologic drill log. Samplers will record weather conditions, sample locations, sample types taken, time of day, chain-of-custody identification numbers, field measurements, and names of the samplers.

Documentation of chemical and radiological sampling and measurement activities is specified by internal procedures, including procedures that detail documentation required for all sampling and survey activities (e.g., field sampling collection forms, near-surface gamma survey data sheets, subsurface gamma radiation logs).

Field sampling and measurement information is documented daily on appropriate forms and in a TMA/E field sampling log. Samplers record sampling locations, sample identification numbers, depth of sample, type of sample, analysis required, data collected, and name of sampler. Examples of this documentation are included in the quality assurance project plan, Section 5.0.

Field sampling team members will also be responsible for maintaining and documenting appropriate chain-of-custody procedures. These procedures are also described in the quality assurance project plan.

6.6 FIELD TEAM ORGANIZATION

The field team will be organized as described in Section 1.2.

6.7 DECONTAMINATION

Decontamination will be conducted as necessary to ensure that personnel and equipment leaving a controlled area meet DOE guidelines for release.

Decontamination of sampling equipment between samples will be conducted in accordance with technical specifications in the drilling subcontract. Appendix A of this document contains descriptions of decontamination procedures and technical specifications to be used for radiological and chemical sampling activities during this remedial investigation. Appendix A of the work plan-implementation plan contains DOE guidelines.

6.8 EXPENDABLE SUPPLIES

Expendable supplies will be identified during the presampling readiness review to accommodate sampling, decontamination, and health and safety activities. Supplies not already in inventory at the FUSRAP central stock point in Middlesex, New Jersey, will be purchased and onsite before field activities begin. Purchase and delivery of supplies identified before the start of drilling are the responsibility of the BNI operations supervisor. Any supplies not identified ahead of time can be purchased locally by the BNI operations supervisor. Should the BNI operations supervisor be unavailable, TMA/E may also purchase or rent small items such as coveralls, shoe covers, and gloves.

6.9 EQUIPMENT

Equipment for sampling, decontamination, and personnel protection (as appropriate) will be identified during the readiness review and will be made available onsite before field activities begin.

Major equipment such as drill rigs, split-spoon samplers, and radiation measurement instruments required for the remedial investigation will be supplied by subcontractors as specified in the contract package.

7.0 ADDITIONAL PHASES OF REMEDIAL INVESTIGATION WORK

The activities described in this plan are intended to fill all currently known data requirements. However, depending on some of the results of these efforts, additional characterization of the Maywood site may need to be implemented. Planning for these additional remedial investigation activities will begin as data are generated during the initial investigation. The overall objective of any additional work would be to augment data collected in the previous investigations and further define conditions at the Maywood site. Any data collected during the additional work effort would be used to:

- Refine estimates of contaminant source volumes
- Further evaluate potential impacts to human health and the environment
- Further evaluate remedial action alternatives for the properties

Specific follow-up activities may include:

- Completion of additional soil borings and analysis for chemical and radiological constituents

- Collection and analysis of additional groundwater and surface water samples (including groundwater elevation measurements)

- Site-specific testing of remedial action alternatives such as treatment of hazardous constituents

The approach for completion of the additional characterization activities will be based, in part, on information collected during the initial characterization effort.

Procedures and specifications for collection and analysis of samples (including quality control samples), completion of field measurements, installation of boreholes, sample handling and preservation, and equipment decontamination will be consistent with those described in Sections 2.0, 3.0, and 5.0 and Appendix A of this plan.

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APPENDIX A

SUMMARY OF TECHNICAL SPECIFICATIONS FOR BOREHOLES AND THE INSTALLATION OF MONITORING WELLS

APPENDIX A

SUMMARY OF TECHNICAL SPECIFICATIONS FOR BOREHOLES AND THE INSTALLATION OF MONITORING WELLS

Characterization of FUSRAP sites typically includes a site geologic investigation and collection of various environmental samples for analysis in the laboratory. The principal support activities to accomplish a site characterization include drilling radiological/chemical and geologic boreholes and installing groundwater monitoring wells.

Because all specialized support activities are typically conducted by subcontractors, details about the performance of these activities are contained in the scope of work and the technical specifications developed for a subcontract. The scope of work and drawings specifically define the tasks that will be done, and the technical specifications identify how the tasks are to be done. This appendix summarizes the requirements delineated in the subcontract document.

A.1 RADIOLOGICAL AND CHEMICAL BOREHOLES

The specifications include a discussion of general requirements related to any contract activity. These requirements include quality standards that address quality control of the materials used for the activity and any standards specific to the activity. For radiological and chemical boreholes, all work is conducted in compliance with Occupational Safety and Health Administration (OSHA) Standards (29 CFR 1926/1910). Specific requirements are summarized in the following sections.

A.1.1 Documentation

When radiological and chemical boreholes are drilled, specific information must be recorded in field logs. All logs show borehole number, date of drilling, locations (i.e., site coordinates), ground surface elevation, description of the material encountered by the boring, depth at which each change in material occurs, depths at which samples were obtained and the type of sample in each instance, percentage of sample recovery, depth to water table, depth to original ground, and any other data pertinent to the identification of subsurface materials.

A.1.2 Equipment and Materials

Specific requirements for equipment and materials are developed for the following items:

- Drill rig and support equipment
- Cement/bentonite grout
- Granular bentonite
- Cleaning material (deionized water, hydrochloric acid, soap, solvents)
- Temporary casing
- Surface protection materials (plastic sheeting, plywood)
- Perimeter barricade
- Borehole cover and markers
- Sediment barriers
- Sampling equipment

A.1.3 Field Operations

Predrilling

- Underground utilities in the work area are evaluated. Before drilling operations begin, all local utility companies (e.g., gas, water, sewer, electric, telephone) are contacted to determine and confirm locations of underground utilities in the work areas. All utility locations in the work areas are identified and visibly marked.

- A water-handling procedure is developed. All water discharged from the boreholes during drilling operations is collected in a mud tub. A mud pit will not be excavated. Contents of the mud tub are transferred to drums and disposed of or stored onsite where indicated on the design drawings.

- Safety and security measures are evaluated. Perimeter barricades are provided around work areas during work operations, if required. Barricades are placed to provide sufficient mobility for work operations within the barricaded area and not interfere with activities of occupants of the work areas. Barricades remain in place until all work within the barricaded area is completed.

Drilling

- Drilling operations are managed from the field site. Boreholes are drilled at locations shown on the design drawings and in the sequence determined at the site. Some adjustment of locations may be required at the site.

- Before drilling begins, surface protection material is placed over and around the drill hole location in a manner that will prevent the drill spoils from contacting the surrounding surfaces. Drill spoils are confined on the surface protection material around each borehole, collected, and transported to and disposed of in the spoils area shown on the design drawing.

- All drill holes are drilled straight and free of obstructions to permit free and easy installation of temporary casing for downhole radiological logging.

- When obstructions are encountered in drill holes or if unstable material is encountered, suitable methods are used to drill through such obstructions. Where necessary to keep the holes open and enable the holes to be advanced, temporary casings may be used.

- Drilling is not permanently interrupted before reaching the required depth without prior approval.

- Drill holes abandoned before reaching the required depth because of equipment failure, negligence, or other such causes are subject to rejection and replacement with a supplementary hole adjacent to the abandoned hole. Abandoned holes are backfilled as specified.

- Until abandoned drill holes are backfilled, borehole covers and appropriate markers are used to minimize the hazardous condition created by an open drill hole.

- Drilling is performed in a manner that permits continuous soil sampling.

- For drilling and sampling activities associated with chemical boreholes, the tool joint lubricant for assembly of drill rods, auger flights, sampling apparatus, and other downhole items is Teflon tape, graphite powder, or apiezon grease (e.g., Dow Corning High Vacuum Grease or equivalent material). Oil or grease are not used on downhole items for chemical boreholes.

General

- All downhole items such as augers and temporary casings are cleaned and radiologically surveyed before work commences at the next borehole. Cleaning is done with brushes, scrapers, rags, and other items as necessary to remove surface contamination. Materials are kept wet during brushing and scraping operations to reduce the potential for inhalation of contaminants.

- The deionized water and soap used for cleaning are handled and disposed of with the water from the decontamination operations. Solvent (isopropyl alcohol), used and unused, is handled as a flammable material. The hydrochloric acid (3-5 percent) is handled and disposed of independently.

Cleaning for radiological boreholes

The sampling apparatus and other downhole items used in radiological boreholes are cleaned before each use so that they are free of visible soil, debris, and other foreign matter.

Cleaning for chemical boreholes

The drill rod assemblies, lead auger flights, center plugs, sampling apparatus, and other downhole items that could affect sample integrity are cleaned before each use in a chemical borehole in accordance with the applicable method set forth below.

Method I: When not analyzing for metals

(1) Clean with one or both of the following:
- Steam with soap
- High-pressure water with soap

(2) Rinse with deionized water
(3) Rinse with isopropyl alcohol
(4) Rinse thoroughly with deionized water
(5) Air dry before use

Method II: When analyzing for metals

(1) Clean with one or both of the following:
   - Steam with soap
   - High-pressure water with soap
(2) Rinse with deionized water
(3) Rinse with nitric acid
(4) Rinse with deionized water
(5) Rinse with isopropyl alcohol
(6) Rinse thoroughly with deionized water
(7) Air dry before use

Soil samples

- Soil samples are obtained using a recognized sampling technique such as a split-barrel sampler, thin-walled tube sampler, Central Mine Equipment (CME) sampler, or other technique as approved by BNI before sampling.

- Samples are submitted to BNI at the point and time of recovery. BNI is responsible for furnishing containers, placing samples into containers, and labeling container as appropriate.

Backfilling boreholes

All boreholes are backfilled upon direction from BNI unless noted otherwise. Boreholes drilled thorough surface asphalt or concrete are backfilled with cement/bentonite grout using the tremie method and allowing for emplacement of an asphalt or concrete patch. Boreholes not drilled through surface asphalt or concrete are backfilled using either the dry-pack method or the tremie method. The dry-pack method is not used for drill holes that contain water. The backfilling-with-spoils method may be used only if specifically allowed in the subcontract scope of work or design drawings.

Dry-pack method

The dry-pack method is performed using granular bentonite emplaced in maximum 0.3-m (1-ft) lifts. Each lift is thoroughly rodded with a solid bar or suspended weight to prevent voids in the filled borehole. The dry-pack method is not used when the borehole contains water, unless approved in advance by BNI.

Tremie method

The tremie method uses cement/bentonite grout starting at the bottom of the borehole. Grout is emplaced in one continuous operation. The tremie pipe is withdrawn as grout is emplaced but is at all times kept below the surface of the grout. Should loss or shrinkage of grout occur, holes are refilled with grout until grout is within 1.3 cm (0.5 in.) of the required elevation as shown on the design drawings.

Backfilling-with-spoils method

Drill spoils from a borehole may be used to fill that hole only where permitted by the design drawings or scope of work. Backfilling is performed in maximum 0.3-m (1-ft) lifts. Each lift is thoroughly compacted using a solid bar or suspended weight to preclude voids. Backfill is emplaced until it is at the same elevation as the area surrounding the borehole.

A.2 GEOLOGIC BOREHOLES

The specifications include a discussion of general requirements related to any contract activity. These requirements include quality standards that address quality control materials used for the activity and any standard that is specific to the activity. For geologic boreholes, all work will be conducted using the specific requirements summarized in the following sections.

- OSHA 29 CFR — Occupational Safety and Health Standards (Parts 1910 and 1926)
- ASTM D 1586 — Penetration Test and Split-Barrel Sampling of Soils
- ASTM D 1587 — Standard Method for Thin-Walled Tube Sampling of Soils
- ASTM D 2113 — Standard Practice for Diamond Core Drilling for Site Investigation
- USBR E-18 — Field Permeability Tests in Boreholes (Earth Manual)

A.2.1 Documentation

When geologic boreholes are drilled, specific information must be recorded in field logs. All logs show borehole number; date of drilling; location (i.e., site coordinates); ground surface elevation; description of the material in the boring; depth at which each change in material occurs; depths at which samples were obtained and the type of sample in each instance; percentage of sample recovery depth to water table; depth to original ground; and any other data pertinent to the identification of subsurface materials.

A.2.2 Equipment and Materials

Specific requirements for equipment and materials will be developed for the following items:

- Drill rig and support equipment

- Permeability testing equipment
- Cement/bentonite grout
- Granular bentonite
- Hole support and conductor casings
- Surface protection materials (plastic sheeting, plywood)
- Protective barriers
- Sampling equipment

A.2.3 Field Operations

Predrilling

- Underground utilities in the work area are evaluated. Before drilling operations begin, all local utility companies (e.g., gas, water, sewer, electric, telephone) are contacted to determine and confirm locations of underground utilities in the work areas. All utility locations in the work areas are identified and visibly marked.

- A water-handling procedure is developed. All water discharged from the boreholes during drilling operations is collected in a mud tub. A mud pit will not be excavated. Contents of the mud tub are disposed of where indicated on the design drawings.

- Safety and security measures are evaluated. Perimeter barricades are provided around work areas during all work operations, if required. Barricades are placed to provide sufficient mobility for work operations within the barricaded area and not interfere with activities of occupants of the work areas. Barricades remain in place until all work within that barricaded area is completed.

Drilling

- Drilling operations are managed from the field site. Boreholes are drilled at locations shown on the design drawings and in the sequence determined at the site. Some adjustment of locations may be required at the site.

- Before drilling begins, surface protection material is placed over and around the drill hole location in a manner that will prevent the drill spoils from contacting the surrounding surfaces. Drill spoils are confined on the surface protection material around each borehole, collected, and transported to and disposed of in the spoils area shown on the design drawing.

- All drill holes are drilled straight and free of obstructions to permit free and easy installation of temporary casing for downhole radiological logging.

- When obstructions or unstable materials are encountered in drill holes, suitable methods are used to drill through such obstructions. Where necessary, temporary casings may be used to keep the holes open and enable the holes to be advanced.

- Drilling is not permanently interrupted before reaching the required depth without prior approval.

- Drill holes abandoned before reaching the required depth because of equipment failure, negligence, or other such causes are subject to rejection and replacement with a supplementary hole adjacent to the abandoned hole. Abandoned holes are backfilled as specified. Until abandoned drill holes are backfilled, borehole covers and appropriate markers are used to minimize the hazardous condition created by an open drill hole.

- Drilling is performed in a manner that permits disturbed and undisturbed sampling of the overburden and core sampling of rock where required.

- Core drilling begins at the top of rock, and all intervals in rock are advanced by diamond core drilling methods (ASTM D 2113). All drilling is done in a manner that allows the maximum amount of core recovery.

- No drilling additives, drilling mud, organic solvents or cleaning solutions may be introduced into drill holes without prior approval by BNI.

Sampling

- Soil samples are obtained by a recognized sampling technique using a split-barrel sampler, thin-walled tube sampler, CME-type sampler, or other device as approved by BNI before sampling.

- Core sampling is conducted in accordance with ASTM D 2113 unless directed otherwise by BNI. Sampling is continuous, and all core samples are preserved in labeled core boxes.

- Samples are submitted to BNI at the point and time of recovery. BNI is responsible for furnishing containers, placing samples in containers, and labeling containers as appropriate.

Conductor casing

Conductor casings are installed through contaminated strata, as determined by BNI, as shown on the design drawings. Boreholes that require conductor casings are reamed to the diameter and length shown on the design drawings, and the conductor casing is installed in accordance with the technical specifications. Conductor casings remain in place following installation. Specific wells and borings using conductor casing are those drilled in suspected or known areas of contamination. Details of monitoring well construction using conductor casing are shown in Figure A-1.

Backfilling boreholes

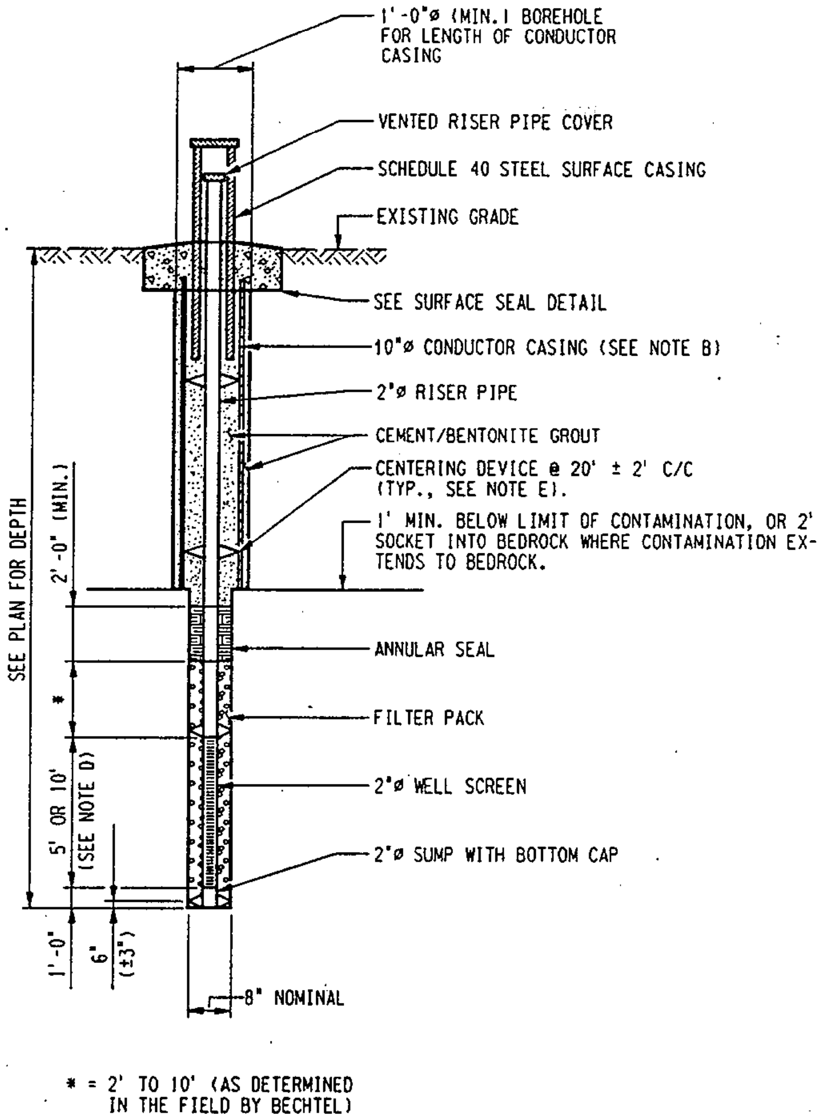
All boreholes are backfilled upon direction from BNI unless noted otherwise. Boreholes drilled thorough surface asphalt or concrete are backfilled with cement/bentonite grout using the tremie method to allow for placement of an asphalt or concrete patch. Boreholes not drilled through surface asphalt or concrete are backfilled using either the dry-pack method or the tremie method. The dry-pack method is not used for drill holes that contain water. The backfilling-with-spoils method may be used only if specifically allowed in the subcontract scope of work or design drawings.

Dry-pack method

The dry-pack method is performed using granular bentonite emplaced in maximum 0.3-m (1-ft) lifts. Each lift is thoroughly rodded with a solid bar or suspended weight to prevent voids in the filled borehole. The dry-pack method is not used when the borehole contains water unless approved in advance by BNI.

Tremie method

The tremie method uses cement/bentonite grout starting at the bottom of the borehole. Grout is emplaced in one continuous operation. The tremie pipe is withdrawn as grout is emplaced but is at all times kept below the surface of the grout. Should loss or shrinkage of grout occur, holes are refilled with grout until grout is within 1.3 cm (0.5 in.) of the required elevation shown on the design drawings.



TYPE III WELL INSTALLATION (SEE NOTES A & C)

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NOTES:

A. TYPE III BOREHOLE IS FOR OUTDOOR LOCATIONS WHERE: A MONITORING WELL IS TO BE INSTALLED THROUGH A POTENTIALLY CONTAMINATED STRATA INTO AN UNCONTAMINATED STRATA; OR OVERBURDEN COLLAPSES UPON REMOVAL OF AUGER.

B. CONDUCTOR CASING SHALL BE INSTALLED TO THE REQUIRED DEPTH PRIOR TO DRILLING BELOW THE BOTTOM OF THE CONDUCTOR CASING. CONDUCTOR CASING SHALL BE EMBEDDED 1" TO 3" IN THE CONCRETE SURFACE SEAL (EXCEPT FLUSH MOUNT SEAL).

C. LIMIT OF CONTAMINATION WILL BE ESTABLISHED IN THE FIELD BY BECHTEL.

D. THE LENGTH OF THE WELL SCREEN WILL BE ESTABLISHED IN THE FIELD BY BECHTEL.

E. IN LIEU OF CENTERING DEVICES, INSTALLATION OF CASING, SCREEN AND FILTER PACK MAY BE MADE THROUGH HOLLOW STEM AUGER PROVIDED THAT RISER CASING AND SCREEN ARE LOCATED IN THE CENTER OF THE HOLE UPON COMPLETION.

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Figure A-1
Standard Well Installation

Backfilling-with-spoils method

Drill spoils from a borehole may be used to fill that hole only where permitted by the design drawings or scope of work. Backfilling is performed in maximum 0.3-m (1-ft) lifts. Each lift is thoroughly compacted using a solid bar or suspended weight to preclude voids. Backfill is emplaced until it is at the same elevation as the area surrounding the borehole.

A.3 INSTALLATION OF MONITORING WELLS

The specifications include a discussion of general requirements related to any contract activity. These requirements include standards that address quality control materials used for the activity and any applicable standards specific to the activity. For the installation of monitoring wells, all work will be conducted using the standards and codes listed below. Specific requirements are summarized in the following sections.

- OSHA 29 CFR Occupational Safety and Health Standards (Parts 1910 and 1926)
- ASTM A 312 Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipe
- ASTM C 136 Standard Method for Sieve Analysis of Fine and Coarse Aggregates

A.3.1 Documentation

When monitoring wells are to be installed, the subcontractor will be required to provide the following documentation:

- Catalog cuts
- Samples of materials

- Certified sieve analysis
- Detail or shop drawings

All documentation will be transmitted to BNI at least two weeks before use, fabrication, or implementation.

A.3.2 Equipment and Materials

Specific requirements for equipment and materials will be developed for the following items:

- Drill rig and support equipment
- Conductor casing
- Riser pipe
- Screen
- Filter pack
- Annular seal
- Cement/bentonite grout
- Surface casing and protective cap
- Well cap
- Surface seal
- Centering device

A.3.3 Monitoring Well Installation

- Monitoring wells are installed in previously drilled boreholes at specified locations. If necessary, the boreholes are reamed to the size shown on the design drawings.

- The final depth of the hole is measured and the stainless steel riser pipe assembly (i.e., riser pipe screen, sump, and bottom cap) is constructed and installed in the borehole. Installation is conducted in accordance with technical specifications.

- After the riser pipe assembly is installed, the hole is cleaned by pumping water into the riser pipe and allowing it to flow to the surface through the annulus. The filter pack is installed during cleaning, as specified in the technical specifications.

- After installation of the filter pack, the annular seal is installed, and the remainder of the annular space is filled with grout. Should loss or shrinkage of grout occur, holes are refilled until they remain full.

- Each monitoring well is tested after the grout has set to confirm that the well is operative.

- The surface casing, cap, and seal are installed at each monitoring well, as shown on the design drawings.

A.3.4 Well Development

Installed wells are developed to maximize the yield of water per foot of drawdown and to extract from the water-bearing formation the maximum practical quantity of fines that may be drawn through the screen when the well is pumped under maximum conditions of drawdown. The subcontractor will be required to submit the well development procedures to BNI for review. Well development procedures will be in accordance with NJDEP Permit No. NJ0054500.