Formerly Utilized Sites Remedial
Action Program (FUSRAP)

Maywood Chemical Company Superfund Site

ADMINISTRATIVE RECORD

Document Number

MISS- 036.

US Army Corps
of Engineers®

DOE/OR-20722-193.1

Work Plan-Implementation Plan for the Remedial Investigation/Feasibility Study-Environmental Impact Statement for the Maywood Site, Maywood, New Jersey

November 1992

U.S. Department of Energy
Oak Ridge Field Office
Formerly Utilized Sites Remedial Action Program

4.100 161.1

DOE/OR-20722-193.1

Work Plan-Implementation Plan for the Remedial Investigation/Feasibility Study-Environmental Impact Statement for the Maywood Site, Maywood, New Jersey

November 1992

prepared by
Environmental Assessment and Information Sciences Division, Argonne National Laboratory, and Bechtel National, Inc.

prepared for
U.S. Department of Energy, Oak Ridge Field Office, Formerly Utilized Sites Remedial Action Program under Contract W-31-109-Eng-38

CONTENTS

CONTENTS

(continued)

CONTENTS

(continued)

FIGURES

FIGURES

(continued)

TABLES

TABLES

(continued)

NOTATION

The following is a list of the acronyms, initialisms, and abbreviations (including units of measure) used in this document. Acronyms used in tables only are defined in the respective tables.

ACRONYMS, INITIALISMS, AND ABBREVIATIONS

AEC	U.S. Atomic Energy Commission
ANL	Argonne National Laboratory
ARAR	applicable or relevant and appropriate requirement
BNI	Bechtel National, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended
CLP	contract laboratory program
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DOE-OR	U.S. Department of Energy, Oak Ridge Operations
EG&G	EG&G Energy Measurements Group
EIS	environmental impact statement
EP	Extraction Procedure
EPA	U.S. Environmental Protection Agency
FFA	Federal Facilities Agreement
FS	feasibility study
FUSRAP	Formerly Utilized Sites Remedial Action Program
HSL	Hazardous Substance List
ICRP	International Commission on Radiological Protection
IP	Implementation Plan
MISS	Maywood Interim Storage Site
MOU	memorandum of understanding
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act of 1969, as amended
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
PCB	polychlorinated biphenyl
pH	negative logarithm of the hydrogen ion concentration
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RI	remedial investigation
ROD	record of decision
SARA	Superfund Amendments and Reauthorization Act of 1986
TBC	to-be-considered (requirements)

TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
VOC	volatile organic compound
WP	Work Plan

UNITS OF MEASURE

°C	degrees Celsius
°F	degrees Fahrenheit
cm	centimeter(s)
cm^2	square centimeter(s)
cpm	count(s) per minute
dpm	disintegration(s) per minute
ft	foot (feet)
g	gram(s)
gal	gallon(s)
gpm	gallon(s) per minute
h	hour(s)
ha	hectare(s)
in.	inch(es)
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
L	liter(s)
lb	pound(s)
μCi	microcurie(s)
μg	microgram(s)
μR	microroentgen(s)
m	meter(s)
m^3	cubic meter(s)
MeV	million electron volts
mi	mile(s)
mi^2	square mile(s)
mR	milliroentgen(s)
mrem	millirem(s)
pCi	picocurie(s)
ppb	part(s) per billion
ppm	part(s) per million
rem	roentgen-equivalent-man
s	second(s)
WL	working level(s)
WLM	working level month(s)
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)

FOREWORD

This work plan-implementation plan (WP-IP) 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. DOE is responsible for controlling the release of all contaminants from the site.

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a remedial investigation/feasibility study (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, this work plan-implementation 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. It is DOE policy to integrate National Environmental Policy Act (NEPA) values with the procedural and documentation requirements of CERCLA. DOE has determined that an environmental impact statement is the appropriate level of NEPA review for the Maywood Site. An environmental impact statement (EIS) IP is prepared to provide guidance for the preparation of an EIS and records the results of the scoping process. Nothing in this WP-IP is intended to represent a statement on the legal applicability of NEPA to remedial actions under CERCLA. This integrated NEPA/CERCLA WP-IP also describes the approach that will be used to evaluate potential remedial action alternatives and describes the organization, project controls, and task schedules that will be employed to address both CERCLA requirements and NEPA values.

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) intends to conduct a comprehensive review and analysis leading to remedial action for a set of properties, collectively referred to as the Maywood site, in and near Maywood, New Jersey. Action will be taken under DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP). The U.S. Atomic Energy Commission (AEC), a predecessor agency of DOE, established FUSRAP in 1974 to identify and decontaminate sites where radioactive contamination remained from activities carried out under contract to the Manhattan Engineer District and the AEC. Congress authorized and requested DOE to clean up radioactive contamination at the Maywood site as part of a decontamination research and development project under FUSRAP through the Energy and Water Development Appropriations Act of 1984. DOE and the U.S. Environmental Protection Agency (EPA) Region II have divided between themselves the responsibility for cleanup of radioactive and chemical contamination identified on the Maywood site. This division is based upon DOE's assigned responsibility under FUSRAP, EPA's statutory responsibilities, and a negotiated Federal Facilities Agreement (FFA) between DOE and the EPA Region II office that was signed on September 17, 1990, and became effective on April 22, 1991 (DOE 1990b).

The Maywood site is comprised of the Maywood Interim Storage Site (MISS) and various vicinity properties — including the Stepan Company property (former Maywood Chemical Works) and numerous residential, commercial, federal, state, and municipal properties in Maywood, Rochelle Park, and Lodi, New Jersey. The MISS is a temporary storage site on the northern corner of property that was once owned by the Stepan Company. It is the only property of the Maywood site that is owned by DOE and the only one over which DOE has direct control. The limits of DOE's responsibilities for the Maywood site are defined under the definition of FUSRAP waste in Section 1.4.2. Excavated soils from several decontaminated properties are currently stored on the MISS pending a decision on their final disposition. To date, 82 vicinity properties have been designated for cleanup, and designation is being considered for 2 more properties. Of the 82 designated properties, 25 have been fully decontaminated, and 2 have been partially decontaminated. Characterization reports have been published for 55 of the 56 properties not yet fully decontaminated.

1.1 GENERAL SITE INFORMATION

The Maywood site is in a highly developed area that is north-northwest of downtown Manhattan (New York City) and northeast of Newark, New Jersey. Politically, it is located in the borough of Maywood, borough of Lodi, and township of Rochelle Park, New Jersey (Figure 1). Properties in these communities became contaminated as a result of thorium processing at the former Maywood Chemical Works. In addition, some properties in the borough of Lodi, New Jersey, became contaminated as a result of fill materials or stream deposits from old Lodi Brook, which originated at the Maywood Chemical Works. The MISS, Stepan Company property, and other vicinity properties may also be contaminated with nonradioactive contaminants.

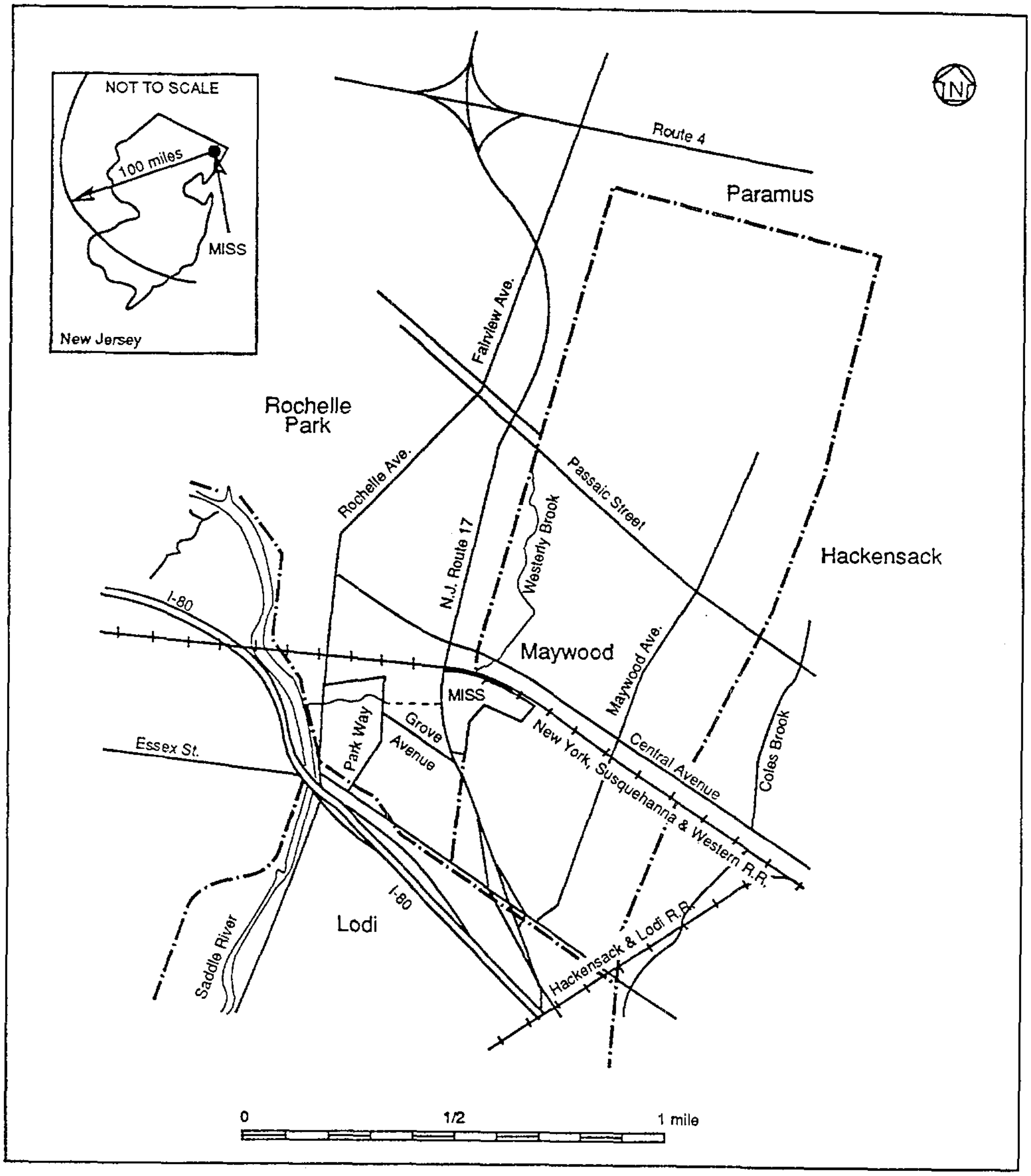


FIGURE 1 Location of the Maywood Interim Storage Site, Maywood, New Jersey

The Maywood Chemical Works was founded in 1895. In 1916, the company began processing monazite sand to extract thorium for use in manufacturing gas mantles for various lighting devices. The company continued this work until 1956. Process wastes from manufacturing operations were pumped to areas surrounded by earthen dikes on property west of the plant. Subsequently, some of the contaminated wastes migrated onto adjacent properties along Grove Avenue and Park Way. In 1932, New Jersey Route 17 was built through the Maywood Chemical Works property over the earthen dikes, separating the property into two areas. Several tunnels were constructed under Route 17, apparently to allow continued access between the two areas.

In 1954, the AEC issued a license to the Maywood Chemical Works to possess, process, manufacture, and distribute radioactive materials. The Stepan Chemical Company (now called the Stepan Company) purchased the Maywood Chemical Works in 1959; in 1961, the company was issued an AEC radioactive materials storage license because of the contaminated wastes on-site. The Stepan Company itself was never involved in the manufacture or processing of any radioactive materials. Beginning in 1963, the Stepan Company performed a series of remedial actions to stabilize or remove and bury radioactive materials on-site (see Section 2.2). A number of radiological surveys of the Stepan Company site and vicinity have been conducted to identify the locations of radioactive contamination resulting from past manufacturing and processing activities (see Section 2.4.2). Limited chemical sampling has also been performed.

In December 1982, EPA proposed to include the Maywood site on its National Priorities List (NPL). The NPL listing occurred on September 8, 1983, with the designation "Maywood Chemical Company Site." The interim storage of residual radioactive wastes at the site began in 1984.

1.2 JUSTIFICATION AND OBJECTIVES FOR THE PROPOSED ACTION

The primary threat to human health and the environment associated with the Maywood site is related to the potential for uncontrolled releases of contaminants from exposed surfaces and subsurface disposal areas. Contaminants could be released from these sources via infiltration and percolation, wind dispersal, gaseous emissions, surface runoff, leaching to groundwater, and disturbance by humans or animals (see Section 3.0). Direct exposure to gamma rays at the site is also a possibility. Releases from the materials currently being stored at the MISS could also occur (e.g., as a result of containment system failure due to a natural disaster or as a result of discontinuation of facility maintenance in the future). Therefore, the permanent disposition of stored materials and the cleanup and disposition of currently uncontained materials are necessary for the long-term protection of human health and the environment in the area.

The overall objective for remedial action at the Maywood site, both at MISS and off-site, is to eliminate, reduce, or otherwise mitigate the potential for exposure to contaminants in order to minimize threats to human health and the environment resulting from such exposure. Specific objectives of the remedial action process are as follows:

- Characterize contamination at the site
- Assess potential risks to human health and the environment that could result from exposure to site contaminants
- Mitigate any immediate hazards associated with site conditions
- Assess potential remedial action alternatives and select and implement a permanent remedy
- Minimize potential health hazards to personnel conducting characterization and remedial action activities

All remedial action activities at the Maywood site will be conducted in accordance with provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for applicable or relevant and appropriate requirements (ARARs) (see Section 3.8).

1.3 ENVIRONMENTAL COMPLIANCE PROCESS

Remedial and removal actions conducted by DOE at the Maywood site are being coordinated with EPA Region II under CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA). It is DOE policy to integrate the requirements of CERCLA with the values of the National Environmental Policy Act (NEPA) for remedial actions at sites for which it has responsibility. The remedial investigation/feasibility study (RI/FS) conducted under CERCLA is the primary process for environmental compliance associated with DOE remedial actions. Under the integrated CERCLA/NEPA policy, the CERCLA process is supplemented, as appropriate, to incorporate NEPA values. This work plan-implementation plan (WP-IP) outlines the approach for evaluating remediation alternatives for the Maywood site.

A key element of the integrated CERCLA/NEPA process is to determine the level of environmental analysis appropriate under NEPA. This determination is a function of many factors, including the complexity of a proposed action, the likelihood for significant environmental impacts, and the potential for considerable public interest. DOE has determined that an environmental impact statement (EIS) is the appropriate level of NEPA review for the Maywood site. Thus, DOE is preparing an RI/FS-EIS to determine the nature and extent of existing contamination and to evaluate alternative response actions for the site.

The Maywood site is one of four FUSRAP sites in New Jersey. The other three sites, located at Wayne, Middlesex, and New Brunswick Laboratory (see Figure 2), have similar contaminants and environmental issues. Because the four sites are not located near each other, DOE is planning to conduct separate response actions at each site. The Wayne site is located 21 km (13 mi) west of the Maywood site in Passaic County; both the Middlesex site, located 50 km (31 mi) southwest, and New Brunswick Laboratory, located 48 km (30 mi) southwest, are in Middlesex County.

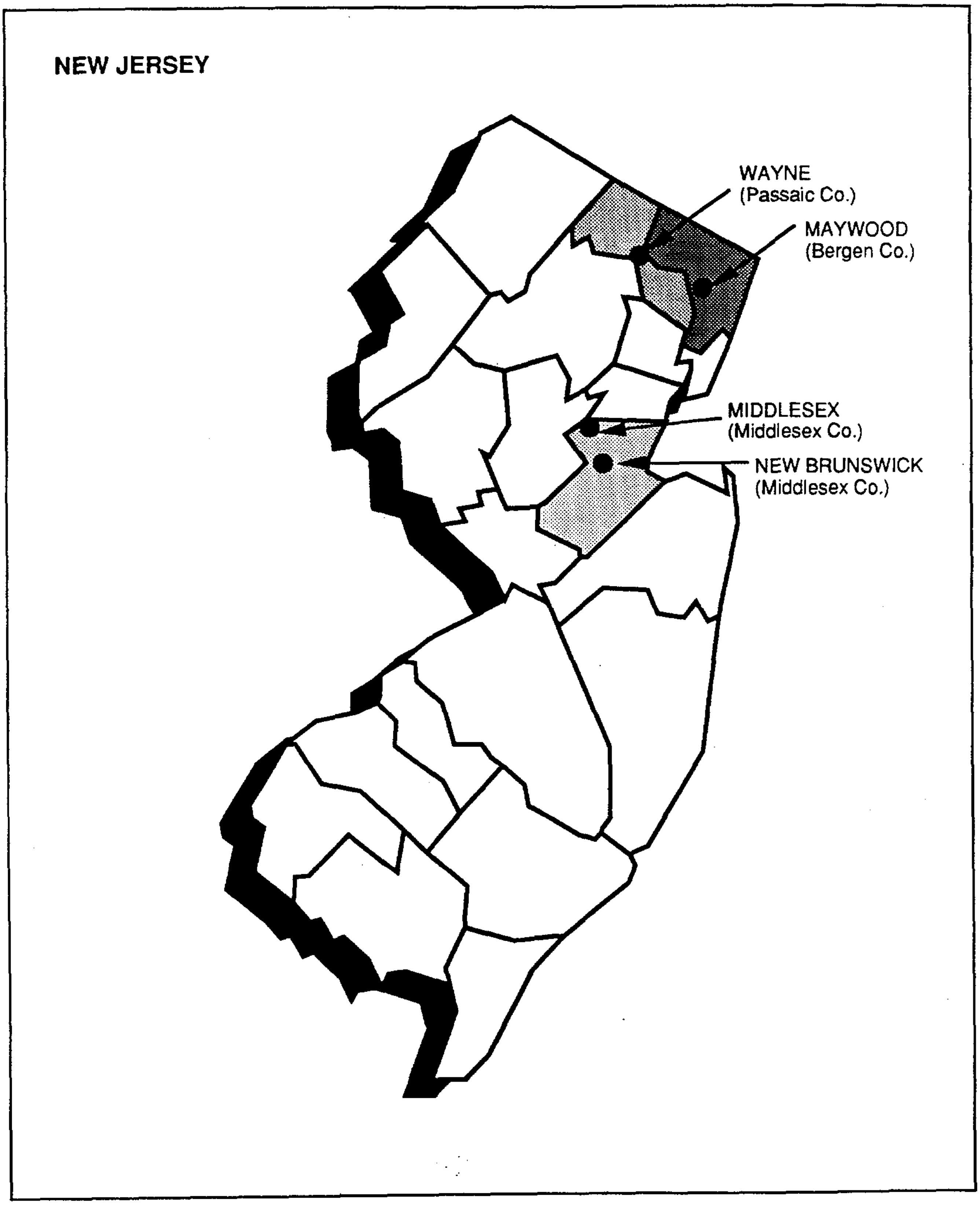


FIGURE 2 Locations of Four Related FUSRAP Sites in New Jersey

4.100 161.3

DOE has determined that response actions at the Wayne and Middlesex sites will also require preparation of an RI/FS-EIS. DOE intends to use the RI/FS-EIS for the Maywood site as a lead document, which will address common issues associated with remedial actions at all three sites. The CERCLA/NEPA documents for Wayne and Middlesex will focus on site-specific impacts and refer back to the lead document on common issues.

This RI/FS-EIS WP-IP describes the history, environmental setting, and nature and extent of contamination at the Maywood site (Section 2.0) and presents an initial evaluation of site contamination (Section 3.0). This initial evaluation addresses potential contaminant sources, environmental transport mechanisms and receptors, and data gaps. In addition, the WP-IP identifies preliminary response objectives, technologies, and alternatives for site remediation (Section 3.0). Activities planned to obtain the data needed for completion of the RI/FS-EIS process and the 14 standard tasks for completing an RI/FS are also presented (Sections 4.0 and 5.0). Finally, the WP-IP describes the schedule, organization, and project controls that will be employed to fulfill the requirements of the proposed studies (Section 6.0). This WP-IP also includes the following appendixes: Appendix A, DOE Radiological Protection Requirements and Guidelines; Appendix B, Potential Response Actions and Technologies for Environmental Media at the Maywood Site; Appendix C, Scoping Process; Appendix D, Responses to Public Scoping Comments; Appendix E, Related Federal Projects; and Appendix F, English/Metric-Metric/English Equivalents.

1.4 EXTERNAL INVOLVEMENT

1.4.1 Coordination with Other Agencies

Consultation with certain federal and state agencies is required by statute. In addition, many federal and state agencies have some degree of responsibility for certain geographical or resource areas addressed in the EIS. Such agencies may have an interest in the preparation of the EIS. Federal and state agencies with whom consultation is required by law are listed in Table 1.

Executive Order 12580 delegated to DOE the authority to conduct remedial action at sites under its control. Consistent with this order, DOE is the lead agency for remedial action at the Maywood site. The DOE plans and activities for the site are being overseen by EPA Region II, and a formal interagency agreement (an FFA to clarify DOE and EPA responsibilities) was executed under CERCLA Section 120 because the site is on the NPL (Number 167). The major elements of this agreement are described in Section 1.4.2. Plans and activities for the site are also being coordinated with appropriate New Jersey state agencies, including the New Jersey Department of Environmental Protection and Energy (NJDEPE). The identification of federal and state regulations that may impact site remediation is being coordinated with EPA Region II and NJDEPE, respectively. Through its community relations plan for the Maywood site, DOE also provides for the participation of federal and state legislators, local and county officials, and the general public in the decision-making process for site remediation.

TABLE 1 Agencies with Whom Consultation is Required by Law

Subject Area	Legislation	Agency
Endangered species	Endangered Species Act of 1973, as amended; state laws	U.S. Fish and Wildlife Service; state agencies
Migratory birds	Migratory Bird Treaty Act	U.S. Fish and Wildlife Service
Historic preservation	Archaeological and Historic Preservation Act of 1974; Archaeological Resources Protection Act of 1979	State Historic Preservation Office; President's Advisory Council
American Indian lands	American Indian Religious Freedom Act, as amended	Potentially affected Indian tribes
Work in navigable waters	Section 404 of Federal Water Pollution Control Act	Corps of Engineers
Prime and unique farmlands	Council on Environmental Quality (memo of August 30, 1976)	Soil Conservation Service
Floodplains	Executive Order 11988	Corps of Engineers; state agencies
Wetlands	Executive Order 11990	Corps of Engineers; state agencies
Water-body alteration	Fish and Wildlife Coordination Act	U.S. Fish and Wildlife Service; state agencies
Water and air pollution	Various water pollution and air emission acts and standards (e.g., Federal Water Pollution Control Act, Clean Air Act, Safe Drinking Water Act)	U.S. Environmental Protection Agency; state agencies
Land use	Federal Land Policy and Management Act of 1976	Soil Conservation Service
Water use and availability	Water Resources Planning Act of 1965; Safe Drinking Water Act; others	Office of Water Policy; state agencies
Air	Clean Air Act, as amended	U.S. Environmental Protection Agency; state agencies
Radiation	Various acts and standards (e.g., Clean Air Act, Safe Drinking Water Act)	U.S. Environmental Protection Agency; state agencies
Noise	Noise Pollution and Abatement Act of 1970; Noise Control Act of 1972	U.S. Environmental Protection Agency; state agencies
Siting and planning	State siting acts; county zoning regulations	State and county agencies

On August 10, 1984, a memorandum of understanding (MOU) between the borough of Maywood and DOE was signed, which established the framework for DOE activities in the area. The MOU limits DOE activities to storing only materials that originated from the former Maywood Chemical Works and storing these materials only at MISS. Pending permanent disposition of the materials, the MOU commits DOE to take the necessary steps to prevent migration of contamination from MISS and to prevent unauthorized entry to the site.

Two additional CERCLA investigations are taking place in the vicinity of the Maywood site. The first is an investigation being conducted by Stepan Company under an EPA Region II CERCLA Section 106 enforcement action. This investigation is focused on the Stepan Company property and on a drum field that was discovered during drilling in a radioactively contaminated area on the adjacent Sears property. DOE and the Stepan Company have signed a cooperative agreement to define their respective roles and responsibilities. Coordination with the Stepan Company is essential to accomplish a complete, cost-effective investigation and appropriate remediation of the Stepan Company property and the drum field. DOE plans to address radioactive contamination, mixed wastes, any thorium-232 processing wastes, and any chemical contamination shown to have migrated from MISS; the Stepan Company will address all other chemical contamination. Both DOE and Stepan Company will exchange information beneficial to the other with regard to identifying contaminants and determining the extent of contamination.

EPA is also performing a CERCLA investigation at the municipal well field in Lodi. Monitoring results from the wells indicated detectable quantities of volatile organic compounds (VOCs), and one well had elevated levels of radioactivity (principally uranium). The well field is no longer being used as a drinking water source. Coordinating the DOE effort with this activity is expected to involve at least the exchange of groundwater monitoring information.

For purposes of analysis and assessment, the cumulative risks associated with exposure to contaminants will be included in the RI/FS-EIS for the Maywood site. Information generated by EPA Region II related to non-FUSRAP wastes will be available in a timely manner to support this process [non-FUSRAP wastes are those not covered by the definition of FUSRAP wastes given in the FFA (see Section 1.4.2)]. Characterization data in the work plan for the Stepan Company property will allow for input into the risk assessment for the Maywood RI/FS-EIS. The well field at Lodi is located in proximity to the Maywood site, and input from the Lodi CERCLA process may be necessary to complete the Maywood RI/FS-EIS process. Periodic meetings between the appropriate contractors for all three RI/FS projects have been instituted. Such meetings will enhance the exchange of information and streamline investigations.

1.4.2 Summary of Federal Facilities Agreement

On September 17, 1990, DOE and EPA Region II negotiated and signed an FFA defining the specific responsibilities and interactions of each agency relative to DOE's remedial action activities at the Maywood site (DOE 1990b). The FFA was signed on September 17, 1990, and became effective on April 22, 1991.

The stated intent of the FFA is to:

- Ensure that the environmental impacts associated with past and present activities at the Maywood site are thoroughly investigated and appropriate remedial action taken as necessary to protect public health or welfare or the environment,

- Establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the Maywood site in accordance with CERCLA, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and Superfund guidance and policy,

- Evaluate all past investigative and response actions taken at the site by DOE and all related documentation to determine whether they are the functional equivalent of, and consistent with, those actions and documentation required by CERCLA as amended, the NCP, and Superfund guidance and policy,

- Facilitate cooperation, exchange of information, and participation of the parties in such actions, and

- Ensure that removal and remedial actions at the Maywood site will be in compliance with federal and state ARARs.

In addition, specific elements of the agreement are included to:

- Identify removal actions that are appropriate at the Maywood site prior to implementation of the final remedial action(s) for the site.

- Identify operable unit alternatives that are appropriate at the Maywood site prior to implementation of the final remedial action(s) for the site.

- Establish requirements for the performance of an RI to determine fully the nature and extent of the threat to public health or welfare or the environment caused by the release or threatened release of FUSRAP waste at the site.

- Establish requirements for the performance of an FS for the Maywood site to identify, evaluate, and select alternatives for the appropriate remedial action(s) to prevent, mitigate, or abate the release or threatened release of FUSRAP waste at the Maywood site in accordance with CERCLA.

- Identify the nature, objective, and schedule of response actions to be taken at the Maywood site. Response actions at the Maywood site shall attain that degree of cleanup of hazardous substances, pollutants, or contaminants mandated by CERCLA.

- Implement the selected removal actions and final remedial action(s) in accordance with CERCLA, the NCP, and Executive Order 12580.

- Provide for continued operation and maintenance of the selected remedial action(s), as necessary.

- Assure compliance with federal and state hazardous waste laws and regulations for matters covered by the FFA.

As defined in the FFA, "FUSRAP waste" is specifically limited to:

- All radioactive and chemical contamination, whether commingled or not, occurring on the DOE-owned MISS and

- All radioactive contamination exceeding DOE action levels and related to thorium processing at the Maywood Chemical Works site, occurring on a vicinity property.

Also included is any chemical or nonradioactive contamination on vicinity properties that would satisfy either of the following requirements:

- If the chemical or nonradioactive contamination is mixed or commingled with radioactive contamination that exceeds DOE action levels or

- If chemical or nonradioactive contamination originated at MISS or if it is associated with specific thorium manufacturing or processing activities at the Maywood Chemical Works site that resulted in the radioactive contamination.

1.4.3 Public Participation

DOE is committed to a program of public participation in the remedial action process for the Maywood site. A formal community relations program is in place for the site, the purpose of which is to gather information from the affected community, inform the public of ongoing and planned activities, and facilitate public input to remedial action decisions. In accordance with this program, DOE interacts with the public through such mechanisms as news releases, public meetings, discussions with local interest groups, receipt of and response to public comments, and the maintenance of a public repository for documents and information related to the site and its cleanup. The Maywood community relations plan is discussed in Sections 4.4.2 and 5.2.

2.0 SITE BACKGROUND AND SETTING

2.1 GENERAL SITE DESCRIPTION

The Maywood site includes MISS and a number of residential, commercial, federal, state, and municipal properties in its immediate vicinity (Figure 3). It is located in the borough of Maywood, borough of Lodi, and township of Rochelle Park, Bergen County, New Jersey, and is approximately 20 km (12 mi) north-northwest of New York City and 21 km (13 mi) northeast of Newark, New Jersey.

MISS is a 4.7-ha (11.7-acre) fenced lot that was originally part of a 12.1-ha (30-acre) property owned by the Stepan Company. The site contains a waste storage pile (consisting of about 27,000 m^3 [35,000 yd^3] of contaminated materials), two buildings (Building 76 and a pumphouse), a reservoir, and two rail spurs (Figure 4). The lot 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 areas. Residential units are located north of the railroad line and within 100 m (300 yd) to the west of the MISS.

Eighty-two vicinity properties in Rochelle Park, Maywood, and Lodi are currently designated as being radioactively contaminated as a result of thorium-processing activities carried out at the Maywood Chemical Works. In Rochelle Park, the contaminated properties include the Ballod property and nine residential units on Grove Avenue and Park Way. In Maywood, they include the Stepan Company property, eight residential properties on Davison and Latham streets, one residential property on West Central Avenue, part of New Jersey Route 17, the Scanel property (vacant), the Sears warehouse, the Sears small truck repair shop, and eight commercial properties. In Lodi, they include a right-of-way to Interstate 80 and 50 residential, commercial, and governmental properties on Trudy Drive, Hancock Street, Branca Court, Long Valley Road, Essex Street, Redstone Lane, Columbia Lane, Garibaldi Avenue, Sidney Street, and Avenues B, C, E, and F. Additional details regarding the vicinity properties are presented in Table 2 and Figure 3.

2.2 SITE HISTORY

The history of the Maywood site began with the construction of the Maywood Chemical Works in 1895. In 1916, the plant began extracting thorium and rare earths from monazite sand for use in the manufacture of gas mantles for various lighting devices. Wastes from this processing were pumped into two areas surrounded by earthen dikes on property west of the plant. (These areas were separated from the plant and partially covered by the construction of Route 17 in 1932.) Contaminants from these wastes subsequently migrated onto adjacent properties located on Grove Avenue and Park Way (ANL 1984).

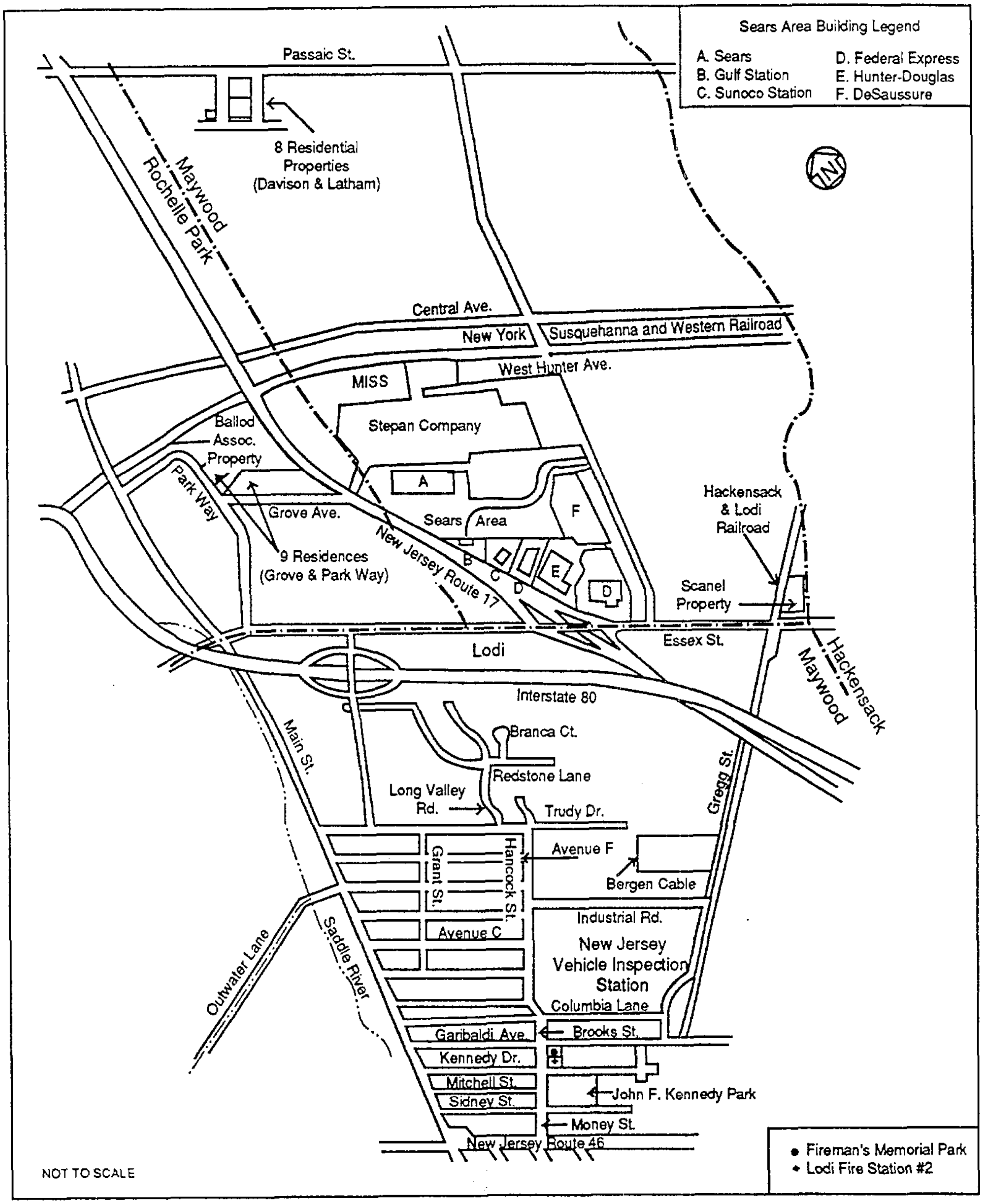


FIGURE 3 Map of the Maywood Site Showing the Locations of the Maywood Interim Storage Site and Vicinity Properties

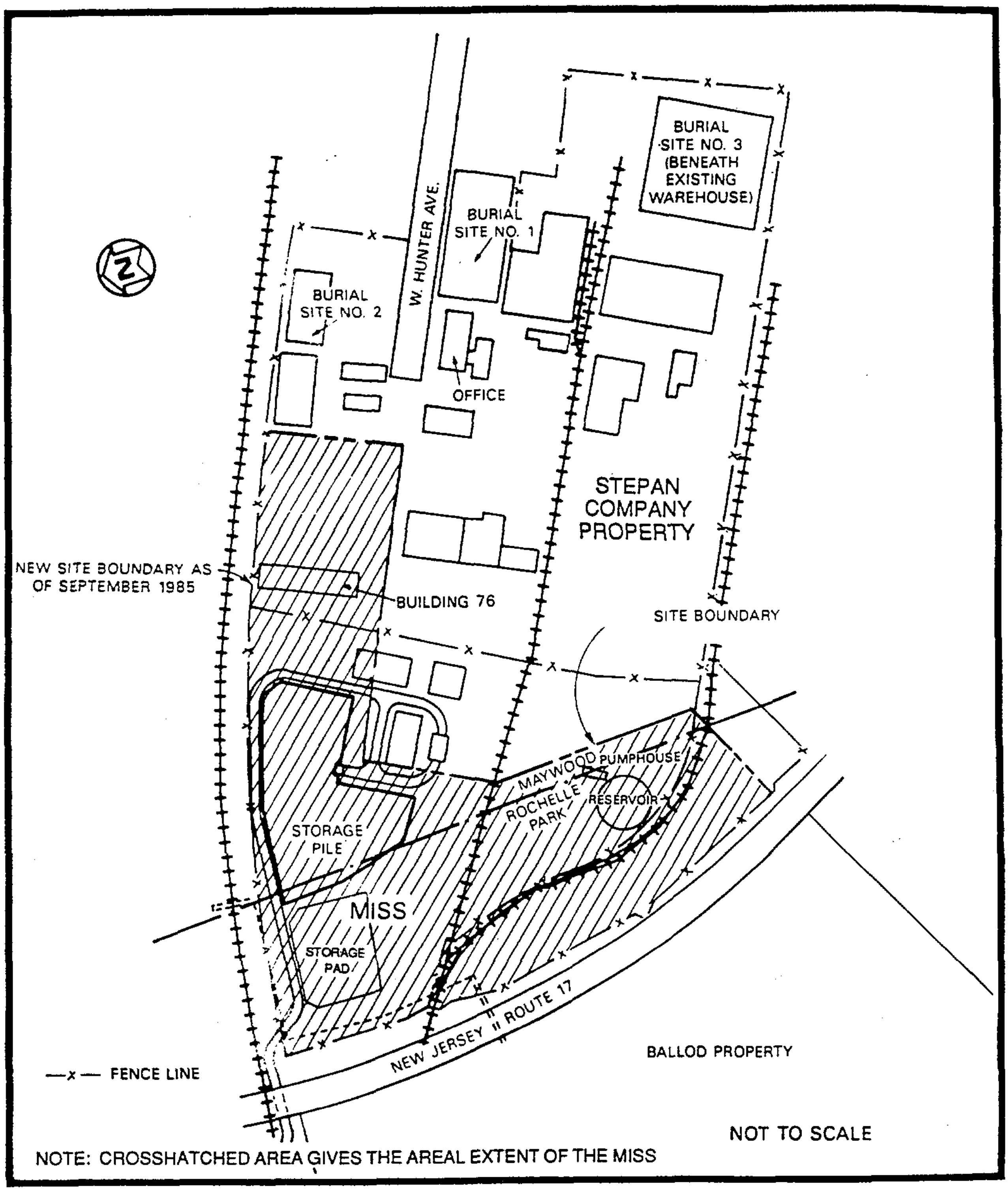


FIGURE 4 Layout of the Maywood Interim Storage Site and Adjacent Stepan Company Property

TABLE 2 Status of the Maywood Site Properties

Property	Type of Property	Status[a]	Reference(s)[b]
Maywood Interim Storage Site, Maywood	Storage site	C	NUS Corp. (1983) BNI (1987f)
Sears property, Maywood	Commercial	C	BNI (1987a)
Ballod property, Rochelle Park	Commercial	C R -[c]	Cole et al. (1981) Crotwell (1985) BNI (1986a)
Stepan Company property, Maywood	Commercial	C	Morton (1982)
Scanel property, Maywood	Commercial	C	Kannard (1986a)
Hunter Douglas property, Maywood	Commercial	C	BNI (1987b)
Federal Express property, Maywood	Commercial	C	BNI (1987c)
Gulf station property, Maywood	Commercial	C	BNI (1989v)
DeSaussure property, Maywood	Commercial	C	BNI (1989w)
Sunoco station property, Maywood	Commercial	C	BNI (1987d)
New Jersey Vehicle Inspection Station, Lodi	State	C	BNI (1987e)
Bergen Cable property, Lodi	Commercial	C	Kannard (1987)
New Jersey Route 17, Maywood and Rochelle Park	State	C	Kannard (1986b)
New York, Susquehanna, and Western Railroad property (western right-of-way), Maywood	Commercial	C	Kannard (1986c)
454 Davison Avenue, Maywood	Residential	C R V	ORNL (1986a) BNI (1986b) ORNL (1986b)
459 Davison Avenue, Maywood	Residential	C R V	ORNL (1981a) BNI (1986b) ORNL (1986c)
460 Davison Avenue, Maywood	Residential	C R V	ORNL (1981b) BNI (1986b) ORNL (1986d)
464 Davison Avenue, Maywood	Residential	C R V	ORNL (1981c) BNI (1986b) ORNL (1986e)
468 Davison Avenue, Maywood	Residential	C R V	ORNL (1981d) BNI (1986b) ORNL (1986f)

TABLE 2 (continued)

Property	Type of Property	Status[a]	Reference(s)[b]
459 Latham Street, Maywood	Residential	C	ORNL (1981e)
		R	BNI (1986b)
		V	ORNL (1986g)
461 Latham Street, Maywood	Residential	C	ORNL (1981f)
		R	BNI (1986b)
		V	ORNL (1986h)
467 Latham Street, Maywood	Residential	C	ORNL (1981g)
		R	BNI (1986b)
		V	ORNL (1986i)
10 Grove Avenue, Rochelle Park	Residential	C	BNI (1984a)
		R	BNI (1986c)
		V	ORNL (1986j)
22 Grove Avenue, Rochelle Park	Residential	C	BNI (1984b)
		R	BNI (1986c)
		V	ORNL (1986k)
26 Grove Avenue, Rochelle Park	Residential	C	BNI (1984c)
		R	BNI (1986c)
		V	ORNL (1986l)
30 Grove Avenue, Rochelle Park	Residential	C	BNI (1984d)
		R	BNI (1986c)
		V	ORNL (1986m)
34 Grove Avenue, Rochelle Park	Residential	C	BNI (1984e)
		R	BNI (1986c)
		V	ORNL (1986n)
38 Grove Avenue, Rochelle Park	Residential	C	BNI (1984f)
		R	BNI (1986c)
		V	ORNL (1986o)
42 Grove Avenue, Rochelle Park	Residential	C	BNI (1984g)
		R	BNI (1986c)
		V	ORNL (1986p)
86 Park Way, Rochelle Park	Residential	C	BNI (1984h)
		R	BNI (1986c)
		V	ORNL (1986q)
90 Park Way, Rochelle Park	Residential	C	BNI (1984i)
		R	BNI (1986c)
		V	ORNL (1986r)
59 Avenue C, Lodi	Residential	C	ORNL (1984b)
		R	BNI (1986d)
		V	ORNL (1986s)

TABLE 2 (continued)

Property	Type of Property	Status[a]	Reference(s)[b]
58 Trudy Drive, Lodi	Residential	C	ORNL (1984c)
		R	BNI (1986d)
		V	ORNL (1986t)
59 Trudy Drive, Lodi	Residential	C	ORNL (1984d)
		R	BNI (1986d)
		V	ORNL (1986u)
60 Trudy Drive, Lodi	Residential	D	ORNL (1989a)
		C	BNI (1989m)
61 Trudy Drive, Lodi	Residential	C	ORNL (1984e)
		R	BNI (1986d)
		V	ORNL (1986v)
62 Trudy Drive, Lodi	Residential	D	ORNL (1989b)
64 Trudy Drive, Lodi	Residential	C	BNI (1985c)
		R	BNI (1986d)
		V	ORNL (1986w)
121 Avenue F, Lodi	Residential	C	BNI (1985d)
		R	BNI (1986d)
		V	ORNL (1986x)
123 Avenue F, Lodi	Residential	C	BNI (1985a)
		R	BNI (1986d)
		V	ORNL (1986y)
3 Hancock Street, Lodi	Residential	C	BNI (1985b)
		R	BNI (1986d)
		V	ORNL (1986z)
4 Hancock Street, Lodi	Residential	D	ORNL (1989c)
		C	BNI (1989a)
5 Hancock Street, Lodi	Residential	D	ORNL (1989d)
		C	BNI (1989b)
6 Hancock Street, Lodi	Residential	D	ORNL (1989e)
		C	BNI (1989c)
7 Hancock Street, Lodi	Residential	D	ORNL (1989f)
		C	BNI (1989d)
8 Hancock Street, Lodi	Residential	D	ORNL (1989g)
		C	BNI (1989e)
9 Hancock Street, Lodi	Residential	C[d]	BNI (1989x)
10 Hancock Street, Lodi	Residential	D	ORNL (1989h)
		C	BNI (1989f)
80 Hancock Street, Lodi	Commercial	D	ORNL (1989i)
		C	BNI (1989g)

TABLE 2 (continued)

Property	Type of Property	Status[a]	Reference(s)[b]
100 Hancock Street, Lodi	Commercial	D C	ORNL (1989j) BNI (1989h)
2 Branca Court, Lodi	Residential	D C	ORNL (1989k) BNI (1989j)
4 Branca Court, Lodi	Residential	D C	ORNL (1989l) BNI (1989k)
6 Branca Court, Lodi	Residential	D C	ORNL (1989m) BNI (1989l)
7 Branca Court, Lodi	Residential	D C	ORNL (1986za) BNI (1988a)
11 Branca Court, Lodi	Residential	D C	ORNL (1986zb) BNI (1988b)
14 Long Valley Road, Lodi	Residential	D C	ORNL (1989n) BNI (1989y)
16 Long Valley Road, Lodi	Residential	D C	ORNL (1986zc) BNI (1988c)
18 Long Valley Road, Lodi	Residential	D C	ORNL (1986zd) BNI (1988d)
20 Long Valley Road, Lodi	Residential	D C	ORNL (1986ze) BNI (1988e)
22 Long Valley Road, Lodi	Residential	D C	ORNL (1986zf) BNI (1988f)
24 Long Valley Road, Lodi	Residential	D C	ORNL (1989o) BNI (1989z)
26 Long Valley Road, Lodi	Residential	D C	ORNL (1986zg) BNI (1988g)
11 Redstone Lane, Lodi	Residential	D C	ORNL (1986zh) BNI (1988h)
17 Redstone Lane, Lodi	Residential	D C	ORNL (1989p) BNI (1989i)
19 Redstone Lane, Lodi	Residential	C[d]	BNI (1989za)
Lodi Municipal Park, Lodi	Municipal	D C	ORNL 1986zi) BNI (1988i)
80 Industrial Road, Lodi	Commercial	D C	ORNL (1989q) BNI (1989n)
106 Columbia Lane, Lodi	Residential	D C	ORNL (1989r) BNI (1989o)

TABLE 2 (continued)

Property	Type of Property	Status[a]	Reference(s)[b]
99 Garibaldi Avenue, Lodi	Residential	D C	ORNL (1989s) BNI (1989p)
Fire Station No. 2, Lodi	Municipal	D C	ORNL (1989t) BNI (1989q)
Firemen's Memorial Park, Lodi	Municipal	D C	ORNL (1989t) BNI (1989r)
72 Sidney Street, Lodi	Commercial	D C	ORNL (1988) BNI (1989s)
113 Essex Street, Maywood (National Community Bank)	Commercial	D	ORNL (1989u)
160/174 Essex Street, Lodi (National Community Bank)	Commercial	D C	ORNL (1989v,w) BNI (1989t)
John F. Kennedy Municipal Park, Lodi	Municipal	D C	ORNL (1989x) BNI (1989u)
Interstate 80 (right-of-way), Lodi	Federal	D C	ORNL (1989y) BNI (1989zb)
90 Avenue C, Lodi	Residential	D[e]	ORNL (1989z)
108 Avenue E, Lodi	Residential	D	ORNL (1989za)
112 Avenue E, Lodi	Residential	D	ORNL (1989zb)
113 Avenue E, Lodi	Residential	D	ORNL (1989zc)
79 Avenue B, Lodi	Residential	D	ORNL (1989zd)
136 W. Central Avenue, Maywood	Residential	D	ORNL (1989ze)
200 Rt. 17, Maywood (Sears small truck repair)	Commercial	D	ORNL (1989zf)
Rt. 17 and Essex Street, Maywood (Joseph Muscarelle Associates)	Commercial	D	ORNL (1989zg)

[a]C = Radiological characterization completed on property.
R = Remedial action performed on property.
V = Verification performed on property by independent verification contractor.
D = Designation survey completed.
[b]NUS Corp. = NUS Corporation; BNI = Bechtel National, Inc.; ORNL = Oak Ridge National Laboratory.
[c]Only part of site remediated.
[d]Property not yet designated.
[e]Partial remediation completed in 1991 as a time-critical removal action. Documentation of the cleanup being prepared.

Contaminated materials were also disseminated to vicinity properties from the Maywood Chemical Works in the form of fill. Although the fill consisted of tea and coca leaves from another process conducted at the Maywood Chemical Works, it was apparently mixed with thorium-processing wastes from the plant. In 1928, wastes were brought to several nearby areas for use as mulch and fill. From 1944 to 1946, wastes were apparently mixed with thorium-processing wastes from the plant. In 1928, wastes were brought to several nearby areas for use as mulch and fill. From 1944 to 1946, wastes were transported to a vacant lot at 464 Davison Street for surface grading and for filling a ditch that extended across several lots between Davison and Latham streets. Some of the fill on the 464 Davison Street lot was subsequently incorporated by residents into the lawns and gardens of nearby properties; a house was constructed on the lot in 1967 (NRC 1981a).

Additional contaminated materials were apparently disseminated through stream action. Old photographs and maps indicate that the course of a previously existing stream (Lodi Brook), whose headwaters originate near the Maywood Chemical Works, closely coincides with the distribution of contaminated materials in the borough of Lodi (Mata 1984). Most of the original stream has since been replaced by a subsurface storm drain system.

In 1954, AEC issued a license to the Maywood Chemical Works for continued manufacture of radioactive materials (under the Atomic Energy Act of 1954). Processing operations were terminated in 1956, and the plant was sold to the Stepan Chemical Company (later shortened to Stepan Company) in 1959.

Although the Stepan Company did not subsequently process any radioactive materials at the plant, they began a cleanup of residual thorium wastes in 1963; the extent of these wastes was delineated by AEC inspections and information concerning the past history of the site. Residues and tailings on the property west of Route 17 were partially stabilized at this time. In 1966, 6,400 m^3 (8,400 yd^3) of contaminated material was removed from this property and buried east of Route 17 on the Stepan Company property (Burial Site No. 1) (Figure 4). In 1967, an additional 1,600 m^3 (2,100 yd^3) of materials was removed and buried in an area now covered by a plant parking lot (Burial Site No. 2). Finally, in 1968, the Stepan Company excavated another 6,600 m^3 (8,600 yd^3) of materials from the property west of Route 17 and buried it under an area later occupied by a warehouse (Burial Site No. 3). During that same year, AEC conducted a survey of the property west of Route 17 and certified it for use without radiological restrictions, and the Stepan Company then sold this property. The property was purchased by Ballod Associates in the 1970s (Cole et al. 1981).

The presence of radioactive materials in the vicinity of the Stepan Company plant was brought to public attention by a private citizen in 1980, who reported the discovery of radioactive contamination near Route 17 to the NJDEP. A survey conducted by the state identified the contaminants as thorium-232 and radium-226. The NRC was notified of the results and undertook additional surveys from November 1980 to January 1981, which confirmed high concentrations of thorium-232 in soil samples collected from both the Stepan Company and Ballod properties (NRC 1981a). Because of these results, the NRC requested a comprehensive survey of the area.

In late January 1981, EG&G Energy Measurements Group conducted an aerial radiological survey of the Stepan Company and surrounding properties (EG&G 1981). The survey, which covered a 10-km^2 (4-mi^2) area, indicated contamination not only on the Stepan Company and Ballod properties but also on areas to the north and south of the Ballod property. During February 1981, Oak Ridge Associated Universities performed a separate radiological ground survey of the Ballod property (Cole et al. 1981); because of the results of this survey, the property was designated for remedial action (Coffman 1983). Another radiological survey of the Stepan Company and Ballod properties (commissioned by the Stepan Company) was conducted in June with similar findings (Morton 1982). Limited chemical sampling was also performed by Ebasco Services (1987, 1988).

Following these investigations, Oak Ridge National Laboratory (ORNL) and Bechtel National, Inc. (BNI), embarked on a survey program of properties in the vicinity of the Stepan Company plant. Surveys of properties along Davison Avenue and Latham Street were performed by ORNL in June 1981, and seven properties were designated for remedial action (ORNL 1981a, 1981b, 1981c, 1981d, 1981e, 1981f, 1981g); one additional property on Davison Avenue was designated in 1986 (ORNL 1986q). In late 1983, properties on Grove Avenue and Park Way were surveyed by BNI, and nine of these properties were designated for remedial action (Coffman 1983). A "drive-by" survey of Lodi (using a mobile van) was conducted by ORNL in June 1984 (ORNL 1984a), the results of which indicated additional contamination; this survey was followed by ground surveys in the area (ORNL 1984b, 1984c, 1984d, 1984e). In September 1983, EPA added the Maywood site to the NPL.

DOE was authorized to undertake a decontamination research and development project at the Maywood site by the Energy and Water Appropriations Act of 1984, and the site was assigned to FUSRAP. In 1985, in order to expedite cleanup of the vicinity properties, DOE negotiated access to a 4.7-ha (11.7-acre) portion of the Stepan Company property for use as a storage facility for contaminated materials; this area on the Stepan Company property was designated as MISS. Subsequently, DOE began a program of environmental monitoring at MISS and removal actions (i.e., cleanup) at the vicinity properties. In September 1985, ownership of MISS was transferred to DOE.

Removal actions were initiated within the context of a two-phase decontamination plan. During the first phase, radioactive wastes on the vicinity properties were to be removed to MISS, where they would be stored for up to 25 years. During the second phase, the stored wastes and all other wastes associated with the former thorium-processing activities were to be moved to a permanent disposal site (ANL 1987). During 1984 and 1985, approximately 27,000 m^3 (35,000 yd^3) of contaminated materials was removed from the Ballod property and from 17 vicinity properties located on Davison Avenue, Latham Street, Grove Avenue, and Park Way in Maywood and Rochelle Park. These materials were stored in a protective enclosure cell at MISS. During 1985, an additional 380 m^3 (500 yd^3) of contaminated materials was removed from eight vicinity properties located on Avenue C, Avenue F, Hancock Street, and Trudy Drive in Lodi and another portion of the Ballod property in Rochelle Park. These materials were added to the storage pile at the MISS property.

Because of local opposition, no further removal action was undertaken from 1986 through 1988. However, environmental monitoring of MISS and surveying of the vicinity properties continued. Contamination was detected on 48 of the 53 properties surveyed during this period. To date, 82 properties have been designated as having contamination that exceeds DOE guidelines for residual radioactivity. Of these, 25 have been fully remediated and 2 partially remediated; 55 have been characterized and reports published. Designation for cleanup is currently being considered for 2 additional properties that have been characterized and reports published. Other properties will be added to this list if they are designated for cleanup as a result of the RI/FS-EIS process and ongoing survey activities.

2.3 ENVIRONMENTAL SETTING

2.3.1 Topography

The Maywood site is located in the glaciated section of the Piedmont Plateau of north-central New Jersey. The terrain is generally level, with minor relief created by occasional shallow ditches and low mounds; elevations range from 15 to 20 m (51 to 67 ft) above mean sea level. The surface slopes gently to the west and is poorly drained (Cole et al. 1981).

2.3.2 Geology and Soils

Bedrock underlying the Maywood site consists of igneous and sedimentary rock of Triassic age. The Brunswick Formation has alternating beds of reddish-brown sandstone, mudstone, and shale, and it ranges from 1,800 to 2,400 m (6,000 and 8,000 ft) in thickness (Carswell and Rooney 1976). This formation contains three basalt units (Watchung Basalt), ranging from 110 to 260 m (350 and 850 ft) in thickness. Erosion of the sedimentary rock has created prominent ridges out of the more resistant basalt.

Unconsolidated materials of glacial origin (boulders, gravel, silt, and clay) overlie the bedrock in many parts of the region. The composition and characteristics of these deposits vary within the area, according to depositional history. Unstratified deposits laid down directly by glaciers (till) contain unsorted rock fragments ranging from clay-sized particles to boulders. Stratified materials include bedded, well-sorted units deposited by glacial meltwater into streams and lakes.

Structurally, the local bedrock exhibits a monoclinal dip of 10 to 15° northwest and contains shallow open folds (Carswell and Rooney 1976). The Brunswick Formation is characterized by vertical jointing that is parallel to and transverse to the strike of the beds. Minor north-trending faults in the Triassic formations are bounded on the northwest by the northeast-trending Ramapo Fault. The Ramapo Fault at its nearest location is about 21 km (13 mi) west-northwest of the Maywood site. Considerable seismic activity has occurred along the Ramapo Fault in northern New Jersey/eastern New York

(Algermissen 1983; U.S. Geological Survey, undated). This area is part of an apparently broad, diffuse region of seismic activity that extends north-northeast from New Jersey to New Brunswick, Canada. However, although numerous earthquakes have been recorded locally, they are typically of low magnitude and cause little structural damage.

Historically, the unconsolidated glacial deposits in the Maywood area were capped with a well-developed deciduous forest soil. However, extensive agricultural and urban development disturbed or destroyed much of this original soil horizon, and most of the current soil cover in the area may be classified as urban fill.

2.3.3 Hydrology and Water Quality

Surface Water. The Maywood site lies within the Saddle River drainage basin. MISS is located approximately 0.8 km (0.5 mi) east of the Saddle River (a tributary of the Passaic River) and approximately 1.6 km (1 mi) west of the drainage divide of the Hackensack River basin. Drainage conditions at the site are poor. Rainwater runoff from MISS empties into the Saddle River via Westerly Brook, which flows under the site and Route 17 through a concrete storm drain and eventually empties into the Saddle River. Neither the Saddle River nor Westerly Brook is used as a source of potable water (Jacobson 1982).

Groundwater. Groundwater in the Maywood area occurs in both the Brunswick Formation and the unconsolidated glacial deposits. The Brunswick Formation is a productive aquifer that is a major source of water for public and industrial use (Carswell and Rooney 1976; Morton 1982; ANL 1984). Groundwater flows through weathered rock and secondary fracture openings in the Brunswick Formation, forming a system of tabular aquifers and aquicludes. Wells yield from 1.3 to 47 L/s (20 to 750 gpm). The water is moderately mineralized and moderately hard to very hard.

The unconsolidated glacial deposits provide a more variable source of groundwater. Small yields [e.g., 0.13 L/s (2 gpm)] are available from unstratified till deposits, whereas stratified stream and lake deposits yield as much as 57 L/s (900 gpm). Water quality from these deposits is highly variable, depending on location and sediment source; it ranges from soft to hard but is generally not mineralized.

According to the EPA's proposed Ground Water Classification Guidelines, groundwater at the site is at least Class IIA, which is defined as a current source of drinking water. Because of this classification, maximum contaminant levels are applicable or relevant and appropriate requirements for groundwater at the site.

2.3.4 Ecology

Terrestrial Ecosystems. The Maywood site is located within the glaciated portion of the Appalachian Oak Forest Section of the Eastern Deciduous Forest Province (Bailey 1978). However, past agricultural and urban development has destroyed the forest habitat in the area. Prior to recent removal actions on the Ballod property and MISS, these areas supported an early successional community dominated by grasses and forbs with scattered shrubs and trees (e.g., aspen, elm, and oak). The residential properties contain plant species common to landscaped yards, such as grasses (fescue and blue grass), garden vegetables and/or flowers, evergreen shrubs, and trees (ANL 1984).

Animal life is limited by the lack of suitable local habitat. Commonly occurring species are those adapted to suburban and urban environments. Bird species include house sparrow, red-winged blackbird, common crow, common grackle, starling, mourning dove, robin, and wood thrush. Mammalian species include Norway rat, house mouse, meadow vole, raccoon, eastern cottontail rabbit, opossum, and eastern gray squirrel. Woodchuck burrows were observed at MISS prior to recent remedial activities. A small number of reptile and amphibian species (e.g., eastern garter snake and American toad) probably inhabit the area (ANL 1984).

Aquatic Ecosystems. Aquatic habitats are limited to drainageways, small temporary ponds, Westerly and Lodi brooks, and the Saddle River. No wetlands have been identified in the area. Westerly Brook traverses MISS but does not actually constitute an aquatic habitat because it is encased in concrete pipe beneath the site. Similarly, much of Lodi Brook has been incorporated into a subsurface storm drain system. However, surface-feeding ducks (e.g., mallard, black duck) are commonly observed on the Saddle River and accessible portions of Westerly Brook. Mosquito larvae, beetles, bugs, snails, isopods, midges, aquatic worms, and other invertebrates typically occur in these habitats and in stream and temporary pond habitats (ANL 1987).

Threatened and Endangered Species. No threatened or endangered species have been identified at the Maywood site (Chezik 1989).

2.3.5 Climate, Meteorology, and Air Quality

Climate and Meteorology. The regional climate is humid, with a mean annual precipitation of about 120 cm (48 in.) and approximately 120 days of precipitation per year. August is the wettest month, with an average of 12 cm (4.8 in.) of rain. The area receives approximately 77 cm (30 in.) of snow per year. About 25 to 30 thunderstorms and an average of less than one tornado (statewide) occur annually. Floods sometimes accompany heavy rains associated with storms of tropical origin. Prolonged droughts are rare, typically occurring only once every 15 years. Mean monthly temperatures range from a January low of -1.2°C (29.8°F) to a July high of 23.8°C (74.9°F). The prevailing winds are from the northwest during October to April and from the southwest during the remainder of the year (Gale Research Company 1980).

Air Quality. Air quality monitoring stations in Bergen County are located in Cliffside Park, Fort Lee, and Hackensack. During 1987, these monitoring stations measured sulfur dioxide, ozone, nitrogen oxides, carbon monoxide, trace metals, inhalable particulates, particulate organic matter, and smoke shade (NJDEP 1988); overall air quality was rated "good" for 185 days, "moderate" for 168 days, "unhealthful" for 9 days, and "very unhealthful" for 1 day (data were not available for two days during the year). In 1987, for the first time, all New Jersey stations monitoring ozone levels reported violations of the primary ambient air quality standards. Cliffside Park reported that ozone levels exceeded the state and federal maximum daily 1-hour average of 0.12 ppm (235 $\mu g/m^3$) on nine days. However, other pollutants monitored in Bergen County remained within the state and federal standards. During the fall and winter of 1986-1987, the NJDEP conducted a statistical sampling in which New Jersey homes were screened for radon-222. The statewide average for the screened homes was 5.2 pCi/L, ranging from 0.1 to 246 pCi/L. In Bergen County, the average was 1.81 pCi/L, ranging from 0.3 to 19.1 pCi/L (Camp Dresser & McKee 1989).

2.3.6 Land Use and Demography

MISS is zoned for commercial and industrial use. Lands adjacent to MISS are zoned for limited commercial, light industrial, or single-family residential use.

The estimated 1990 populations of the boroughs of Maywood and Lodi were 9,470 and 22,360, respectively; the 1990 estimate for the township of Rochelle Park was 5,590. The estimated 1990 population of Bergen County as a whole was 825,400, reflecting a 2 percent decrease from 1985 (U.S. Bureau of the Census, unpublished data).

2.3.7 Archeological and Historical Sites

None of the buildings comprising the Maywood site are currently listed in the *National Register of Historic Places*. Although no archeological surveys have been conducted at the site, the history of extensive ground disturbance associated with urban development in the area suggests a low probability of finding a site meeting criteria for inclusion in the *National Register*.

2.4 NATURE AND EXTENT OF CONTAMINATION

The following discussion of the origins and nature of radioactive and nonradioactive contamination at the Maywood site is based on information compiled by reviewing reports of previous surveys and historical information about operations conducted at the site. The data presented in Sections 2.4.1 and 2.4.2 are summarized in Chapter 3; a complete evaluation of these data will be included in the RI report for the Maywood site.

The principal contaminants at the Maywood site are radioactive contaminants associated with the thorium-232 and uranium-238 decay chains. The contaminants originated from the processing of monazite sands for the extraction of thorium and rare earth metals by the Maywood Chemical Works. The Maywood Chemical Works also produced detergents, alkaloids, essential oils, and lithiated compounds, including lithium chloride and lithium hydroxide.

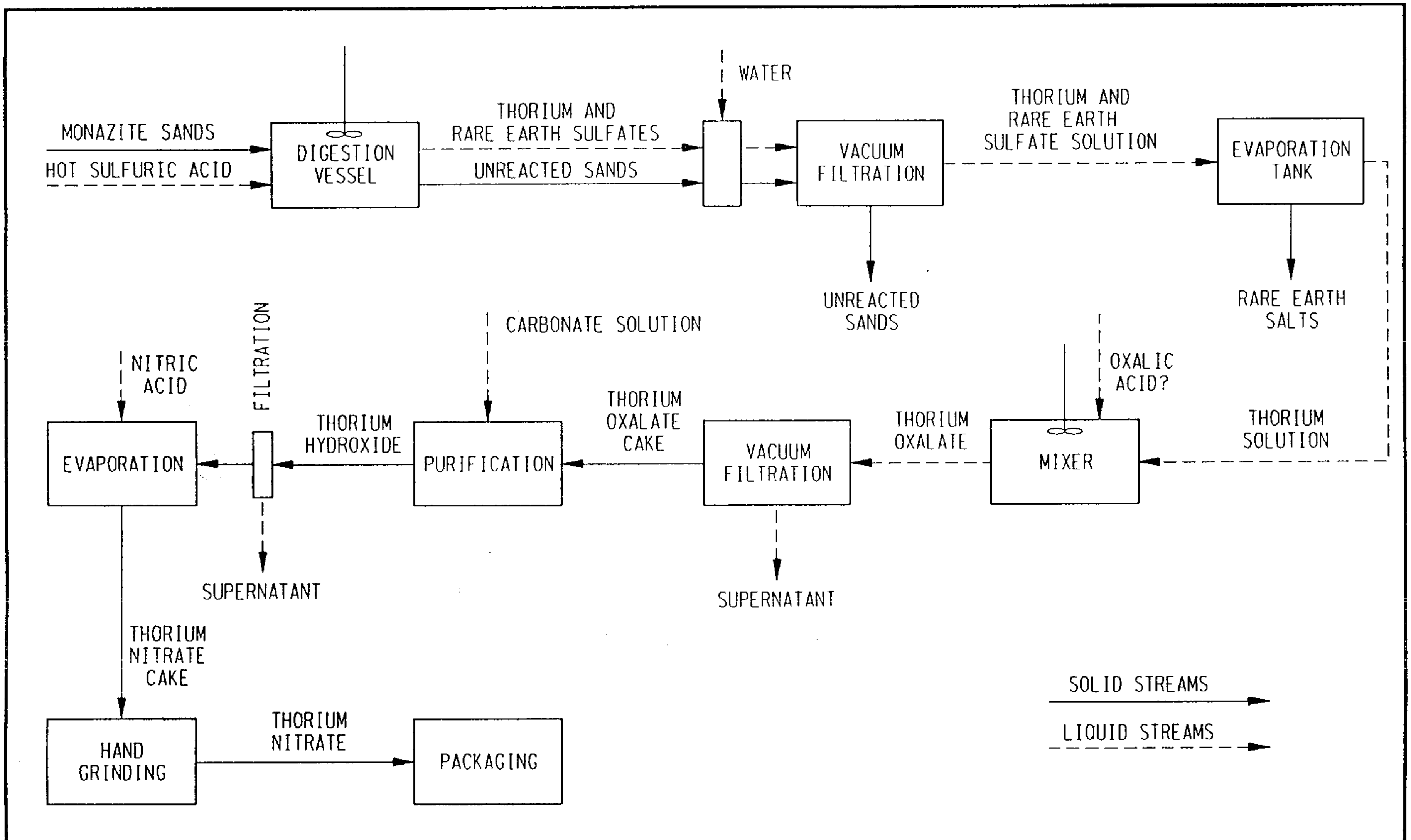
2.4.1 Origins of the Contamination

The Maywood Chemical Works was founded in 1895 and in 1916 began processing monazite sand to extract thorium and rare earths. The manufacturing process included the production of thorium nitrate from monazite sands. In the early decades, from 1916 to 1954, thorium nitrate was used for gas mantles; later, between 1954 and possibly 1959, it was used as a product suitable for purification to AEC reactor-grade levels (NRC 1981a). Thorium extraction stopped in 1956, but thorium processing using 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 detrimental in reactor-grade materials (Albert 1966). This change may be inferred from memos in the early 1950s (Harris 1951; Heatherton 1951), which referred to the use of oxalic acid in the extraction process; oxalic acid is an expensive material and would not be cost-effective in the production of lower-grade mantle material.

The process that may have been used to produce thorium nitrate at the Maywood Chemical Works for the AEC is diagrammed in Figure 5. The following description of the process is based on correspondence about plant operations (Harris 1951; Heatherton 1951; National Lead Company of Ohio 1951) and on a reconstruction of the chemical processes (Albert 1966; Cuthbert 1958; Eister and Kennedy 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 — leaving unreacted monazite, silica, rutile, and zircon — and then vacuum filtered. The filtrate was evaporated, separating the uranium and rare earths from the thorium sulfate solution. Reagents, perhaps oxalic acid (NRC 1981a), were added to the thorium sulfate solution to form thorium oxalate, and the solution was filtered. Purification involved redissolving the thorium oxalate, treating it with a carbonate solution, and precipitating it as a hydroxide. Purification of thorium by solvent extraction was not performed at the Maywood Chemical Works because the technology was not established until 1958 (Teh et al. 1983). During finishing, the 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. In this reconstruction, the primary chemicals used in the extraction process would be sulfuric acid, nitric acid, ammonium hydroxide, oxalic acid, and ammonium oxalate. Throughout this process, the rare earths would concentrate, either as a product or in the waste stream.

The slurry, containing processing wastes from the thorium operation, was pumped to lower-lying areas to the west of the Maywood Chemical Works facility, and earthen dikes were constructed to contain the wastes (Cole et al. 1981). A series of retention structures appears to have been constructed across an existing stream channel. As one basin was filled with process wastes, another dike was built across the stream to form another basin. Historical aerial surveys (Mata 1984) and recent geological and radiological surveys (BNI 1987f) show that these retention ponds covered most of the Ballod and MISS properties (Figure 6). The northern diked area was known to contain primarily lithium wastes; the southern diked area contained both thorium and lithium wastes (NRC 1981a). In addition, various other inorganic and organic chemicals have been identified in soils and groundwater at the MISS (BNI 1985e, 1986e, 1987g, 1988j, 1989zc, 1990a; Ebasco Services 1987, 1988).



* ADDITIONAL PROCESS INCLUDED CONVERSION OF THORIUM HYDROXIDE TO THORIUM CHLORIDE WHICH WAS SOLD AS AN INTERMEDIATE PRODUCT. THORIUM HYDROXIDE WAS FORMED AGAIN AND NITRIC ACID WAS ADDED TO PRODUCE THORIUM NITRATE. (*SOURCE*: ATOMIC ENERGY COMMISSION COMPLIANCE INSPECTION REPORT DATED 5/24/57.)

138 R01F002.DGN

FIGURE 5 Process Possibly Used to Produce Mantle-Grade Thorium Nitrate at the Maywood Chemical Works

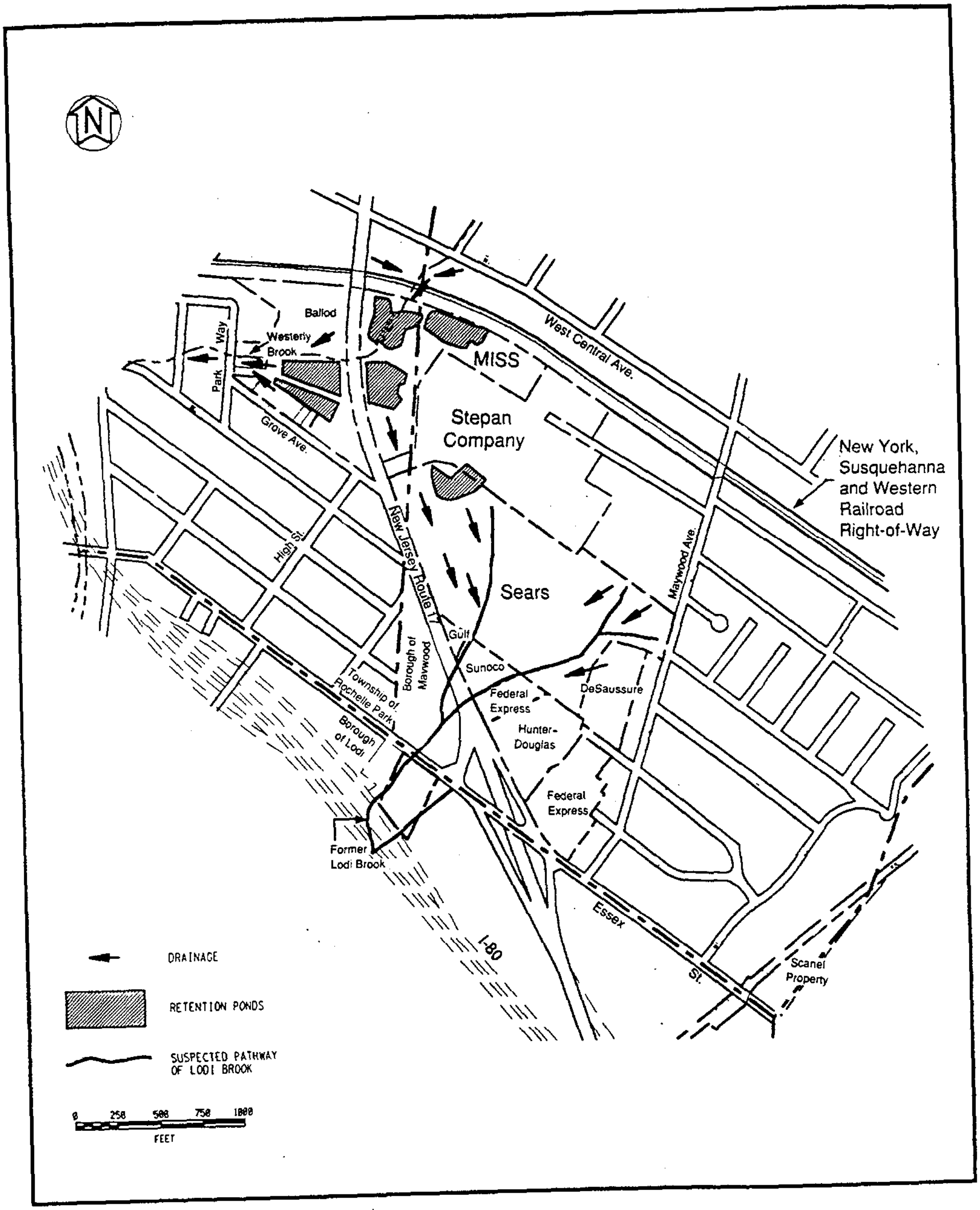


FIGURE 6 Retention Ponds and Drainage Pathways at the Maywood Site

Because of the low natural abundance of thorium within the area of the Maywood site compared with recently measured soil concentrations, it is clear that the contamination at the site originated during operation of the Maywood Chemical Works. Geological data (BNI 1987f) indicate that contamination on properties near the Maywood Chemical Works site resulted from deposition within the Lodi Brook stream channel, swampy areas, and adjacent areas affected by flood or high-water events. In addition, some contaminants apparently were eroded from the Ballod property onto adjacent properties on Grove Street and Park Way and some were spread down two streams crossing the Sears property (BNI 1987a), resulting (at least partially) in contamination of the Sears property and properties farther south in Lodi along the former Lodi Brook (Figure 6). The contamination of many commercial properties (e.g., Scanel, Gulf station, and Sunoco station) may have resulted from fill emplacement as well as from stream transport (Kannard 1986a; BNI 1987d, 1989v). Aerial surveys (Mata 1984) and historical records (BNI 1987f; Morton 1982; NRC 1981a) also indicate that sludge was removed from the Ballod property on three occasions and buried on the Stepan Company property.

Contamination of residential areas in Lodi may have resulted from the use of contaminated fill for landscaping and/or from stream deposition (BNI 1989c). According to an area resident, fill from an unknown source was brought to Lodi and spread over large portions of the previously low-lying and swampy area; however, the dominant mechanism is believed to have been migration of contamination along the former Lodi Brook (BNI 1989c).

Residential areas between Davison and Latham streets were probably contaminated when wastes from the Maywood Chemical Works were used as fill in the area. Information about seven of these properties was obtained from the owner of a property on Latham Street whose father moved there in 1928 and was employed by the Maywood Chemical Works (ORNL 1981f). According to this information, much of the processing wastes from a separate plant operation was in the form of a rich organic material consisting of decaying tea and coca leaves, and this material was removed on several occasions, with company approval, and used as mulch for gardens, flowers, and shrubbery and as general fill material for lawns. Apparently, thorium-processing wastes from the mantle operation were mixed with this organic material. Specifically, the resident's father owned a vacant lot at 464 Davison Avenue, and he had many truckloads of the material deposited on this property. The material was used primarily to fill in a ditch that laterally traversed the back of several lots between Davison Avenue and Latham Street. In addition, many neighbors in the area used this material in vegetable and flower gardens and as fill for low spots on their properties. After the material was spread over the Davison Avenue lot, the lot was sold, and a house was constructed on the property in 1967.

2.4.2 Radiological Conditions

Maywood Interim Storage Site. Several radiological surveys were conducted at the Maywood Chemical Works between 1963 and 1968 to support AEC licensing activities at the site (Jones 1987). The results of these surveys indicate that the tailings pile and slurry pile contained radioactive materials. These materials were subsequently buried in Burial Sites Nos. 1, 2, and 3. In one AEC survey taken over the slurry pile with an open-shield

Geiger-Mueller counter, readings ranged from 0 to 9 mR/h at waist level and were 5.5 mR/h at contact with the top of the pile. Because open-shield readings contain both beta and gamma components, these readings are higher than the gamma-only readings discussed in this section. Moreover, these readings were taken close to the source, which tends to give higher numbers. Presumably, the maximum contact readings observed were lower than the waist-level readings because of either different measurement locations or the wider field of view at waist level when surrounded by a diffuse inhomogeneous source.

Some level of contamination was also detected in various environmental media, as follows: soil, 0.1 to 40 mR/h (contact); surface water, 0.05 to 0.1 mR/h (contact); and vegetation, 0.1 to 0.2 mR/h (contact). Generally, water and vegetation will not give meter readings even when highly contaminated internally. These readings probably indicate that surfaces are contaminated with radioactive particulates. Building 21 had ambient levels ranging from 0.6 to 8 mR/h. From the AEC survey and other surveys, it was concluded that large portions of the site were contaminated and that some remedial action was needed.

Three separate excavations and burials were conducted between 1966 and 1968 to prepare a portion of the Stepan Company property to be certified for use without radiological restrictions (BNI 1987f). In a 1968 closeout survey, AEC indicated that the criteria for release without restrictions had been met in the former waste storage area and southern dike. Average gamma-ray readings at the southern dike ranged from 0.05 to 0.1 mR/h, with maximum readings up to 0.3 mR/h (Jones 1987).

In September 1980, the NJDEP received a letter from a private citizen reporting that he had found radioactive contamination in an area near Route 17 in Rochelle Park (NRC 1981a). Subsequent surveys and soil sample analyses by NJDEP in October 1980 identified the presence of thorium-232 and radium-226 in the area currently identified as MISS (NJDEP 1980a, 1980b). The gamma readings at 0.9 m (3 ft) above ground level ranged from 16 to 420 μR/h and generally increased in an easterly direction away from Route 17 toward the distribution warehouse (1,000 μR/h = 1 mR/h). Maximum ground-level gamma readings approached 1,000 μR/h. Soil samples collected from this area contained concentrations of thorium-232 ranging from 0.29 to 74 pCi/g and radium-226 ranging from less than 1.0 to 14 pCi/g (NJDEP 1980a, 1980b).

Additional surveys conducted by the NRC in November 1980 (NRC 1981a) confirmed the previous reports of contamination. The survey results indicate aboveground gamma radiation levels ranging from 0.02 to 3 mR/h. Soil samples collected from areas where radiation levels were above 1 mR/h had thorium concentrations ranging from 700 to 3,000 pCi/g. The radioactive contamination appeared to be either a white or yellow clay-like material, quite different from the local brown-sandy soil (NRC 1981a).

An aerial radiological survey to measure terrestrial gamma radiation was performed in January 1981 over a 10-km^2 (4-mi^2) area centered on the Stepan Company property (EG&G 1981). The isoradiation contours for gross exposure rates (derived from gross count rates) are shown in Figure 7. These values include the 6- to 7.5-μR/h average background activity in the area. Areas of higher than normal gamma exposure rates have

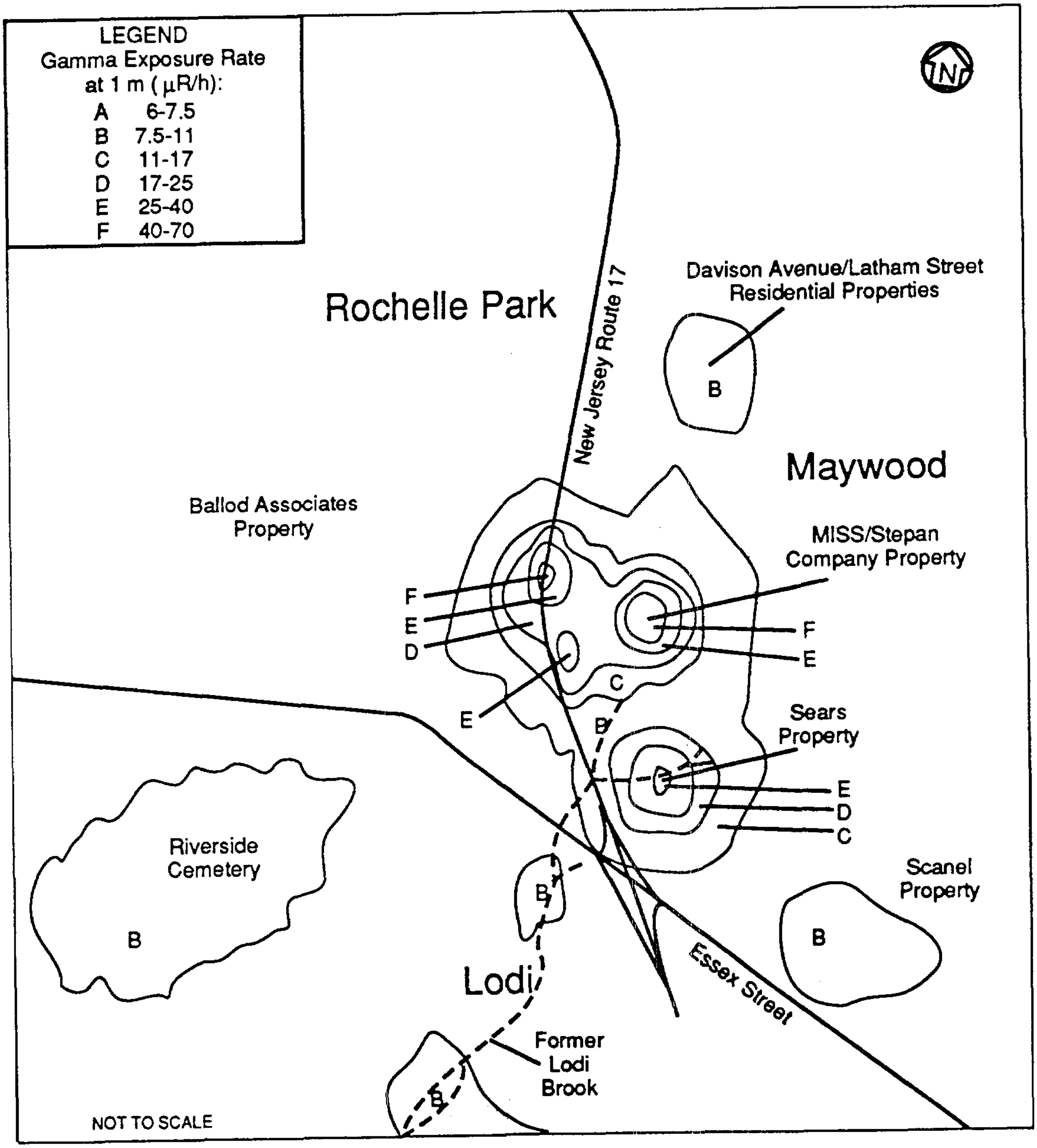


FIGURE 7 Gross Exposure Rate Isoradiation Contours (Source: Modified from EG&G 1981)

been observed directly over the Ballod Associates, Stepan Company, and Sears area properties (large central contours); over the Davison Avenue and Latham Street properties (to the north); and over the Scanel property (to the southeast). In Lodi, south of Essex street, three areas of elevated exposure rates appear in the gross exposure rate readings but do not appear when the thallium-208 emission at 2.614 MeV is isolated (thallium-208 is in the thorium-232 decay series). For the Riverside Cemetery, this is probably due to the presence of uranium in granite tombstones. For the other two areas, these readings may still be associated with contamination along the former Lodi Brook because both areas overlie sites of known contamination (EG&G 1981). Activity due to thorium-232 at 1 m (3.3 ft) above ground level ranged from 40 to 70 μR/h.

In May 1981, NRC inspectors surveyed the interiors of 13 buildings on the Stepan Company property (NRC 1981b). Building 76, which is part of MISS and adjacent to the former thorium-processing area, was the only building with radiation levels above 0.02 mR/h. Radiation readings ranged from 0.06 to 0.2 mR/h. Smear surveys showed no detectable removable contamination in any of the buildings.

Radiation levels on the lawn in the vicinity of the former thorium-processing area ranged from 0.1 to 0.5 mR/h (NRC 1981b). Thermoluminescent dosimeters were placed at various locations around the MISS from February 10 to March 24, 1981; the measured gamma exposure rates ranged from about 15 to 800 μR/h (NRC 1981b).

Nuclear Safety Associates, Inc., conducted a comprehensive survey of the Stepan property, including the MISS area, in June 1981 (Morton 1982). The survey included measurements in the buildings, on the plant grounds, on the waste burial pits, and on the field at the west end of the site. Gamma exposure rates inside Building 76 ranged from about 25 to 130 μR/h, with a geometric mean of 61 μR/h; these rates are significantly higher than the background gamma exposure rate of 6 to 7.5 μR/h in the Maywood area. Gamma levels around the periphery of Building 76 ranged from 33 to 400 μR/h and were less than 600 μR/h along the fence between Buildings 76 and 78 (Morton 1982). Elevated gamma levels were measured in the southwestern portion of the field between Route 17 and the rail spur (460 μR/h, maximum), in an area in the northwestern quadrant of MISS (250 μR/h, maximum), and along the northern fence boundary (200 μR/h).

These aboveground measurements, coupled with in situ gamma measurements and gamma spectrum analysis of soil samples, were used to identify deposits of thorium-bearing residues in the field (Morton 1982). The survey identified several settling areas with near-surface concentrations of thorium-232 ranging from less than 5 pCi/g to about 2,000 pCi/g. In other areas, thorium-232 concentrations ranged from less than 80 pCi/g to about 3,000 pCi/g. Thorium concentrations measured in the ground between Buildings 76 and 78 tended to be higher than at other locations at MISS. Thorium was processed in this area, although all the buildings except Building 76 and the pumphouse have been demolished and the area covered. Peak thorium-232 concentrations of over 6,000 pCi/g were measured within 1.2 m (4 ft) of the surface (Morton 1982).

From May through August 1986, BNI conducted radiological and limited chemical characterization studies of MISS. The results of these studies confirmed that thorium-232 is a primary radioactive contaminant at MISS, although elevated concentrations of radium-226 and uranium-238 were also detected (BNI 1987f). In the center of Building 76, a single ambient radon-222 concentration of 0.5 pCi/L was measured. This measurement did not confirm the presence of contamination under the building, but the ambient external exposure rate of 85 μR/h at 1 m (3.3 ft) is believed to result from the high concentrations of materials directly to the east of and beneath the structure (BNI 1987f).

Near-surface gamma measurements were made with a 2-in. × 2-in. sodium-iodide, thallium-activated, crystal gamma scintillation detector; the crystal is coupled to a photomultiplier tube and the signal fed to a scaler. These measurements and previous radiological data (EG&G 1981; NRC 1981a, 1981b; Morton 1982; Jones 1987) were used to determine the extent of surface contamination as well as the basis for selecting the locations of biased soil samples. Near-surface gamma measurements for MISS ranged from about 5,000 to 994,000 cpm (BNI 1987f); a measurement of 11,000 cpm is approximately equal to the DOE guideline of 5 pCi/g for thorium-232.

Biased surface soil samples were collected from the 13 locations shown in Figure 8 and analyzed for uranium-238, thorium-232, and radium-226 (BNI 1987f). The concentrations of thorium-232 and radium-226 in some samples exceeded current DOE guidelines for acceptable levels of residual contamination in soils (DOE 1990a — Chapter IV [reproduced in Appendix A]). Radium-226 concentrations ranged from 1.7 to 7.9 pCi/g whereas thorium concentrations ranged from 3.3 to 95.2 pCi/g. Maximum uranium-238 concentrations were less than 68.7 pCi/g. The DOE guidelines for acceptable uranium-238 residual contamination in soils have not yet been established for the Maywood site. They will be developed on a site-specific basis as part of the RI/FS-EIS process.

Surface sediment samples were taken from a storm drain and two manholes (Figure 8) and analyzed for radium-226, thorium-232, and uranium-238. Concentrations ranged from 0.8 to 5.4 pCi/g for radium-226 and 1.7 to 18.3 pCi/g for thorium-232 (BNI 1987f); the data for uranium-238 are not reported here because of a laboratory error. The average background concentration for both thorium-232 and radium-226 in the Maywood area is 1.0 pCi/g.

Downhole gamma logging was performed at the locations shown in Figure 9; concentrations ranged from about 2,000 to more than 4,300,000 cpm (BNI 1987f). A measurement of 40,000 cpm is approximately equal to the DOE guideline for thorium-232 of 15 pCi/g for subsurface contamination (DOE 1990a).

Subsurface soil samples were collected at the locations shown in Figure 10 and analyzed for uranium-238, thorium-232, and radium-226. Concentrations ranged from background levels to 1,699 pCi/g for thorium-232, from background levels to 447 pCi/g for radium-226, and from less than 7 to 304 pCi/g for uranium-238 (BNI 1987f).

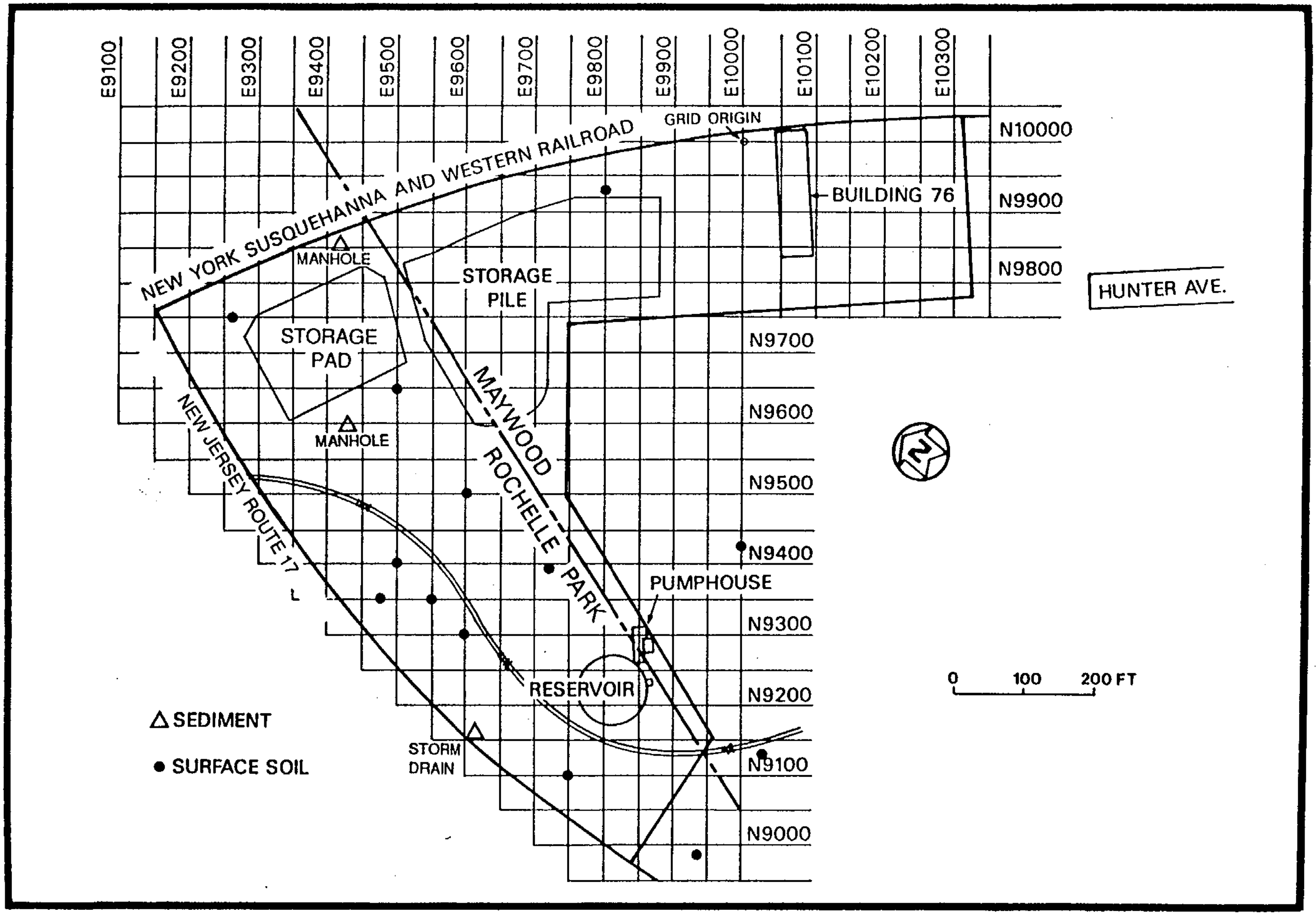


FIGURE 8 Surface Soil and Sediment Sampling Locations at the MISS

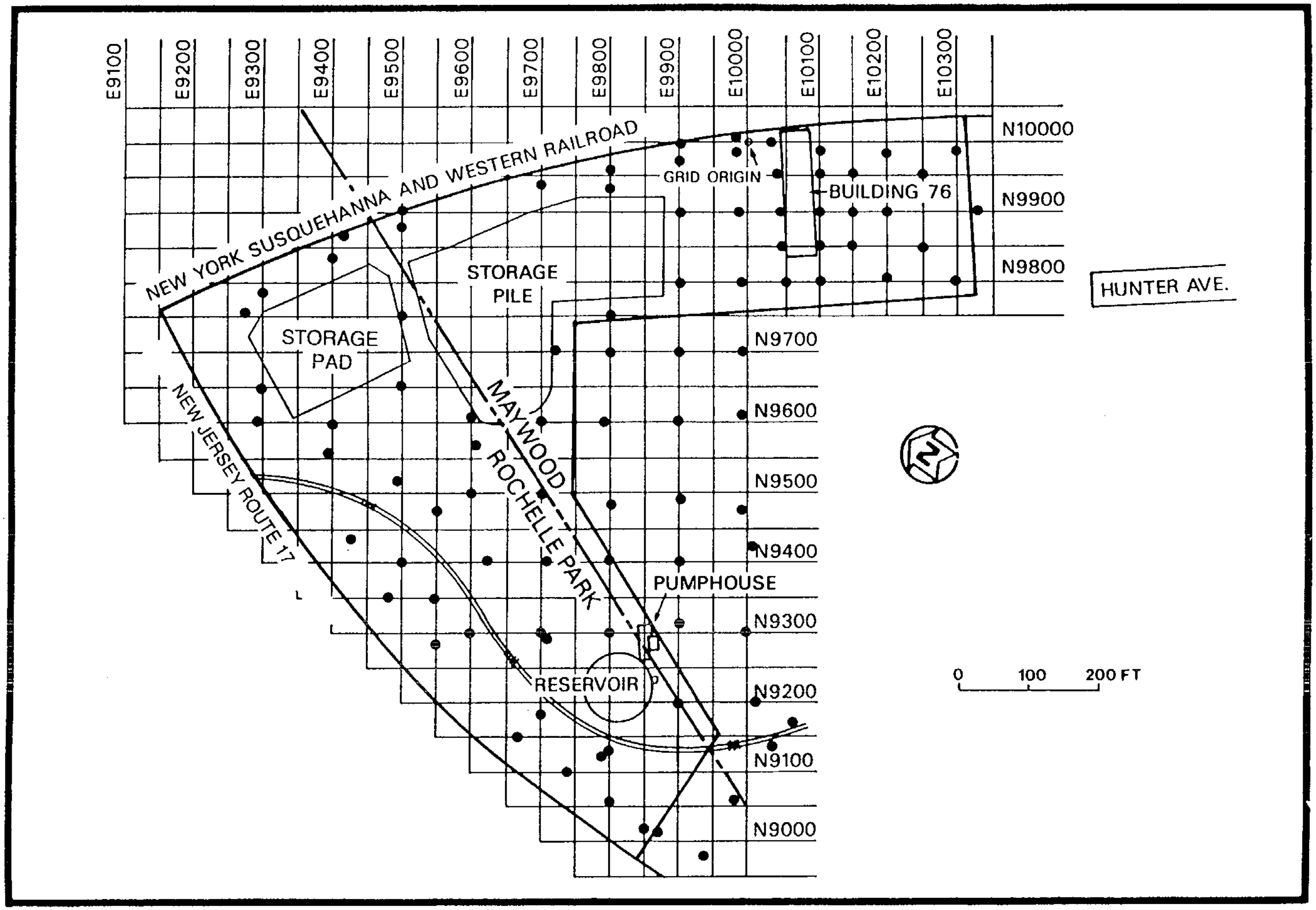


FIGURE 9 Borehole Locations at the MISS

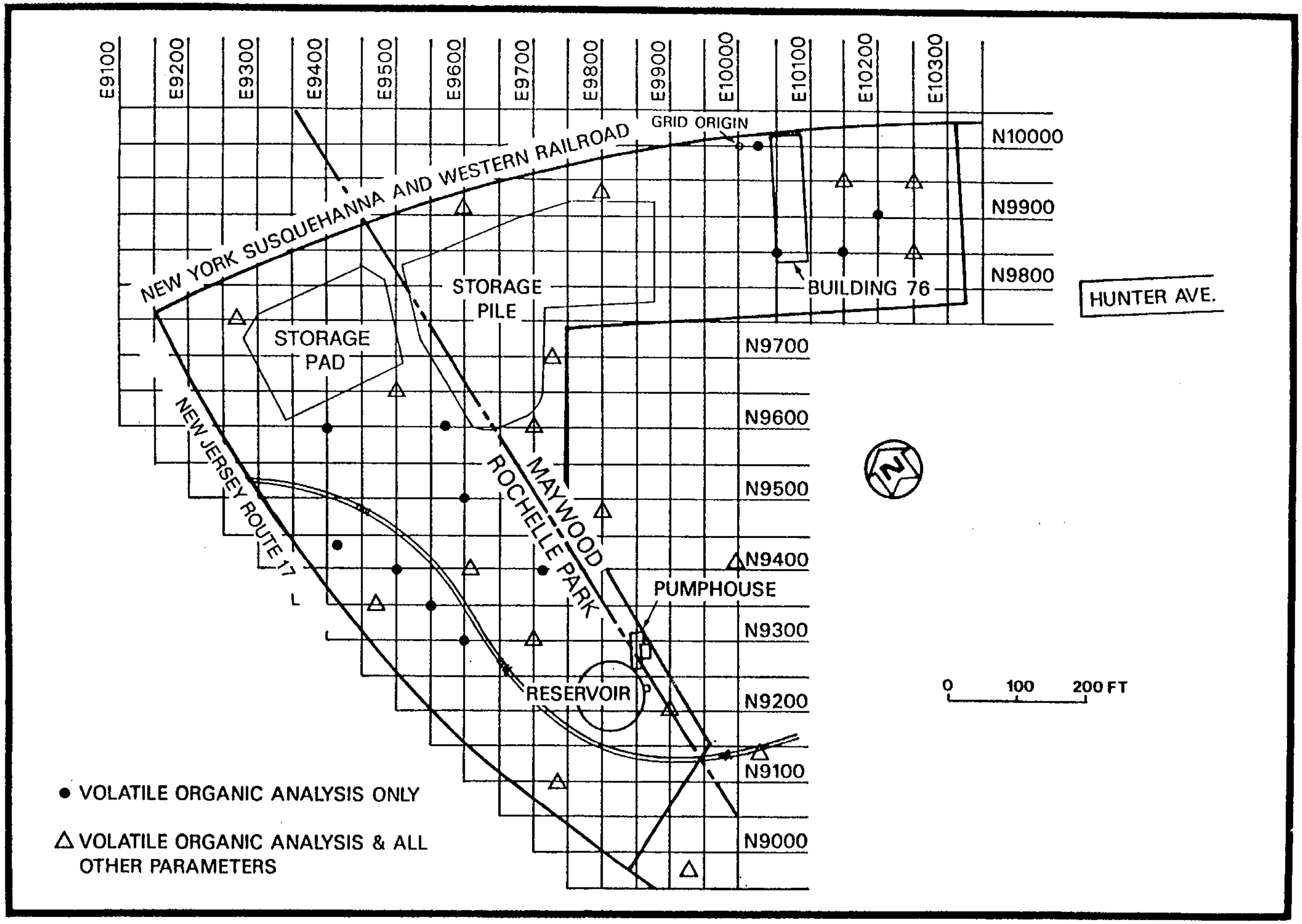


FIGURE 10 Subsurface Soil and Chemical Sampling Locations at the MISS

Results of field surveys at MISS indicate that essentially all areas of the site are contaminated with uranium-238, thorium-232, and radium-226 and that thorium-232 is the major contaminant. In many cases, surface and subsurface contamination levels exceed DOE guidelines for acceptable concentrations of thorium-232 and radium-226 in soil. Figure 11 shows the extent of surface and subsurface contamination at MISS.

Additional information about radiological and chemical conditions for MISS and its vicinity properties (including Stepan Company) is being obtained through DOE's environmental monitoring program conducted since 1984 (BNI 1985e, 1986e, 1987g, 1989zc, 1990a, 1991, 1992). This program is structured around quarterly sampling regimes.

Monitoring has included quarterly radiological sampling of the surface water drainage paths at locations 1 through 4 shown in Figure 12 (BNI 1989zc) and analysis of these samples for total uranium, radium-226 and thorium-232. The surface water sampling locations were established on the Saddle River (No. 1) and on Westerly Brook (Nos. 2, 3, and 4). Location 4 was formerly accessible by a manhole, but the manhole is now welded shut and the location is no longer sampled. Locations 5 and 6 were established on the Ballod property west of MISS; however, standing water is not always present at these locations. Surface water sampling locations were selected on the basis of migration potential and discharge routes from the site. Because surface water runoff from the site discharges underground to a storm sewer via Westerly Brook, samples are collected both upstream (location 3) and downstream (locations 1 and 2).

Annual average concentrations of total uranium, radium-226, and thorium-232 in surface water at the MISS from 1984 through 1991 are presented in Table 3. These data show that the concentrations of these radionuclides appear to have remained stable at MISS during this time. (In some cases, the concentrations reported in Table 2, and in other tables in this section, are lower than background concentrations in the Maywood area. (This is not entirely unexpected when site-specific concentrations are low because the environment is inherently inhomogeneous and the statistical fluctuations in count rates are more apparent at low levels.)

As part of the environmental monitoring program, sediment samples are also collected quarterly at the surface water sampling locations where sediment is present (see Figure 12). The results of sediment analyses for the period 1984-1991 are presented in Table 4. The measured values have been fairly consistent since 1984, although the values for total uranium appear to be increasing with time.

Groundwater monitoring has been conducted quarterly since 1985. Thirty-one on-site, upgradient and downgradient wells (Figure 13) are used to monitor the upper and lower groundwater systems for total uranium, radium-226, thorium-232, pH, total organic carbon, total organic halides, specific conductance, metals, and lithium; sampling for volatiles and semivolatiles is conducted during one quarter per year. Monitoring wells labeled MISS or B38 and ending in A or S (e.g., MISS-1A, B38W17A, and B38W15S) are shallow wells, and wells labeled MISS or B38 and ending in B or D (e.g., MISS-1B, B38W17B, and B38W15D) are deeper wells. The MISS-A wells extend approximately 0.9 to 5.2 m (3 to 17 ft) below the surface, whereas the MISS-B wells extend into the Brunswick Formation

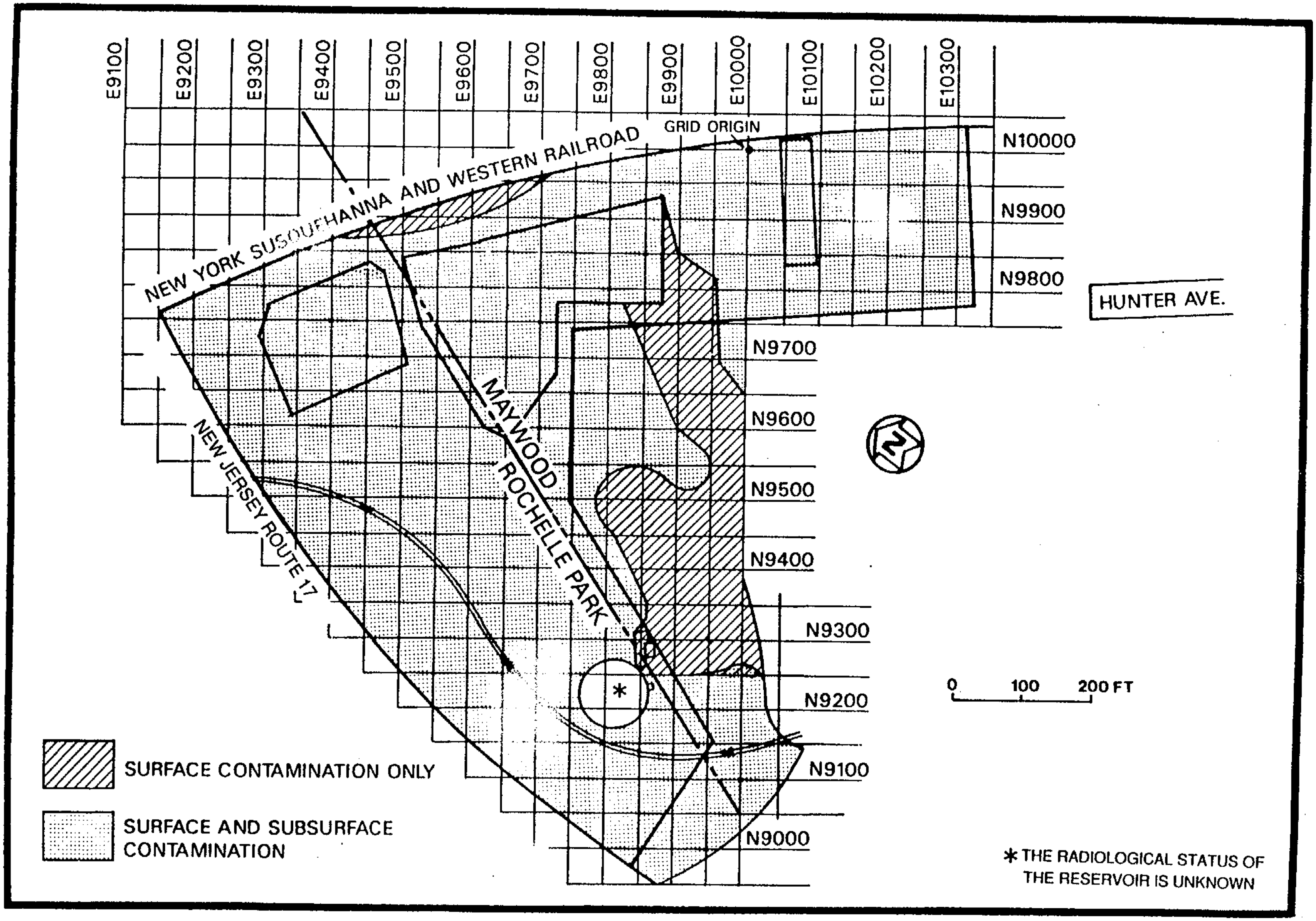


FIGURE 11 Areas of Surface and Subsurface Contamination at the MISS

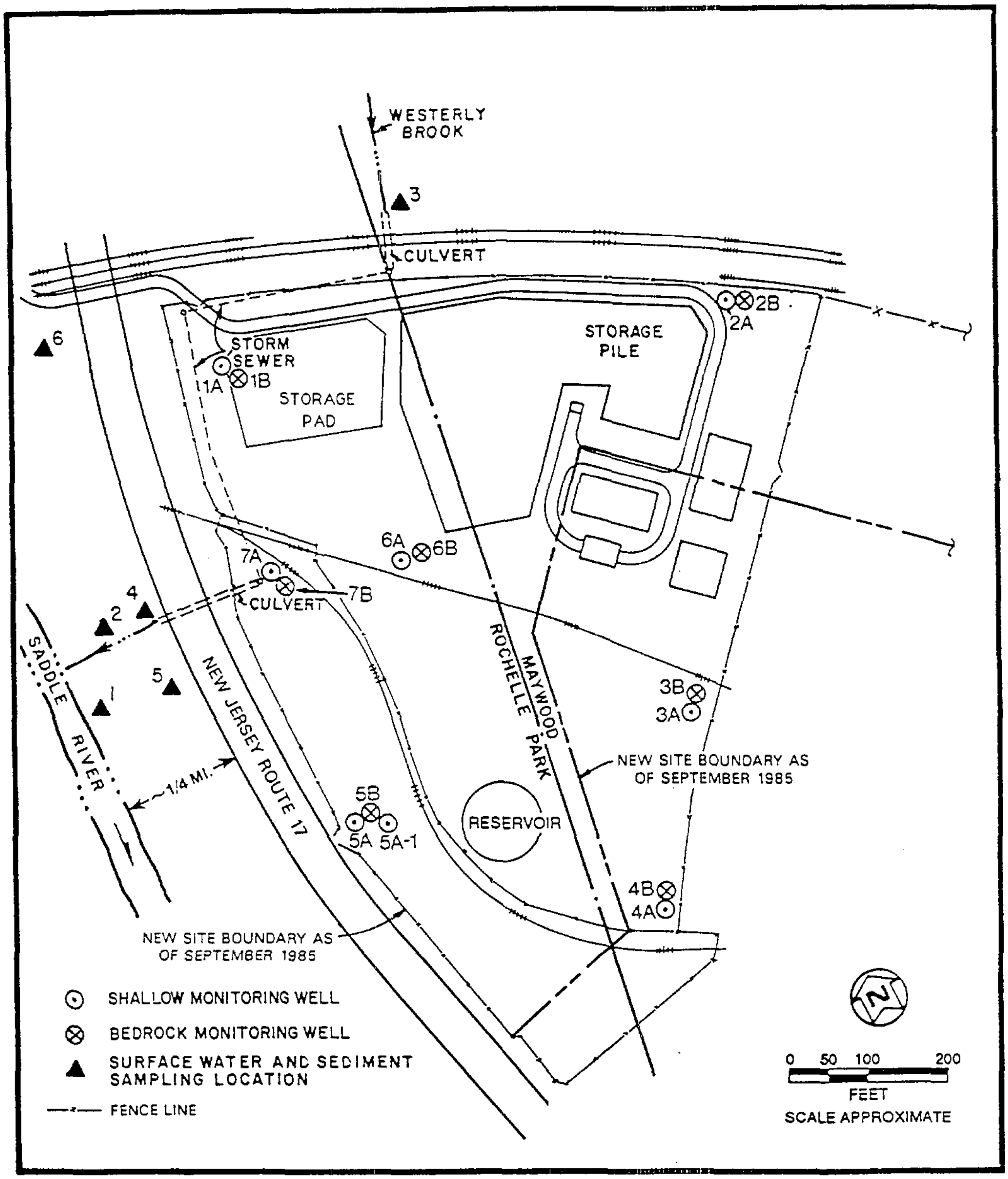


FIGURE 12 Surface Water and Sediment Sampling Locations in the Vicinity of the MISS (the numbers 1A and 1B through 7A and 7B refer to monitoring wells MISS-1A and MISS-1B through MISS-7A and MISS-7B; see Figure 13 for more details on groundwater sampling locations)

TABLE 3 Annual Average Concentrations of Total Uranium, Radium-226, and Thorium-232 in Surface Water at the MISS, 1984-1991

Radionuclide	Sampling Location[a]	Radionuclide Concentration[b] (pCi/L) 1984	1985	1986	1987	1988	1989	1990	1991
Total uranium	1	3.0	<3.0	<3.0	<3.0	3.0	<5.0	3	1.7
	2	3.0	<3.0	<3.0	<3.0	4.3	<5.0	4	1.9
	3	3.0	<3.0	<3.0	<3.0	3.8	<5.0	3	1.7
Radium-226	1	0.4	0.2	0.4	0.4	0.4	0.3	0.3	0.3
	2	0.2	0.4	0.4	0.2	0.3	0.3	0.3	0.2
	3	0.7	0.4	0.6	0.3	0.3	0.4	0.4	0.6
Thorium-232	1	0.4	0.2	<0.1	<0.1	<0.1	0.1	<0.1	0.2
	2	0.5	0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1
	3	0.4	0.1	0.1	<0.1	0.1	<0.1	<0.1	0.2

[a]Sampling locations are shown in Figure 12. Location 3 is upstream of MISS and represents background in the area. Locations 4, 5, and 6 are not reported because no data are available for these locations for 1986-1991, and only very limited data are available for prior years.

[b]Concentrations include background.

Sources: BNI (1985e, 1986e, 1987g, 1988j, 1989zc, 1990a, 1991, 1992).

TABLE 4 Annual Average Concentrations of Total Uranium, Radium-226, and Thorium-232 in Sediments at the MISS, 1984-1991

Radionuclide	Sampling Location[a]	Radionuclide Concentration[b] (pCi/L)							
		1984	1985	1986	1987	1988	1989	1990	1991
Total uranium	1	0.1	0.6	1.0	1.2	1.6	1.5	1.0	3.2
	2	0.3	0.7	1.2	1.1	1.2	0.8	1.0	1.2
	3	1.5	0.8	0.8	1.1	1.0	1.7	1.0	2.5
Radium-226	1	0.9	0.4	0.2	0.4	0.4	0.5	0.4	0.8
	2	0.5	0.4	0.3	0.3	0.5	0.4	0.5	0.7
	3	0.4	0.5	0.4	0.4	0.4	0.6	0.5	0.5
Thorium-232	1	0.5	0.3	0.7	0.4	0.4	0.3	0.5	1.4
	2	0.3	0.2	0.7	0.3	0.4	0.3	0.5	0.6
	3	0.6	0.3	0.4	0.3	0.3	0.3	0.3	0.8

[a]Sampling locations are shown in Figure 12. Location 3 is upstream of MISS and represents background in the area. Location 4 is no longer accessible. No sediment was available at locations 5 and 6.

[b]Concentrations include background.

Sources: BNI (1985e, 1986e, 1987g, 1988j, 1989zc, 1990a, 1991, 1992).

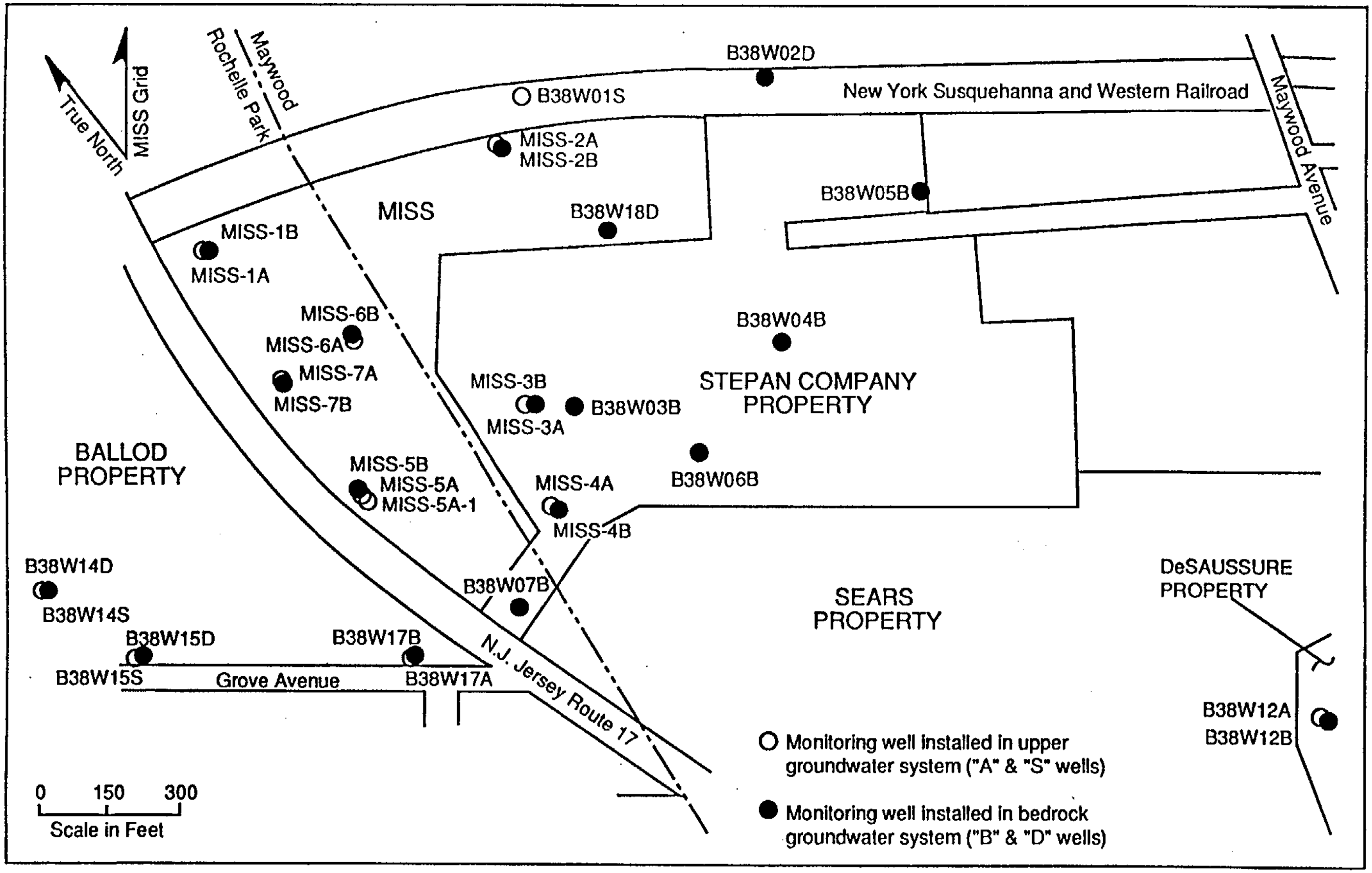


FIGURE 13 Groundwater Sampling Locations in the Vicinity of the MISS

bedrock aquifer, approximately 5.2 to 18 m (17 to 59 ft) deep. The groundwater flows from the northeast to the southwest in both layers (BNI 1989zc). Thus, wells MISS-2A and MISS-2B represent groundwater quality upgradient of MISS. Well MISS-5A-1 has been dry since installation, and wells MISS-1A and MISS-7A have been dry during most sampling periods.

All but nine of the B38 wells are of recent construction. Well characteristics and monitoring data for these wells are available in the 1989 annual site environmental report (BNI 1990a). Data from the nine older wells are not yet considered reliable enough to release because the wells were installed on Stepan Company property prior to DOE's involvement in this site, and questions remain to be resolved regarding well characteristics.

The results of groundwater analyses for 1985-1991 are presented in Table 5. Generally, the concentrations of total uranium, thorium-232, and radium-226 have been higher in the shallow wells than in the deeper wells (BNI 1989zc). Concentrations of thorium-232 and radium-226 have remained relatively stable throughout the period. Uranium concentrations, however, have been quite variable and have not exhibited a definite trend. Radium-228 to thorium-232 ratios for groundwater at MISS indicate disequilibrium; radium-228 values have ranged from about 2 to 70 times the thorium-232 values (Van Pelt 1988a, 1988b). However, the analytical procedure for radium-228 has yielded unusually high detection limits. Most reported data for radium-228 historically have been "less than" values, as have thorium-232 results. Because the detection limit for radium-228 is much higher than that for thorium-232, a conclusive statement about disequilibrium cannot be made. Given results for other media and based on processing information, it is likely that radium-228 and thorium-232 are in equilibrium.

MISS is also monitored for radon, thoron, and external gamma radiation at 12 site locations (Figure 14). Radon detectors are maintained near the storage pile and at approximately equal intervals along the site perimeter. Two forms of radon are present at the site. Radon-222, the most common form, is part of the uranium-238 decay chain; radon-220 is part of the thorium-232 decay chain. The results of radon-222 and radon-220 analyses for 1984-1991 are presented in Table 6. No statistical difference occurred in the concentrations of either radionuclide between 1987 and 1988 (BNI 1989zc); the concentrations of both, however, decreased in 1985 and increased again in 1987. The increase in radon-222 and radon-220 concentrations in 1987 is thought to be related to the drought in the Northeast during that year, which increased soil porosity and allowed more gas to be emitted (BNI 1989zc).

The concentrations observed in 1985 for both radon-222 and radon-220 were the lowest recorded at MISS and are statistically different from results for the other monitoring years (BNI 1989zc). Statistically significant differences in concentrations did not occur between the other years but did occur between monitoring locations. This difference was particularly significant for locations 5 and 10, both of which are near areas of known contamination. Disturbances of the surface soil cover near these locations in 1986 may be responsible for the observed increase in concentrations. This increase may have been somewhat mitigated by the placement of clean fill material near these locations in 1987 (BNI 1989zc).

TABLE 5 Annual Average Concentrations of Total Uranium, Radium-226, and Thorium-232 in Groundwater at the MISS, 1985-1991

Sampling Location[a]	Total Uranium (pCi/L)						
	1985	1986	1987	1988	1989	1990	1991
MISS-1A	27.0	[b]	-	-	-	-	-
MISS-1B	<3.0	1.6	3.3	2.4	2.2	3.0	2.9
MISS-2A	3.0	0.6	2.4	1.4	2.1	3.0	2.9
MISS-2B	12.0	0.5	2.1	0.8	1.0	3.0	2.7
MISS-3A	<3.0	0.6	2.0	1.5	1.2	3.0	1.2
MISS-3B	<3.0	0.3	3.3	1.3	0.8	2.0	2.0
MISS-4A	<3.0	-	-	3.9	5.5	3.0	-
MISS-4B	<3.0	0.5	2.0	0.7	1.0	3.0	2.6
MISS-5A	63.0	100.0	98.8	-	-	-	-
MISS-5A-1	-	-	-	-	-	-	-
MISS-5B	<3.0	0.3	1.5	0.7	1.5	3.0	3.4
MISS-6A	9.0	8.4	12.1	8.4	8.0	6.0	2.3
MISS-6B	5.0	0.8	2.2	1.1	1.2	3.0	3.5
MISS-7A	-	-	15.9	-	-	-	-
MISS-7B	12.0	4.7	5.0	6.3	7.0	4.0	4.5
B38W01S[c]	NA	NA	NA	NA	2.0	3.0	1.6
B38W02D	NA	NA	NA	NA	2.2	3.0	1.2
B38W04B	NA	NA	NA	0.8	0.9	3.0	1.7
B38W14S	NA	NA	NA	NA	3.2	3.0	4.3
B38W14D	NA	NA	NA	NA	4.1	3.0	4.0
B38W15S	NA	NA	NA	NA	2.6	3.0	2.9
B38W15D	NA	NA	NA	NA	4.8	4.0	5.3
B38W18D	NA	NA	NA	NA	4.8	3.0	7.4

Sampling Location[a]	Radium-226 (pCi/L)						
	1985	1986	1987	1988	1989	1990	1991
MISS-1A	0.1	-	-	-	-	-	-
MISS-1B	0.6	0.6	0.4	0.9	1.4	0.7	0.3
MISS-2A	0.4	0.5	0.4	1.0	1.3	0.9	0.8
MISS-2B	0.3	1.5	0.4	0.7	1.0	0.6	0.3
MISS-3A	0.4	0.6	0.6	1.2	1.6	1.0	1.9
MISS-3B	0.3	0.5	0.3	0.8	1.0	0.5	0.4
MISS-4A	0.4	-	-	2.8	3.8	2.0	-
MISS-4B	0.3	0.4	0.5	1.4	1.3	0.7	0.4
MISS-5A	0.2	0.6	0.8	-	-	-	-
MISS-5A-1	-	-	-	-	-	-	-
MISS-5B	0.3	0.2	0.3	0.7	1.0	0.6	0.2
MISS-6A	0.2	0.4	0.5	2.0	1.3	0.8	1.0
MISS-6B	0.4	0.5	0.3	0.7	0.9	0.5	0.7
MISS-7A	-	-	0.1	-	-	-	-
MISS-7B	0.3	0.4	0.3	1.5	0.8	0.5	0.2
B38W01S[c]	NA	NA	NA	NA	1.1	0.7	1.0
B38W02D	NA	NA	NA	NA	0.9	1.0	1.2
B38W04B	NA	NA	NA	1.0	1.2	0.4	0.6
B38W14S	NA	NA	NA	NA	1.0	0.5	1.1
B38W14D	NA	NA	NA	NA	1.0	0.5	0.2
B38W15S	NA	NA	NA	NA	1.2	0.8	0.2
B38W15D	NA	NA	NA	NA	0.7	0.5	0.3
B38W18D	NA	NA	NA	NA	0.7	0.5	1.4

TABLE 5 (continued)

Sampling Location[a]	Thorium-232 (pCi/L)						
	1985	1986	1987	1988	1989		
MISS-1A	0.1	-	-	-	-	-	-
MISS-1B	<0.1	<0.2	<0.3	<0.3	<0.3	0.3	0.1
MISS-2A	0.3	<0.2	<0.1	0.4	0.5	0.3	0.2
MISS-2B	<0.2	<0.2	<0.1	<0.3	0.3	0.2	0.1
MISS-3A	<0.1	<0.2	<0.1	0.7	0.5	0.3	0.6
MISS-3B	<0.2	<0.1	<0.2	<0.3	<0.2	0.1	0.2
MISS-4A	<0.1	-	-	1.6	3.4	2.0	-
MISS-4B	<0.1	<0.1	<0.1	<0.2	<0.2	0.2	0.1
MISS-5A	<0.1	0.3	0.3	-	-	-	-
MISS-5A-1	-	-	-	-	-	-	-
MISS-5B	<0.2	<0.1	<0.1	<0.2	<0.3	0.1	0.1
MISS-6A	<0.2	0.1	0.3	<0.2	0.5	0.4	0.5
MISS-6B	<0.3	<0.2	<0.1	0.3	<0.2	0.1	0.6
MISS-7A	-	-	<0.1	-	-	-	-
MISS-7B	<0.2	<0.2	<0.1	<0.3	<0.2	0.2	0.1
B38W01S	NA[c]	NA	NA	NA	0.2	0.2	0.2
B38W02D	NA	NA	NA	NA	0.3	0.3	0.2
B38W04B	NA	NA	NA	<0.2	<0.2	0.1	0.1
B38W14S	NA	NA	NA	NA	0.4	0.2	0.7
B38W14D	NA	NA	NA	NA	0.3	0.2	0.1
B38W15S	NA	NA	NA	NA	0.5	0.2	0.2
B38W15D	NA	NA	NA	NA	<0.2	0.1	0.1
B38W18D	NA	NA	NA	NA	0.3	0.1	1.2

TABLE 5 (continued)

[a]Sampling locations are shown in Figure 13. Background wells: MISS-2A and MISS-2B (operational 1985; B38W04B (operational 1988); B38W01S and B38W02D (operational 1989). New monitoring wells: B38W14S, B38W14D, B38W15S, B38W15D, and B38W18D (operational 1989).

[b]A hyphen indicates that no measurement was made because the well is a shallow well used to monitor groundwater in unconsolidated material and, therefore, occasionally does not contain water.

[c]NA = no data available because the well was not operational at this time.

Sources: BNI (1985e, 1986e, 1987g, 1988j, 1989zc, 1990a, 1991, 1992).

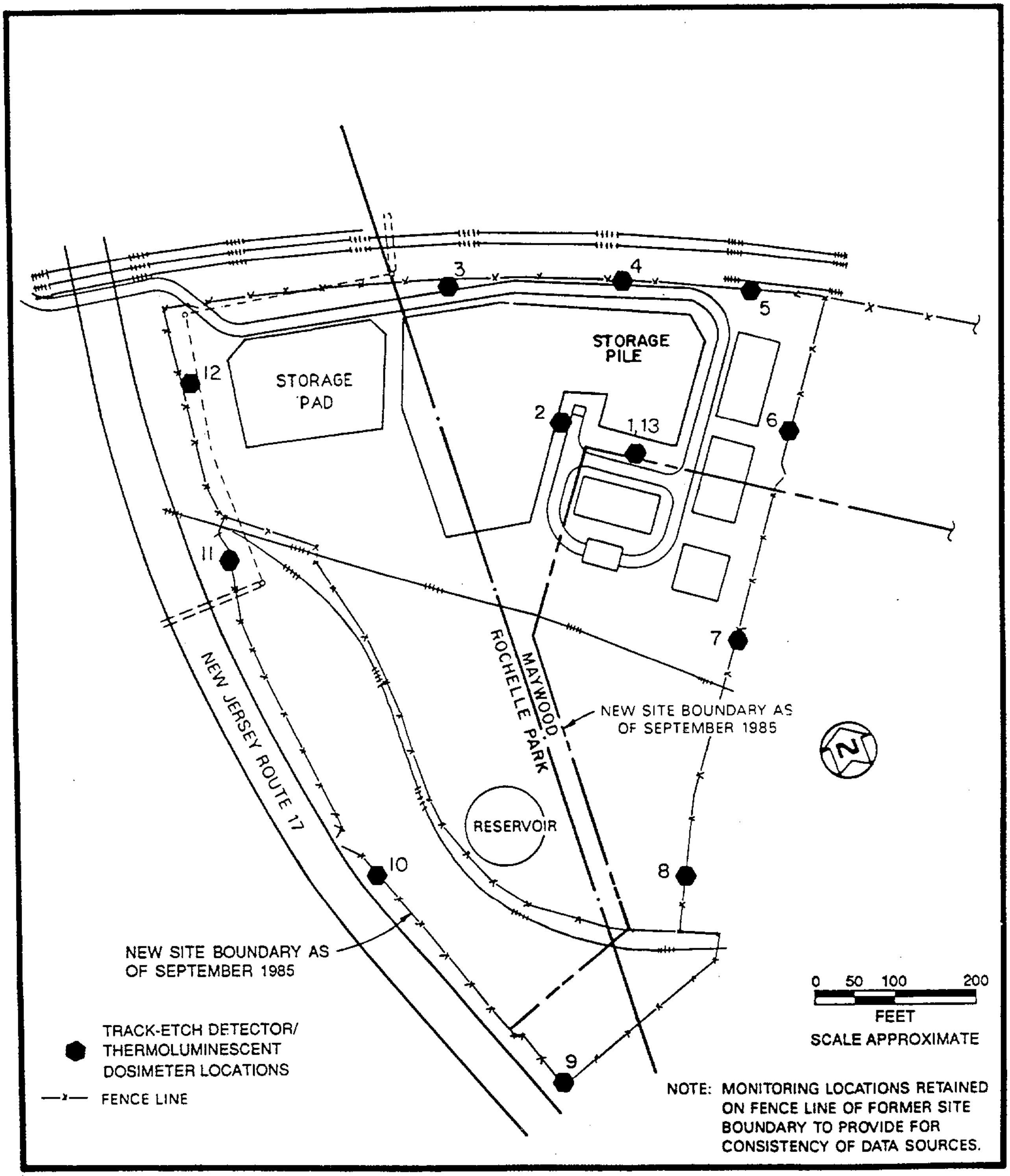


FIGURE 14 Radon and External Gamma Radiation Monitoring Locations at the MISS

TABLE 6 Annual Average Concentrations of Radon-220 and Radon-222 at the MISS, 1984-1991

Sampling Location[a]	Radon-220[b] (pCi/L)								Radon-222[b] (pCi/L)							
	1984	1985	1986	1987	1988	1989	1990	1991	1984	1985	1986	1987	1988	1989	1990	1991
1	8.1	0.5	<MDL	0.2	0.4	0.5	-[c]	1.1	0.9	0.3	0.6	0.7	0.6	0.4	0.3	0.5
2	2.1	0.6	<MDL	0.3	0.5	0.5	-	0.9	0.8	0.2	1.2	1.2	0.9	0.4	0.5	0.6
3	2.1	0.3	0.1	0.4	0.2	0.4	-	0.4	0.9	0.3	1.2	1.5	0.6	0.4	0.4	0.5
4	1.4	0.5	<MDL	<MDL	1.4	0.4	-	1.3	0.8	0.4	1.6	1.1	1.9	0.9	0.6	0.4
5	9.9	3.2	9.2	9.2	6.4	7.3	-	19.4	1.3	0.5	9.9	9.7	7.4	1.0	2.0	0.8
6	1.1	1.0	0.6	1.3	1.0	0.7	-	1.6	1.2	0.2	1.9	2.4	1.4	0.6	0.4	0.5
7	0.2	0.3	<MDL	0.5	0.3	0.6	-	0.5	0.9	0.2	0.9	1.1	0.8	0.6	0.4	0.6
8	0.6	0.02	0.07	0.4	0.1	0.3	-	0.1	0.6	0.3	0.8	1.0	0.4	0.4	0.3	0.6
9	<MDL	0.2	<MDL	0.1	0.2	0.1	-	0.4	1.0	0.2	0.9	1.1	0.5	0.5	0.3	0.6
10	2.1	2.7	6.0	4.0	0.5	0.4	-	1.7	0.8	0.4	6.5	4.9	1.0	0.6	0.4	0.6
11	<MDL	0.2	0.04	0.1	0.4	0.2	-	0.9	2.7	0.2	1.3	0.8	0.8	0.5	0.3	1.2
12	1.4	1.2	1.7	1.7	0.6	0.3	-	1.5	1.4	0.2	2.6	2.3	1.1	0.8	0.3	0.7
13[d]	1.2	2.9	0.6	0.2	0.1	0.1	-	0.7	0.7	0.3	1.2	1.1	0.4	0.5	0.5	0.6
14[e]	<MDL	0.1	0.4	0.3	<MDL	<0.1	-	0	1.3	0.4	1.0	0.8	0.3	0.5	0.3	0.4
18	NA	NA	NA	NA	NA	0.1	-	0.1	NA	NA	NA	NA	NA	0.4	0.4	0.5
19	NA	NA	NA	NA	NA	<0.1	-	0.1	NA	NA	NA	NA	NA	0.4	0.5	0.6

[a]Sampling locations are shown in Figure 14.

[b]All results include background; MDL = minimum detection limit; NA = no data available because wells not established until 1989.

[c]Due to thoron detector quality control and supply problems, thoron values for 1990 were not obtained.

[d]Location 13 is a quality control for Location 1.

[e]Location 14 is a background detector located at the New Jersey Department of Health, Paterson, about 22 km (14 mi) west of the MISS. Additional background detectors were established in Rochelle Park during January 1989 at the fire station (location 18) and the post office (location 19), both of which are about 0.8 km (0.5 mi) south of the MISS.

Sources: BNI (1985e, 1986e, 1987g, 1988j, 1989zc, 1990a, 1991, 1992).

138_0048 (09/09/92)

Background concentrations measured at sampling location 14 sometimes exceed concentrations measured at MISS. This may be due to normal variations at low environmental levels. However, locations 1 and 13 are duplicates and also show variations, sometimes quite disparate. This may be related to the inherent statistical nature of the alpha-track monitors, for which it is assumed that alpha decays are recorded randomly, but fairly uniformly, over the detector surface; at low concentrations, this may not be true.

External gamma radiation levels were measured at 12 locations corresponding to the radon monitoring locations shown in Figure 14. Each monitoring station contains a minimum of four dosimeters, which are replaced after 1 year of accumulated exposure. The results of external gamma radiation measurements for 1984 through 1991 are presented in Table 7.

Stepan Company Property. Several of the early radiological surveys covered not only the area currently designated as MISS but also the Stepan Company property. Surveys that included the Stepan Company property were conducted by EG&G (1981), the NRC (1981a, 1981b), and Nuclear Safety Associates (Morton 1982).

An aerial survey by EG&G (1981) showed the areas of highest radiation levels directly over the Stepan Company facility, with gamma exposure rates ranging from 40 to 70 μR/h at 1 m (3.3 ft) aboveground. Gamma exposure rates were also measured by the NRC. Thermoluminescent dosimeters were placed at various locations around the perimeter of the Stepan Company facility from February 10 to March 24, 1981; the measured gamma exposure rates ranged from about 10 to 84 μR/h (NRC 1981b).

Water samples were collected by the NRC from two private wells in the immediate vicinity of the Stepan Company facility, from municipal water at the facility, and from Westerly Brook downstream of the facility. No radioactivity above background levels was detected in any of these samples (NRC 1981a).

The NRC also conducted radiological surveys of buildings on the Stepan Company property. Surface wipes were taken from 15 locations throughout a warehouse (Building 3) that was built above Burial Site No. 3 (NRC 1981a). These samples were analyzed for removable surface alpha activity, and no contamination was detected above the minimum detectable alpha activity of 1 pCi/100 cm^2. In addition, the survey failed to detect any gamma exposure rates above the background level of about 0.006 to 0.025 mrem/h (NRC 1981a). Air particulate samples collected in the building had no activity other than that due to the decay products of naturally occurring radon-222 (NRC 1981a). Surveys were also conducted on the interiors of 13 buildings. Only Building 76, currently designated as part of MISS, had radiation levels greater than 0.2 mR/h. Furthermore, smear surveys showed no detectable removable alpha contamination in any of the buildings (NRC 1981b).

Surface samples were collected from 12 buildings on the Stepan Company property by Nuclear Safety Associates and analyzed for alpha activity. Only 3 of 44 samples exhibited any detectable alpha activity, and none of these exceeded 1 dpm/100 cm^2 (Morton 1982).

TABLE 7 Annual Average External Gamma Radiation Levels at the MISS, 1984-1991

Sampling Location[a]	Radiation Level[b] (mR/yr) 1984	1985	1986	1987	1988	1989	1990	1991
Boundary								
3	196	27	38	29	21	29	16	21
4	182	130	91	69	109	112	80	93
5	368	272	172	121	186	154	139	121
6	287	106	83	67	85	68	54	38
7	147	15	24	36	16	13	9	6
8	148	15	18	37	30	9	10	10
9	176	38	23	39	32	17	9	12
10[c]	759	627	496	521	317	173	150	153
11	90	57	50	61	59	35	31	31
12	208	180	88	79	106	90	82	73
On-site								
1	91	48	41	36	40	28	24	25
2	89	50	51	43	52	35	30	26
13[d]	80	46	35	33	39	27	21	25
Off-site[e]								
14	NA	108	63	58	78	63	63	60
18	NA	NA	NA	NA	NA	64	64	59
19	NA	NA	NA	NA	NA	56	78	62

[a]Sampling locations are shown in Figure 14.
[b]Measured background has been subtracted at on-site and boundary locations.
[c]Location 10 is an area of known contamination (Morton 1982).
[d]Location 13 is a quality control for Location 1.
[e]NA = no data available because the wells were not yet operational. Location 14 is a background detector established in September 1984 at the New Jersey Department of Health, Paterson, about 22 km (14 mi) west of the MISS; no measurement was taken in 1984. Additional background detectors were established in Rochelle Park during April 1988 at the fire station (location 18) and the post office (location 19), both of which are about 0.8 km (0.5 mi) south of the MISS.

Sources: BNI (1985e, 1986e, 1987g, 1988j, 1989zc, 1990a, 1991, 1992).

Because the NRC-recommended limit for equipment released to the public at that time was 100 dpm/100 cm^2, it was concluded that none of the surface samples exhibited any significant alpha activity (Morton 1982).

Gamma exposure rates measured in the buildings surveyed by Nuclear Safety Associates (excluding Building 76) were within the expected range for background exposure rates. The geometric mean of the measurements was 7.4 μR/h, about the same as the background radiation exposure rate in the Maywood area (Morton 1982). Gamma radiation measurements around the buildings in the production area averaged 7.8 μR/h, slightly above background levels (Morton 1982). However, gamma exposure rates measured in the parking lot and lawn above Burial Sites Nos. 1 and 2 (used for thorium residues) averaged 11 and 18 μR/h, respectively. A small area near the electrical metering building in the southwestern quadrant of the plant exhibited somewhat elevated gamma radiation levels, apparently associated with a small, shallow deposit of residue (Morton 1982).

On the basis of gamma radiation levels measured in buildings and on the Stepan Company grounds, Morton (1982) concluded that it was very unlikely that any Stepan employee working at the plant would receive a dose greater than the DOE guideline for the general public, which was 500 mrem/yr at that time.

Commercial and Governmental Vicinity Properties. Surveys conducted by NJDEP (1980a, 1980b) and the NRC (1981a) in 1980 and 1981 established thorium-232 and radium-226 soil contamination on the Ballod property west of the current MISS across New Jersey Route 17. An aerial survey commissioned by the NRC (EG&G 1981) confirmed the Ballod property contamination and showed additional nonresidential areas of contamination to the southeast. Subsequent walkover surveys have identified commercial and governmental properties as being radioactively contaminated (Table 1). With the exception of the Ballod property, the contamination on these properties appears to have originated from two principal mechanisms: (1) deposition of sediment carried from the former Maywood Chemical Works by Lodi Brook and/or (2) use of contaminated material for fill. In the case of the Ballod property, the contamination probably resulted from the process waste ponds that were located there.

To date, 23 commercial and governmental properties have been characterized. A removal action has been conducted on only one small section of the Ballod property. Of those vicinity properties that have been characterized, the soil contamination levels of thorium-232 have been measured as high as 3,975 pCi/g on the Ballod property (subsequently removed) (NRC 1981b) and 180 pCi/g on the remaining properties (BNI 1987a). Radium-226 concentrations in soil were as high as 37 pCi/g off the Ballod property (BNI 1987a). Of the uranium-238 data available, a concentration of 80.2 pCi/g was measured in the drainage ditch running adjacent to the DeSaussure property (BNI 1989w). Radium-228 levels reached 390 pCi/g on the Scanel property (NUS Corporation 1983).

Including background, outdoor gamma exposure rate measurements ranged to 146 μR/h (BNI 1989w), whereas indoor measurements reached 13 μR/h (BNI 1989g, 1989w). The 5-year average background exposure rate for the area was 8 μR/h (BNI 1990a).

Indoor radon-222 and radon-220 levels were measured in buildings on the commercial and governmental vicinity properties. The highest radon-222 measurement was 2.2 pCi/L (BNI 1987a), the highest radon-222 decay product level was 0.005 working level (WL) (BNI 1989q), and the highest radon-220 decay product level was 0.003 WL (BNI 1987e, 1989q). EPA has set an indoor remedial action level of 4 pCi/L (annual average) for radon-222 (EPA 1986), whereas DOE has set an indoor remedial action level of 0.02 WL (DOE 1990a). These levels are equivalent at 50 percent equilibrium with radon-222 decay products. The corresponding radon-220 remedial action level would be 0.06 WL. When a hole was cut through the floor of the Sears warehouse, the subfloor radon-222 concentration 72 hours after drilling was 300 pCi/L (BNI 1987a). No background concentration of radon-222 in soil was measured, but a level of 300 pCi/L would not be uncommon in typical soils.

Residential Vicinity Properties. Of the 55 residential properties designated or considered for designation by DOE for remediation, 25 have been fully decontaminated and 30 have been characterized but not yet decontaminated. Nine of the decontaminated properties are in Rochelle Park, eight in Lodi, and eight in Maywood. All of the properties that have been characterized but not yet decontaminated are in Maywood and Lodi. The principal mechanism of contamination for these properties was either use of contaminated fill or deposition of sediment in discharges from the Maywood Chemical Works that emptied into the former Lodi Brook.

For the characterized but not yet decontaminated properties, the peak surface concentrations were 58.3 pCi/g for thorium-232 (BNI 1989d), 11.8 pCi/g for radium-226 (BNI 1989o), and 26.7 pCi/g for uranium-238 (BNI 1988e). For subsurface soils on the same properties, the peak concentrations were 59.2 pCi/g for thorium-232 (BNI 1989o), 5.6 pCi/g for radium-226 (BNI 1989e), and 37.4 pCi/g for uranium-238 (BNI 1989f). Contamination was detected as deep as 2.9 m (9.5 ft) (BNI 1989e).

Exposure rates were measured as high as 79 μR/h outdoors (BNI 1989y) and 15 μR/h indoors (BNI 1989m). Indoor radon-222 levels were measured as high as 4.0 pCi/L (BNI 1989*l*) and 0.008 WL (not a data pair) (BNI 1989x); indoor radon-220 levels were measured as high as 0.004 WL (BNI 1989*l*, 1989x).

2.4.3 Nonradiological Conditions

Chemical sampling data at the Maywood site to date were acquired primarily to meet one or a combination of the following objectives: (1) determine whether any of the known radioactively contaminated materials on-site exhibit characteristics that may also classify the materials as hazardous waste (i.e., solid material possessing hazardous characteristics as defined by the Resource Conservation and Recovery Act [RCRA]), (2) design a health and safety plan for implementation during remedial action activities (BNI 1987f), and (3) meet New Jersey Pollutant Discharge Elimination System (NJPDES) permit requirements for groundwater quality.

Soil, air, and groundwater samples were collected from MISS; soil or sludge samples were also collected from several major commercial properties (i.e., Hunter-Douglas, Sears, Scanel, and the Sunoco station). With the exception of some sludge samples taken from the contents of buried drums or containers discovered on the Sears property (BNI 1987a) (Figure 15), analysis of the majority of the samples indicates the presence of a variety of chemical constituents at low levels (levels slightly above the respective detection limits) and, in most cases, at trace levels (levels below method detection limits but above instrument detection limits). The sludge samples yielded significant amounts of several VOCs typically found in industrial solvents (benzene, toluene, and xylene) or octane-boosting agents related to gasoline contamination. No pesticides or polychlorinated biphenyls (PCBs) were detected in the samples, nor did the soil or sludge samples exhibit RCRA waste characteristics. The significance and impact of these findings cannot be adequately determined until a full chemical characterization is performed for the site to fill in data gaps. Currently available chemical data are summarized in the following subsections; they were compiled from various BNI reports (BNI 1986a, 1987a, 1987b, 1987f).

Maywood Interim Storage Site. MISS has been associated with various chemical plant activities since 1895 (Jones 1987). As a result, chemical contaminants are suspected on the site. For chemical characterization, soil samples were collected from the same 29 boreholes as the radiological subsurface soil samples (Figure 10). These samples were analyzed for VOCs, semivolatile organic compounds, metals, pesticides, and PCBs. Maximum concentrations detected were 88 ppb for methylene chloride, 11 ppb for acetone, less than 5 ppb for benzene, and less than 13 ppb for toluene. Methylene chloride was detected in most of the VOC samples; however, it is believed that the methylene chloride and acetone may have resulted from contamination during the sampling and subsequent laboratory analysis (BNI 1987f). Additional sampling and analysis will be conducted to verify these findings.

Analysis for base-neutral-acid extractables was performed on soil samples to determine the extent of semivolatile organic contamination (BNI 1987f). Although several semivolatiles were identified in the samples, the concentrations were lower than the detection limits specified by the laboratory method used for the analysis. The maximum concentrations approximated for some semivolatile compounds seem to cluster around an area east of Building 76 (Table 8) where radioactive contamination was also found. The analysis for PCBs in these soils yielded negative results.

The results of the metals analysis in soil are presented in Table 9, along with background soil concentrations. The following metals exceeded the range for background concentrations in soils: antimony, arsenic, cadmium, chromium, copper, lead, mercury,

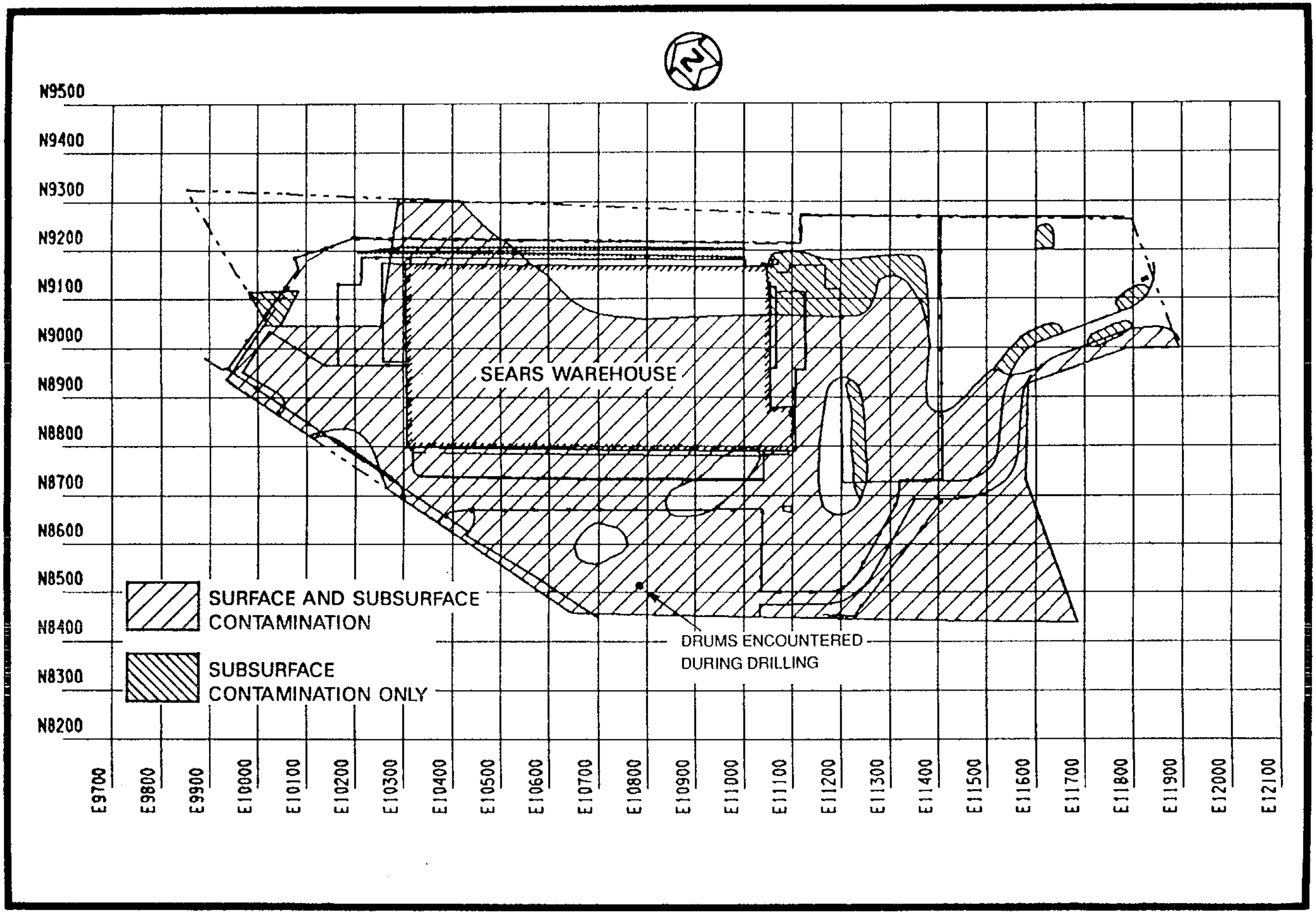


FIGURE 15 Locations of Contaminated Areas and Buried Drums at the Sears Property

TABLE 8 Concentrations of Contaminants in Soil Samples Apparently Forming a Cluster of Chemical Contamination at the MISS

Contaminant	Concentration (μg/kg) at Sampling Location[a]		
	N9950, E10150	N9950, E10250	N10000, E10030
Napthalene	-	-	7
Acenaphthalene	-	-	10
Acenaphthene	-	7	6
Dibenzofuran	-	7	5
Fluorene	-	-	8
Phenanthrene	21	8	180
Dibutyl phthalate	-	25	6
Fluoranthene	32	160	340
Pyrene	37	200	230
Butylbenzyl phthalate	-	14	300
Benz(a)anthracene	18	87	150
bis(2-Ethylhexyl)phthalate	-	15	7
Chrysene	18	76	120
Benzo(b)fluoranthene	27	110	-
Benzo(k)fluoranthene	28	-	150
Benzo(a)pyrene	16	70	110
Indeno(1,2,3-ncd)pyrene	13	50	73
Dibenz(a,h)anthracene	5	18	34
Benzo(g,h,i)perylene	10	41	85

[a]Except for fluorene, the values presented in this table are below the specified detection limits for the respective contaminant but represent the analytical laboratory's closest approximation of the value. A hyphen means no data reported.

Source: Data from BNI (1987f).

TABLE 9 Concentrations of Metals in Soils at the MISS

Metal	Concentration Range in Soil (ppm)	EP Toxicity[a] Test Concentration (ppm)	EP Toxicity[a] EPA Limit (ppm)	Background Concentration (ppm) Mean	Background Concentration (ppm) Range
Antimony	<1 - 44	NA[b]	NA	NA	2 - 10
Arsenic	1.9 - 51	0.07	5	2	1 - 50
Barium	5 - 105	0.0171	100	500	100 - 3,000
Beryllium	<0.06 - 3	NA	NA	6	0.1 - 40
Cadmium	<0.4 - 20	<0.02	1	0.06	0.01 - 0.7
Chromium	5 - 3,920	<0.002	5	100	5 - 3,000
Copper	<1 - 167	NA	NA	20	2 - 100
Lead	<1 - 790	0.112	5	10	2 - 200
Mercury	<0.03 - 93	<0.001	0.2	0.03	0.01 - 3
Nickel	5 - <73	NA	NA	40	10 - 1,000
Selenium	<0.14 - 3	<0.003	1	?	0.01 - 2
Silver	<0.2 - <18	<0.02	5	0.1	0.01 - 5
Thallium	<5 - 744	NA	NA	0.1	NA
Zinc	16 - 304	NA	NA	50	10 - 300

[a]The EP toxicity test is an EPA-specified procedure formerly used to test the potential for RCRA-designated contaminants to be leached from waste materials.

[b]NA = no data available.

Sources: Background concentrations, Braunstein (1981); other data, BNI (1987f).

selenium, thallium, and zinc. However, it was determined that the soil samples did not exhibit hazardous waste characteristics as defined by RCRA (i.e., EP toxicity,[1] ignitability, reactivity, and corrosivity).

Concentrations of VOCs in air were monitored at two locations: borehole N9295,E9705 and the sump area; the results are presented in Table 10. The data indicate the presence of several VOCs (BNI 1987f). A complete chemical characterization of soil and groundwater will be carried out as part of the RI/FS-EIS process to further determine the significance of these findings and to allow for the estimation of potential air emissions. In addition, the health and safety program includes routine monitoring for organic vapors at each sampling location. Particulates are monitored as necessary.

Groundwater samples have been collected annually since 1985 from a group of wells at MISS (see Figure 13). The groundwater quality under MISS was monitored, and the analyses included the parameters in the New Jersey list of priority pollutants (BNI 1986e) as well as pH, total organic carbon, total organic halides, and specific conductance. The results indicate the presence of low levels of a few VOCs (methylene chloride, acetone, and benzene) as well as low levels of bis(2-ethylhexyl) phthalate, a semivolatile organic compound. Benzene was detected consistently at well 2B, which is upgradient of groundwater flow at MISS. Although the presence of these contaminants would not be expected in pristine groundwater, their occurrence at low levels is not unusual in groundwater underlying areas with a long history of industrial use. Comparisons of the concentrations detected with maximum contaminant levels promulgated under the Safe Drinking Water Act indicates, however, that water beneath MISS would require treatment before it could be used as a public drinking water supply (BNI 1989zc).

Organic contaminants were detected in soil samples collected at several other MISS locations as well (BNI 1987f). Benzyl alcohol (39 ppb), benzoic acid (55 ppb), and trichlorobenzene (12 ppb) were identified at grid coordinates N9420,E10005; phenol (120 ppb), nitrobenzene (13 ppb), and 2,4-dichlorophenol (5 ppb) were identified at grid coordinates N9650,E9500. In addition, polynuclear aromatics were identified at grid points N9300, E9700 and N9485, E9800, in close proximity to the borehole (N9295, E9705) where air monitoring results indicate the presence of numerous VOCs (Table 10).

Stepan Company Property. Two studies are available that may provide some information on the extent and characteristics of nonradioactive contamination on the Stepan Company property (Ebasco Services 1987, 1988). However, these studies were not available for review, so details are not included in this WP-IP.

[1]EP (Extraction Procedure) toxicity is a characteristic formerly assigned to hazardous wastes when they leached significantly in a test specified in 40 CFR Part 261, Appendix II; EP toxicity has been replaced by the toxicity characteristic leaching procedure (TCLP) as specified in the NCP (EPA 1990).

TABLE 10 Maximum Concentrations of VOCs in Air at Borehole N9295, E9705 and the Sump Area

	Concentration (ppm)	
Compound	N9295, E9705	Sump Area
Benzene	22.7	-
Cyclohexene	1.6	0.2
Heptanoic acid	-	0.7
Hexanoic acid	-	2.3
2-Hexanone	3.7	-
Methylchlorobenzene[a]	1.2	-
Methylcyclopentanine	-	0.3
Toluene	4.3	1.4

[a]Isomer of methylchlorobenzene not specified (BNI 1987f).

Commercial and Governmental Vicinity Properties. Chemical characterization of the commercial and governmental vicinity properties is generally limited to the larger properties (Kannard 1986a; Ebasco Service's 1987, 1988; Leichtweis 1987; BNI 1987a, 1987b, 1987d, 1987e). Studies were undertaken at the Hunter-Douglas, Sears, Scanel, and Sunoco station properties to determine whether hazardous waste is mixed with radioactive waste and to provide information needed to design health and safety plans for future remedial actions.

At the Hunter-Douglas property, soil samples collected to a depth of about 4.9 m (16 ft) from a single borehole on the property were composited and analyzed for VOCs, semivolatile compounds, metals, pesticides, PCBs, and RCRA-specified hazardous waste characteristics (BNI 1987b). No VOCs were present in the composite sample; however, the data are suspect because the holding time for VOC analyses was exceeded by the analytical laboratory. Although some semivolatile compounds were identified, the concentrations were below the analytical laboratory's specified detection limit, i.e., naphthalene, 80 ppb; 2-methylnaphthalene, 88 ppb; and bis(2-ethylhexyl) phthalate, 30 ppb. No PCBs or pesticides were detected in any of the samples. Soil concentrations of metals were typical of background concentrations. All EP toxicity concentrations for both metals and pesticides were below the criteria set in 40 CFR 261.24 at the time of analysis. These samples did not exhibit the RCRA characteristics of corrosivity, reactivity, or ignitability as specified in 40 CFR 261.21, 261.22, and 261.23.

Sampling activities at the Sears property included the collection of soil samples to a depth of about 4.9 m (16 ft) from 10 boreholes (BNI 1987a). These samples were composited and analyzed for VOCs, semivolatile compounds, metals, pesticides, PCBs, and RCRA-specified hazardous waste characteristics. Only a general evaluation of the VOC data from the Sears property can be made because holding-time protocols for all VOC analyses were exceeded by the analytical laboratory. Two VOCs, methylene chloride and acetone, were detected at levels above the laboratory's specified detection limit; however, they may be artifacts of the sampling and analytical procedures. Two other VOCs, methyl ethyl ketone and ethyl benzene, were identified at levels below the laboratory's specified detection limit. On two occasions, subsurface containers were apparently penetrated during boring operations (see Figure 15). Significant amounts of the following VOCs were identified in the sludge material taken from the boreholes: benzene, 120 ppm; toluene, 240 ppm; and xylene, 1,200 ppm.

The semivolatile compounds identified on the Sears property were phenol, 190 ppb; 2-chlorophenol, 170 ppb; 1,4-dichlorobenzene, 74 ppb; N-nitroso-di-n-propylamine, 92 ppb; 1,2,4-trichlorobenzene, 80 ppb; 4-chloro-3-methylphenol, 210 ppb; acenaphthene, 97 ppb; 4-nitrophenol, 420 ppb; 2,4-dinitrotoluene, 89 ppb; pentachlorophenol, 260 ppb; pyrene, 90 ppb; naphthalene, 80 ppb; 2-methylnaphthalene, 88 ppb; benzoic acid, 8,000 ppb; and bis(2-ethylhexyl) phthalate, 27 ppb. The majority of these compounds were in samples collected adjacent to the DeSaussure building. No PCBs were detected in any of the 10 samples. The pesticides hexachlorocyclohexane and dichlorodiphenyltrichloroethane (DDT) were measured in one sample at concentrations commonly found in agricultural soils. The following metals exceeded the range for published background soil concentrations (Braunstein 1981) and are also listed by NJDEPE as hazardous constituents: antimony, cadmium, copper, lead, thallium, and zinc. However, these samples did not exhibit the RCRA characteristics of corrosivity, reactivity, ignitability, or EP toxicity as specified in 40 CFR 261.21, 261.22, 261.23, and 261.24 at the time of analysis.

Subsurface soil composites obtained from the Scanel and Sunoco station properties were analyzed for VOCs and semivolatile compounds; PCBs and pesticides; metals; and the hazardous waste characteristics of corrosivity, reactivity, ignitability, and EP toxicity. With the exception of several semivolatile compounds detected at low concentrations (potentially consistent with anthropogenic levels in the area), no VOCs, PCBs, pesticides, metals, or hazardous waste characteristics were detected in the Scanel soil sample. The sample from the Sunoco station property yielded metal concentrations consistent with background soil levels (Braunstein 1981); no semivolatile compounds, PCBs, pesticides, or RCRA characteristics were detected in this sample. Although methylene chloride was detected, the result is invalid due to failure to meet the holding time for VOC analysis. Further sampling will be conducted to confirm the presence or absence of this compound.

Residential Vicinity Properties. To date, no sampling has been performed to characterize the extent of nonradioactive contamination on the residential vicinity properties.

2.4.4 Summary of Site Conditions

The following conclusions are based on historical surveys of the Maywood site and on the ongoing environmental monitoring and site characterization activities:

- The site has been occupied or associated with various chemical plant activities since 1895. One of the major activities of the Maywood Chemical Works from 1916 to 1956 was the extraction of thorium from monazite sands.

- The land surface has been modified considerably over the period of operations. Damming of creeks and berming were used to create retention ponds for process wastes. These operations have resulted in contamination of essentially all of the former Maywood Chemical Works property.

- The primary radioactive contaminant at the site is thorium-232 and its decay products, with lesser amounts of uranium-238 and its decay products, including radium-226.

- No evidence exists that radionuclides are migrating via surface water at this time. The results of sediment sampling also support this conclusion. However, substantial contamination appears to have occurred via this route in the past.

- Groundwater monitoring shows evidence of radioactive and chemical contamination. Although some organic contaminants have been detected on-site, similarly elevated upgradient concentrations suggest that the source of contamination may not be MISS. Further studies should be carried out to confirm this possibility.

- Contaminant characterization of the remaining Lodi properties and the Stepan Company property is being or will be performed to further define the extent of contamination.

- Limited characterization of the MISS detected several chemical constituents; however, RCRA characteristics were not found. Additional sampling is needed to confirm this conclusion.

- Limited chemical sampling has likewise been performed on the Sears, Sunoco station, Hunter-Douglas, and Scanel properties. In each case, some chemical constituents were detected but no RCRA characteristics were identified. More data are needed to adequately determine the nature of the chemical contamination on the vicinity properties.

3.0 INITIAL SITE EVALUATION

3.1 CONCEPTUAL SITE MODEL

A conceptual site model was developed to describe current understanding of the contaminant sources, migration pathways, and potential receptors and routes of exposure associated with contaminants at the Maywood site. This model is based on available site characterization data and will be revised, as needed, to reflect the findings of ongoing characterization activities. The conceptual site model is described in Sections 3.1.1 through 3.1.3.

3.1.1 Contaminant Sources

The contaminant sources at the Maywood site were identified on the basis of a review of historical records and the results of radiological and chemical characterization studies of the site (see Chapter 2). The primary sources of contamination at the Maywood site are (1) subsurface soils, (2) surface soils, (3) the MISS waste pile, and (4) buried drums. The possibility of buildings being sources of contamination was investigated for MISS, the Sears property, and the New Jersey Vehicle Inspection Station; the building surveys determined that the contaminants are under rather than within the buildings (NRC 1981a, 1981b; Morton 1982; BNI 1987a, 1987e, 1987f). In the following brief description of contaminant sources related to the Maywood site, not all source categories are applicable to all subgroup properties that comprise the site (i.e., MISS; Stepan Company property; commercial and governmental properties; and residential properties).

Contaminated Subsurface Soils. Downhole gamma logging and subsurface soil sampling have shown that subsurface soils are also contaminated with thorium-232, radium-226, and uranium-238 (BNI 1987f). Measured concentrations of thorium-232, and radium-226 have exceeded DOE guidelines for subsurface soils, and uranium-238 has been measured at concentrations exceeding background levels.

Subsurface soils were also analyzed for VOCs, semivolatile compounds, priority pollutant metals, pesticides, PCBs, and RCRA characteristics (Kannard 1986a; BNI 1987a, 1987b, 1987d, 1987e, 1987f). The results of these analyses indicate the existence of a wide variety of inorganic and organic contaminants. However, sufficient data are not currently available to characterize the magnitude or extent of contamination. Air monitoring in the vicinity of the boreholes where subsurface soil samples were collected indicates the presence of numerous VOCs (BNI 1987f).

Three waste-burial sites have been identified on the Stepan Company property. Contaminated materials (thorium-processing residues and tailings) were excavated from the Ballod property west of Route 17 and buried on three separate occasions between 1966 and 1968 (BNI 1987f). In addition, five other waste-burial sites have been identified in the vicinity of the former Maywood Chemical Works.

Contaminated Surface Soils. Soils are known to be contaminated by thorium-232 and radium-226 at levels exceeding current DOE guidelines (see EG&G 1981; NRC 1981a, 1981b; Morton 1982; Jones 1987; BNI 1987f, 1988a, 1988b, 1988c, 1988d, 1988e, 1988f, 1988g, 1988h, 1988i, 1989zc). It is possible that the soils are also contaminated with uranium-238; however, the data are not sufficient to quantify the extent of this contamination. Radioactively contaminated soils have been found throughout the Maywood site and, thus, will be considered as a major source category.

Surface sediment samples collected from a storm drain and two manholes also indicate the presence of thorium-232 and radium-226 at concentrations exceeding DOE guidelines (BNI 1987f). Samples were also analyzed for uranium-238, but the data were invalidated due to a laboratory error.

Although not as thoroughly characterized, surface soils have been found to contain a variety of organic and inorganic constituents at MISS, Stepan Company property, and some commercial vicinity properties. The possibility of chemical contamination of soils on other properties cannot be discounted because sufficient data are not available.

MISS Waste Pile. The interim storage pile at MISS contains about 27,000 m^3 (35,000 yd^3) of contaminated materials removed from 26 vicinity properties in 1984 and 1985 (BNI 1987f). The interim storage pile was prepared by grading the ground surface until level, rolling the surface until firmly packed, constructing a berm around the entire area, and installing a leachate collection system (15-cm [6-in.] layer of sand or fine soil) covered with a Hypalon liner. An additional 15-cm layer of sand was placed on top of the liner to serve as a drainage medium for any leachate that might form after the storage pile was completed. A 30-cm (12-in.) layer of fine-grained contaminated materials was placed over the upper sand layer to protect it and the liner during placement of the contaminated materials. Upon completion of the removal action, the pile was covered with additional Hypalon, sealed to the bottom liner, and held down by concrete blocks. Other than the potential for radon-222 or radon-220 emissions, no evidence currently exists that the pile is contributing to further contamination of the MISS or any other properties (BNI 1987f).

Buried Drums. Buried drums have been identified through aerial photographs and ground-level inspection. In addition, drums were encountered during drilling on the Sears property. Organic vapors were associated with the boreholes on the Sears property, and benzene, toluene, and xylenes were measured in the contents. Metal detectors showed numerous metallic items buried along the former western stream channel (BNI 1987a).

Contaminated Buildings. Building 76 and the pumphouse are the only buildings on the MISS property. Radiological surveys of these buildings indicate that they are free of both fixed and removable contamination (NRC 1981a, 1981b; Morton 1982). The radiation measured in Building 76 is believed to be the result of high concentrations of radioactive material directly east of and beneath the structure (BNI 1987f). Thus, these buildings have not been given further consideration as a primary contaminant source.

Other Sources. Although radon-222, radon-220, and external gamma exposure are not sources, they are directly associated with the MISS sources. Annual average radon-222 concentrations for 2 of the 10 fence-line monitors have exceeded DOE guidelines for residual radioactive material (Appendix A) in 3 of 9 years and the unrestricted access limits under New Jersey Bureau of Radiation Protection regulations (1 pCi/L over background) in 4 of 9 years (BNI 1989zc, 1990a). Radon-220 concentrations exceeded the New Jersey regulation (10 pCi/L over background) at one monitoring station in 1991.

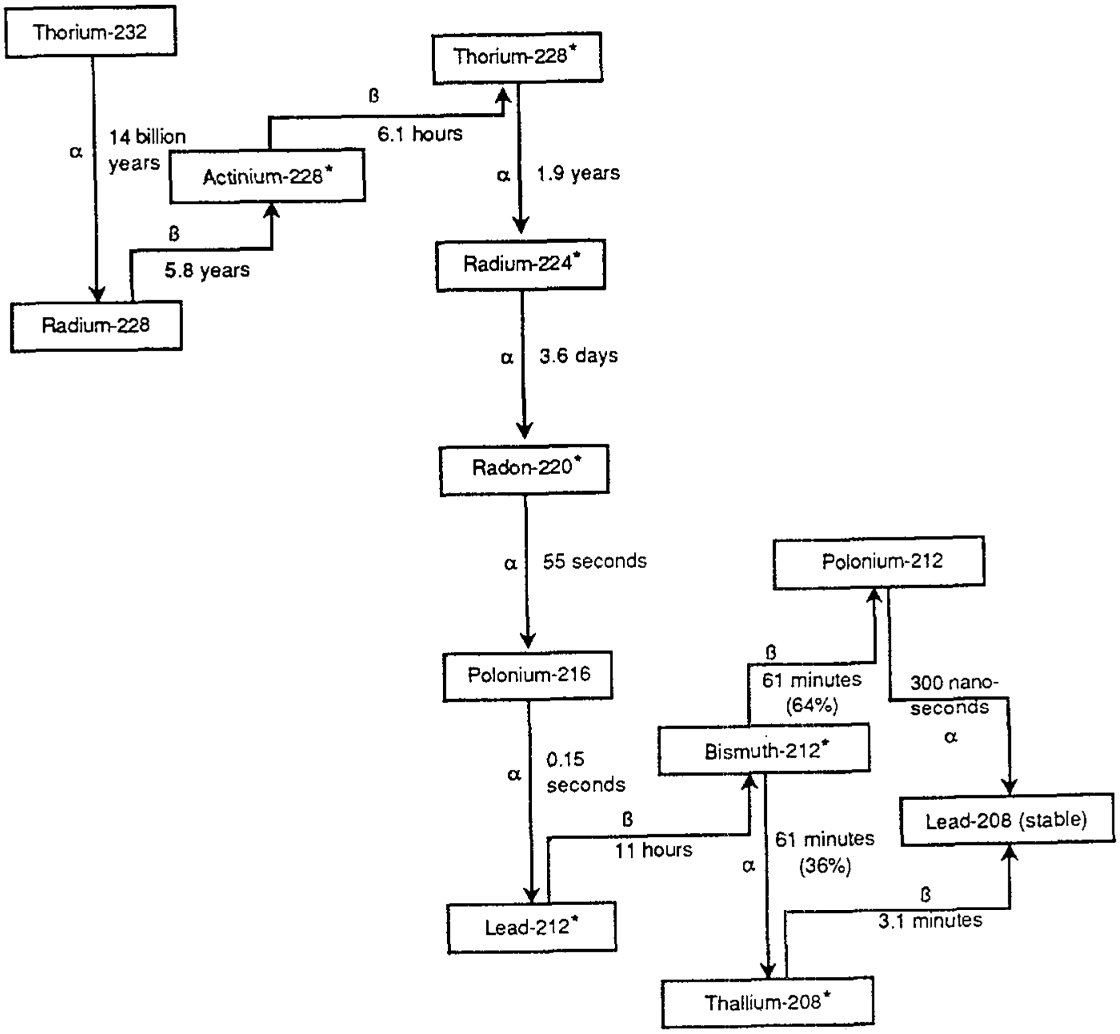
Some gamma radiation exposure levels measured within the site and at the boundary were elevated above background levels. For two locations, the average annual exposure levels (excluding background) were 192 and 400 mR/yr for the eight reporting years of 1984 through 1991.

3.1.2 Potential Contaminants of Concern

Radioactive Contaminants. It is currently believed that radionuclides are the major contaminant at the Maywood site. Site surveys have detected thorium-232, radium-226, uranium-238, radon-222, and radon-220 (NRC 1981a; NUS Corporation 1983; BNI 1985e, 1986e, 1987g, 1988j, 1989zc, 1990a; VanPelt 1988a, 1988b). However, because processing also required chemical materials, the assumption that radionuclides are the dominant contaminant is preliminary and cannot be confirmed until field sampling work provides all necessary radiological and chemical data for all sites.

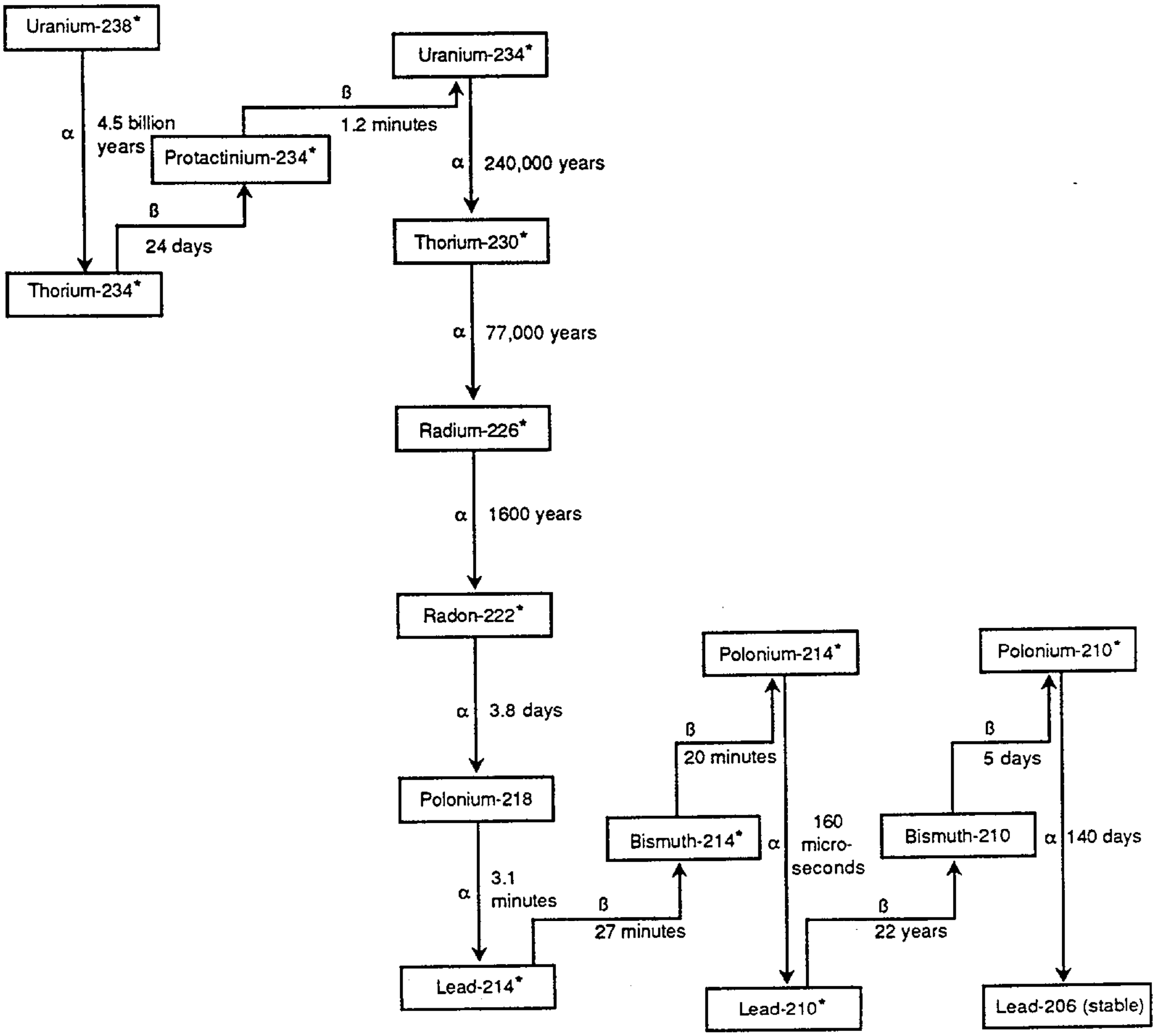
To help identify the radionuclides of concern at the Maywood site, the probable thorium extraction process was reconstructed from Maywood Chemical Works correspondence and chemical insight (Figure 5). In raw monazite ore, thorium exists as thorium phosphate, up to 20 percent by weight (Dana 1955). Thorium-232 would coexist with all of the decay products in the thorium decay series (Figure 16); thorium-232 and the decay products would be in secular equilibrium, a state where each radionuclide in the series has the same apparent activity (decay rate) as the parent, thorium-232. Uranium-238 and all of its decay products in the uranium decay series (Figure 17) would also be present in the monazite ore at lower concentrations and would also be in secular equilibrium. To a very small extent, uranium-235 from the actinium decay series, and all of its associated decay products, would also be present; however, due to their low natural abundance, the impact of the actinium decay series can be considered negligible.

Extraction of thorium would remove a substantial amount of the thorium-232 and thorium-228 in the thorium decay series but would leave the nonthorium decay products. Unextracted thorium-232 and thorium-228 would be in the waste component. Because of the relatively short half-lives of their decay products, these radionuclides would reestablish an equilibrium state in 20 to 30 years. In addition, the nonthorium decay products would generate similar decay products. Because one of the decay products, radon-220, is gaseous, a portion would be lost by emission from exposed surfaces and would decay elsewhere. The combination of unextracted thorium, nonthorium decay products from the extraction



NOTES:
Only the dominant decay mode is shown.
The times shown are half-lives.
The symbols α and β indicate alpha and beta decay.
An asterisk indicates that the isotope is also a gamma emitter.

FIGURE 16 Thorium-232 Radioactive Decay Series



NOTES:
Only the dominant decay mode is shown.
The times shown are half-lives.
The symbols α and ß indicate alpha and beta decay.
An asterisk indicates that the isotope is also a gamma emitter.

FIGURE 17 Uranium-238 Radioactive Decay Series

process, ingrowth decay products, and partially lost radon-220 would lead to a complex mix of radionuclides in wastes that is probably not predictable, is probably not in equilibrium, and would require direct assessment.

Most of the thorium-234 and thorium-230 from the uranium decay series would be removed during extraction, leaving residual thorium-234, thorium-230, and the uranium series decay products, including radium-226, in the waste component. In the case of thorium-234, after a quick decay through protactinium-234m, decay would essentially halt because of the quarter-million-year half-life of uranium-234. For thorium-230 (with a half-life of 77,000 years), the 1,600-year half-life of radium-226 would greatly slow further decay within the series. Thus, waste materials would contain the unextracted fraction of thorium-234 and thorium-230, the unextracted uranium-238, and decay products from both the ore and the ingrowth components (protactinium-234m, uranium-234, and radium-226). Radon-222 is gaseous and would be partially emitted from waste surfaces and decay elsewhere. For this series, secular equilibrium would not reestablish itself. The concentrations of series radionuclides would best be determined by direct measurement.

The radionuclides of concern for the Maywood site have been identified from an understanding of the thorium extraction process, the risk coefficients for these radionuclides, and the existence of specific DOE guidelines for residual radioactive material. The dose conversion factors for the radionuclides residual to the extraction process and those formed by ingrowth are given in Table 11. Radionuclides covered by DOE guidelines for residual radioactive material are thorium-232, thorium-230, radium-228, and radium-226.

In summary, the radionuclides of concern (because they have high risk coefficients, are covered by DOE guidelines, and are present in monazite sands) are thorium-232, uranium-238, radium-228, and radium-226. Thorium-234, thorium-228, actinium-228, protactinium-234m, and radium-224 need not be measured directly in the field because they have short half-lives relative to the time that has elapsed since extraction occurred, and these nuclides can be easily inferred from their parent. Field measurements are required for the following radionuclides:

- Thorium-232
- Thorium-230
- Uranium-238
- Radium-228
- Radium-226
- Radon-222

Chemical Contaminants. Potential chemical contaminants have been identified from the limited chemical characterization of the environment in the vicinity of MISS and from knowledge of the type of processes and materials used during the various activities carried out at the Maywood Chemical Works. The reconstructed extraction process shows that thorium was present as an oxide, a sulfate, an oxalate, a hydroxide, and a nitrate. According to NRC records, thorium was also present on the site as a phosphate and a chloride (NRC 1981a). Of these, the oxide, oxalate, phosphate, and hydroxide are very

TABLE 11 Dose Conversion Factors for Uranium and Thorium Decay Series Radionuclides of Major Concern

Radionuclide	Committed Effective Dose Equivalent Conversion Factor[a] (rem/μCi) Ingestion[b]	Committed Effective Dose Equivalent Conversion Factor[a] (rem/μCi) Inhalation[c]	Radionuclide	Effective Dose Equivalent Conversion Factor[d] (rem/WLM)
Actinium-228	0.002	0.13	Radon-222	1
Protactinium-234m	0.002	0.0008	Radon-220	0.33
Radium-228	1.44	4.77		
Radium-226	1.32	8.58		
Radium-224	0.37	3.16		
Thorium-234	0.014	0.035		
Thorium-232	2.73	1,151		
Thorium-230	0.55	262		
Thorium-228	0.40	342		
Uranium-238	0.25	118		
Uranium-234	0.28	132		

[a]Accumulated dose for 50 years following intake.

[b]When the reference source allowed a choice of fractional uptake, the most restrictive fraction was selected. Fractional uptake is the fraction of ingested radionuclide absorbed by the blood from the small intestine. Selections were made for uranium-238 and uranium-234. Source: Eckerman et al. (1988)

[c]When the reference source allowed a choice of lung clearance class, the factor corresponding to Class Y was selected. Class Y corresponds to a clearance half-time from the lung to the blood and gastrointestinal tract on the order of years, as opposed to days (Class D) or weeks (Class W). Selections were made for all but radium, for which the only choice was Class W. Source: Eckerman et al. (1988).

[d]WLM = working level month; exposure to 1 working level (WL) of radon-222 or radon-220 decay products for 170 hours produces an exposure dose of 1 WLM. Source: International Commission on Radiological Protection (ICRP 1981).

insoluble; the sulfate is only slightly soluble; and the nitrate and chloride are highly soluble. However, the thorium ion has a high distribution coefficient (Sheppard et al. 1984) and, thus, would be bound to the soil matrix, greatly impeding its mobility. Consequently, thorium nitrate, thorium chloride, and thorium sulfate would not be expected to move by dissolution and transport in groundwater but rather through physical movement of the process and waste materials. The chemical forms of uranium and its decay products, including radium-226, and of thorium and its decay products, including radium-228, are uncertain in the process and waste materials.

Chemicals associated with the various site operations are discussed in Section 2.4.1, and compounds identified in environmental samples are described in Section 2.4.3. These include a wide variety of VOCs and semivolatile organics as well as several metals. Further characterization of the extent and magnitude of the chemical contamination at the Maywood site will be performed as part of the site assessment.

3.1.3 Contaminant Release and Transport

Contaminants could be released from the four primary sources into one of four environmental media: (1) atmosphere, (2) groundwater, (3) surface water, and (4) stream sediments. In addition to these primary sources, exposure to contaminants could occur as a result of either direct contact or external exposure to gamma rays. The release and subsequent migration of contaminants is governed by a variety of physical and chemical properties of the media as well as the contaminants. The governing properties include, but may not be limited to, the dynamics of groundwater, surface water, and the atmosphere; physicochemical properties of the transport media and the surrounding media; chemistry of the local environment; climatology; and physicochemical properties of the contaminants. The solubility and geochemical behavior of uranium, thorium, and other inorganic contaminants is strongly dependent upon the Eh-pH conditions of the environment. The release and transport phenomena as a function of the contaminant source are described in the following subsections. Figures 18 through 21 are diagrams of the relationships between the various release mechanisms and the transport media.

Contaminated Subsurface Soils. Two primary mechanisms are considered for contaminant release from subsurface soils. One mechanism is infiltration of water and subsequent leaching of contaminants to the groundwater. Because the groundwater at MISS contains elevated levels of total uranium (BNI 1985e, 1986e, 1987g, 1988j, 1989zc, 1990a, 1991, 1992), neither subsurface leaching nor leaching of surface soils can be discounted (see discussion in following subsection).

The other potential release mechanism is gaseous emissions. The elevated radon-222 and radon-220 levels measured at the MISS fence line (BNI 1989zc, 1990a) may result from the upward diffusion of these gases through the soil column and their subsequent release to the atmosphere. Because the diffusion rate in the lower soil layers is highly dependent on many environmental factors, this source may be highly variable and difficult to quantify except through long-term averaging. Nevertheless, this release mechanism must

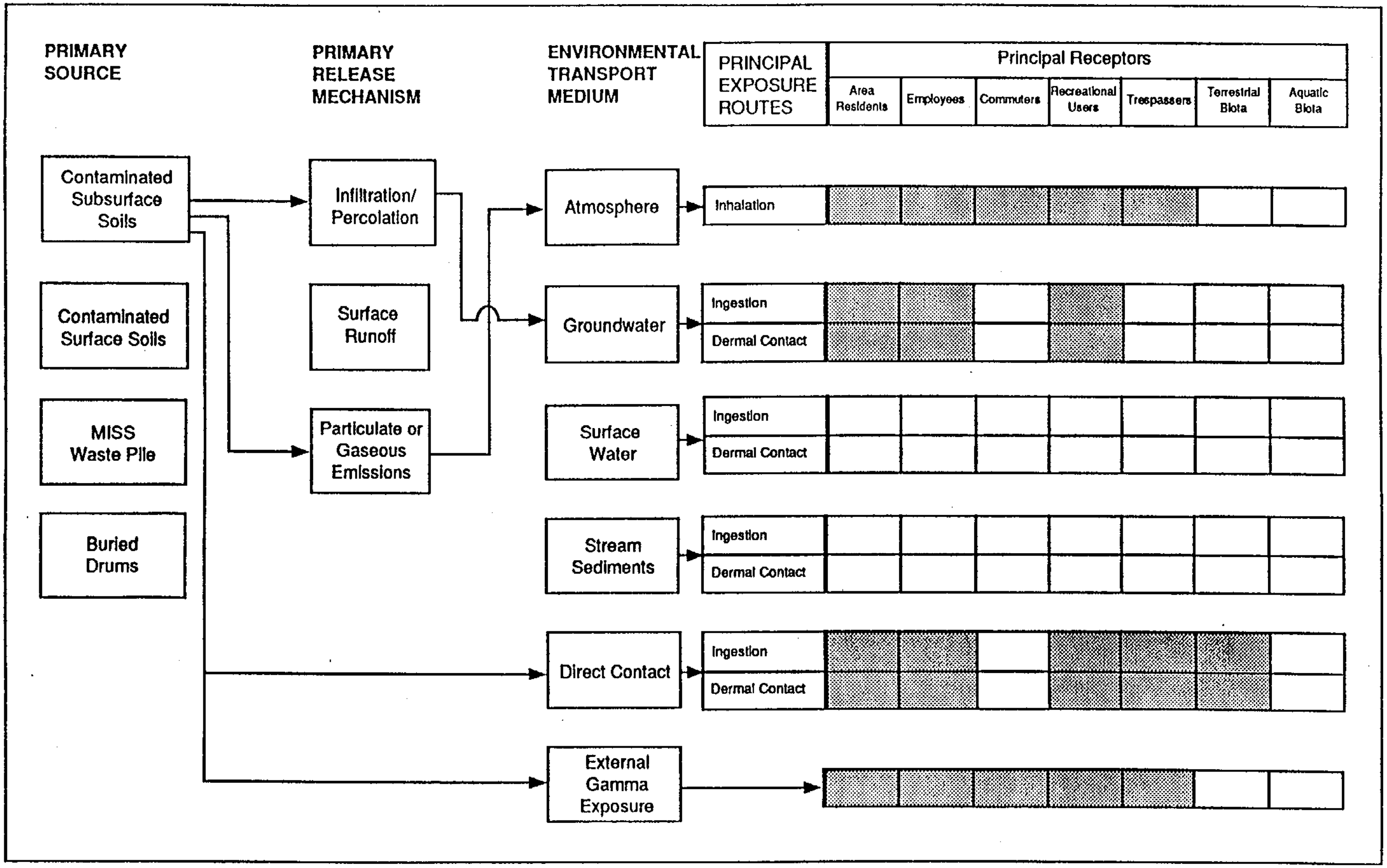


FIGURE 18 Conceptual Site Model for Contaminated Subsurface Soils

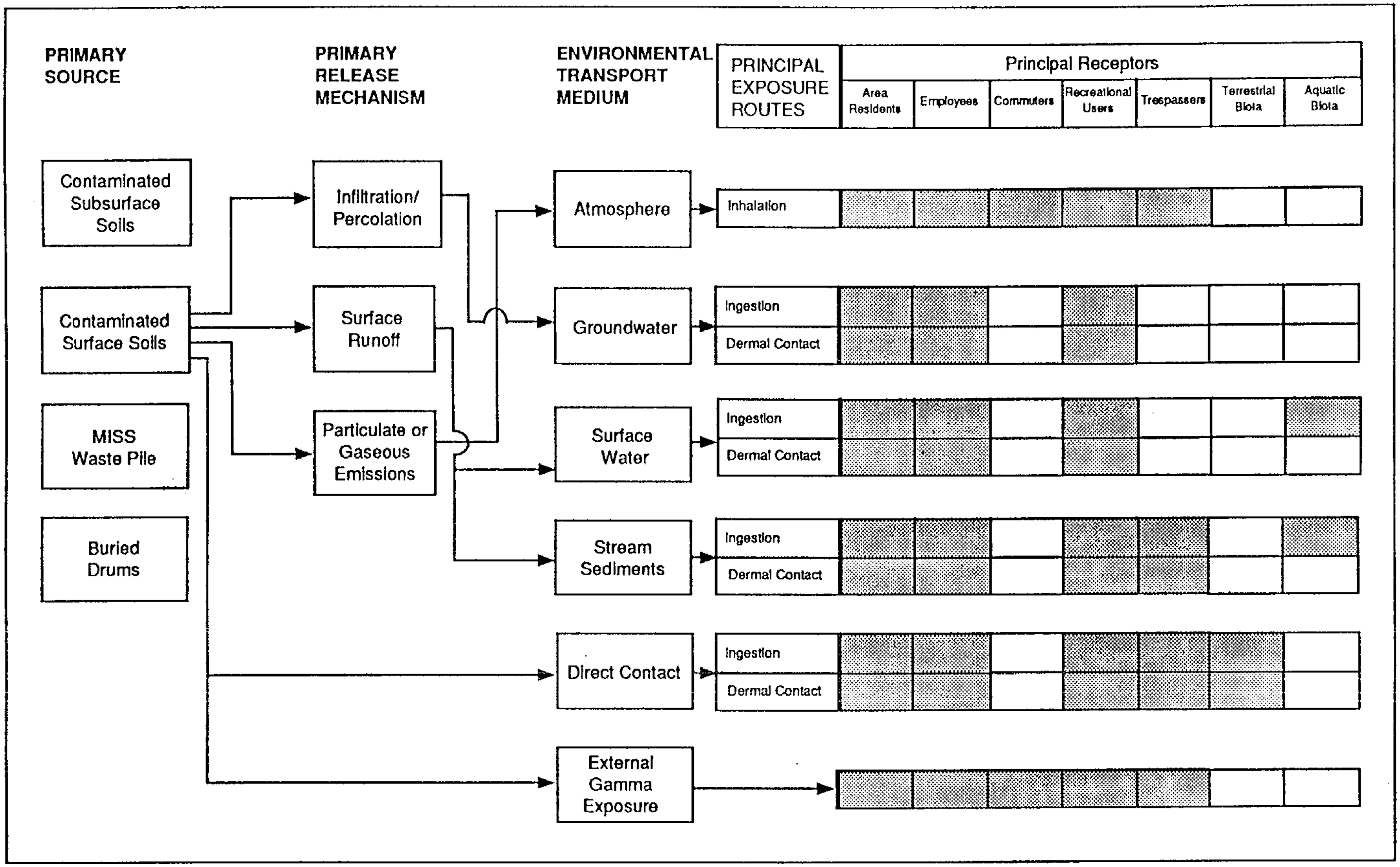


FIGURE 19 Conceptual Site Model for Contaminated Surface Soils

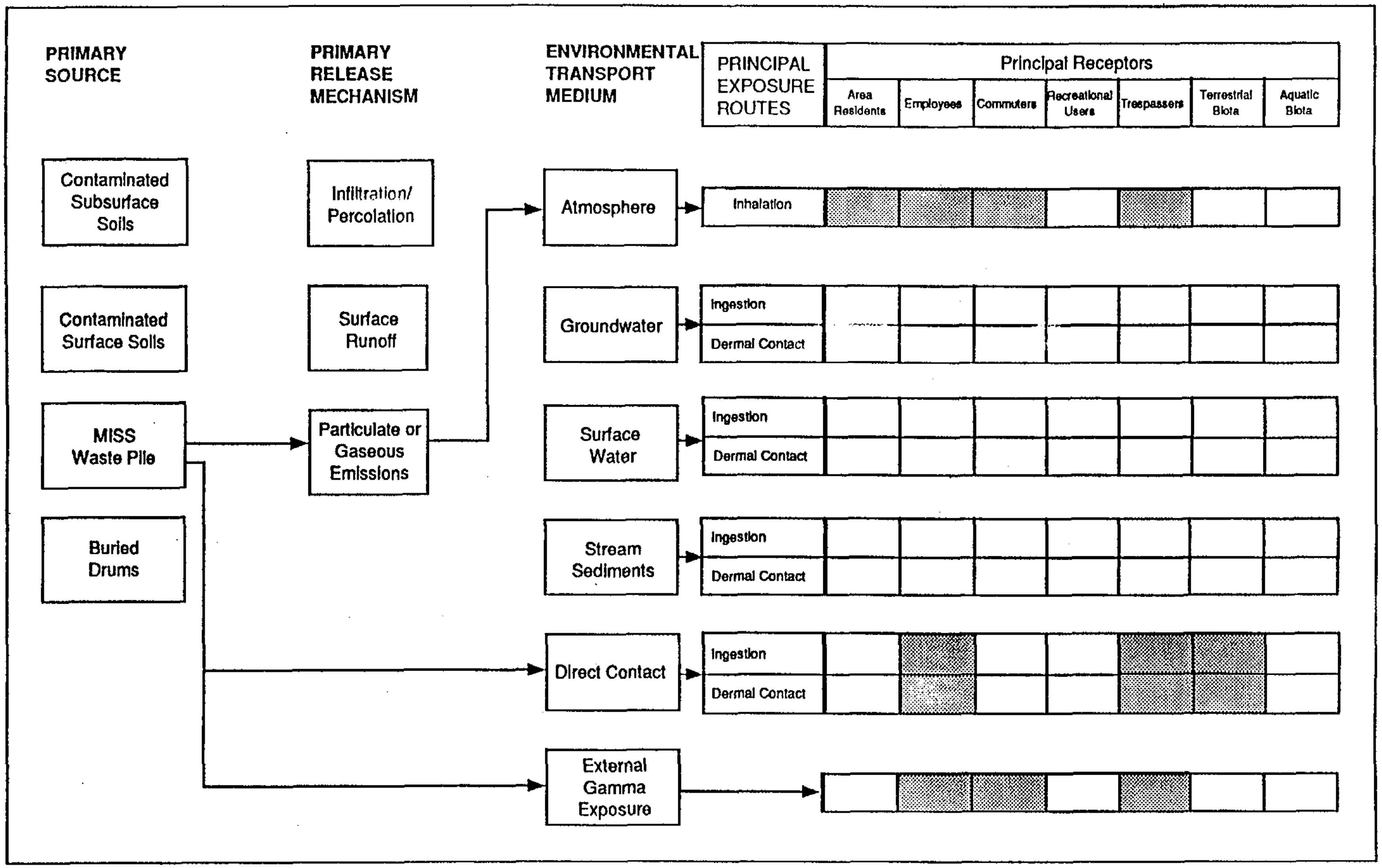


FIGURE 20 Conceptual Site Model for the MISS Waste Pile

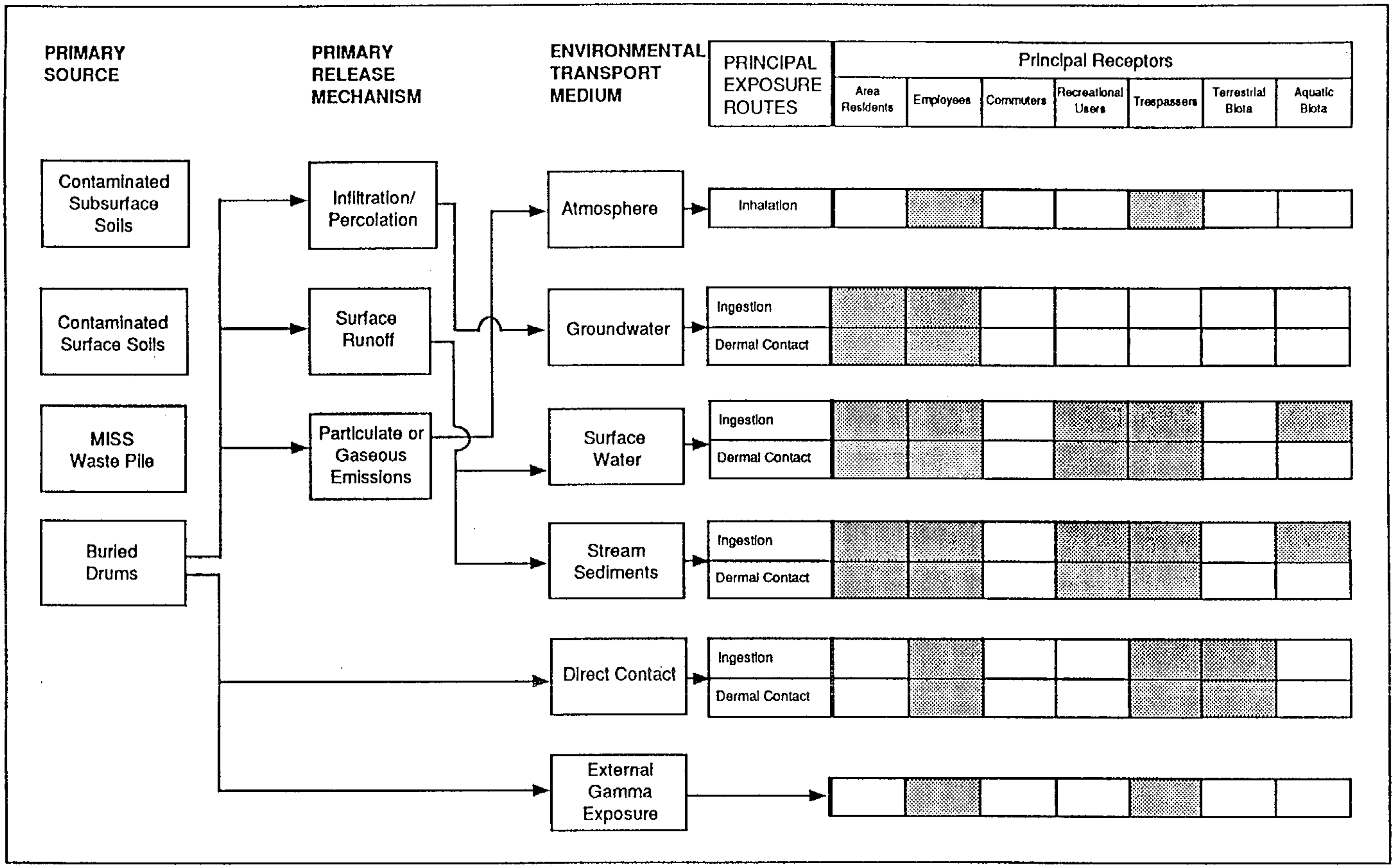


FIGURE 21 Conceptual Site Model for Buried Drums

be considered. Furthermore, as with contaminated surface soils, insufficient data exist to discount VOC releases from the subsurface soils to the atmosphere, and further chemical characterization of the subsurface soils may be necessary.

Contaminated Surface Soils. Three primary release mechanisms are associated with contaminated surface soils at the Maywood site. One mechanism is infiltration of water and subsequent leaching of contaminants to the groundwater. The groundwater in the area has been found to be contaminated with uranium. Total uranium concentrations in the groundwater are two or more times local background levels, and one well averaged more than 100 times local background levels over a 3-year period (shallow well 5A; see Figure 12 and Table 5) (BNI 1985e, 1986e, 1987g, 1988j, 1989zc, 1990a, 1991, 1992).

The second release mechanism considered is soil erosion and surface runoff directly to surface waters or indirectly into surface waters through storm drains. Historically, much of the contamination in the vicinity properties south of the former Maywood Chemical Works in Lodi is believed to have resulted from deposition within the stream channels, swampy areas, and adjacent areas affected by flood or high-water events (BNI 1987f). In addition, some contaminants apparently were eroded onto areas adjacent to the Maywood Chemical Works, and some were probably spread downstream through natural drainage paths (BNI 1987a). The surface water data for thorium-232, radium-226, and uranium-238 near MISS appear to have been stable over the past 8 years (Table 3); however, no surface water data are available for comparison with other locations known to be radioactively contaminated (e.g., Sears property) or for surface waters potentially contaminated with chemicals. The possibility of contamination being released indirectly to surface waters through storm drains is substantiated by the discovery of radium-contaminated sediments in a storm drain and two manholes (BNI 1987f) (Figure 8). It is not clear, however, if the contamination is related to ongoing releases or to past disposal practices.

A third release mechanism is gaseous releases to the atmosphere. Although the source is unknown, elevated levels of radon-222 and radon-220 have been measured at the MISS fence line (BNI 1989zc, 1990a). Radon-222 and radon-220 flux measurements will be made on surrounding soils at the MISS. Radon-222 and radon-220 do not appear to be a problem at any location other than the MISS. Insufficient data exist to discount VOC releases from the surface soils to the atmosphere; further chemical characterization of the surface soils may be necessary.

Fugitive dust emissions are not expected to be significant because few unpaved roads exist in the area. Furthermore, the area is highly developed and generally paved over, and unpaved areas tend to be vegetated with grass or shrubs.

MISS Waste Pile. The primary release mechanism associated with the MISS waste pile is gaseous emissions of radon-222, radon-220, and possibly VOCs. Radon-222 flux has been measured at MISS as part of compliance monitoring for the Clean Air Act. The presence of a sealed Hypalon cap over the waste pile prevents pile emissions. Thus, emissions from the surrounding soil may be the primary source. Neither release mechanism (i.e., from the waste pile or the surrounding soil) can be discounted at this time because the elevated radon-222 and radon-220 levels measured at the perimeter of the site are unexplained. Release mechanisms not believed to be affecting the waste pile are fugitive dust emissions, infiltration, and surface runoff. The Hypalon cap is an adequate barrier to the resuspension of unconsolidated materials in the waste pile, and it also provides an impervious surface that limits the effects of precipitation. Finally, because the area is diked, runoff from the adjacent watershed is prevented from causing erosion of the base of the waste pile.

Buried Drums. Buried or partially buried drums have been discovered on the Sears property (BNI 1987a). The condition of these drums is unknown. Most are still buried in an old stream channel. Some of the drums punctured during soil drilling on the Sears property have been sampled. These drums contain sludge material contaminated with benzene, toluene, and xylenes. The primary release mechanisms for ruptured drums are direct gaseous releases to the atmosphere and contamination of the soil.

Sanitary/Storm Drains. A secondary source of contamination at MISS is the sanitary sewers that received discharges of wastes during former plant operations at the Maywood Chemical Works and the storm sewers receiving contaminated surface runoff. The possibility of releasing contamination indirectly to surface waters through storm drains is substantiated by the discovery of radium-contaminated sediments in a storm drain and two manholes at MISS (BNI 1987f) (Figure 8). It is not clear, however, if the contamination resulted from ongoing releases or from past disposal practices.

3.1.4 Potential Receptors and Routes of Exposure

The Maywood site is situated in a densely populated urban area of mixed residential, commercial, industrial/chemical, and recreational land use. Potential receptors include area residents, employees of area businesses and offices, commuters, users of area recreational facilities, and trespassers. In addition, terrestrial and aquatic biota may be exposed. These receptors can be exposed through six environmental pathways: (1) atmosphere, (2) groundwater, (3) surface water, (4) stream sediments, (5) direct contact with the contaminated materials, and (6) external exposure to gamma rays. Three possible routes of exposure are inhalation, ingestion, and dermal contact.

Exposure to external radiation has unique characteristics. Because of the nature of radioactive materials (i.e., the decay process by which electromagnetic radiation is emitted from radioactive materials) an individual may receive a dose from external radiation without the necessity of a transport medium or a route of exposure. The magnitude of external radiation exposure is governed by the length of exposure, distance from the source, and amount of shielding between the source and receptor.

Several possible risk assessment scenarios can be developed through consideration of the various combinations of receptor, pathway, and route of exposure. All possible combinations need not be considered because some can be eliminated through a preliminary screening process. The following exposure scenarios are based on an understanding of the current Maywood site conditions:

- Area Residents

  - Inhalation of radon-222, radon-220, and possible VOCs from contaminated subsurface or surface soils, the MISS waste pile, and buried drums.

  - Ingestion of contaminated surface water or groundwater used for domestic water supply in area homes.

  - Ingestion of contaminated sediments or subsurface or surface soils from the resident's property or from other contaminated locations (e.g., commercial and governmental vicinity properties).

  - Dermal contact with contaminated surface water or groundwater used for domestic water supply in area homes.

  - Dermal contact with contaminated sediments or subsurface or surface soils on the resident's property or from other contaminated locations.

  - External gamma exposure from contaminated subsurface or surface soils.

- Area Employees

  - Inhalation of radon-222, radon-220, and possible VOCs from contaminated subsurface or surface soils, the MISS waste pile, and buried drums.

  - Ingestion of contaminated surface water or groundwater used for domestic water supply in the place of employment.

  - Ingestion of contaminated sediments or subsurface or surface soils from the employer's property.

  - Dermal contact with contaminated surface water or groundwater used for domestic water supply in the place of employment.

  - Dermal contact with contaminated sediments or subsurface or surface soils on the employer's property or from other contaminated locations.

  - External gamma exposure from contaminated subsurface or surface soils.

- Commuters

  - Inhalation of radon-222, radon-220, and possible VOCs from contaminated subsurface or surface soils, the MISS waste pile, and buried drums.

  - External gamma exposure from contaminated subsurface or surface soils.

- Recreational Users

  - Inhalation of radon-222, radon-220, and possible VOCs from contaminated subsurface or surface soils, the MISS waste pile, and buried drums.

  - Ingestion of contaminated surface water or groundwater used for domestic water supply at the recreational area.

  - Ingestion of contaminated sediments or subsurface or surface soils from the recreational area.

  - Dermal contact with contaminated surface water or groundwater used for domestic water supply at the recreational area.

  - Dermal contact with contaminated sediments or subsurface or surface soils on the recreational property.

  - Dermal contact with contaminated surface water used for recreational purposes.

  - External gamma exposure from contaminated subsurface or surface soils at the recreational area.

- Site Trespassers

  - Inhalation of radon-222, radon-220, and possible VOCs from contaminated subsurface or surface soils, the MISS waste pile, and buried drums.

  - Ingestion of contaminated subsurface or surface soils.

  - Dermal contact with contaminated subsurface or surface soils.

  - External gamma exposure from contaminated subsurface or surface soils at the recreational area.

- Nearby Terrestrial and Aquatic Biota
  - Ingestion of contaminated sediments or subsurface or surface soils.
  - Dermal contact with contaminated sediments or subsurface or surface soils.

Any individual receptor may have exposures that cross over the various receptor lines. For example, an area resident might also be an area employee, recreational user, and possibly a site trespasser; thus, this individual's exposure could be significantly greater than that of another area resident. These exposure scenarios will be revised, as necessary, to reflect the findings of ongoing characterization activities.

The presence of contaminants at the Maywood site, and the potential for release of such contaminants to surface waters, could impact local ecosystems. Transient or permanent populations of aquatic and terrestrial species that inhabit the site and nearby areas are currently being exposed to low levels of contamination. The potential impacts to local biota resulting from these exposures will be assessed as part of the baseline risk assessment for the Maywood site.

3.2 TOXICOLOGICAL AND ENVIRONMENTAL PROPERTIES OF SELECTED CONTAMINANTS

As background information for this work plan, a general description of the toxicological effects associated with radiation exposure and brief descriptions of the major toxicological effects of selected chemical contaminants associated with the Maywood site are presented in Sections 3.2.1 and 3.2.2. Potential transport pathways and the environmental fate of these contaminants are also discussed. For most of the contaminants identified at the site, the potential is greater for chronic rather than acute exposure of humans and biota under current site conditions. An assessment of potential risks to human health and the environment from current site conditions will be carried out in the baseline risk assessment.

3.2.1 Radiation Toxicity

Radiation exposures at the Maywood site are all classified as low-level exposures. For these low-level exposures, the dose rates are relatively close to background radiation levels, exposure periods of several years to a lifetime are usually required to accumulate significant doses, and health effects, if they appear, do not manifest themselves for years to decades.

Radiation health effects for humans have only been confirmed at relatively high doses or high dose rates or with large populations. For low doses, health effects are presumed to occur but can only be estimated statistically. The general practice is to assume that half the dose gives rise to half as many health effects, one-third the dose gives one-third as many health effects, and so on. Under this assumption, the only point of zero health effects is at zero dose. Risk estimates are strictly applicable only to large populations because the appearance of a health effect after an exposure is a chance event. For small populations (e.g., one person) predicting health effects with certainty is not possible.

Medical practice has shown that the body has mechanisms to repair radiation-damaged cells. It is believed that these mechanisms probably operate for low-level radiation exposure where doses and dose rates are low, but this has not been confirmed. For radiations that deposit their energy in tissue over short distances (e.g., alpha particles), repair may occur less frequently than for radiations that deposit their energy in tissue over relatively longer distances (e.g., gamma rays or beta particles).

The potential health effects associated with exposures at the Maywood site are somatic, primarily increased risks of various types of cancer in the exposed individual. Studies with insects and animals have also shown that the offspring of exposed subjects may be affected, but such effects have not been established for humans. The sources of increased risk are emissions of alpha and beta particles and gamma and X rays from decay products in the thorium and uranium decay chains. The potential contaminants of concern are discussed in Section 3.1.2.

Except for the way they are created, X rays and gamma rays are similar; both are photons (waves with particulate properties). Gamma rays generally have higher energies than X rays, and gamma rays are emitted by the atomic nucleus whereas X rays are emitted outside the nucleus. Both are primarily an external hazard because they can easily penetrate tissue and reach internal organs.

Alpha particles are helium nuclei (two protons bound to two neutrons) and are the most effective radioactive emission in damaging cells because they lose their energy rapidly over very short distances. Alpha particles are almost exclusively an internal hazard because, for external exposure, they generally lose almost all of their energy in the dead skin cell layer of the body before reaching living tissue. Within the body, alpha particle energy is quickly deposited in living cells.

Beta particles are electrons and are intermediate in their effectiveness in damaging cells because they lose their energy over longer distances. Beta particles are primarily an internal hazard; however, in cases of external skin exposure, beta particles can penetrate to living skin cells — thus representing an external hazard as well.

The exposure pathways can be separated into either external or internal exposure. External exposure occurs when the radioactive material is outside the body. Gamma rays and X rays are emitted and then enter the body, exposing internal organs. Beta particles can sometimes cause external exposure but only to the skin. Alpha particles are almost never an external exposure problem because generally their energy is dissipated in dead skin cells before they penetrate to living skin cells. Internal exposure occurs when the radioactive material enters the body by inhalation or ingestion. Inhaled material can be exhaled, deposited in the lung, expelled from the lungs to be spit or swallowed and excreted, or taken up by the blood and relocated to other organs where it is excreted over time. Ingested material enters the blood and is either expelled in the urine or feces or relocated to other organs and excreted over time. For internal exposures, alpha and beta particles are the dominant concern because their energy is absorbed in cells before the particles leave the body. Gamma rays and X rays are most likely to leave the body without depositing a large fraction of their energy.

For inhalation of any of the radionuclides listed as potential contaminants of concern in Section 3.1.2, the lungs are the primary organ of health concern. For soluble materials, additional critical organs are the bones for thorium and the kidneys and whole body for uranium. For ingestion of the potential contaminants of concern, excluding radon gases, the bones are the primary organ of health concern. Again, for soluble materials, the kidneys and the whole body are additional critical organs for uranium (Eckerman et al. 1988; ICRP 1979; National Research Council 1988, 1990).

3.2.2 Chemical Toxicity

Although the extent of chemical contamination at the Maywood site has not been fully characterized, data from sampling and analyses to date have identified varying amounts of a few inorganic and organic chemicals. These include metals such as cadmium, lead, chromium, and mercury; VOCs such as benzene, toluene, and xylenes; and semivolatile compounds (mostly polycyclic aromatic hydrocarbons) such as chrysene, benzo(a)pyrene, and benz(a)anthracene. Significant amounts of benzene, toluene, and xylene were found in buried drums. Other potential sources of chemical contaminants are the rare earths concentrated by the monazite ore extraction process and lithium compounds produced in a separate, nonradiological, process. Recognizing that the exact significance and impact of the presence of these chemicals cannot be ascertained until the site has been fully characterized, it is expected that the potential risk from chemical contamination at the site would not likely be a major issue on the basis of the levels of contaminants detected in samples collected to date. This observation will be further evaluated through continued monitoring and sampling and through performance of a risk assessment during the remedial investigation process.

Metal compounds such as those found on-site may undergo a wide range of transformation processes, forming complexes with inorganic species and organic ligands that are present in the environment. These processes, collectively referred to as speciation, can occur in all environmental media. The speciation of a metal in a given environment affects its bioavailability, solubility, volatility, and sorptive properties. In addition to speciation, the fate of metals is affected by the properties of the environmental media. For example, properties affecting the mobility of a metal compound in soil include the cation-exchange capacity and pH of the soil, and the solubility of metals in water depends on the presence of other chemical species and on pH. Certain compounds of these metals are carcinogenic and may induce teratogenic as well as reproductive and neurological effects.

Organic compounds such as VOCs (e.g., benzene, toluene, and xylenes) and PAHs may occur at certain levels as anthropogenic background compounds, especially in an industrialized area such as that surrounding the Maywood site. These compounds may adversely affect organs such as the liver, kidney, lungs, and skin.

Rare earths are considered mildly to moderately toxic to humans (Seiler et al. 1988), with inhalation the primary route of concern; symptoms include sensitivity to heat, itching, skin lesions, and central nervous system effects (Sax and Lewis 1989). Lithium is commonly found in human tissue and is used therapeutically as a carbonate for the treatment of depression. Lithium hydride is corrosive and may cause skin burns or respiratory irritation (Klaasen et al. 1986).

3.3 PRELIMINARY RESPONSE OBJECTIVES AND TECHNOLOGIES

The overall objective of the response action at the Maywood site (including both removal and remedial actions) is to clean up, stabilize, or otherwise control contamination to ensure protection of human health and the environment. Additional broad objectives, established on the basis of specific criteria identified in CERCLA, as amended, are presented in Section 3.3.1. Potential response actions and technologies are discussed in general in Section 3.3.2, and preliminary response action objectives that are specific to contaminated environmental media at the Maywood site are addressed in Section 3.3.3 and Appendix B. In Section 3.4, general response technologies are assembled into preliminary remedial action alternatives to fulfill the response objectives identified for the site. These objectives, technologies, and alternatives will continue to be developed during the RI/FS-EIS process.

3.3.1 Selection Criteria for Remedial Actions

Section 121 of CERCLA, as amended, identifies a strong statutory preference for remedial actions that are reliable and provide long-term protection. The primary requirements for a final remedy are that it be both protective of human health and the environment and cost-effective. Additional selection criteria include the following:

- Preferred remedies are those in which the principal element is treatment to permanently or significantly reduce the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants;

- Where practical treatment technologies are available, off-site transport and disposal without treatment is the least preferred alternative; and

- Permanent solutions and alternative treatment technologies or resource recovery technologies should be assessed and used to the maximum extent practicable.

These criteria for final remedies constitute the general objectives for remedial actions at the Maywood site. Long-term protection and permanence are the primary objectives in determining how the Maywood materials should be managed. Cost-effectiveness and practical treatment technologies that are applicable to contaminated materials will also be considered during development of remedial action alternatives.

3.3.2 General Response Actions and Technologies

The purpose of the remedy selection process is to select remedies that (1) are protective of human health and the environment, (2) maintain protection over time, (3) minimize the amount of untreated wastes, and (4) minimize the need for long-term management. A broad overview of response actions and technologies that could be implemented to achieve the objectives of remedial action at the Maywood site, based on the current understanding of site contamination, is presented in this section. The discussion emphasizes source control response actions.

The objective of source control response actions is to directly impact the source of contaminated materials at a waste site to minimize the potential for population exposure. A range of alternative technologies that reduce the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants will be developed. This range will seek to include an alternative that removes or destroys the contaminants to the maximum extent feasible or that eliminates or minimizes the need for long-term management. Other alternatives will vary in the degree of treatment, the quantities and characteristics of the treatment residuals, and the untreated wastes that must be managed. One or more alternatives will be included that involve little or no treatment but provide protection of human health and the environment, primarily by preventing or controlling exposure to the contaminants through engineered controls. The alternatives will be developed and screened on the basis of effectiveness, implementability, and cost. Source control response actions that may be applicable to managing the Maywood site include institutional controls, removal, treatment, temporary storage, and disposal.

Institutional controls can involve the use of access restrictions, such as physical barriers (e.g., fences) and ownership or deed restrictions, and/or monitoring to reduce the potential for public exposure to contaminated materials. Such controls are currently in place at MISS to limit access and use. However, these methods generally serve as a reliable means of protecting human health and the environment only when used as support for other response actions.

Removal of contaminated materials can be achieved by excavation, decontamination and/or demolition, and collection technologies. Contaminated soils and sludges can be excavated with standard construction equipment. Structural surfaces can be decontaminated by a number of conventional methods (e.g., vacuuming, abrasive blasting, and scabbling), and buildings can be demolished using standard construction equipment. Finally, contaminated groundwater can be collected using various conventional methods (e.g., extraction wells and gravity drain and pumping systems). Care must be exercised in designing groundwater collection and treatment systems so as not to release or concentrate naturally occurring radioactive materials.

Treatment encompasses a wide range of chemical, physical, and biological technologies that address various types of contamination in different media. Materials associated with the Maywood site that contain chemicals and radionuclides include soils and sludges, mixed solids and process wastes, and groundwater. Only a limited number of technologies are effective when radionuclides are present because radioactivity cannot be destroyed by treatment. Technologies that can reduce the toxicity, mobility, and/or volume of radioactive wastes can be divided into two general categories: (1) those that remove radioactive constituents from the waste matrix and (2) those that change the form of the waste and/or matrix. The first category generally consists of chemical processes (although there are exceptions, such as physical separation techniques), and the second category generally consists of physical processes. Biological processes are typically used to treat chemical organic wastes rather than radioactive wastes.

Chemical treatment technologies alter the nature of hazardous chemical constituents in contaminated liquids, sludges, or solids and can reduce waste toxicity, mobility, and/or volume. When radioactive components are present, a chemical extraction or leaching process can be used to remove them from the waste matrix and reduce the volume and/or mobility of the waste; the liquid leachate can then be reprocessed to isolate the radioactive components. Chemical treatment of groundwater (e.g., by precipitation and adsorption) typically follows its collection and removal, although treatment can also be conducted in situ. Soils, sludges, and solid wastes can be chemically treated either in situ (e.g., with a lixiviant wash) or following removal/excavation (e.g., in an engineered system).

Physical treatment technologies can reduce the toxicity, mobility, and/or volume of waste materials, although in certain cases (e.g., sludge stabilization), the total contaminated volume may increase. Physical treatment can be used to remove contaminants from groundwater (e.g., by sedimentation, filtration, and distillation) and is typically conducted following groundwater collection and removal. Physical treatment technologies can also alter the structure of contaminated solids to facilitate stabilization and handling, and they can be implemented in situ or following excavation. Contaminated sludges can be physically treated by dewatering technologies in situ (e.g., by gravity drainage trenches and pumping) or following excavation (e.g., by vacuum filtration or drying beds). Physical treatment technologies that could be considered for contaminated soils and sludges include solids separation, nonthermal and thermal extraction, and thermal destruction.

Biological treatment technologies can alter the nature of a waste and remove contaminants (typically organics) from a waste matrix; they can be implemented in situ or following the removal of contaminated materials. Biological processes are routinely employed in conventional wastewater treatment systems and can reduce waste toxicity, mobility, and/or volume. Such processes include trickling filters and surface impoundments (e.g., aerated lagoons). Organic debris and soils and sludges that contain nitrogen compounds and/or organic contaminants can also be treated by biological processes.

Temporary storage reduces waste mobility by isolating contaminants in a manner that protects human health and the environment during the short term until the ultimate disposition of the materials can be determined. (For example, this response technology can be used to manage materials that may result from general waste consolidation.) Temporary storage can involve the placement of contaminated materials in an existing engineered structure or in a structure newly constructed for containment purposes.

Disposal typically reduces waste mobility through the permanent placement of contaminated materials in a manner that protects human health and the environment for the long term. Disposal options for solids/sludges include (1) on-site disposal in a land-based facility, (2) off-site disposal in a land-based facility, and (3) disposal in the ocean. The latter option is not currently viable because of such factors as regulatory restrictions and public concern. For contaminated liquids, disposal is typically preceded by treatment; discharge options include land application and release to a surface water, either on-site or off-site.

Additional considerations in evaluating potential response actions and technologies are provided in the NCP. One or more innovative technologies will be developed for further consideration if, compared with demonstrated treatment technologies, they offer the potential for comparable or superior performance or implementability, fewer or lesser adverse impacts, or lower costs for similar levels of performance. In addition, where appropriate for groundwater response actions, a limited number of alternatives that attain site-specific remediation levels within different restoration time periods can be developed, using one or more different technologies.

3.3.3 Media-Specific Response Objectives and Technologies

Preliminary response objectives for remedial actions at the Maywood site have been identified for the following environmental media: soil/sludge, surface water, groundwater, and structural materials. Potential response actions and technologies associated with these environmental media that could achieve the remedial action objectives for the Maywood site are summarized in Appendix B. Additional objectives and technologies that may be appropriate for the Maywood site will be identified and evaluated (screened) during the RI/FS-EIS process.

3.4 CONCEPTUAL REMEDIAL ACTION ALTERNATIVES

Preliminary alternatives for remedial action at the Maywood site were developed according to the categories specified for remedial action in the current NCP, as follows:

- No action;
- Alternatives for treatment or disposal at an off-site facility, as appropriate;
- Alternatives that attain applicable or relevant and appropriate requirements (ARARs) for protecting human health and the environment;
- Alternatives that exceed ARARs; and

- Alternatives that do not attain ARARs but will reduce the likelihood of present or future threats from hazardous substances and will provide significant protection to human health and the environment (including an alternative that closely approaches the level of protection provided by those alternatives that attain ARARs).

Section 105 of CERCLA, as amended, required the President (who subsequently delegated this responsibility to EPA) to propose amendments to the NCP. A revision was promulgated on March 8, 1990 (EPA 1990). The two categories of final remedial action alternatives (discussed in Section 3.3.2) developed in the revised NCP are:

- Source control response actions — response actions that reduce the toxicity, mobility or volume of the contaminants, ranging from alternatives that involve little or no treatment and rely on engineered controls to alternatives that remove or destroy the contaminants, thereby reducing the need for long-term management.

- Groundwater response actions — response actions that attain site-specific remediation levels within different restoration time periods, ranging from alternatives involving no action to alternatives that offer superior performance or implementability, fewer adverse impacts, and lower cost.

A limited number of conceptual remedial action alternatives have been identified for the Maywood site on the basis of these categories and the preliminary response objectives and technologies presented in Appendix B. (Only a general discussion of ARARs is possible at this stage of the RI/FS-EIS process; see Section 3.8.) These conceptual alternatives address the radioactively and chemically contaminated materials — including soil/sludge, surface water, groundwater, and structural materials — at the Maywood site. The alternatives are:

- Alternative 1: No action,

- Alternative 2: On-site disposal,

- Alternative 3: Off-site disposal,

- Alternative 4: On-site treatment with on-site disposal,

- Alternative 5: On-site treatment with off-site disposal, and

- Alternative 6: Off-site treatment with off-site disposal.

These alternatives are briefly described in Sections 3.4.1 through 3.4.6 and represent basic combinations of potential response actions. Options may be identified within certain of the action alternatives (i.e., Alternatives 2 through 6) to incorporate appropriate elements of other alternatives as the RI/FS-EIS process develops. For example, Alternative 4 might be varied to incorporate an element of Alternative 6 (off-site treatment and/or disposal) on a limited basis if a licensed facility were available for certain materials (e.g., those contaminated only with PCBs). Similarly, Alternative 5 could incorporate the focus of Alternative 2 (on-site containment for disposal) on a limited basis (e.g., if excavation of a small area of contaminated soil located beneath a paved surface would create a greater risk to workers than containing the contamination in place and monitoring/maintaining the area for the long term).

3.4.1 No Action

The no-action alternative is included pursuant to the requirements of NEPA and CERCLA to provide a baseline for comparison with other alternatives and to assess the impacts on human health and the environment from current and projected conditions at the Maywood site. If this option were selected, no reduction would occur in the toxicity, mobility, or volume of contaminated materials at the site. Potential exposure to contaminants would probably continue for the short term at current levels; over time, long-term exposure would likely increase — in terms of both levels of exposure and size of potentially affected population.

3.4.2 On-site Disposal

On-site disposal would reduce waste mobility and would require monitoring and maintenance, permanent access restrictions, and other institutional controls (e.g., management of a buffer zone between the facility and surrounding areas). On-site disposal could involve in-situ containment (e.g., with caps and slurry walls) and/or construction of an engineered facility to isolate materials following their removal (e.g., via building demolition, drum consolidation, or soil excavation). Most importantly, this alternative would involve a determination of site suitability (including site capacity and consideration of its location in an urbanized area) prior to any waste removal or design and construction activities.

3.4.3 Off-site Disposal

Off-site disposal would reduce waste mobility and could require either (1) use of an existing disposal facility or (2) siting and construction of a new facility to receive the radioactively and chemically contaminated wastes from the Maywood site. An exhaustive canvass would be conducted of existing facilities that could satisfy criteria for the effective disposal of these wastes. This alternative would involve removing the wastes, satisfying transportation requirements, and complying with general operational and management requirements for the disposal facility (similar to those identified for the on-site disposal option described in Section 3.4.2). The total waste volume, without treatment, currently in the MISS pile is estimated to be about 27,000 m^3 (35,000 yd^3). The total waste volume associated with the Maywood site is estimated to be about 260,000 m^3 (340,000 yd^3) (BNI 1989zd). If the siting and construction of a new off-site disposal facility is selected to receive waste from Maywood, a separate NEPA review for more detailed assessment of site-specific impacts will be necessary.

3.4.4 On-site Treatment with On-site Disposal

On-site treatment with on-site disposal would reduce the mobility and could reduce the toxicity and/or volume of contaminated materials. This alternative would involve issues similar to those identified for the on-site disposal alternative (Section 3.4.2), in addition to issues related to the design, construction, and operation of various treatment systems to accommodate the site's contaminated materials. On-site treatment and disposal could be conducted in situ (e.g., using vitrification or cementation and capping/grouting technologies). Conversely, treatment could be conducted in an engineered facility following removal of the contaminated materials. Either method would require the implementation of institutional controls during treatment operations. With extensive treatment, it is estimated that the total waste volume could be reduced significantly.

3.4.5 On-site Treatment with Off-site Disposal

On-site treatment with off-site disposal would reduce the mobility and could reduce the toxicity and/or volume of contaminated materials. This alternative would involve issues related to on-site treatment following excavation (similar to those identified in Section 3.4.4) and issues related to off-site disposal (similar to those identified in Section 3.4.3).

3.4.6 Off-site Treatment with Off-site Disposal

Off-site treatment with off-site disposal would reduce the mobility and could reduce the toxicity and/or volume of the contaminated materials. This alternative would involve general issues related to treatment (similar to those identified in Section 3.4.4) and issues related to off-site disposal (similar to those identified in Section 3.4.3). Siting, design, construction, and operation of off-site treatment systems would be required if existing facilities were unavailable to treat all of the site's contaminated materials (e.g., radioactive and mixed wastes).

3.5 OPERABLE UNITS AND REMOVAL ACTIONS

Under the FFA executed with EPA Region II, DOE is to identify operable units in this work plan. Hence, the Maywood site has been divided into four operable units, as follows: (1) MISS, (2) the Stepan Company property, (3) commercial and governmental vicinity properties, and (4) residential vicinity properties. This grouping enables DOE to address similar problems that likely have similar solutions. It may be necessary, however, to modify these operable units sometime in the future to better manage the cleanup activities. Although portions of or complete operable units may be addressed through removal actions under the jurisdiction of DOE, operable units generally will be addressed through a record of decision (ROD). Single or multiple operable units may be addressed in each ROD. One RI/FS-EIS will be prepared to address cleanup and management of the resultant wastes from all areas of the Maywood site for which DOE has responsibility.

Under the FFA, DOE has sole responsibility for determining areas to be addressed by removal actions. Any removal action must be conducted in accordance with the FFA, CERCLA, and the NCP, and such actions are subject to EPA notification.

3.6 DATA GAPS

An evaluation of existing information on the Maywood site has identified important data gaps with respect to physical characteristics of the site, source characteristics, and nature and extent of contamination. The field sampling plan summarized in Section 4.3.1 has been prepared to obtain the data necessary to fill these gaps so that, when the RI phase is completed, sufficient data will exist for preparation of the baseline risk assessment and for detailed assessment of remedial action alternatives in the RI/FS-EIS. The current data gaps identified for completion of the RI phase are summarized in Sections 3.6.1 through 3.6.6.

3.6.1 Site Physical Characteristics

Previous studies have indicated an apparent anomaly of the groundwater flow near the Westerly Brook culvert (Figure 22). Three explanations are possible for the anomaly: (1) interaction with and flow along a relict buried stream channel, (2) near-surface groundwater recharge and flow into or along the buried Westerly Brook conduit, and (3) groundwater interaction between the upper (overburden) and the lower (bedrock) systems.

Additional studies are needed to fully understand the groundwater flow beneath MISS. These studies will include definition of the groundwater entry into Westerly Brook, identification of relict surface water channels, and evaluation of the interaction between groundwater systems. The groundwater flow anomaly and plans for investigating this anomaly are discussed in detail in the field sampling plan for MISS. Also, wells within a 4.8-km (3-mi) radius will be canvassed to determine current groundwater usage. The results of this canvass will help determine the level of additional groundwater sampling in the area.

3.6.2 Source Characteristics

Previous surveys have established that the Maywood site is radioactively contaminated with thorium, uranium, and radium. At MISS, uranium occurs in the groundwater, and both radon-222 and radon-220 occur in the adjacent areas where access is unrestricted. However, additional information is needed to determine the presence and identity of nonradioactive contaminants in media such as air, surface and subsurface soils, surface water, and groundwater. Mixed waste may also be present. The vertical and horizontal boundaries for both radioactive and nonradioactive contamination on-site has yet to be defined. Once the sources, types, and levels of contamination have been identified, the results can be used to determine the soil-to-groundwater transfer or leaching potential for these contaminants and to evaluate the significance of transport pathways (e.g., groundwater).

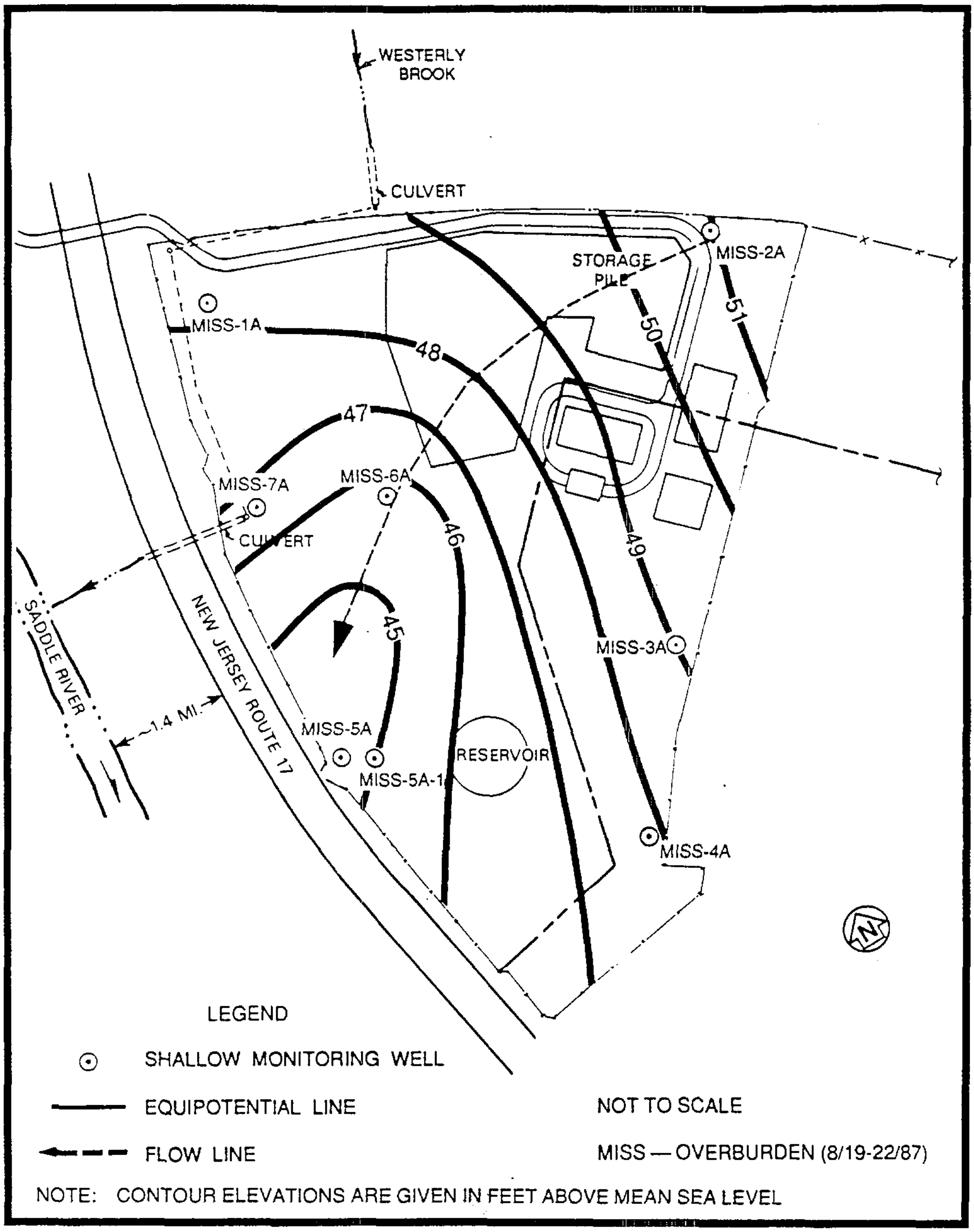


FIGURE 22 Potentiometric Contour Map of Groundwater in the Overburden Aquifer beneath the MISS

3.6.3 Nature and Extent of Contamination

Preliminary investigations have indicated that additional chemical information should be collected to better define the extent of nonradioactive and mixed waste contamination. Additional studies are also needed to confirm or refine results from previous surveys, as well as to complete the identification of contaminated properties that should be included for remedial action.

3.6.4 Treatability Studies

Additional data may be needed regarding the amenability of the various waste materials present at the Maywood site to specific treatment technologies. The results of characterization studies will be used to identify treatment technologies applicable to the contaminated materials present at the site, and waste treatability studies may be initiated to evaluate the feasibility and effectiveness of the technologies.

3.6.5 Summary of Radiological Data

Potential health risks and the need for compliance with DOE guidelines for residual radioactive material were considered in identifying the radionuclides of concern for the Maywood site for which field data are required. These radionuclides are thorium-232, thorium-230, radium-226, uranium-238, radon-222, and radon-220. For each operable unit, there are data gaps that must be filled in order to obtain the information needed to assess risk and plan for effective remediation.

Maywood Interim Storage Site. The following is a summary of existing data and data gaps for MISS:

- Subsurface and Surface Soils
  - Radium-226, uranium-238, and thorium-232 data are available.
  - Thorium-230 concentration data are needed.
  - Background concentrations in soil are needed for thorium-232, thorium-230, uranium-238, and radium-226.
  - Flux data for radon-222 are available for the interim storage pile.
- Surface Water
  - Total uranium, radium-226, and thorium-232 data are available.
  - Thorium-230 and uranium-238 data are needed.
  - Uranium-234 data can be inferred from parent data.

- Background concentrations in surface water are needed for thorium-232, thorium-230, uranium-238, and radium-226; these data should be collected to ensure that no contamination from the site is included in the measured background concentrations.

- Groundwater
  - Radium-226, thorium-230, thorium-232, uranium-234, uranium-235, uranium-238, and total uranium data are available (NJPDES permit data; BNI 1985e, 1986e, 1987g, 1988j, 1989zc, 1990a).
  - Background concentrations in groundwater are needed for each sampled radionuclide; these data should be collected to ensure that there is no interference from site contaminants.

- Air
  - Radon-222 and radon-220 data are available.

- Surface Contamination
  - For Building 76 and the pumphouse, confirmation data are needed for removable and fixed surface contamination.

Stepan Company Property. The following is a summary of existing data and data gaps for the Stepan Company property:

- Gamma exposure rate measurements are available within buildings and over most outdoor surfaces; these measurements should be confirmed.
- Limited surface and subsurface soil concentration data are available for thorium-232, uranium-238, and radium-226; additional surface and subsurface soil concentrations are needed.
- Surface and subsurface soil concentrations are required for thorium-230.
- Limited radon-222 and radon-220 sampling has been done.
- Limited measurements for fixed and removable contamination within buildings do not indicate any problems; these measurements should be confirmed.
- Groundwater data are available for radium-226, thorium-230, thorium-232, and total uranium (Adler 1991).

Commercial and Governmental Vicinity Properties. The following is a summary of existing data and data gaps for the commercial and governmental vicinity properties:

- The same data gaps that were identified for surface soils at MISS apply to surface soils and sediments for these properties.

- Wells should be canvassed to determine if and where wells exist that draw from the contaminated aquifer under MISS. Once this is accomplished, sampling should be performed for all contaminants of concern.

Residential Vicinity Properties. The data gaps identified for the commercial and governmental vicinity properties also exist for the residential vicinity properties.

3.6.6 Summary of Chemical Data

Analysis of the data available for preparation of this WP-IP indicates that too few samples have been collected to allow for a complete characterization of the nature of nonradioactive contaminants at the Maywood site. Furthermore, the areas investigated have been too limited and do not include all areas of concern, such as the residential vicinity properties. Data on background concentrations representative of this heavily industrialized area are also needed. Uncertainties associated with these data (e.g., failure to meet appropriate holding times for VOC analyses and possible sampling and laboratory contamination resulting in suspect data) indicate that these results may be inconclusive. Therefore, full characterization of the nonradioactive contamination is necessary. The objectives of this characterization should include, but not be limited to, (1) evaluation of RCRA characteristics in the waste materials and (2) comprehensive sampling and analysis, using appropriate levels of quality assurance/quality control (i.e., levels equivalent to Level III or IV, as appropriate), to fill in the data gaps identified for the Maywood site and to confirm previous results.

3.7 FEASIBILITY TESTING

Several potential remedial action technologies may require bench-scale or pilot-scale treatability studies. The remedial technologies that may warrant such testing for use at the Maywood site include:

- Building decontamination: if confirmatory surveys determine that the buildings are contaminated, on-site testing of various decontamination methods may be necessary to assess their effectiveness for specific application to the Maywood site. This information is needed to determine both feasibility and cost.

- Solids separation: historically, separation of soil and radioactive contaminants has been ineffective and highly dependent on physical characteristics of the soil and the radionuclides of concern. Bench-scale testing may be needed to determine the usefulness of this treatment approach for the Maywood soils and sediments.

- Chemical treatment: depending on the results of the RI, it may be necessary to conduct treatability studies for removing specific chemical contaminants from the soil.

- In-situ tests: technologies to immobilize the wastes may need testing to determine their applicability to the Maywood site -- for example, surface spraying for contaminated buildings and equipment, cutoff walls and grouting/stabilization for groundwater protection, and vitrification for contaminated soils and sediments.

- Groundwater treatment: removal of chemically contaminated groundwater may withdraw naturally occurring radon-222 and radon-220 gases concurrently. Before these gases are vented or withdrawn on collection media, groundwater should be sampled and pilot testing performed.

3.8 PRELIMINARY IDENTIFICATION OF REGULATORY REQUIREMENTS

Potential requirements for a proposed remedial action can be grouped into two general categories, (1) applicable or relevant and appropriate requirements (ARARs), and (2) to-be-considered requirements (TBCs). The first category consists of promulgated standards (e.g., public laws codified at the state or federal level) that may be applicable to a proposed action or relevant and appropriate to all or part of that action. The second category consists of standards or guidelines that have been published but not promulgated and that may have significance for all or part of the action (e.g., DOE Orders). Remedial actions at the Maywood site will be conducted in accordance with both ARARs and TBCs, as appropriate.

A potential ARAR is applicable if its jurisdictional prerequisites are specifically met by the conditions of the site (e.g., location in a floodplain) and/or proposed action; if the conditions of a requirement are not specifically applicable, then a determination must be made as to whether they are sufficiently similar to be considered both relevant and appropriate (e.g., in terms of contaminant similarities and the nature and setting of the proposed action). Potential TBCs are typically considered only if no promulgated requirements exist that are either applicable or relevant and appropriate. Thus, TBC requirements may be considered secondary to ARARs; in fact, they are often based on promulgated standards and can require the same degree of compliance as ARARs (e.g., DOE Orders).

In addressing each requirement that may affect a proposed action, a determination is made regarding its relationship to (1) the location of that action, (2) the contaminants involved, and (3) the specific activities that would be conducted. Location-specific requirements are based on the specific setting and nature of a site (e.g., its location in a floodplain and proximity to wetlands or the presence of archeological and cultural resources). Contaminant-specific requirements address certain chemical species or a class of contaminants (e.g., thorium or PCBs, respectively) and relate to the level of contamination allowed for a specific pollutant in soil, water, and/or air. Action-specific requirements relate to specific activities that are proposed to be implemented at a site (e.g., incineration of organically contaminated soil). Thus, the determination of potential ARARs and TBCs for a site is based on factors specific to that site and the individual action(s) proposed for implementation.

Identification of potential location- and contaminant-specific requirements is initiated during the planning stage of the RI/FS-EIS process. This identification is refined during site characterization (the RI phase) as the nature and extent of contamination and the site setting become more fully understood. Action-specific requirements are identified as the potential alternatives for the proposed action are developed in the FS phase (i.e., as the specific components of these alternatives are assembled).

The preliminary identification of potential requirements for remedial action at the Maywood site is based on the current understanding of site contamination (e.g., soil and sediments, air, building materials, surface water, and groundwater potentially contaminated with radionuclides and chemicals) and the site's location (i.e., in an urbanized area). Requirements that may affect the proposed management of the Maywood site are listed in Table 12. This list is limited to federal requirements; a list of potential state requirements will be provided by the state of New Jersey, as required under CERCLA, and will be evaluated for inclusion as the RI/FS-EIS process proceeds. Certain of these laws and orders are generically applicable to the authorization, objectives, planning, or implementation of policies or actions related to environmental response (e.g., the Atomic Energy Act and a number of federal orders). Because many of the components of this group have led to the establishment of standard policies and procedures for undertaking response actions, they will not be discussed in detail in the RI/FS-EIS report. All aspects of the proposed action would fully comply with these laws and orders. Those requirements that may have specific significance to the proposed Maywood remedial action (e.g., RCRA, the Uranium Mill Tailings Radiation Control Act, and the Clean Air Act) will be summarized and evaluated in the FS report.

TABLE 12 Federal Requirements Potentially Applicable to the Proposed Remedial Action at the Maywood Site

---

Federal Laws

Archeological and Historic Preservation Act of 1974
Archeological Resources Protection Act of 1979
Atomic Energy Act of 1954, as amended
Clean Air Act of 1963, as amended
Clean Water Act, as amended (also referred to as Federal Water Pollution Control Act of 1972, as amended)
Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986
Department of Energy Organization Act of 1977
Endangered Species Act of 1973, as amended
Fish and Wildlife Coordination Act of 1934, as amended
Hazardous Materials Transportation Act of 1974, as amended
National Historic Preservation Act of 1966, as amended
Noise Control Act of 1972
Noise Pollution and Abatement Act of 1970
Occupational Safety and Health Act of 1970
Safe Drinking Water Act of 1974, as amended
Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended by the Hazardous and Solid Waste Amendments of 1984
Toxic Substances Control Act of 1976
Uranium Mill Tailings Radiation Control Act of 1978, as amended

Executive Orders

Executive Order 11490, Assigning Emergency Preparedness Functions to Federal Departments and Agencies
Executive Order 11514, Protection and Enhancement of Environmental Quality
Executive Order 11738, Providing for Administration of the Clean Air Act and the Federal Water Pollution Control Act with Respect to Federal Contracts, Grants, or Loans
Executive Order 11807, Occupational Safety and Health Programs for Federal Employees
Executive Order 11988, Floodplain Management
Executive Order 11990, Protection of Wetlands
Executive Order 11991, Relating to the Protection and Enhancement of Environmental Quality
Executive Order 12088, Federal Compliance with Pollution Control Standards
Executive Order 12146, Management of Federal Legal Resources
Executive Order 12580, Superfund Implementation

TABLE 12 (Cont'd)

Department of Energy Orders

Order 1540.1 Materials Transportation and Traffic Management
Order 4240.1H Designation of Major System Acquisition and Major Projects
Order 4320.1A Site Development and Facility Utilization Planning
Order 4700.1 Project Management System
Order 5400.1 General Environmental Protection Program
Order 5400.3 Hazardous and Radioactive Mixed Waste Program
Order 5400.4 Comprehensive Environmental Response, Compensation, and Liability Act Requirements
Order 5400.5 Radiation Protection of the Public and the Environment
Order 5440.1D National Environmental Policy Act Compliance Program
Order 5480.1B Environment, Safety, and Health Program for Department of Energy Operations
Order 5480.4 Environmental Protection, Safety, and Health Protection Standards
Order 5480.11 Radiation Protection for Occupational Workers
Order 5481.1B Safety Analysis Review System
Order 5482.1B Environmental Protection, Safety, and Health Protection Appraisal Program
Order 5483.1A Occupational Safety and Health Program for Government-Owned Contractor-Operated Facilities
Order 5484.1 Environmental Protection, Safety, and Health Protection Information Reporting Requirements
Order 5000.3 Unusual Occurrence Reporting System
Order 5500.2 Emergency Planning, Preparedness, and Response for Operations
Order 5700.6B Quality Assurance
Order 5820.2 Radioactive Waste Management

4.0 WORK PLAN-IMPLEMENTATION PLAN RATIONALE

4.1 OVERVIEW OF DATA OBJECTIVES AND PROPOSED ACTIVITIES

A major element of the RI/FS-EIS process is obtaining sufficient site-specific information to allow for an assessment of remedial action alternatives. Collection and documentation of data are conducted during the RI phase; analysis of alternatives is conducted in the FS-EIS phase. As described in Section 3.5, the RI/FS-EIS for the Maywood site will include four operable units: (1) MISS (owned by DOE), (2) the property owned by Stepan Company, (3) commercial and governmental vicinity properties, and (4) residential vicinity properties. The data objectives and field activities associated with each operable unit are summarized in Table 13. The proposed activities for each operable unit are discussed in Sections 4.1.1 through 4.1.4.

4.1.1 Maywood Interim Storage Site

The MISS operable unit consists of the property owned by DOE. A radiological characterization report was issued in 1987 (BNI 1987f); however, additional characterization will be required (Section 3.6) because of the limited nature of the chemical characterization work performed to date. Future characterizations will include comprehensive chemical as well as radiological investigations of the groundwater, surface water, and soils.

One of the objectives for future field activities is to investigate what appears to be a groundwater anomaly. Groundwater flow beneath MISS is not completely understood, and this potential migration pathway needs to be evaluated further. The apparent anomalous flow will be investigated by installing two additional wells on the site to monitor the shallow and deep groundwater systems. Once they are installed, water levels in these wells will be monitored weekly for at least 1 year. These newly installed wells will also be sampled quarterly for radioactive and chemical contaminants, as described in the field sampling plan. The additional water-level measurements and contaminant concentrations should allow evaluation of groundwater transport of contaminants. In addition to the proposed new wells, all existing wells will have water levels monitored on a weekly basis for at least 1 year. These data will be incorporated into the existing water level data base for the other wells to see if a consistent groundwater flow pattern occurs on the site.

Additional field sampling will be carried out to determine the range of potential chemical contamination at MISS. Surface water and sediment samples will be analyzed to determine if contamination is migrating into Westerly Brook, a tributary of the Saddle River. Borehole sampling will be used to define the vertical and horizontal boundaries of any chemical contamination. Boreholes will be drilled in on-site soils and samples collected for chemical analyses. In each borehole, a composite sample over the entire depth of radioactive contamination will be analyzed for RCRA characteristics to determine if hazardous wastes are commingled with radioactive wastes. In addition, a discrete interval will be sampled in 50 percent of the boreholes and the samples analyzed for metals and

TABLE 13 Summary of Data Objectives and Field Activities for the Maywood Site

		Field Activities		
Operable Unit/Data Objectives	Status	Chemical Characterization	Radiological Characterization	Geological/Physical Characterization
Maywood Interim Storage Site				
Determine nature and extent of contamination; identify indicator contaminants; determine presence of hazardous (RCRA) waste.[a]	Completed	Limited soil, air, and groundwater sampling for priority pollutant constituents; testing of soil samples for RCRA characteristics.	NRC radiological survey; EG&G aerial radiological survey; BNI characterization and ongoing monitoring for environmental reports.	Installation of 29 monitoring wells.
	Planned	Analyze soil samples from 20 boreholes for VOCs, semivolatiles, metals, mobile ions, pH, and RCRA characteristics; the Toxicity Characteristic Leaching Procedure (TCLP) tests will also be performed.	Analyze soil samples and do gamma logging for 20 boreholes; analyze for thorium-232, radium-226, and uranium-238.	Install 20 chemical boreholes
		Analyze soil samples for TCLP (metals only),[b] sulfide and cyanide reactivity, and total petroleum hydrocarbons (TPHs).[c]	None.	Drill about 37 holes in storage pile.
		Analyze soil samples for VOCs and semivolatiles as confirmation of previous data.	None.	Drill 8 holes.
		Analyze groundwater samples from 29 existing wells for VOCs, semivolatiles, metals, mobile ions, pH, temperature, specific conductance, and dissolved oxygen.	Analyze groundwater samples from 29 existing wells for thorium-232, thorium-230, radium-228, radium-226, and uranium-238.	None.

TABLE 13 (continued)

Operable Unit/Data Objectives	Status	Field Activities: Chemical Characterization	Field Activities: Radiological Characterization	Field Activities: Geological/Physical Characterization
Maywood Interim Storage Site (Cont'd)				
Investigate potential migration into Westerly Brook; explain apparent groundwater anomaly.	Completed	None.	None.	None.
	Planned	Analyze groundwater samples for VOCs, semivolatiles, metals, mobile ions, pH, temperature, specific conductance, and dissolved oxygen.	Analyze groundwater samples for thorium-232, thorium-230, radium-228, radium-226, and uranium-238.	Install 2 monitoring wells.
Determine well locations and potential groundwater contamination in the area.	Completed	None.	None.	None.
	Planned	Analyze groundwater samples for VOCs, semivolatiles, metals, mobile ions, pH, temperature, specific conductance, and dissolved oxygen.	Analyze groundwater samples for thorium-232, thorium-230, radium-228, radium-226, and uranium-238.	Canvass area wells.
Assess treatability studies.	Completed	None.	None.	None.
	Planned	Perform bench-scale tests, as required, to determine feasibility of treatment technology if literature search is inconclusive.	Perform bench-scale tests, as required, to determine feasibility of treatment technology if literature search is inconclusive.	Perform bench-scale tests, as required, to determine feasibility of treatment technology if literature search is inconclusive.
Investigate radon/thoron levels and measurement methods.	Completed	Not applicable.	Ongoing measurements for environmental monitoring reports.	Not applicable.
	Planned	Not applicable.	Cross-check thoron measurement methods; determine source of elevated radon/thoron levels.	Not applicable.

TABLE 13 (continued)

Operable Unit/Data Objectives	Status	Field Activities		
		Chemical Characterization	Radiological Characterization	Geological/Physical Characterization
Stepan Company Property				
Identify health and safety concerns.	Completed	Routine well sampling for evironmental monitoring reports.	Routine well sampling for environmental monitoring reports.	Installation of monitoring wells.
	Planned	Perform sampling as required.	Perform routine well sampling for environmental monitoring reports.	None.
Determine extent of surface and subsurface radioactive contamination.	Completed	Responsibility of Stepan Company.	NRC radiological survey; EG&G aerial radiological survey; Nuclear Safety Associates survey.	None.
	Planned	Perform sampling as required.	Perform characterization studies.	Evaluate potential groundwater pathway.
Determine extent of surface contamination in buildings.	Completed	Not applicable.	Nuclear Safety Associates survey.	Not applicable.
	Planned	Not applicable.	Collect air samples and smear samples; measure gamma exposure rates.	Not applicable.
Determine hazardous/RCRA characteristics in wastes known to be radioactive.	Completed	None.	None.	Not applicable.
	Planned	Analyze wastes for TCLP (metals only),[b] total PCBs, TPHs,[c] and sulfide and cyanide reactivity.	Not applicable.	Not applicable.
Commercial and Governmental Vicinity Properties				
Identify health and safety concerns; define extent of contamination; determine RCRA characteristics in wastes known to be radioactive.	Completed	Soil/sludge sampling at Sunoco, Sears, Scanel, and Hunter-Douglas properties.	Radiological characterization studies in 1985, 1986, 1987, and 1988.	None.
	Planned	Analyze wastes for TCLP (metals only),[b] total PCBs, TPHs,[c] and sulfide and cyanide reactivity.	Characterize and designate additional properties as required.	None.

TABLE 13 (continued)

		Field Activities		
Operable Unit/Data Objectives	Status	Chemical Characterization	Radiological Characterization	Geological/Physical Characterization
<u>Residential Vicinity Properties</u>				
Identify health and safety concerns; define extent of contamination; determine RCRA characteristics in wastes known to be radioactive.	Completed	None.	Radiological characterization studies in 1986, 1987, and 1988.	None.
	Planned	Analyze wastes for TCLP (metals only)[b] total PCBs, TPHs,[c] and sulfide and cyanide reactivity.	Characterize and designate additional properties as required.	None.

[a]Hazardous (RCRA) wastes for the Maywood site are as defined by the NJDEP (1989).

[b]The complete TCLP test, including organic constituents, will be performed on 10 percent of the samples.

[c]Samples yielding more than 1,000 ppm TPH would be analyzed for EPA priority pollutants.

components on the Target Compound List (TCL). Also, a discrete interval below the zone of radioactive contamination will be sampled in each borehole and the samples analyzed for metals and TCL.

NJDEP is concerned that mixed waste (i.e., radioactive waste contaminated with RCRA-characteristic materials) could be present in the storage pile at MISS. The pile was sampled in the fall of 1990 with the objective of determining the extent of potential mixed waste in the interim storage pile and surrounding soils.

Additional data may be collected in the future to support technology evaluations for the FS-EIS phase. The objective would be the performance of treatability studies to evaluate the possibility of reducing the mobility and/or volume of contaminated materials.

4.1.2 Stepan Company Property

The Stepan Company property operable unit is comprised of the land currently owned by the Stepan Company, including the plant proper and associated warehouses. The Stepan Company is negotiating amendments to a consent order with EPA to perform an RI/FS on the Stepan property. DOE assumes that the Stepan Company will be responsible for all chemical characterization activities. Thus, the DOE effort on the Stepan Company property will concentrate on characterizing the radioactive contamination and testing for RCRA characteristics in the radioactive wastes. The current field sampling plan for the Maywood site does not include chemical characterization activities because of ongoing negotiations and sampling activities being considered by EPA and Stepan Company at this property. The field sampling plan will be supplemented, as needed, based upon the results of these negotiations.

To date, no sampling and analysis have been performed by DOE on this operable unit; however, DOE will perform radiological characterization in the future. The data objectives include:

- Defining the hydrogeological conditions,
- Confirming the presence or absence of potential contaminants, both radioactive and chemical, and
- Identifying additional contaminants of concern and determining their specific concentrations as well as background concentrations.

Additional treatability studies may be performed by DOE for the contaminated materials identified on the Stepan Company property for which DOE has responsibility. The objective of these studies would be to evaluate if certain technologies can effectively reduce the volume or toxicity of the wastes; these studies cannot be identified at this time because characterization activities have not been completed. Several buildings exist on the Stepan Company property. Depending on the results of the characterization, these buildings might have to be decontaminated or dismantled.

4.1.3 Commercial and Governmental Vicinity Properties

The objectives of data collection for the commercial and governmental vicinity properties operable unit include:

- Defining the vertical and horizontal extent of radioactive contamination,
- Identifying potential health and safety concerns associated with characterization and remediation, and
- Evaluating the presence of RCRA characteristics in radioactively contaminated wastes.

These objectives will be attained by surface walkover surveys and limited soil sampling. The current field sampling plan focuses on characterization needs for the MISS and does not include the commercial and governmental vicinity properties operable unit, although characterization of the MISS may require off-site work to obtain the necessary data. The plan will be supplemented, as needed, to fully characterize the commercial and governmental vicinity properties following completion of currently planned activities.

4.1.4 Residential Vicinity Properties

The objectives of data collection for the residential vicinity properties operable unit are identical to those for the commercial and governmental vicinity properties, namely:

- Defining the vertical and horizontal extent of radioactive contamination,
- Identifying potential health and safety concerns during characterization and remediation, and
- Evaluating the presence of RCRA characteristics in radioactively contaminated wastes.

As for the commercial and governmental properties, additional characterization on the residential properties will be performed, as needed, following completion of currently planned activities and evaluation of resultant data.

4.2 DATA QUALITY OBJECTIVES

Data quality objectives are qualitative and quantitative statements that specify the quality of the data required to support decisions during remedial activities. Data quality objectives are applicable to all data collection activities, as well as to preliminary assessments/site inspections, remedial investigations, feasibility studies, remedial design, remedial action, and verification. The level of detail and the quality of data that are required vary according to the intended uses of the data.

The EPA guidance on data quality objectives (EPA 1987) establishes five levels of data quality applicable to various data gathering activities during the RI/FS process. Table 14 summarizes the analytical levels and their uses. These levels apply only to chemical contaminants; there are no corresponding levels for radioactive contaminants. Table 15 provides EPA guidance on the appropriate level of data quality for the stages of an RI/FS. As shown, significant overlap can occur in the levels allowable for a certain activity. In general, however, the degree of data quality required increases as the risk associated with utilizing incorrect data increases.

The required analytical level can range from Level I to Level V. Although data quality equivalent to Level III is common to most data needs and may be sufficient for most purposes, future analyses will include data quality up to Level IV if determined to be appropriate. However, because determination of potentially responsible parties is not required for DOE at the Maywood site, data above Level IV may not be required. The analytical procedures used to evaluate chemical data were derived from those found in the contract laboratory program (CLP) as well as other EPA procedures. Standard industry methods were used to ensure the quality of the radiological analyses. For both the radiological and chemical analyses, these controls should be adequate to achieve analytical levels equivalent to Levels III and IV. Additional details on the data quality objectives are provided in the quality assurance project plan for the Maywood site.

4.3 SAMPLING AND ANALYSIS PLAN RATIONALE

The sampling and analysis plan for the Maywood site actually consists of two individual documents, the field sampling plan and the quality assurance project plan. The sampling and analysis plan provides detailed descriptions of how, when, and where samples are collected during the site investigation and describes the types of radiological and chemical analyses that are performed on the collected samples. The quality assurance project plan provides procedures undertaken to ensure the quality and integrity of the collected data. Brief summaries of the field sampling plan and quality assurance project plan for the Maywood site are presented in Sections 4.3.1 and 4.3.2.

4.3.1 Field Sampling Plan

The field sampling plan documents the field activities that are planned to be undertaken at the Maywood site. It includes the site characterization rationale, a summary of existing data, RI data requirements, sample types and measurements, sampling frequency, analytical procedures, and an operating plan for the site. The field activities associated with the Maywood site were selected to address site characteristics and waste properties that would be useful in identifying permanent solutions and appropriate treatment technologies. The data collected from the field activities will also be used to support data needs for the modeling effort for engineering analyses and for human health and environmental risk assessment. The field sampling plan has been issued as a separate document (BNI 1990c).

The field sampling plan identifies data gaps (summarized in Section 3.6) and describes proposed activities to accomplish data objectives. The data objectives for the

TABLE 14 Summary of Generic EPA Guidance Regarding Analytical Levels Appropriate to Data Uses

Data Uses	Analytical Level	Type of Analysis	Limitations	Data Quality
Site characterization Monitoring during implementation	I	• Total organic/inorganic vapor detection using portable instruments • Field test kits	• Instruments respond to naturally occurring compounds	• If instruments calibrated and data interpreted correctly, can provide indication of contamination
Site characterization Evaluation of alternatives Engineering design Monitoring during implementation	II	• Variety of organics by gas chromatography; inorganics by atomic absorption; X-ray fluorescent analyzer • Tentative identification; analyte-specific • Detection limits vary from low ppm to low ppb	• Tentative identification • Techniques/instruments limited mostly to volatiles, metals	• Dependent on quality assurance/ quality control steps employed • Data typically reported in concentration ranges
Risk assessment Determination of potentially responsible parties Site characterization Evaluation of alternatives Engineering design Monitoring during implementation	III	• Organics/inorganics using EPA procedures other than Contract Laboratory Program (CLP) procedures • Tests for RCRA hazardous waste characteristics, as given in 40 CFR Part 261, Subpart C	• Tentative identification in some cases • Can provide data of same quality as Level IV	• Similar detection limits to CLP • Less rigorous quality assurance/ quality control
Risk assessment Determination of potentially responsible parties Evaluation of alternatives Engineering design	IV	• Organics/inorganics (Hazardous Substances List [HSL]) by gas chromatography/mass spectrometry; atomic absorption; inductively coupled plasma • Low ppb detection limit	• Tentative identification of non-HSL parameters • Some time may be required for validation of packages	• Goal is data of known quality • Rigorous quality assurance/ quality control
Risk assessment Determination of potentially responsible parties	V	• Nonconventional parameters • Method-specific detection limits • Modification of existing methods • Hazardous constituents identified in 40 CFR Part 261, Appendix VIII	• May require method development/modification • Mechanism to obtain services requires special lead time	• Method-specific

Source: Adapted from EPA (1987).

TABLE 15 Summary of Generic EPA Guidance Regarding Appropriate Analytical Levels According to Data Uses

	Appropriate Analytical Level				
Data Uses	I	II	III	IV	V
Site characterization (including health and safety)	X	X	X	-	-
Risk assessment	-	-	X	X	X
Evaluation of alternatives	-	X	X	X	-
Engineering design of remedial action	-	X	X	X	-
Monitoring during implementation of remedial action	X	X	X	-	-
Determination of potentially responsible parties	-	-	X	X	X

Source: Data from EPA (1987).

Maywood site include a description of the physical characteristics of the site, identification of contaminant sources and migration pathways, and determination of the applicability of various treatability studies. These data objectives are summarized in Section 4.1 of this WP-IP. A phased characterization approach is being utilized for field sampling activities and data evaluation; this approach is discussed in detail in the field sampling plan. The types of sampling and analyses for the Maywood site include radionuclides, metals, mobile ions, organic compounds, and geochemical and engineering parameters. The field sampling plan will be supplemented, as needed, prior to initiating additional characterization activities. The field sampling plan and associated documents (quality assurance project plan, health and safety plan, and community relations plan) have been issued for public review and comment (BNI 1990b, 1990c, 1990d, 1990e).

4.3.2 Quality Assurance Project Plan

The quality assurance project plan outlines the quality assurance/quality control requirements that were implemented to ensure the defensibility and integrity of analytical data collected for the Maywood site. The quality assurance project plan defines goals for the level of the quality assurance effort and data requirements in terms of precision, accuracy, representativeness, completeness, and comparability. The overall quality assurance objective is to develop and ensure implementation of procedures for field sampling, chain of custody, laboratory analysis, and reporting that will provide legally defensible data. The quality assurance objectives are categorized into analytical requirements, data quality objectives, and sample handling objectives. The quality assurance project plan has been issued as a separate document (BNI 1990e).

4.4 SUMMARY OF OTHER MAJOR PLANS

4.4.1 Health and Safety Plan

A health and safety plan has been developed for the Maywood site to ensure the health and safety of on-site personnel during the performance of site characterization and response action activities. The plan includes the safety standards that must be met by all personnel and subcontractors performing on-site activities. Addressing the health and safety of on-site personnel also serves to minimize any potential impacts to the general public and the nearby environment. Key elements of the health and safety program for the Maywood site include:

- Using appropriate protective equipment and safeguards;
- Identifying areas where specific safety hazards exist;
- Training on-site personnel in the proper use of safety equipment and adherence to written procedures;
- Performing medical surveillance of on-site personnel, including radiological and nonradiological bioassays;

- Developing standard operating procedures and procedures to be followed in emergency situations; and

- Holding periodic meetings to reemphasize the salient features of the health and safety program, existing site conditions, and any changes in site conditions.

The health and safety plan is being issued as a separate document (BNI 1990d).

4.4.2 Community Relations Plan

A community relations plan has been developed for the Maywood site to ensure effective exchange of information with the general public. This plan was developed using DOE's previous experience with the affected community, EPA guidance relative to community relations, and interviews conducted with key individuals in the affected community. The Maywood site community relations plan summarizes background information about the site, describes the history of community involvement, describes community relations strategies, provides a schedule of community relations activities, and lists affected and interested groups and individuals. This plan, which was tailored to the needs of the Maywood site, provides for meaningful exchange of information on such matters as potential health impacts, environmental issues, remedial action plans, project costs, and specific site activities. The community relations plan for the Maywood site has been issued as a separate document (BNI 1990b).

5.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY–ENVIRONMENTAL IMPACT STATEMENT TASKS

The EPA has defined fourteen standard tasks as comprising the RI/FS process in *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988a). This task structure will be used in implementing the RI/FS-EIS process for the Maywood site and should enhance coordination with EPA Region II, the State of New Jersey, and local citizens and officials. The RI/FS tasks and the phased approach suggested by EPA are shown in Figure 23 and are briefly described in Sections 5.1 through 5.14. Reference is included to other sections of this WP-IP and to other project documents, including those for vicinity properties, to explain the means by which these 14 tasks are being implemented for the Maywood site.

To date, 82 vicinity properties in Maywood, Lodi, and Rochelle Park have been designated as contaminated; 2 additional properties are believed to be contaminated but have not been designated. Characterization for the Maywood site is ongoing, with field sampling taking place in the fall of 1989 and the fall of 1990. Additional field work will be undertaken to complete the remaining characterizations and to fill any data gaps identified as the RI/FS-EIS process continues.

Cumulative impacts of the Maywood, Wayne, and Middlesex sites will be addressed in future documents. The intent is not to address overlapping contamination problems because there do not appear to be any and the distances between sites are too great; rather, the intent is to avoid duplication and to address common issues (such as treatability studies) that might be mutually applicable, to look at potentially common disposal options, to look at ARAR compliance from a broader perspective, and to collectively work with the various federal and state agencies and communities where issues are common.

5.1 TASK 1: PROJECT PLANNING

The project planning task initiates the RI/FS-EIS process and establishes the project basis by:

- Collecting and documenting the CERCLA scoping information (Chapters 1 and 2),
- Collecting and evaluating existing data (Sections 2.1, 2.3, and 2.4),
- Developing a conceptual site model (Section 3.1),
- Identifying preliminary response objectives and potential remedial action alternatives (Sections 3.3 and 3.4),
- Identifying operable units and potential removal actions (Section 3.5).

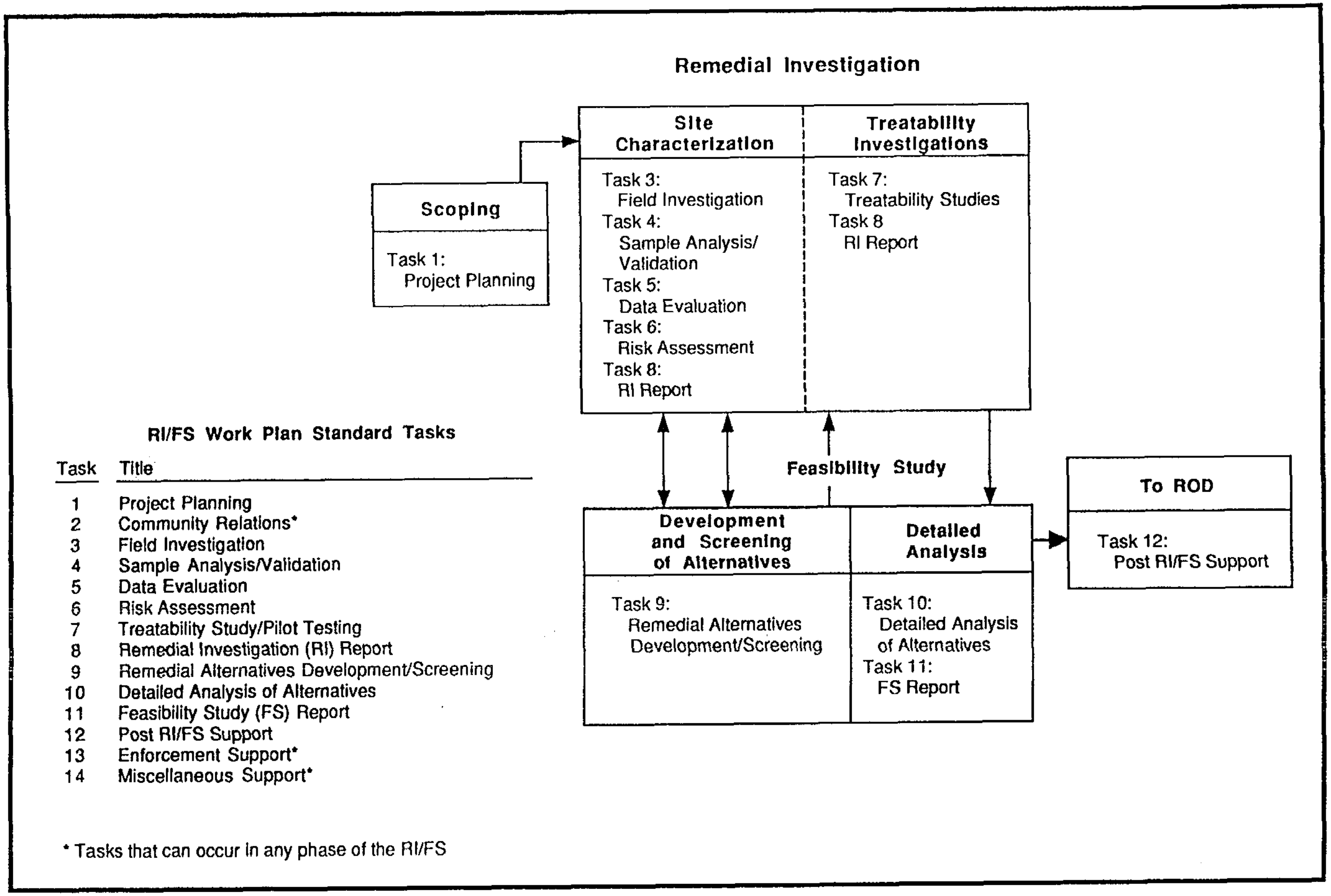


FIGURE 23 Relationship of RI/FS Tasks to Phased RI/FS Approach

- Identifying various feasibility studies to support the RI/FS-EIS process (Section 3.7),

- Compiling a list of potential federal ARARs (Section 3.8),

- Determining data needs and defining data quality objectives (Sections 3.6, 4.1, and 4.2),

- Identifying major project plans, including the field sampling plan and the quality assurance project plan (Section 4.3),

- Documenting RI/FS tasks (Chapter 5), and

- Developing schedules for completion of major project elements and identifying project organization and project management (Chapter 6).

All of these elements are included in this WP-IP, which constitutes an overview of project planning for the Maywood site RI/FS-EIS process. All project scoping required under CERCLA has been completed. The NEPA scoping process was initiated when the Notice of Intent describing the proposed action was published in the *Federal Register* (November 16, 1990) and distributed to those persons and agencies who might be interested or affected. During the public comment period, a public meeting was held (December 6, 1990) to receive oral and/or written comments on the proposed action. The results of the NEPA scoping process, including an analysis of public and agency comments to identify significant issues and describe how they will be resolved, are presented in Appendix C. Responses to public scoping comments are included in Appendix D. Many elements described in this WP-IP are summaries of more comprehensive documents. Each of the summaries contained in the WP-IP reflects the current status of the respective task. Information in this WP-IP will be updated in the future, as appropriate.

5.2 TASK 2: COMMUNITY RELATIONS

Task 2 incorporates all efforts related to the preparation and implementation of the community relations plan. Community relations were initiated for the Maywood site in 1984 when DOE assumed control of the site. These efforts have continued to date, and a community relations plan has been prepared consistent with EPA requirements. These efforts will continue until the RI/FS-EIS process has been completed and the selected remedy is implemented. The community relations plan for the Maywood site includes background information about the site, the history of community involvement, community relations strategies, a schedule of community relations activities, and a list of affected and interested groups and individuals. The plan also addresses interviews with members of the community to determine (1) citizen concerns, (2) information needs, and (3) how and when citizens wish to be involved in the RI/FS-EIS process. The community relations plan describes the activities that DOE will undertake to ensure a full program of public participation.

DOE has been providing information about its remedial activities to officials, environmental groups, and the media in the Maywood area for several years through news releases, fact sheets, and briefings. These mechanisms will continue to be used to inform the public. An information repository has been established at the borough of Maywood library located at 459 Maywood Avenue in Maywood, New Jersey, to provide the public with access to documentation related to the RI/FS-EIS process, including transcripts of relevant public meetings.

5.3 TASK 3: FIELD INVESTIGATION

Task 3 includes all efforts related to field work performed to conduct the RI for the Maywood site. Planned field activities have been completed; if additional field investigations are required as the RI/FS-EIS progresses, they will be scheduled, as needed, and the field sampling plan will be supplemented to identify the means by which data will be acquired. This approach (summarized in Section 4.1) was devised to ensure that these investigations are conducted in a systematic and cost-effective manner.

5.4 TASK 4: SAMPLE ANALYSIS/VALIDATION

Sample analyses are being performed by two independent laboratories subcontracted by BNI. Thermo Analytical/Eberline (TMA/E) Laboratory performs the radiological analyses using standard industry practices and DOE-accepted methods. The Roy F. Weston Analytical Laboratory (Weston) analyzes those samples requiring chemical analyses. The chemical analyses follow the technical specifications set forth in the BNI/Weston subcontract with regard to analytical methods, quality control measures, and data acceptability consistent with EPA guidelines. Quality control is accomplished by internal and external audits, analyses of quality control samples, and participation in laboratory intercomparison tests. These procedures provide for an analytical level equivalent to Level III (see Section 4.2).

Data validation includes all efforts related to ensuring that analytical data are sufficiently accurate and precise to meet the appropriate level of data quality objectives for a particular piece of information. The integrity of data is validated by checking the quality control data associated with the sample analysis. This activity is conducted in accordance with *Functional Guidelines for Evaluating Organics Analyses* (EPA 1988c) and *Functional Guidelines for Evaluating Inorganics Analyses* (EPA 1988b). In practice, data validation includes manual and/or computerized checking of the data against checklists. These checklists have been developed to guide the data reviewer through the validation process and to consistently recognize data that are suspect. Although the checking differs for each type of data generated (i.e., field gamma scans, radioisotopic analyses, volatile organics analyses, and RCRA characteristic testings), common elements include items such as completeness of data, acceptability of detection limits, indications of field or laboratory contamination of samples, and reproducibility of results. Plans for data validation have been prepared to assist in this activity.

5.5 TASK 5: DATA EVALUATION

Task 5 includes efforts related to evaluating the data after they have been validated under Task 4. The task begins when the first set of validated data is received and ends during preparation of the RI report when it is determined that no additional data are required. For the Maywood site, Task 5 is being performed concurrently with data validation.

Data evaluation tasks are intended to provide the information needed to complete the RI/FS-EIS process. For example, groundwater data collected during the RI that have been validated should complete the understanding of the groundwater system present at the Maywood site. The measured concentrations of uranium, thorium, radium, and various chemical contaminants in the aquifers — in conjunction with identified groundwater receptors — will enable calculation of the potential health risk to members of the public who may drink this groundwater.

Typical products of the data evaluation task for the Maywood site will include drawings delineating the boundaries of contamination for the different contaminants present, tables listing contaminant concentrations for the various media, quantification of migration pathways as appropriate, and tabulation of engineering data (such as waste volume) necessary for evaluating the remedial action alternatives. All calculations will be documented in calculation logs and checked by an independent reviewer before sign-off. Where computations are performed with computer programs, either validated software will be used or the calculation methods will be hand-verified. The procedures used will be provided in the RI report.

5.6 TASK 6: RISK ASSESSMENT

Task 6 consists of efforts related to assessing potential risks to human health and the environment. It includes assessment of baseline risks during the RI, setting of preliminary performance goals for conducting the FS, and comparison of risks among evaluated alternatives. Work begins during the data evaluation task and ends during the evaluation of remedial action alternatives. Efforts on Task 6 have not yet been initiated but are scheduled to begin in the near future.

After the site characterization data have been validated and evaluated, a baseline risk assessment will be carried out to determine potential threats to human health and the environment in the absence of any remedial action at the Maywood site. To evaluate the hazards posed by current site conditions, the assessment will analyze the environmental transport pathways to potential receptors from areas where radioactive and chemical contaminants are currently located. The risk assessment will also be used to assist in screening alternatives and determining acceptable levels of residual contamination (i.e., cleanup limits) for radioactive and chemical species. An overview of the risk assessment process is shown in Figure 24.

The first step in the risk assessment process is the collection and evaluation of site data in order to identify the contaminants present at the site that would be the focus of the

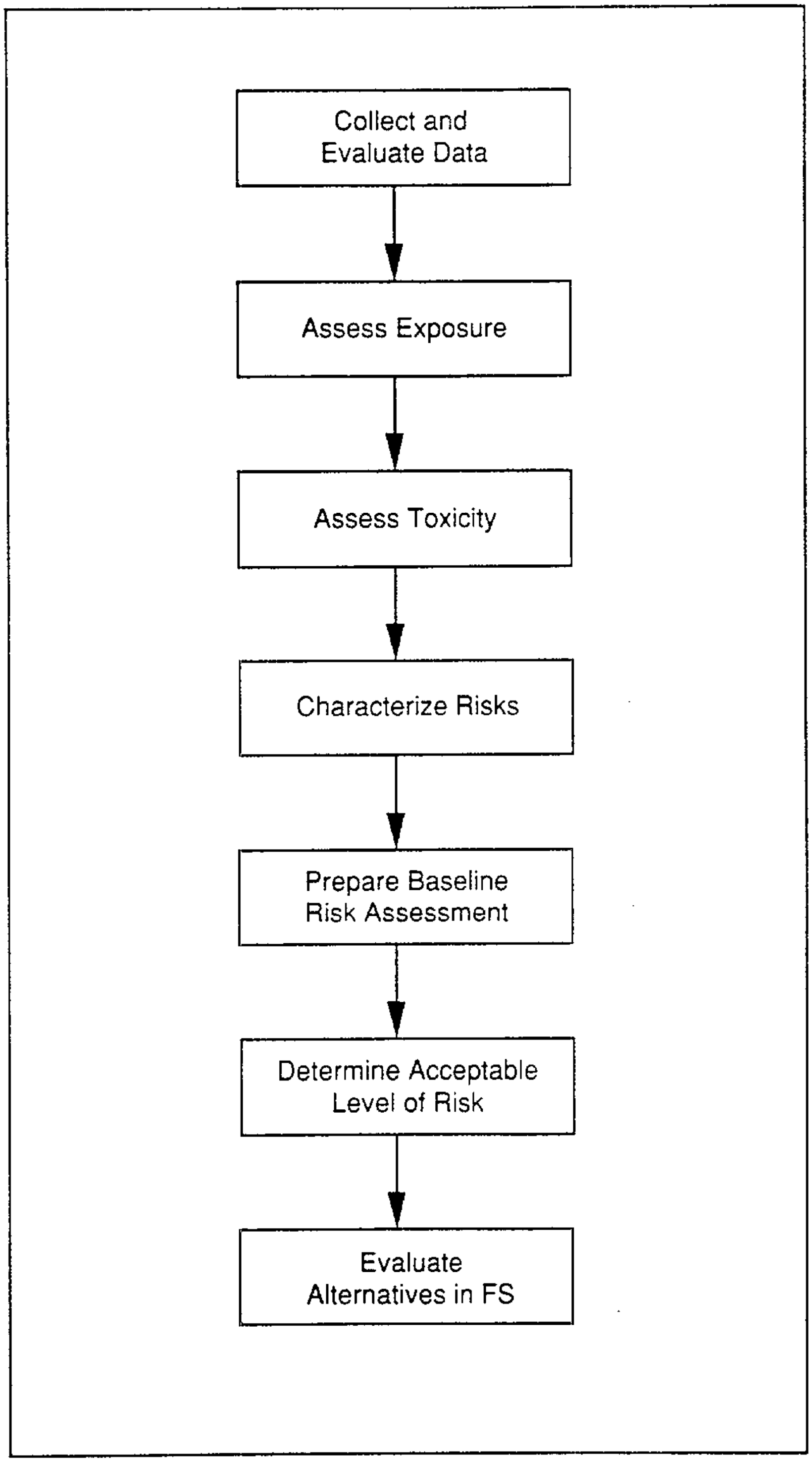


FIGURE 24 Overview of the Risk Assessment Process

risk assessment. The second step is assessing exposure. This involves analyzing contaminant releases, identifying exposed populations, identifying all potential pathways of exposure, estimating exposure point concentrations for specific pathways, and estimating contaminant intakes for specific pathways. Possible pathways that will be evaluated for the Maywood site include soil, sediment, groundwater, surface water, air, and external radiation exposure (see Section 3.1). Information from the literature and earlier site studies regarding environmental chemistry and contaminant fates will be considered and incorporated, where valid and applicable, in all estimates of chemical and radionuclide exposure point concentrations. The baseline risk assessment will evaluate existing data to confirm that the pollutant transport models adequately reflect conditions at the site and to determine where additional data are needed to properly characterize risks.

The risk assessment for both chemicals and radionuclides will be conducted based upon the approach outlined in EPA's *Risk Assessment Guidance for Superfund* (RAGS) (EPA 1989b). The four steps in risk assessment are (1) data evaluation and identification of contaminants of concern, (2) exposure assessment, (3) toxicity assessment, and (4) risk characterization. Contaminants to be assessed are radionuclides and those chemicals for which DOE has responsibility under the Federal Facilities Agreement (see Section 1.4.2).

Site-specific background data for the radioactive contaminants of concern (listed in Section 3.1.2) will be gathered in accordance with the field sampling plan, if not already available from past surveys or ongoing monitoring. Site data exceeding radiological background levels will be used, under plausible scenarios, to estimate committed effective dose equivalents or, for radon-222 and radon-220, the exposure dose in working level months. Risks will be computed. The RAGS approach will be followed to the maximum extent feasible.

Risk assessment for chemicals will also follow the RAGS approach. In applying RAGS guidance, site-specific chemical background data will be used, where available, to distinguish between the abundant local industrial contaminants and the potential Maywood site contaminants. Where site-specific chemical background data are not available, other background data gathered for the region will be used or, as a final resort, the background level for a particular parameter will be considered to be zero.

No substantial chemical contamination is indicated from the limited chemical data collected to date. Metals are the only known contaminants of concern, and these are present at moderate levels. However, past field work has concentrated on radiological sampling, and chemical contamination is largely uncharacterized. Field sampling efforts are planned to further characterize the nature and extent of the nonradiological contamination.

For both radionuclides and chemicals, separate calculations will be made to characterize doses associated with critical areas of the site (i.e., residential properties) or critical populations (i.e., remedial action workers). The scenarios described in Section 3.1.4 and outlined in Figures 18 through 21 are appropriate to assess current conditions and future land uses.

Atmospheric modeling will probably be limited to radon-222 at MISS and to fugitive dust. It is expected that the area source code MILDOS-AREA (Yuan et al. 1989) will be used in modeling radon, radon flux, and radioactive fugitive dust. The RESRAD code, DOE's code for implementing its residual radioactivity guidelines (Gilbert et al. 1989), can be used to compute radiological doses from the following pathways: ingestion of plants and aquatic foods, ingestion of drinking water from groundwater and surface water sources, inhalation of fugitive dust, direct gamma-ray exposure, and exposure to indoor radon. The RESRAD code has provisions for projecting exposure periods up to 10,000 years into the future. If required, the Industrial Source Complex (ISC) code (Bowers et al. 1979) will be used to model airborne chemical contaminants.

Radiological risk estimators will be drawn from guidance of the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurement (NCRP), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the National Research Council's Committee IV on the Biological Effects of Ionizing Radiations (BEIR IV, National Research Council 1988), and EPA's background document for the Clean Air Act (EPA 1989c). DOE is in the process of evaluating radiological slope factors in EPA's *Health Effects Assessment Summary Tables* (EPA 1989a) and BEIR V (National Research Council 1990). Until their review is complete, these sources cannot be used for radiological calculations. Direct contact with radionuclides will be handled simply, through multiplying exposure rate by the time relevant to the scenario by the appropriate risk factor.

Chemical risk assessment is anticipated to be a phased process starting with simple, worst-case calculations and progressing to complex computer modeling only if warranted by field sampling results and the results of simple calculations. The initial calculations will be based upon the premise of worst-case consequences if there is no dilution by spreading and no degradation with time. In this way, the upper limit on both current and future land uses can be set for each specific area of concern within the Maywood site. Potential exposure pathways are discussed in Section 3.1.3 and illustrated in Figures 18 through 21.

It is anticipated that the ecological assessment will be very limited because of the urban, industrial nature of the site. The intention is to work with the State of New Jersey in identifying species common to the area and in selecting species, if appropriate, for ecological assessment.

In all cases, prior to initiating the risk assessment effort, DOE intends to secure concurrence from EPA and the State of New Jersey on the selection of exposure pathways to be assessed, the specific methodologies, and, if appropriate, the computer modeling codes to be utilized.

Identification of sensitive receptors near the site will be based on demographic records and standard demographic statistical techniques. A population activity profile will be developed, based on area land use and population structure, to delineate exposure coefficients required for a quantitative evaluation of risks. The baseline risk assessment ends with the characterization of risks to human health and the environment in the absence of any remedial action at the site. The risk assessment process continues in the FS phase with an evaluation of risks associated with various remedial action alternatives.

In the risk assessment process for the Maywood site, the chemical and radiological risks will be analyzed separately to allow for a clear presentation of the source of risk (i.e., radiological or chemical). Combining the radiological and chemical risks could mask distinct information that would aid in the selection of the appropriate remedy. The total risk, which is the sum of the radiological and chemical risks, will also be provided.

5.7 TASK 7: TREATABILITY STUDIES/PILOT TESTING

Task 7 includes efforts related to the performance of pilot-scale or bench-scale treatability studies. It also includes any post-screening investigations. Such studies will likely be necessary for the Maywood site wastes to test volume reduction or treatment technologies that have not yet been proven reliable or effective in full-scale operation or to develop sufficient preliminary design information on which to base evaluations of various remedial action alternatives in the RI/FS-EIS. Potential remedial action technologies for the Maywood site that may warrant pilot-scale or bench-scale treatability studies are the separation of chemicals and/or radionuclides from soils, the in-situ immobilization of wastes, and the coincidental collection or emission of naturally occurring radioactive materials during air stripping (see Section 3.7). These technologies will be based upon the results of characterization and engineering studies.

5.8 TASK 8: REMEDIAL INVESTIGATION REPORT

Task 8 covers all efforts related to the reporting of RI findings once the data have been evaluated under Tasks 5 and 6. Task 8 covers all draft and final RI reports and includes the following activities:

- Formatting data for reporting purposes,
- Preparing associated graphics,
- Writing the report,
- Printing and distributing the report,
- Holding review meetings, and
- Revising the report based on agency comments.

The proposed RI report outline is provided in Table 16. This outline, which is based on the EPA-recommended format given in their most recent guidance document (EPA 1988a) will be used to prepare the RI report for the Maywood site.

TABLE 16 Proposed Outline of the RI Report

EXECUTIVE SUMMARY

1 INTRODUCTION

- 1.1 Purpose of Report
- 1.2 Site Background
- 1.3 Report Organization

2 STUDY AREA INVESTIGATION

- 2.1 Site Description
- 2.2 Site History
- 2.3 Previous Investigations
  - 2.3.1 Surface Features
  - 2.3.2 Contaminant Sources
  - 2.3.3 Meteorology
  - 2.3.4 Surface Water and Sediments
  - 2.3.5 Geology
  - 2.3.6 Soil and Vadose Zone
  - 2.3.7 Groundwater
  - 2.3.8 Human Population
  - 2.3.9 Ecology

3 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

- 3.1 Surface Features
- 3.2 Meteorology
- 3.3 Surface Water Hydrology
- 3.4 Geology
- 3.5 Soils
- 3.6 Hydrogeology
- 3.7 Demography and Land Use
- 3.8 Ecology

4 NATURE AND EXTENT OF CONTAMINATION

- 4.1 Potential Routes of Migration for Radioactive/Chemical Contaminants
  - 4.1.1 Sources
  - 4.1.2 Soil and Vadose Zone
  - 4.1.3 Groundwater
  - 4.1.4 Surface Water and Sediments
  - 4.1.5 Air

5 CONTAMINANT FATE AND TRANSPORT

- 5.1 Migration Routes
- 5.2 Contaminant Persistence
- 5.3 Contaminant Migration

TABLE 16 (continued)

6 BASELINE RISK ASSESSMENT

- 6.1 Human Health Evaluation
  - 6.1.1 Exposure Assessment
  - 6.1.2 Toxicity Assessment
  - 6.1.3 Risk Characterization
- 6.2 Environmental Evaluation

7 SUMMARY AND CONCLUSIONS

- 7.1 Summary
  - 7.1.1 Nature and Extent of Contamination
  - 7.1.2 Fate and Transport
  - 7.1.3 Risk Assessment
- 7.2 Conclusions
  - 7.2.1 Data Limitations (if any)
  - 7.2.2 Recommended Remedial Action Objectives

REFERENCES

APPENDIXES

5.9 TASK 9: REMEDIAL ALTERNATIVES DEVELOPMENT/SCREENING

Task 9 involves the initial development and screening of remedial action alternatives that will be fully evaluated under Task 10. The objective of the Task 9 screening process is to narrow the range of alternatives that will undergo full evaluation. The process begins with the refinement of remedial response objectives, proceeds through a narrowing of the potential technologies based on applicability and effectiveness, and ends with the identification of a set of remedial action alternatives. Each remedial action alternative may involve application of a single technology or a combination of two or more technologies. Task 9 consists of the following activities:

- Identifying response objectives and response actions,
- Listing potential remedial technologies,
- Screening remedial technologies based on site-specific criteria,
- Assembling potential remedial action alternatives from the screened technologies,
- Evaluating potential remedial action alternatives based on screening criteria (i.e., effectiveness, implementability, and cost), and
- Identifying candidate remedial action alternatives for detailed evaluation in Task 10.

5.10 TASK 10: DETAILED ANALYSIS OF ALTERNATIVES

Task 10 involves detailed analysis and comparison of remedial alternatives. The following criteria are used to evaluate the candidate alternatives identified in Task 9:

- Overall protection of human health and the environment,
- Compliance with ARARs,
- Long-term effectiveness and permanence,
- Reduction of toxicity, mobility, and volume,
- Short-term effectiveness,
- Implementability,
- Cost,

- State acceptance, and
- Community acceptance.

A summary for each alternative, including the no-action alternative, is prepared using these nine criteria. The relative advantages and disadvantages are then used to compare and evaluate the remedial action alternatives. Use of these nine criteria is consistent with the NCP (EPA 1990).

5.11 TASK 11: REMEDIAL INVESTIGATION/FEASIBILITY STUDY–ENVIRONMENTAL IMPACT STATEMENT REPORT

Similar to Task 8 (RI report task), Task 11 involves the coordination and preparation of the RI/FS-EIS report. The task is complete when the draft RI/FS-EIS has been released to the public for comment as prescribed by NEPA, comments are addressed, and the RI/FS-EIS is issued as final. The following are Task 11 activities:

- Formatting data for reporting purposes,
- Preparing associated graphics,
- Writing the report,
- Printing and distributing the report,
- Holding review meetings, and
- Revising the report based on agency comments.

Table 17 provides the outline of an FS report based on the EPA-recommended format given in their most recent guidance document (EPA 1988a). This outline will be modified to incorporate NEPA-related issues that are beyond the scope of a typical FS. The specific outline of the RI/FS-EIS will be based upon the preliminary outline presented in Table 16.

5.12 TASK 12: POST REMEDIAL INVESTIGATION/FEASIBILITY STUDY–ENVIRONMENTAL IMPACT STATEMENT SUPPORT

Task 12 includes efforts to prepare the proposed plan and responsiveness summary, support development of the ROD, and conduct any predesign activities. Task 12 activities include:

- Preparing the proposed plan,
- Attending public meetings,
- Preparing the responsiveness summary and draft ROD,

TABLE 17 Outline for an FS Report Based on EPA Recommendations

---

EXECUTIVE SUMMARY

1 INTRODUCTION

- 1.1 Purpose and Organization of Report
- 1.2 Background Information
  - 1.2.1 Description of Site and Nearby Environment
  - 1.2.2 Site History
  - 1.2.3 Nature and Extent of Contamination
  - 1.2.4 Contaminant Fate and Transport
  - 1.2.5 Baseline Risk Assessment

2 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

- 2.1 Introduction
- 2.2 Remedial Action Objectives
  - 2.2.1 Identification of ARARs
  - 2.2.2 Identification of Acceptable Exposure Levels
  - 2.2.3 Development of Remedial Action Objectives
- 2.3 General Response Actions
- 2.4 Identification and Screening of Technology Types and Process Options
  - 2.4.1 Identification and Screening of Technologies
  - 2.4.2 Evaluation of Technologies and Selection of Representative Technologies

3 DEVELOPMENT AND SCREENING OF ALTERNATIVES

- 3.1 Development of Alternatives
  - 3.1.1 Alternative 1
  - 3.1.2 Alternative 2
  - 3.1.3 Alternative 3, etc.
- 3.2 Screening of Alternatives
  - 3.2.1 Alternative 1
  - 3.2.2 Alternative 2
  - 3.2.3 Alternative 3, etc.
- 3.3 Identification of Final Alternatives

4 DETAILED ANALYSIS OF ALTERNATIVES

- 4.1 Alternative 1
  - 4.1.1 Description
  - 4.1.2 Evaluation[a]
- 4.2 Alternative 2
  - 4.2.1 Description
  - 4.2.2 Evaluation[a]
- 4.3 Alternative 3
  - 4.3.1 Description
  - 4.3.2 Evaluation[a]
- 4.4 Summary

TABLE 17 (continued)

[a]Includes analysis of environmental consequences such as radiological impacts, chemical impacts, surface water and groundwater impacts, socioeconomic and historical/cultural impacts, ecological impacts, cumulative impacts, mitigative measures, unavoidable adverse impacts, irreversible and irretrievable commitments of resources, relationship between local short-term use of the human environment and the maintenance and enhancement of long-term productivity.

- Finalizing documents in response to agency and public comments,
- Preparing the predesign report, and
- Completing the conceptual design.

The proposed plan is a summary document (typically fewer than 10 pages) that identifies the preferred remedial action alternative and the reasons for the preference, describes the alternatives evaluated in the RI/FS-EIS process, and solicits public review and comment on all screened alternatives presented in the RI/FS-EIS. An annotated outline for the proposed plan, which was developed from EPA guidance, is presented in Table 18. Preparation of the ROD and responsiveness summary will be initiated following the public review period of the RI/FS-EIS. The ROD will be prepared to meet both CERCLA and NEPA requirements.

5.13 TASK 13: ENFORCEMENT SUPPORT

Task 13 includes all efforts associated with enforcement aspects of a project in terms of potentially responsible parties. Because DOE has assumed responsibility for the Maywood site, Task 13 is not applicable to this project.

5.14 TASK 14: MISCELLANEOUS SUPPORT

Task 14 is used to report on work that is associated with the project but does not fall under any of the other thirteen tasks. Task 14 activities will vary but may include the following:

- Special efforts related to public health assessments and
- Support for review of special state or local site-specific or related projects.

These activities will be performed, as needed, for the Maywood site.

TABLE 18 Annotated Outline of the Proposed Plan

Introduction

Provide site name and location.
Identify lead and support agencies.
Introduce document's purpose, which is to:
Fulfill requirements of Section 117(a),
Describe alternatives analyzed,
Identify preferred alternative and explain rationale for preference,
Serve as companion to the RI/FS and administrative record file, and
Solicit public involvement in selection of a remedy.
Stress importance of public input on all alternatives.

Site Background

Provide brief overview of site.
Describe site history.

Scope and Role of Operable Unit or Response Action

Describe scope of problem that the action will address.
Describe role of action within site strategy.
Identify how action addresses principal threat(s).

Summary of Site Risks

Provide overview of baseline risk assessment, by describing the:
Contaminated media,
Chemicals of concern,
Baseline exposure scenarios (e.g., routes of exposure, current and future land-use scenarios), and
Current and potential site risks (including both carcinogenic and noncarcinogenic threats).
Discuss ecological risk(s), as appropriate.

Summary of Alternatives

Provide narrative description of alternatives evaluated in detailed analysis of FS — including engineering components, treatment components, estimated present-worth cost, implementation time, and the major ARARs associated with the alternative(s).

Evaluation of Alternatives and the Preferred Alternative

Identify the preferred alternative.
Introduce the nine evaluation criteria and discuss how they are utilized in the Superfund program.
Provide the rationale for the preferred alternative by profiling it against the nine criteria and highlighting how it compares to the other alternatives (major advantages and disadvantages). State/support agency and community acceptance should be addressed to the extent adequate information is available at the time.
Discuss the lead agency's belief that the preferred alternative would satisfy the statutory findings, including the preference for treatment as a principal element.
When the support agency concurs with the preferred alternative, its recommendation that the alternative meets the statutory findings should also be included.

Community Participation[a]

Provide notice of public comment period (written comments are encouraged).
Note time and place for public meeting(s) (if scheduled) or offer opportunity for meeting(s).
Provide the location of administrative record files and information repositories

---

[a]Community includes the general public and potentially responsible parties.

6.0 PROJECT MANAGEMENT

6.1 PROJECT SCHEDULE

The overall schedule for the environmental compliance activities planned for the Maywood site is the subject of negotiations between DOE and EPA Region II under the FFA. Once the negotiations have been completed, the schedule will be made available to the public. The negotiated schedule will show the various tasks and the projected durations of these tasks through the ROD.

6.2 PROJECT ORGANIZATION

Remedial action at the Maywood site is being conducted by DOE under FUSRAP, which is administered by the Division of Eastern Area Programs within the Office of Environmental Restoration and Waste Management (Figure 25). The Division of Eastern Area Programs is responsible for policy decisions related to conducting remedial actions at the site. Responsibility for management and technical direction of remedial action activities for FUSRAP has been delegated to the DOE Field Office in Oak Ridge, Tennessee (DOE-OR). The Former Sites Restoration Division within DOE-OR manages the day-to-day activities for FUSRAP. DOE-OR has functional responsibility for preparation of the environmental compliance documents, although various groups at DOE Headquarters have review and concurrence authority. The Assistant Secretary for Environment, Safety and Health is responsible for approving publication of the RI/FS-EIS. A phased RI/FS-EIS process is being used for this action (Figure 26).

Several organizations are under contract to DOE-OR to support implementation of FUSRAP. At the outset of the WP-IP development process, two organizations were responsible for preparation of the Maywood site RI/FS-EIS: Bechtel National, Inc. (BNI), and Argonne National Laboratory (ANL). A new management system for FUSRAP was implemented in March 1991. In this new system, BNI was retained as the project management contractor, and Science Applications International Corporation (SAIC) was selected as the environmental studies contractor. For the remainder of the RI/FS-EIS process, responsibilities will be shared by BNI, SAIC, and ANL (as shown in Figure 25).

Under the previous management plan, the project management contractor for remedial action activities at the Maywood site was BNI. As such, BNI was responsible for the collection of all necessary site characterization and environmental data required for the RI report. The environmental analysis contractor for the Maywood site was ANL. In this role, ANL provided an independent analysis of the environmental impacts of alternatives proposed for remedial action, and ANL was assigned responsibility for the work plan. Data and information provided by BNI for the WP-IP were supplemented, as necessary, by visiting the site, meeting and consulting with other agencies, performing technical analyses, and reviewing existing documents.

According to 40 CFR 1506.5(c), except as provided in §§ 1506.2 and 1506.3 any environmental impact statement prepared pursuant to the requirements of NEPA shall be

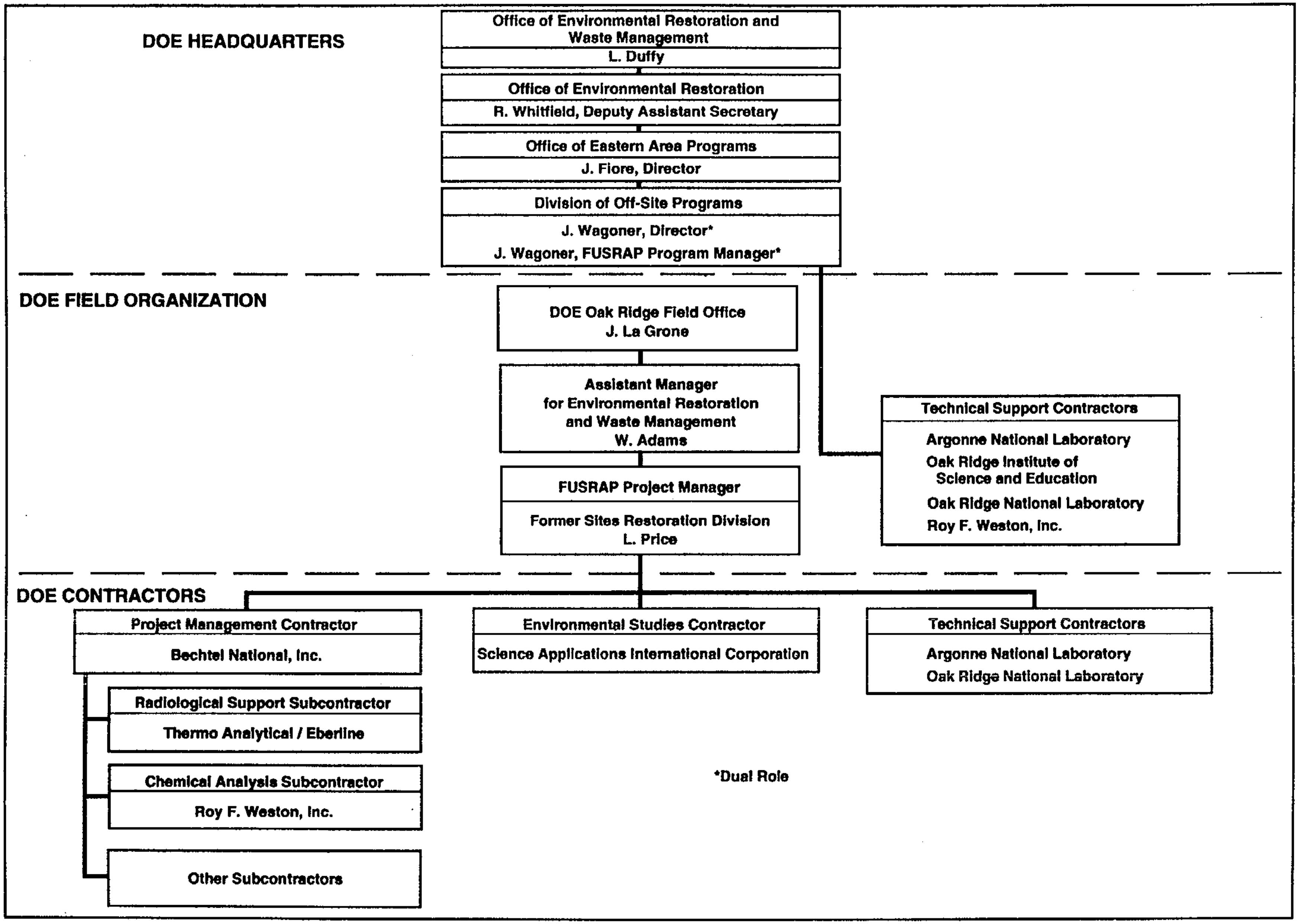


FIGURE 25 Project Organization

4 32 1748.6

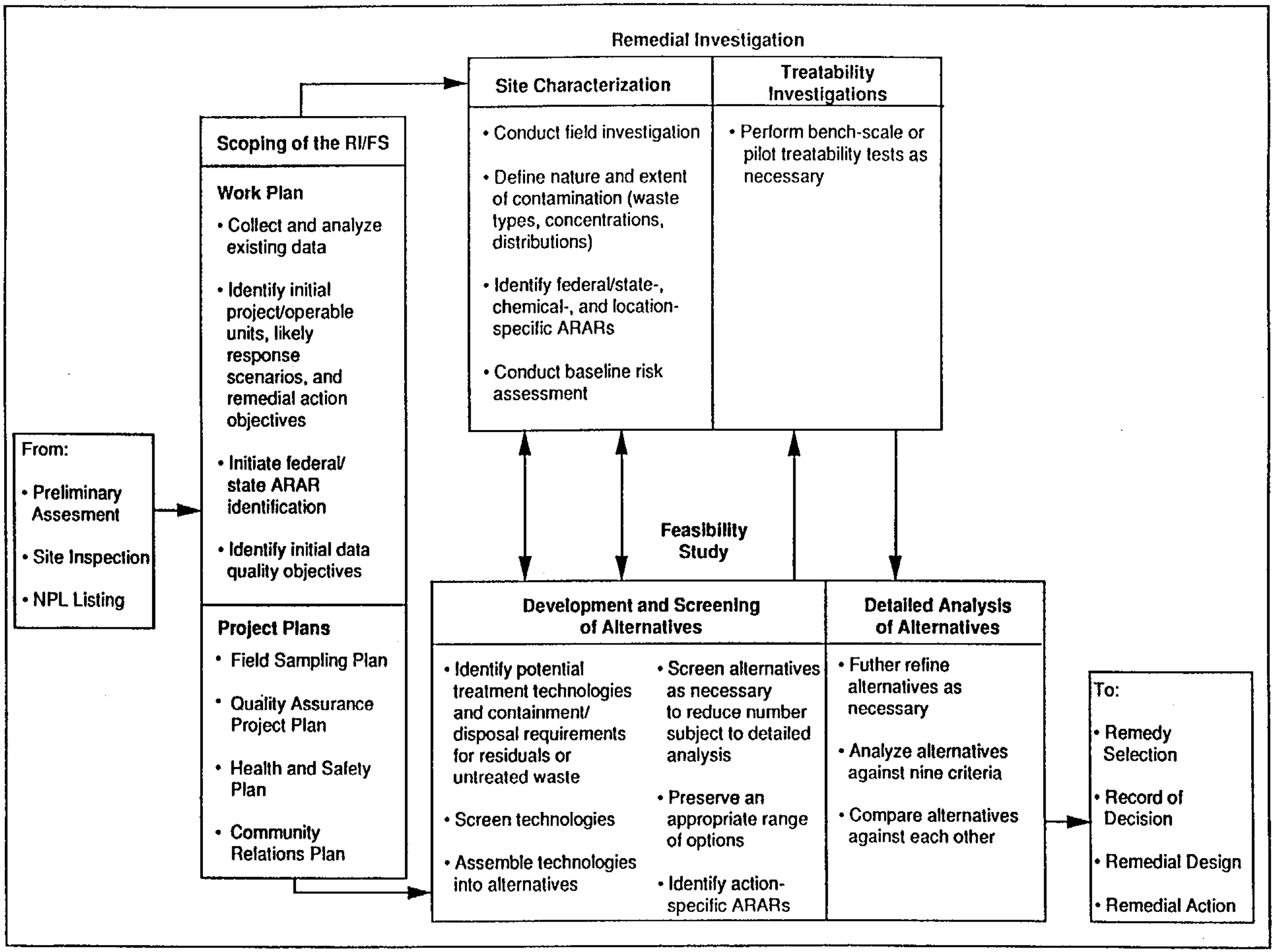


FIGURE 26 Phased RI/FS Process

prepared directly by or by a contractor selected by the lead agency or where appropriate under § 1501.6(b), a cooperating agency. It is the intent of these regulations that the contractor be chosen solely by the lead agency, or by the lead agency in cooperation with cooperating agencies, or where appropriate by a cooperating agency to avoid any conflict of interest. Contractors shall execute a disclosure statement prepared by the lead agency, or where appropriate the cooperating agency, specifying that they have no financial or other interest in the outcome of the project. If the document is prepared by contract, the responsible Federal official shall furnish guidance and participate in the preparation and shall independently evaluate the statement prior to its approval and take responsibility for its scope and contents. Nothing in this section is intended to prohibit any agency from requesting any person to submit information to it or to prohibit any person from submitting information to any agency.

6.3 PROJECT COORDINATION AND RESPONSIBILITIES

Under the new management plan, responsibilities for the Maywood site project have been redistributed. Generically, for FUSRAP,

- Bechtel National, Inc., has responsibility for
  - Overall project management,
  - Procurement,
  - Quality assurance,
  - RI field work,
  - Remedial design,
  - Response actions,
  - Site surveillance and maintenance,
  - Site environmental, safety, and health programs at the site,
  - Regulatory compliance of operations, and
  - Community relations.
- Science Applications International Corporation has responsibility for
  - Field investigation planning design,
  - Field data analysis/documentation,
  - Site risk assessments,

- Remedial alternatives analysis,

- Regulatory analysis, and

- NEPA/CERCLA/RCRA documents.

- Bechtel and SAIC will interact as follows:

  - BNI will implement SAIC's plans for characterization,

  - SAIC will prepare the baseline risk assessment and FS reports from information supplied by BNI,

  - BNI will develop the cleanup design on the basis of the SAIC analysis, and

  - BNI will implement the remedial action to carry out the SAIC analysis.

In addition, four organizations provide technical support for FUSRAP to the Division of Eastern Area Programs: Argonne National Laboratory, Oak Ridge National Laboratory, Oak Ridge Institute for Science and Education, and Roy F. Weston, Inc. (Figure 25). These organizations carry out the following functions:

- Conduct radiological surveys to identify and designate vicinity properties that require remedial action.

- Conduct post-response action radiological surveys to provide an independent verification of the adequacy of cleanup and prepare associated verification reports.

- Perform technical review of FUSRAP documents.

6.4 PROJECT CONTROLS

Project controls are implemented to provide detailed planning for cost, schedule, and technical performance. In this way, efforts toward achievement of project goals are maximized. Project controls are implemented for FUSRAP as a whole because there are 33 sites in 13 states for which costs and schedules must be tracked and controlled. To implement these controls, BNI has established a system that conforms with the criteria for cost and schedule control systems developed by the U.S. Department of Defense. The system used by BNI has been validated by DOE. This system provides a basis for assessing the quality of the cost and schedule controls used by the project participants; aids in ensuring effective planning, management, and control of project work; and provides a quick and effective means of measuring cost, schedule, and technical performance. This cost and schedule control system utilizes a work breakdown structure to divide the total FUSRAP project into sites and then into discrete work packages that can be effectively managed. The work breakdown structure also provides the framework for integrating budget requirements with schedule and technical performance. Finally, it establishes the management analysis and reporting structure to permit data presentation to various levels of management.

A project document control center is maintained at BNI's office in Oak Ridge, Tennessee, to collect, register, distribute, and retain all documents. All documents related to the Maywood site are coded with work breakdown structure number 138 to associate them with the site. Subject codes are also assigned from predetermined categories that can be used to organize documents. The project document control center system provides for rapid identification and retrieval of all project documents by allowing documents to be searched/sorted by work breakdown structure number, subject code, author, recipient, transmittal date, a unique identification number, or any combination of the above.

All related information obtained during the RI/FS-EIS process for the Maywood site is being retained by the project document control center. This includes aerial photographs, topographic maps, reports on features of the site and its surrounding area, correspondence involving the site, findings of previous surveys, and analytical data obtained during site characterization. Types of characterization data on file include radiological and chemical data based on analyses of soil, groundwater, and surface water; borehole logging data; air sampling data; and information about geological and soil properties. Well construction data and field notebooks and documentation (e.g., chain-of-custody forms) are also on file at the project document control center. Additional information on the project document control center is given in the quality assurance project plan.

7.0 REFERENCES[*]

Adler, T., 1991, *Stepan Quarterly Radiation Data for 1987, 1988, 1989, 1990*, attachment to letter from T. Adler (Bechtel National, Inc., Oak Ridge, Tenn.) to L. Jensen (Argonne National Laboratory, Argonne, Ill.), Feb 8.

Albert, R.E., 1966, *Thorium, Its Industrial Hygiene Aspects*, Academic Press, New York.

Algermissen, S.T., 1983, *Introduction to the Seismicity of the United States*, Earthquake Engineering Research Institute, Berkeley, Calif.

Argonne National Laboratory, 1984, *Action Description Memorandum, Proposed 1984 Remedial Actions at Maywood, New Jersey*, prepared by Environmental Research Division, Argonne, Ill., for U.S. Department of Energy, June 8.

Argonne National Laboratory, 1987, *Action Description Memorandum, Interim Remedial Actions at Maywood, New Jersey*, prepared by Energy and Environmental Systems Division, Argonne, Ill., for U.S. Department of Energy, March.

Bailey, R.G., 1978, *Descriptions of the Ecoregions of the United States*, U.S. Forest Service, Intermountain Region, Ogden, Utah.

Bechtel National, Inc., 1984a, *Radiological Survey Report for 10 Grove Avenue, Rochelle Park, New Jersey*, DOE/OR/20722-34, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1984b, *Radiological Survey Report for 22 Grove Avenue, Rochelle Park, New Jersey*, DOE/OR/20722-37, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1984c, *Radiological Survey Report for 26 Grove Avenue, Rochelle Park, New Jersey*, DOE/OR/20722-38, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1984d, *Radiological Survey Report for 30 Grove Avenue, Rochelle Park, New Jersey*, DOE/OR/20722-39, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1984e, *Radiological Survey Report for 34 Grove Avenue, Rochelle Park, New Jersey*, DOE/OR/20722-40, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

---

[*]Copies of all letters cited in this document are available from U.S. Department of Energy, Former Sites Restoration Division, Oak Ridge, Tenn. 37830.

Bechtel National, Inc., 1984f, *Radiological Survey Report for 38 Grove Avenue, Rochelle Park, New Jersey*, DOE/OR/20722-41, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1984g, *Radiological Survey Report for 42 Grove Avenue, Rochelle Park, New Jersey*, DOE/OR/20722-42, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1984h, *Radiological Survey Report for 86 Park Way, Rochelle Park, New Jersey*, DOE/OR/20722-32, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1984i, *Radiological Survey Report for 90 Park Way, Rochelle Park, New Jersey*, DOE/OR/20722-33, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1985a, *Radiological Survey Report for the Residential Property at 123 Avenue F, Lodi, New Jersey*, DOE/OR/20722-64, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., May.

Bechtel National, Inc., 1985b, *Radiological Survey Report for the Residential Property at 3 Hancock Street, Lodi, New Jersey*, DOE/OR/20722-65, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., May.

Bechtel National, Inc., 1985c, *Radiological Survey Report for the Residential Property at 64 Trudy Drive, Lodi, New Jersey*, DOE/OR/20722-66, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., May.

Bechtel National, Inc., 1985d, *Radiological Survey Report for the Residential Property at 121 Avenue F, Lodi, New Jersey*, DOE/OR/20722-67, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., May.

Bechtel National, Inc., 1985e, *Maywood Interim Storage Site Environmental Monitoring Summary, Maywood, New Jersey, Calendar Year 1984*, DOE/OR/20722-60, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., July.

Bechtel National, Inc., 1986a, *Post-Remedial Action Report for the Ballod Associates Property*, DOE/OR/20722-82, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Oct.

Bechtel National, Inc., 1986b, *Post-Remedial Action Report for the Residential Properties on Davison and Latham Streets*, DOE/OR/20722-77, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Feb.

Bechtel National, Inc., 1986c, *Post-Remedial Action Report for the Residential Properties on Grove Avenue and Park Way*, DOE/OR/20722-83, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., March.

Bechtel National, Inc., 1986d, *Post-Remedial Action Report for the Lodi Residential Properties*, DOE/OR/20722-89, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Aug.

Bechtel National, Inc., 1986e, *Maywood Interim Storage Site Environmental Monitoring Summary, Maywood, New Jersey, Calendar Year 1985*, DOE/OR/20722-96, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., May.

Bechtel National, Inc., 1987a, *Characterization Report for the Sears Property, Maywood, New Jersey*, DOE/OR/20722-140, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., May.

Bechtel National, Inc., 1987b, *Radiological and Limited Chemical Characterization Report for the Hunter Douglas Property in Maywood, New Jersey*, DOE/OR/20722-152, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., July.

Bechtel National, Inc., 1987c, *Radiological Characterization Report for the Federal Express Property in Maywood, New Jersey*, DOE/OR/20722-154, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., July.

Bechtel National, Inc., 1987d, *Radiological and Limited Chemical Characterization Report for the Sunoco Station Property in Maywood, New Jersey*, DOE/OR/20722-155, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., July.

Bechtel National, Inc., 1987e, *Radiological Characterization Report for the New Jersey Vehicle Inspection Station in Lodi, New Jersey*, DOE/OR/20722-153, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., June.

Bechtel National, Inc., 1987f, *Characterization Report for the Maywood Interim Storage Site, Maywood, New Jersey*, DOE/OR/20722-139, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., June.

Bechtel National, Inc., 1987g, *Maywood Interim Storage Site Environmental Monitoring Summary, Maywood, New Jersey, Calendar Year 1986*, DOE/OR/20722-148, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., June.

Bechtel National, Inc., 1988a, *Radiological Characterization Report for the Residential Property at 7 Branca Court, Lodi, New Jersey*, DOE/OR/20722-167, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Nov.

Bechtel National, Inc., 1988b, *Radiological Characterization Report for the Residential Property at 11 Branca Court, Lodi, New Jersey*, DOE/OR/20722-168, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Nov.

Bechtel National, Inc., 1988c, *Radiological Characterization Report for the Residential Property at 16 Long Valley Road, Lodi, New Jersey*, DOE/OR/20722-169, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Nov.

Bechtel National, Inc., 1988d, *Radiological Characterization Report for the Residential Property at 18 Long Valley Road, Lodi, New Jersey*, DOE/OR/20722-170, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Nov.

Bechtel National, Inc., 1988e, *Radiological Characterization Report for the Residential Property at 20 Long Valley Road, Lodi, New Jersey*, DOE/OR/20722-171, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Nov.

Bechtel National, Inc., 1988f, *Radiological Characterization Report for the Residential Property at 22 Long Valley Road, Lodi, New Jersey*, DOE/OR/20722-172, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Nov.

Bechtel National, Inc., 1988g, *Radiological Characterization Report for the Residential Property at 26 Long Valley Road, Lodi, New Jersey*, DOE/OR/20722-173, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Nov.

Bechtel National, Inc., 1988h, *Radiological Characterization Report for the Residential Property at 11 Redstone Lane, Lodi, New Jersey*, DOE/OR/20722-174, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Nov.

Bechtel National, Inc., 1988i, *Radiological Characterization Report for the Lodi Municipal Park, Lodi, New Jersey*, DOE/OR/20722-175, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Nov.

Bechtel National, Inc., 1988j, *Maywood Interim Storage Site Environmental Monitoring Summary, Maywood, New Jersey, Calendar Year 1987*, DOE/OR/20722-195, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., April.

Bechtel National, Inc., 1989a, *Radiological Characterization Report for the Residential Property at 4 Hancock Street, Lodi, New Jersey*, DOE/OR/20722-237, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989b, *Radiological Characterization Report for the Residential Property at 5 Hancock Street, Lodi, New Jersey*, DOE/OR/20722-238, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989c, *Radiological Characterization Report for the Residential Property at 6 Hancock Street, Lodi, New Jersey*, DOE/OR/20722-239, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989d, *Radiological Characterization Report for the Residential Property at 7 Hancock Street, Lodi, New Jersey*, DOE/OR/20722-240, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989e, *Radiological Characterization Report for the Residential Property at 8 Hancock Street, Lodi, New Jersey*, DOE/OR/20722-241, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989f, *Radiological Characterization Report for the Residential Property at 10 Hancock Street, Lodi, New Jersey*, DOE/OR/20722-242, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989g, *Radiological Characterization Report for the Residential Property at 80 Hancock Street, Lodi, New Jersey*, DOE/OR/20722-253, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989h, *Radiological Characterization Report for the Residential Property at 100 Hancock Street, Lodi, New Jersey*, DOE/OR/20722-254, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989i, *Radiological Characterization Report for the Residential Property at 17 Redstone Lane, Lodi, New Jersey*, DOE/OR/20722-235, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989j, *Radiological Characterization Report for the Residential Property at 2 Branca Court, Lodi, New Jersey*, DOE/OR/20722-233, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989k, *Radiological Characterization Report for the Residential Property at 4 Branca Court, Lodi, New Jersey*, DOE/OR/20722-232, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989*l*, *Radiological Characterization Report for the Residential Property at 6 Branca Court, Lodi, New Jersey*, DOE/OR/20722-234, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989m, *Radiological Characterization Report for the Residential Property at 60 Trudy Drive, Lodi, New Jersey*, DOE/OR/20722-243, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989n, *Radiological Characterization Report for the Commercial Property at 80 Industrial Road (Flint Ink), Lodi, New Jersey*, DOE/OR/20722-252, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989o, *Radiological Characterization Report for the Residential Property at 106 Columbia Lane, Lodi, New Jersey*, DOE/OR/20722-244, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989p, *Radiological Characterization Report for the Residential Property at 99 Garibaldi Avenue, Lodi, New Jersey*, DOE/OR/20722-246, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989q, *Radiological Characterization Report for the Municipal Property at Lodi Fire Station No. 2 (Kennedy Drive), Lodi, New Jersey*, DOE/OR/20722-249, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989r, *Radiological Characterization Report for the Firemen's Memorial Park, Garibaldi Avenue, Lodi, New Jersey*, DOE/OR/ 20722-250, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989s, *Radiological Characterization Report for the Commercial Property at 72 Sidney Street, Lodi, New Jersey*, DOE/OR/20722-245, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989t, *Radiological Characterization Report for the Commercial Property at 160 & 174 Essex Street (National Community Bank), Lodi, New Jersey*, DOE/OR/20722-251, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989u, *Radiological Characterization Report for the J.F. Kennedy Municipal Park, Lodi, New Jersey*, DOE/OR/20722-255, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989v, *Radiological Characterization Report for the Gulf Station Property, Maywood, New Jersey*, DOE/OR/20722-156, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989w, *Radiological Characterization Report for the DeSaussure Property, Maywood, New Jersey*, DOE/OR/20722-157, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989x, *Radiological Characterization Report for the Residential Property at 9 Hancock Street, Lodi, New Jersey*, DOE/OR/20722-247, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989y, *Radiological Characterization Report for the Residential Property at 14 Long Valley Road, Lodi, New Jersey*, DOE/OR/20722-256, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989z, *Radiological Characterization Report for the Residential Property at 24 Long Valley Road, Lodi, New Jersey*, DOE/OR/20722-236, prepared for U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989za, *Radiological Characterization Report for the Residential Property at 19 Redstone Lane, Lodi, New Jersey*, DOE/OR/20722-248, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989zb, *Radiological Characterization Report for the Property at Interstate 80 (Eastbound Right-of-Way), Lodi, New Jersey*, DOE/OR/20722-178, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1989zc, *Maywood Interim Storage Site Annual Site Environmental Report, Maywood, New Jersey, Calendar Year 1988*, DOE/OR/20722-216, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., April.

Bechtel National, Inc., 1989zd, *Volume Register for FUSRAP and SFMP Sites*, attachment to memorandum from J.W. Darby (Bechtel National, Inc., Oak Ridge, Tenn.) to Distribution, July 6.

Bechtel National, Inc., 1990a, *Maywood Interim Storage Site Annual Site Environmental Report, Maywood, New Jersey, Calendar Year 1989*, DOE/OR/20722-267, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., May.

Bechtel National, Inc., 1990b, *Community Relations Plan for the Remedial Investigation/ Feasibility Study-Environmental Impact Statement for the Maywood Interim Storage Site, Maywood, New Jersey*, DOE/OR/20722-193.2 (Draft), prepared for U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tenn., June.

Bechtel National, Inc., 1990c, *Field Sampling Plan for the Remedial Investigation/Feasibility Study-Environmental Impact Statement for the Maywood Interim Storage Site, Maywood, New Jersey*, DOE/OR/20722-193.3 (Draft), prepared for U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tenn., June.

Bechtel National, Inc., 1990d, *Health and Safety Plan for the Remedial Investigation/ Feasibility Study-Environmental Impact Statement for the Maywood Interim Storage Site, Maywood, New Jersey*, DOE/OR/20722-193.4 (138-HSP-02, Draft) prepared for U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tenn., June.

Bechtel National, Inc., 1990e, *Quality Assurance Project Plan for the Remedial Investigation/ Feasibility Study-Environmental Impact Statement for the Maywood Interim Storage Site, Maywood, New Jersey*, DOE/OR/20722-193.5 (Revision 0, Draft), prepared for U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tenn., June.

Bechtel National, Inc., 1991, *Maywood Interim Storage Site Annual Environmental Report, Maywood, New Jersey, Calendar Year 1990*, DOE/OR/21949-287, prepared for U.S. Department of Energy, Oak Ridge Field Office, Oak Ridge, Tenn., Sept.

Bechtel National, Inc., 1992, *Maywood Interim Storage Site Annual Environmental Report, Maywood, New Jersey, Calendar Year 1991*, DOE/OR/21949-344 (Draft), prepared for U.S. Department of Energy, Oak Ridge Field Office, Oak Ridge, Tenn., May.

Bowers, J.F., J.R. Bjorkland, and C.S. Cheney, 1979, *Industrial Source Complex (ISC) Dispersion Model User's Guide*, EPA-450/4-79-031, U.S. Environmental Protection Agency, Research Triangle Park, N.C.

Braunstein, N.M., ed., 1981, *Health and Control Aspects of Coal Conversion*, Ann Arbor Science, Ann Arbor, Mich.

Camp Dresser & McKee, Inc., 1989, *Summary Report, Statewide Scientific Study of Radon*, prepared by Camp Dresser & McKee, Inc., Edison, N.J., for New Jersey Department of Environmental Protection, Trenton, April.

Carswell, L.D., and J.G. Rooney, 1976, *Summary of Geology and Ground-Water Responses of Passaic County, New Jersey*, U.S. Geological Survey Water Resources Investigations 76-75, June.

Chezik, M.T., 1989, letter from M.T. Chezik (Acting Supervisor, U.S. Fish and Wildlife Service, Absecon, New Jersey) to W.S. Vinikour (Argonne National Laboratory, Argonne, Ill.), March 30.

Coffman, F.E., 1983, letter from F.E. Coffman (Director, Office of Terminal Waste Disposal and Remedial Action, Office of Nuclear Energy, U.S. Department of Energy Headquarters) to J. LaGrone (Manager, Oak Ridge Operations Office, U.S. Department of Energy), Subject: *R&D Decontamination Projects under the Formerly Utilized Sites Remedial Action Program (FUSRAP)*, Aug. 3.

Cole, L.W., et al., 1981, *Radiological Assessment of Ballod Associates Property (Stepan Chemical Company), Maywood, New Jersey*, Oak Ridge Associated Universities, Oak Ridge, Tenn., July.

Crotwell, G.P., 1985, letter from G.P. Crotwell (Bechtel National, Inc.) to R.G. Atkin (Site Manager, Technical Services Division, Oak Ridge Operations Office, U.S. Department of Energy), Subject: *Ballod Characterization Report*, CCN 28153, June 12.

Cuthbert, F.L., 1958, *Thorium Production Technology*, Addison-Wesley Publishing Company, Reading, Mass.

Dana, J.D., 1955, *Dana's Manual of Mineralogy*, 16th ed., revised by C.S. Hulbut, Jr., John Wiley & Sons, New York.

Ebasco Services, Inc., 1987, *Final Report for the Maywood Chemical Company Site: Sears and Vicinity Properties*, New York, N.Y., Feb.

Ebasco Services, Inc., 1988, *Draft Report for the Investigation of Soils and Water at the Maywood Chemical Company Site*, New York, N.Y., Dec.

Eckerman, K.F., A.B. Wolbarst, and A.C.B. Richardson, 1988, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, Federal Guidance Report No. 11, EPA-520/1-88-020, prepared by Oak Ridge National Laboratory, Oak Ridge, Tenn., and U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, D.C., Sept.

EG&G Energy Measurements Group, 1981, *An Aerial Radiologic Survey of the Stepan Chemical Company and Surrounding Area, Maywood, New Jersey*, NRC-8109, prepared by EG&G, Oak Ridge, Tenn., for the U.S. Nuclear Regulatory Commission, April.

Eister, W.K., and R.H. Kennedy, 1974, *The Nuclear Industry*, in Riegel's Handbook of Industrial Chemistry, J.A. Kent, Ed., Van Nostrand Reinhold Co., New York, pp. 719-771.

Gale Research Company, 1980, *Climate of the States, National Oceanic and Atmospheric Administration Narrative Summaries, Tables, and Maps for Each State with Overview of State Climatologist Programs, Volume 1, Alabama - North Dakota*, 2nd ed., Detroit, Mich.

Gilbert, T.L., et al., 1989, *Manual for Implementing Residual Radioactive Material Guidelines*, ANL/ES-160; DOE/CH/8901, prepared by Argonne National Laboratory, Energy and Environmental Systems Division, Argonne, Ill., for U.S. Department of Energy, Assistant Secretary for Nuclear Energy, June.

Harris, W., 1951, memorandum dated August 31, 1951, from W. Harris to M. Eisenbud, Subject: *Thorium Study*, Attachment 1 to letter from S.E. Jones (Aerospace Corporation, Washington, D.C.) to M. Kaye (Bechtel National, Inc., Oak Ridge, Tenn.), April 27, 1987.

Heatherton, R., 1951, memorandum dated September 18, 1951, from R. Heatherton to W. Harris, Subject: *Survey at Maywood Chemical Company, Maywood, New Jersey*, Attachment 2 to letter from S.E. Jones (Aerospace Corporation, Washington, D.C.) to M. Kaye (Bechtel National, Inc., Oak Ridge, Tenn.), April 27, 1987.

International Commission on Radiological Protection, 1979, *Limits for Intakes of Radionuclides by Workers*, ICRP Publ. 30, Part 1, Annals of the ICRP, *2*(3/4).

International Commission on Radiological Protection, 1981, *Limits for Inhalation of Radon Daughters by Workers (Adopted March 1981)*, ICRP Publ. 32, Annals of the ICRP, *6*(1).

Jacobson, R., 1982, letter from R. Jacobson (Attorney, Stepan Chemical Company) to R. Page (U.S. Nuclear Regulatory Commission), April 7.

Jones, S.E., 1987, letter from S.E. Jones (Aerospace Corporation, Washington, D.C.) to M. Kaye (Bechtel National, Inc., Oak Ridge, Tenn.), with attachment (undated): *Attachment 5, Draft - Chronology - Maywood Chemical Works/Stepan Chemical Company*, April 27.

Kannard, J.R., 1986a, letter from J.R. Kannard (Bechtel National, Inc.) to R.G. Atkin (U.S. Department of Energy), Subject: *Radiological Survey Report for the Scanel Property, Maywood, New Jersey*, CCN 39650, Sept. 3.

Kannard, J.R., 1986b, letter from J.R. Kannard (Bechtel National, Inc.) to S.W. Ahrends (U.S. Department of Energy), Subject: *Radiological Characterization Report for New Jersey Route 17 in Rochelle Park, New Jersey*, CCN 42037, Dec. 15.

Kannard, J.R., 1986c, letter from J.R. Kannard (Bechtel National, Inc.) to R.G. Atkin (U.S. Department of Energy), Subject: *Radiological Characterization Report for the New York Susquehanna & Western Railroad Property in the Vicinity of the Maywood Interim Storage Site*, CCN 41493, Nov. 19.

Kannard, J.R., 1987, letter from J.R. Kannard (Bechtel National, Inc.) to S.W. Ahrends (U.S. Department of Energy), Subject: *Radiological Characterization Report for Bergen Cable in Lodi, New Jersey*, CCN 43322, Feb. 23.

Klaasen, C.D, M.O. Amdur, and J. Doull (Eds.), 1986, *Casarett and Doull's Toxicology*, Macmillan Publishing Company, New York.

Leichtweis, C.P., 1987, memorandum from C.P. Leichtweis (Bechtel National, Inc., Oak Ridge, Tenn.) to T.M. Dravecky (Bechtel National, Inc., Oak Ridge, Tenn.), Subject: *MISS Chemical Characterization Data*, CCN 042535, Jan. 12.

Mata, L., 1984, *Site Analysis, Maywood Chemical Sites, Maywood and Rochelle Park, New Jersey*, TS-PIC-84023, prepared by Bionetics Corporation, Warrenton, Va., for U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, Nev., May.

Morton, H.W., 1982, *Natural Thorium in Maywood, New Jersey*, Nuclear Safety Associates, Inc., Potomac, Md., Sept. 29.

National Lead Company of Ohio, 1951, *Survey of Thorium Plant, Maywood Chemical Co., Maywood, N.J.*, Cincinnati, Ohio, Sept.

National Research Council, 1988, *Health Risks of Radon and Other Internally Deposited Alpha-Emitters, BEIR IV*, National Academy Press, Washington, D.C.

National Research Council, 1990, *Health Effects of Exposure to Low Levels of Ionizing Radiation, BEIR V*, National Academy Press, Washington, D.C.

New Jersey Department of Environmental Protection, 1980a, *Results of Soil Samples Collected from Rochelle Park Area*, memorandum from J. Feeney to J. Eng (Division of Environmental Quality, Trenton), Oct. 20.

New Jersey Department of Environmental Protection, 1980b, *Environmental Monitoring at Route 17 Site, Paramus*, memorandum from R. Nunamacher to J. Odonovich (Division of Environmental Quality, Trenton), Oct. 22.

New Jersey Department of Environmental Protection, 1988, *1987 Air Quality Report*, Division of Environmental Quality, Trenton, July.

New Jersey Department of Environmental Protection, 1989, *Preliminary Waste Pile Sampling Plan for Maywood*, letter from E.G. Kaup (Case Manager, Bureau of Federal Case Management, Trenton, N.J.) to R.G. Atkin (Site Manager, Technical Services Division, Oak Ridge Operations, Oak Ridge, Tenn.), Dec. 20.

NUS Corporation, 1983, *Radiological Study of Maywood Chemical, Maywood, New Jersey*, prepared for U.S. Environmental Protection Agency, Final Report, Nov.

Oak Ridge National Laboratory, 1981a, *Results of the Radiological Survey at 459 Davison Avenue, Maywood, New Jersey*, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1981b, *Results of the Radiological Survey at 460 Davison Avenue, Maywood, New Jersey*, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1981c, *Results of the Radiological Survey at 464 Davison Avenue, Maywood, New Jersey*, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1981d, *Results of the Radiological Survey at 468 Davison Avenue, Maywood, New Jersey*, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1981e, *Results of the Radiological Survey at 459 Latham Street, Maywood, New Jersey*, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1981f, *Results of the Radiological Survey at 461 Latham Street, Maywood, New Jersey*, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1981g, *Results of the Radiological Survey at 467 Latham Street, Maywood, New Jersey*, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1984a, *Results of the Mobile Gamma Scanning Activities in Lodi, New Jersey*, ORNL/RASA-84/3, Oak Ridge, Tenn., Oct.

Oak Ridge National Laboratory, 1984b, *Results of the Radiological Survey at 59 Avenue C (LJ006), Lodi, New Jersey*, Oak Ridge, Tenn., Oct.

Oak Ridge National Laboratory, 1984c, *Results of the Radiological Survey at 58 Trudy Drive (LJ004), Lodi, New Jersey*, Oak Ridge, Tenn., Oct.

Oak Ridge National Laboratory, 1984d, *Results of the Radiological Survey at 59 Trudy Drive (LJ003), Lodi, New Jersey*, Oak Ridge, Tenn., Oct.

Oak Ridge National Laboratory, 1984e, *Results of the Radiological Survey at 61 Trudy Drive (LJ002), Lodi, New Jersey*, Oak Ridge, Tenn., Oct.

Oak Ridge National Laboratory, 1986a, *Results of the Radiological Survey at 454 Davison Avenue, Maywood, New Jersey*, ORNL/RASA-85/2, Oak Ridge, Tenn., Feb.

Oak Ridge National Laboratory, 1986b, *Results of the Independent Radiological Verification Survey at 454 Davison Street, Maywood, New Jersey (MJ13L)*, ORNL/RASA-86/75, Oak Ridge, Tenn., Dec.

Oak Ridge National Laboratory, 1986c, *Results of the Independent Radiological Verification Survey at 459 Davison Street, Maywood, New Jersey (MJ14L)*, ORNL/RASA-86/60, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986d, *Results of the Independent Radiological Verification Survey at 460 Davison Street, Maywood, New Jersey (MJ15L)*, ORNL/RASA-86/61, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986e, *Results of the Independent Radiological Verification Survey at 464 Davison Street, Maywood, New Jersey (MJ16L)*, ORNL/RASA-86/62, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986f, *Results of the Independent Radiological Verification Survey at 468 Davison Street, Maywood, New Jersey (MJ17L)*, ORNL/RASA-86/63, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986g, *Results of the Independent Radiological Verification Survey at 459 Latham Street, Maywood, New Jersey, (MJ10L)*, ORNL/RASA-86/74, Oak Ridge, Tenn., Dec.

Oak Ridge National Laboratory, 1986h, *Results of the Independent Radiological Verification Survey at 461 Latham Street, Maywood, New Jersey (MJ11L)*, ORNL/RASA-86/58, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986i, *Results of the Independent Radiological Verification Survey at 467 Latham Street, Maywood, New Jersey (MJ12L)*, ORNL/RASA-86/59, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986j, *Results of the Independent Radiological Verification Survey at 10 Grove Avenue, Rochelle Park, New Jersey (MJ03L)*, ORNL/RASA-86/42, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986k, *Results of the Independent Radiological Verification Survey at 22 Grove Avenue, Rochelle Park, New Jersey (MJ04L)*, ORNL/RASA-86/43, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986l, *Results of the Independent Radiological Verification Survey at 26 Grove Avenue, Rochelle Park, New Jersey (MJ05L)*, ORNL/RASA-86/44, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986m, *Results of the Independent Radiological Verification Survey at 30 Grove Avenue, Rochelle Park, New Jersey (MJ06L)*, ORNL/RASA-86/45, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986n, *Results of the Independent Radiological Verification Survey at 34 Grove Avenue, Rochelle Park, New Jersey (MJ07L)*, ORNL/RASA-86/46, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986o, *Results of the Independent Radiological Verification Survey at 38 Grove Avenue, Rochelle Park, New Jersey (MJ08L)*, ORNL/RASA-86/47, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986p, *Results of the Independent Radiological Verification Survey at 42 Grove Avenue, Rochelle Park, New Jersey (MJ09L)*, ORNL/RASA-86/48, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986q, *Results of the Independent Radiological Verification Survey at 86 Park Way, Rochelle Park, New Jersey (MJ02L)*, ORNL/RASA-86/41, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1986r, *Results of the Independent Radiological Verification Survey at 90 Park Way, Rochelle Park, New Jersey (MJ01L)*, ORNL/RASA-86/18, Oak Ridge, Tenn., July.

Oak Ridge National Laboratory, 1986s, *Results of the Independent Radiological Verification Survey at 59 Avenue C, Lodi, New Jersey*, (LN008V), ORNL/RASA-86/72, Oak Ridge, Tenn., Dec.

Oak Ridge National Laboratory, 1986t, *Results of the Independent Radiological Verification Survey at 58 Trudy Drive, Lodi, New Jersey*, (LN001V), ORNL/RASA-86/65, Oak Ridge, Tenn., Dec.

Oak Ridge National Laboratory, 1986u, *Results of the Independent Radiological Verification Survey at 59 Trudy Drive, Lodi, New Jersey*, (LN002V), ORNL/RASA-86/66, Oak Ridge, Tenn., Dec.

Oak Ridge National Laboratory, 1986v, *Results of the Independent Radiological Verification Survey at 61 Trudy Drive, Lodi, New Jersey*, (LN003V), ORNL/RASA-86/67, Oak Ridge, Tenn., Dec.

Oak Ridge National Laboratory, 1986w, *Results of the Independent Radiological Verification Survey at 64 Trudy Drive, Lodi, New Jersey*, (LN004V), ORNL/RASA-86/68, Oak Ridge, Tenn., Dec.

Oak Ridge National Laboratory, 1986x, *Results of the Independent Radiological Verification Survey at 121 Avenue F, Lodi, New Jersey*, (LN006V), ORNL/RASA-86/70, Oak Ridge, Tenn., Dec.

Oak Ridge National Laboratory, 1986y, *Results of the Independent Radiological Verification Survey at 123 Avenue F, Lodi, New Jersey*, (LN007V), ORNL/RASA-86/71, Oak Ridge, Tenn., Dec.

Oak Ridge National Laboratory, 1986z, *Results of the Independent Radiological Verification Survey at 3 Hancock Street, Lodi, New Jersey*, (LN005V), ORNL/RASA-86/69, Oak Ridge, Tenn., Dec.

Oak Ridge National Laboratory, 1986za, *Results of the Radiological Survey at 7 Branca Court (LJ040), Lodi, New Jersey*, ORNL/RASA-86/34, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1986zb, *Results of the Radiological Survey at 11 Branca Court (LJ043), Lodi, New Jersey*, ORNL/RASA-86/35, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1986zc, *Results of the Radiological Survey at 16 Long Valley Road (LJ053), Lodi, New Jersey*, ORNL/RASA-86/40, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1986zd, *Results of the Radiological Survey at 18 Long Valley Road (LJ052), Lodi, New Jersey*, ORNL/RASA-86/39, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1986ze, *Results of the Radiological Survey at 20 Long Valley Road (LJ051), Lodi, New Jersey*, ORNL/RASA-86/38, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1986zf, *Results of the Radiological Survey at 22 Long Valley Road (LJ050), Lodi, New Jersey*, ORNL/RASA-86/37, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1986zg, *Results of the Radiological Survey at 26 Long Valley Road (LJ049), Lodi, New Jersey*, ORNL/RASA-86/36, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1986zh, *Results of the Radiological Survey at 11 Redstone Lane (LJ035), Lodi, New Jersey*, ORNL/RASA-86/33, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1986zi, *Results of the Radiological Survey at Lodi Municipal Park, Redstone Lane (LJ032), Lodi, New Jersey*, ORNL/RASA-86/32, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1988, *Results of the Radiological Survey at 72 Sidney Street (LJ067), Lodi, New Jersey*, ORNL/RASA-88/18, Oak Ridge, Tenn., April.

Oak Ridge National Laboratory, 1989a, *Results of the Radiological Survey at 60 Trudy Drive (LJ057), Lodi, New Jersey*, ORNL/RASA-88/14, Oak Ridge, Tenn., March.

Oak Ridge National Laboratory, 1989b, *Results of the Radiological Survey at 62 Trudy Drive (LJ080), Lodi, New Jersey*, ORNL/RASA-88/68, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989c, *Results of the Radiological Survey at 4 Hancock Street (LJ060), Lodi, New Jersey*, ORNL/RASA-88/25, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1989d, *Results of the Radiological Survey at 5 Hancock Street (LJ029), Lodi, New Jersey*, ORNL/RASA-87/33, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1989e, *Results of the Radiological Survey at 6 Hancock Street (LJ033), Lodi, New Jersey*, ORNL/RASA-88/53, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989f, *Results of the Radiological Survey at 7 Hancock Street (LJ027), Lodi, New Jersey*, ORNL/RASA-87/32, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1989g, *Results of the Radiological Survey at 8 Hancock Street (LJ026), Lodi, New Jersey*, ORNL/RASA-87/26, Oak Ridge, Tenn., March.

Oak Ridge National Laboratory, 1989h, *Results of the Radiological Survey at 10 Hancock Street (LJ031), Lodi, New Jersey*, ORNL/RASA-88/42, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989i, *Results of the Radiological Survey at 80 Hancock Street (LJ059), Lodi, New Jersey*, ORNL/RASA-88/16, Oak Ridge, Tenn., March.

Oak Ridge National Laboratory, 1989j, *Results of the Radiological Survey at 100 Hancock Street (LJ058), Lodi, New Jersey*, ORNL/RASA-88/15, Oak Ridge, Tenn., March.

Oak Ridge National Laboratory, 1989k, *Results of the Radiological Survey at 2 Branca Court, Lodi, New Jersey (LJ036)*, ORNL/RASA-88/44, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989l, *Results of the Radiological Survey at 4 Branca Court, Lodi, New Jersey (LJ037)*, ORNL/RASA-88/52, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989m, *Results of the Radiological Survey at 6 Branca Court, Lodi, New Jersey (LJ041)*, ORNL/RASA-88/47, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989n, *Results of the Radiological Survey at 14 Long Valley Road (LJ070), Lodi, New Jersey*, ORNL/RASA-88/19, Oak Ridge, Tenn., Dec.

Oak Ridge National Laboratory, 1989o, *Results of the Radiological Survey at 24 Long Valley Road (LJ048), Lodi, New Jersey*, ORNL/RASA-87/35, Oak Ridge, Tenn., Aug.

Oak Ridge National Laboratory, 1989p , *Results of the Radiological Survey at 17 Redstone Lane (LJ030), Lodi, New Jersey*, ORNL/RASA-88/41, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989q, *Results of the Radiological Survey at 80 Industrial Road, Lodi, New Jersey (LJ061)*, ORNL/RASA-88/17, Oak Ridge, Tenn., July.

Oak Ridge National Laboratory, 1989r, *Results of the Radiological Survey at 106 Columbia Lane, Lodi, New Jersey (LJ063)*, ORNL/RASA-88/56, Oak Ridge, Tenn., July.

Oak Ridge National Laboratory, 1989s, *Results of the Radiological Survey at 99 Garibaldi Lane (LJ070), Lodi, New Jersey*, ORNL/RASA-88/57, Oak Ridge, Tenn., July.

Oak Ridge National Laboratory, 1989t, *Results of the Radiological Survey at the Firemen's Memorial Park and Fire Hall No. 2, Garibaldi Avenue and Kennedy Drive, Lodi, New Jersey (LJ066)*, ORNL/RASA-88/58, Oak Ridge, Tenn., August.

Oak Ridge National Laboratory, 1989u, *Results of the Radiological Survey at National Community Bank, 113 Essex Street (MJ021), Maywood, New Jersey*, ORNL/RASA-88/51, Oak Ridge, Tenn., Sept.

Oak Ridge National Laboratory, 1989v, *Results of the Radiological Survey at 160 Essex Street, Lodi, New Jersey (LJ072)*, ORNL/RASA-88/49, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989w, *Results of the Radiological Survey at 174 Essex Street, Lodi, New Jersey (LJ073)*, ORNL/RASA-88/50, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989x, *Results of the Radiological Survey at Kennedy Park, Money and Sidney Streets, Lodi, New Jersey (LJ062)*, ORNL/RASA-88/55, Oak Ridge, Tenn., July.

Oak Ridge National Laboratory, 1989y, *Results of the Radiological Survey at Interstate 80, North Right of Way at Lodi Brook (LJ077), Lodi, New Jersey*, ORNL/RASA-88/66, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989z, *Results of the Radiological Survey at 90 Avenue C (LJ079), Lodi, New Jersey*, ORNL/RASA-88/67, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989za, *Results of the Radiological Survey at 108 Avenue E (LJ084), Lodi, New Jersey*, ORNL/RASA-88/72, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989zb, *Results of the Radiological Survey at 112 Avenue E (LJ082), Lodi, New Jersey*, ORNL/RASA-88/70, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989zc, *Results of the Radiological Survey at 113 Avenue E (LJ081), Lodi, New Jersey*, ORNL/RASA-88/69, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989zd, *Results of the Radiological Survey at 79 Avenue B (LJ091), Lodi, New Jersey*, ORNL/RASA-88/79, Oak Ridge, Tenn., June.

Oak Ridge National Laboratory, 1989ze, *Results of the Radiological Survey at 136 W. Central Avenue (MJ030), Maywood, New Jersey*, ORNL/RASA-88/22, Oak Ridge, Tenn., Feb.

Oak Ridge National Laboratory, 1989zf, *Results of the Radiological Survey at 200 Rt. 17 (MJ035), Maywood, New Jersey*, ORNL/RASA-88/23, Oak Ridge, Tenn., Feb.

Oak Ridge National Laboratory, 1989zg, *Results of the Radiological Survey at Rt. 17 and Essex Street (MJ036), Maywood, New Jersey*, ORNL/RASA-88/24, Oak Ridge, Tenn., Feb.

Sax, N.I., and R.J. Lewis, 1989, *Dangerous Properties of Industrial Materials*, 7th ed., Van Nostrand Reinhold, New York.

Seiler, H.G., et al., 1988, *Handbook of Toxicity of Inorganic Compounds*, Marcel Dekker, Inc., New York.

Sheppard, M.I., et al., 1984, *Soil Nuclide Distribution Coefficients*, Atomic Energy of Canada Limited, Whiteshell Nuclear Research Establishment, Pinawa, Manitoba.

Stokinger, H.F., 1981, *The Metals*, in Patty's Industrial Hygiene and Toxicology, Volume IIA: Toxicology, G.D. Clayton and F.E. Clayton, Eds., John Wiley and Sons, New York.

Teh, C.L., et al., 1983, *Handbook of Solvent Extraction*, John Wiley & Sons, New York.

U.S. Bureau of the Census, 1990, unpublished data.

U.S. Department of Energy, 1980, *Compliance with National Environmental Policy Act: Final Guidelines*, Federal Register, *45*(62):20694-20701, March 28.

U.S. Department of Energy, 1988, *Draft NEPA Compliance Guide, Guidance Manual for Department of Energy Compliance with the National Environmental Policy Act and Related Federal Environmental Statutes*, Volumes I and II, Office of NEPA Project Assistance, Oct.

U.S. Department of Energy, 1989, *Comprehensive Environmental Response, Compensation, and Liability Act Requirements*, DOE Order 5400.4, Washington, D.C., Oct. 6.

U.S. Department of Energy, 1990a, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, Washington, D.C., Feb. 8.

U.S. Department of Energy, 1990b, *Federal Facility Agreement, Maywood Interim Storage Site, Docket No. 11*, CERCLA-FFA-00101, Oak Ridge Operations Office, Oak Ridge, Tenn., Sept. 17.

U.S. Department of Energy, 1990c, *Response Actions at a FUSRAP Site in Maywood, NJ: Intent to Prepare a Remedial Investigation/Feasibility Study–Environmental Impact Statement*, Federal Register, *55*(222):47907-47911, Nov. 16.

U.S. Department of Energy, 1990d, *Response Actions at a FUSRAP Site in Maywood, NJ: Intent to Prepare a Remedial Investigation/Feasibility Study–Environmental Impact Statement*, Federal Register, *55*(222):47907-47911, Nov. 16.

U.S. Environmental Protection Agency, 1986, *A Citizen's Guide to Radon*, OPA-86-004, prepared by U.S. Environmental Protection Agency, Office of Air and Radiation, and U.S. Department of Health and Human Services, Centers for Disease Control, Washington, D.C., Aug.

U.S. Environmental Protection Agency, 1987, *Data Quality Objectives for Remedial Response Activities, Development Process*, EPA/540/6-87/003, Washington, D.C.

U.S. Environmental Protection Agency, 1988a, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, Interim Final, EPA/540/G-89/004, Office of Emergency and Remedial Response, Washington, D.C., Oct.

U.S. Environmental Protection Agency, 1988b, *Laboratory Data Validation: Functional Guidelines for Evaluating Inorganics Analyses*, prepared by the Data Review Work Group for the Hazardous Site Evaluation Division, Washington, D.C., July 1.

U.S. Environmental Protection Agency, 1988c, *Laboratory Data Validation: Functional Guidelines for Evaluating Organics Analyses*, prepared by the Data Review Work Group for the Hazardous Site Evaluation Division, Washington, D.C., Feb. 1.

U.S. Environmental Protection Agency, 1989a, *Health Effects Assessment Summary Tables, Fourth Quarter, FY 1989*, OSWER (OS-2301), Oct.

U.S. Environmental Protection Agency, 1989b, *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)*, EPA/540/1-89/002, prepared by Office of Emergency and Remedial Response, Washington, D.C., Interim Final, Dec.

U.S. Environmental Protection Agency, 1989c, *Risk Assessment Methodology, Environmental Impact Statement for NESHAPS for Radionuclides, Volume I: Background Information Document*, EPA 520/1-89-005, Office of Radiation Programs, Sept.

U.S. Environmental Protection Agency, 1990, *National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule (40 CFR Part 300)*, Federal Register, *55*(46):8666-8854, March 8.

U.S. Geological Survey, undated, *Miscellaneous Field Studies Map MF 1282, Seismicity*, New York.

U.S. Nuclear Regulatory Commission, 1981a, *Stepan Company Inspection*, Report No. 40-8610/80-01, Office of Inspection and Enforcement, Region I, Feb. 18.

U.S. Nuclear Regulatory Commission, 1981b, *Stepan Company Inspection*, Report No. 40-8610/81-02, Office of Inspection and Enforcement, Region I, June 8.

Van Pelt, W.R., 1988a, letter from W.R. Van Pelt (773 Paramus Road, Paramus, N.J.), to P. Allison (Borough Clerk, Borough of Maywood, Paramus, N.J.), March 1.

Van Pelt, W.R., 1988b, letter from W.R. Van Pelt (773 Paramus Road, Paramus, N.J.), to M.A. Rampolla (Deputy Borough Clerk, Borough of Maywood, Paramus, N.J.), March 3.

Yuan, Y.C., J.H.C. Wang, and A. Zielen, 1989, *MILDOS-AREA: An Enhanced Version of MILDOS for Large-Area Sources*, ANL/ES-161, prepared by Argonne National Laboratory, Energy and Environmental Systems Division, Argonne, Ill., for U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tenn., June.

APPENDIX A

DOE RADIOLOGICAL PROTECTION REQUIREMENTS AND GUIDELINES*

*Reprinted from U.S. Department of Energy, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, Chapter IV, Feb. 8, 1990.

CHAPTER IV

RESIDUAL RADIOACTIVE MATERIAL

1. PURPOSE. This chapter presents radiological protection requirements and guidelines for cleanup of residual radioactive material and management of the resulting wastes and residues and release of property. These requirements and guidelines are applicable at the time the property is released. Property subject to these criteria includes, but is not limited to sites identified by the Formerly Utilized Sites Remedial Action Program (FUSRAP) and the Surplus Facilities Management Program (SFMP). The topics covered are basic dose limits, guidelines and authorized limits for allowable levels of residual radioactive material, and control of the radioactive wastes and residues. This chapter does not apply to uranium mill tailings or to properties covered by mandatory legal requirements.

2. IMPLEMENTATION. DOE elements shall develop plans and protocols for the implementation of this guidance. FUSRAP sites shall be identified, characterized, and designated, as such, for remedial action and certified for release. Information on applications of the guidelines and requirements presented herein, including procedures for deriving specific property guidelines for allowable levels of residual radioactive material from basic dose limits, is contained in DOE/CH 8901, "A Manual for Implementing Residual Radioactive Material Guidelines, A Supplement to the U.S. Department of Energy Guidelines for Residual Radioactive Material at FUSRAP and SFMP Sites," June 1989.

   a. Residual Radioactive Material This chapter provides guidance on radiation protection of the public and the environment from:

      (1) Residual concentrations of radionuclides in soil (for these purposes, soil is defined as unconsolidated earth material, including rubble and debris that might be present in earth material);

      (2) Concentrations of airborne radon decay products;

      (3) External gamma radiation;

      (4) Surface contamination; and

      (5) Radionuclide concentrations in air or water resulting from or associated with any of the above.

b. Basic Dose Limit. The basic dose limit for doses resulting from exposures to residual radioactive material is a prescribed standard from which limits for quantities that can be monitored and controlled are derived; it is specified in terms of the effective dose equivalent as defined in this Order. The basic dose limits are used for deriving guidelines for residual concentrations of radionuclides in soil. Guidelines for residual concentrations of thorium and radium in soil, concentrations of airborne radon decay products, allowable indoor external gamma radiation levels, and residual surface contamination concentrations are based on existing radiological protection standards (40 CFR Part 192; NRC Regulatory Guide 1.86 and subsequent NRC guidance on residual radioactive material). Derived guidelines or limits based on the basic dose limits for those quantities are used only when the guidelines provided in the existing standards are shown to be inappropriate.

c. Guideline. A guideline for residual radioactive material is a level of radioactive material that is acceptable for use of property without restrictions due to residual radioactive material. Guidelines for residual radioactive material presented herein are of two kinds, generic and specific. The basis for the guidelines is generally a presumed worst-case plausible-use scenario for the property.

(1) Generic guidelines, independent of the property, are taken from existing radiation protection standards. Generic guideline values are presented in this chapter.

(2) Specific property guidelines are derived from basic dose limits using specific property models and data. Procedures and data for deriving specific property guideline values are given by DOE/CH-8901.

d. Authorized Limit. An authorized limit is a level of residual radioactive material that shall not be exceeded if the remedial action is to be considered completed and the property is to be released without restrictions on use due to residual radioactive material.

(1) The authorized limits for a property will include:

(a) Limits for each radionuclide or group of radionuclides, as appropriate, associated with residual radioactive material in soil or in surface contamination of structures and equipment;

(b) Limits for each radionuclide or group of radionuclides, as appropriate, in air or water; and

(c) Where appropriate, a limit on external gamma radiation resulting from the residual material.

(2) Under normal circumstances expected at most properties, authorized limits for residual radioactive material are set equal to, or below, guideline values. Exceptional conditions for which authorized limits might differ from guideline values are specified in paragraphs IV-5 and IV-7.

(3) A property may be released without restrictions if residual radioactive material does not exceed the authorized limits or approved supplemental limits, as defined in paragraph IV.7a, at the time remedial action is completed. DOE actions in regard to restrictions and controls on use of the property shall be governed by provisions in paragraph IV.7b. The applicable controls and restrictions are specified in paragraph IV.6 and IV.7.c.

e. ALARA Applications. The monitoring, cleanup, and control of residual radioactive material are subject to the ALARA policy of this Order. Applications of ALARA policy shall be documented and filed as a permanent record.

3. BASIC DOSE LIMITS.

a. Defining and Determining Dose Limits. The basic public dose limits for exposure to residual radioactive material, in addition to natural occurring "background" exposures, are 100 mrem (1 mSv) effective dose equivalent in a year, as specified in paragraph II.1a.

b. Unusual Circumstances. If, under unusual circumstances, it is impracticable to meet the basic limit based on realistic exposure scenarios, the respective project and/or program office may, pursuant to paragraph II.1a(4), request from EH-1 for a specific authorization for a temporary dose limit higher than 100 mrem (1 mSv), but not greater than 500 mrem (5 mSv), in a year. Such unusual circumstances may include temporary conditions at a property scheduled for remedial action or following the remedial action. The ALARA process shall apply to the selection of temporary dose limits.

4. GUIDELINES FOR RESIDUAL RADIOACTIVE MATERIAL.

a. Residual Radionuclides in Soil. Generic guidelines for thorium and radium are specified below. Guidelines for residual concentrations of other radionuclides shall be derived from the basic dose limits by means of an environmental pathway analysis using specific property data where available. Procedures for these derivations are given in DOE/CH-8901. Residual concentrations of radioactive material in soil are defined as those in excess of background concentrations averaged over an area of 100 m^2.

(1) Hot Spots. If the average concentration in any surface or below-surface area less than or equal to 25 m^2, exceeds the limit or guideline by a factor of $(100/A)^{0.5}$, [where A is the area (in square meters) of the region in which concentrations are elevated], limits for "hot-spots" shall also be developed and applied. Procedures for calculating these hot-spot limits, which depend on the extent of the elevated local concentrations, are given in DOE/CH-8901. In addition, reasonable efforts shall be made to remove any source of radionuclide that exceeds 30 times the appropriate limit for soil, irrespective of the average concentration in the soil.

(2) Generic Guidelines. The generic guidelines for residual concentrations of Ra-226, Ra-228, Th-230, and Th-232 are:

(a) 5 pCi/g, averaged over the first 15 cm of soil below the surface; and

(b) 15 pCi/g, averaged over 15-cm-thick layers of soil more than 15 cm below the surface.

(3) Ingrowth and Mixtures. These guidelines take into account ingrowth of Ra-226 from Th-230 and of Ra-228 from Th-232, and assume secular equilibrium. If both Th-230 and Ra-226 or both Th-232 and Ra-228 are present and not in secular equilibrium, the appropriate guideline is applied as a limit for the radionuclide with the higher concentration. If other mixtures of radionuclides occur, the concentrations of individual radionuclides shall be reduced so that either the dose for the mixtures will not exceed the basic dose limit or the sum of the ratios of the soil concentration of each radionuclide to the allowable limit for that radionuclide will not exceed 1. Explicit formulas for calculating residual concentration guidelines for mixtures are given in DOE/CH-8901.

b. Airborne Radon Decay Products. Generic guidelines for concentrations of airborne radon decay products shall apply to existing occupied or habitable structures on private property that are intended for release without restriction; structures that will be demolished or buried are excluded. The applicable generic guideline (40 CFR Part 192) is: In any occupied or habitable building, the objective of remedial action shall be, and a reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL. [A working level (WL) is any combination of short-lived radon decay products in 1 L of air that will result in the ultimate emission of 1.3 x 10^5 MeV of potential alpha energy.] In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL. Remedial actions by DOE are not required in order to comply with this guideline when there is reasonable assurance that residual radioactive material is not the source of the radon concentration.

c. External Gamma Radiation. The average level of gamma radiation inside a building or habitable structure on a site to be released without restrictions shall not exceed the background level by more than 20 μR/h and shall comply with the basic dose limit when an "appropriate-use" scenario is considered. This requirement shall not necessarily apply to structures scheduled for demolition or to buried foundations. External gamma radiation levels on open lands shall also comply with the basic limit and the ALARA process, considering appropriate-use scenarios for the area.

d. Surface Contamination. The generic surface contamination guidelines provided in Figure IV-1 are applicable to existing structures and equipment. These guidelines are generally consistent with standards of the NRC (NRC 1982) and functionally equivalent to Section 4, "Decontamination for Release for Unrestricted Use," of Regulatory Guide 1.86, but apply to nonreactor facilities. These limits apply to both interior equipment and building components that are potentially salvageable or recoverable scrap. If a building is demolished, the guidelines in paragraph IV.6a are applicable to the resulting contamination in the ground.

e. Residual Radionuclides in Air and Water. Residual concentrations of radionuclides in air and water shall be controlled to the required levels shown in paragraph II.1a and as required by other applicable Federal and/or State laws.

5. AUTHORIZED LIMITS FOR RESIDUAL RADIOACTIVE MATERIAL.

a. Establishment of Authorized Limits. The authorized limits for each property shall be set equal to the generic or derived guidelines unless it can be established, on the basis of specific property data (including health, safety, practical, programmatic and socioeconomic considerations), that the guidelines are not appropriate for use at the specific property. The authorized limits shall be established to (1) provide that, at a minimum, the basic dose limits of in paragraph IV.3, will not be exceeded under the "worst-case" or "plausible-use" scenarios, consistent with the procedures and guidance provided in DOE/CH-8901, or (2) be consistent with applicable generic guidelines. The authorized limits shall be consistent with limits and guidelines established by other applicable Federal and State laws. The authorized limits are developed through the project offices in the field and are approved by the Headquarters Program Office.

Figure IV-1
Surface Contamination Guidelines

Radionuclides[2]	Allowable Total Residual Surface Contamination (dpm/100 cm^2)[1] Average[3,4]	Maximum[4,5]	Removable[4,6]
Transuranics, I-125, I-129, Ra-226, Ac-227, Ra-228, Th-228, Th-230, Pa-231.	RESERVED	RESERVED	RESERVED
Th-Natural, Sr-90, I-126, I-131, I-133, Ra-223, Ra-224, U-232, Th-232.	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay product, alpha emitters.	5,000	15,000	1,000
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.[7]	5,000	15,000	1,000

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

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

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

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

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

6/ The amount of removable material per 100 cm^2 of surface area should be determined by wiping an area of that size with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wiping with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. It is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

7/ This category of radionuclides includes mixed fission products, including the Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

---

b. Application of Authorized Limits. Remedial action shall not be considered complete until the residual radioactive material levels comply with the authorized limits, except as authorized pursuant to paragraph IV.7 for special situations where the supplemental limits and exceptions should be considered and it is demonstrated that it is not appropriate to decontaminate the area to the authorized limit or guideline value.

6. CONTROL OF RESIDUAL RADIOACTIVE MATERIAL. Residual radioactive material above the guidelines shall be managed in accordance with Chapter II and the following requirements.

a. Operational and Control Requirements. The operational and control requirements specified in the following Orders shall apply to interim storage, interim management, and long-term management.

(1) DOE 5000.3, Unusual Occurrence Reporting System

(2) DOE 5440.1C, Implementation of the National Environmental Policy Act

(3) DOE 5480.4, Environmental Protection, Safety, and Health Protection Standards

(4) DOE 5482.1B, Environmental, Safety, and Health Appraisal Program

(5) DOE 5483.1A, Occupational Safety and Health Program for DOE Employees at Government-Owned, Contractor-Operated Facilities

(6) DOE 5484.1, Environmental Protection, Safety, and Health Protection Information Reporting Requirements

(7) DOE 5820.2A, Radioactive Waste Management.

b. Interim Storage.

(1) Control and stabilization features shall be designed to provide, to the extent reasonably achievable, an effective life of 50 years with a minimum life of at least 25 years.

(2) Controls shall be designed such that Rn-222 concentrations in the atmosphere above facility surfaces or openings in addition to background levels, will not exceed:

(a) 100 pCi/L at any given point;

(b) An annual average concentration of 30 pCi/L over the facility site; and

(c) An annual average concentration of 3 pCi/L at or above any location outside the facility site.

(d) Flux rates from the storage of radon producing wastes shall not exceed 20 pCi/sq.m-sec., as required by 40 CFR Part 61.

(3) Controls shall be designed such that concentrations of radionuclides in the groundwater and quantities of residual radioactive material will not exceed applicable Federal or State standards.

(4) Access to a property and use of onsite material contaminated by residual radioactive material should be controlled through appropriate administrative and physical controls such as those described in 40 CFR Part 192. These control features should be designed to provide, to the extent reasonable, an effective life of at least 25 years.

c. Interim Management.

(1) A property may be maintained under an interim management arrangement when the residual radioactive material exceeds guideline values if the residual radioactive material is in inaccessible locations and would be unreasonably costly to remove. provided that administrative controls are established by the responsible authority (Federal, State, or local) to protect members of the public and that such controls are approved by the appropriate Program Assistant Secretary or Director.

(2) The administrative controls include but are not limited to periodic monitoring as appropriate; appropriate shielding; physical barriers to prevent access; and appropriate radiological safety measures during maintenance, renovation, demolition, or other activities that might disturb the residual radioactive material or cause it to migrate.

(3) The owner of the property should be responsible for implementing the administrative controls and the cognizant Federal, State, or local authorities should be responsible for enforcing them.

d. Long-Term Management.

(1) Uranium, Thorium, and Their Decay Products.

(a) Control and stabilization features shall be designed to provide, to the extent reasonably achievable, an effective life of 1,000 years with a minimum life of at least 200 years.

(b) Control and stabilization features shall be designed to limit Rn-222 emanation to the atmosphere from the wastes to less than an annual average release rate of 20 $pCi/m^2/s$ and prevent increases in the annual average Rn-222 concentration at or above any location outside the boundary of the contaminated area by more than 0.5 pCi/L. Field verification of emanation rates shall be in accordance with the requirements of 40 CFR Part 61.

(c) Before any potentially biodegradable contaminated wastes are placed in a long-term management facility, such wastes shall be properly conditioned so that the generation and escape of biogenic gases will not cause the requirement in paragraph IV.6d(1)(b) to be exceeded and that biodegradation within the facility will not result in premature structural failure in violation of the requirements in paragraph IV.6d(1)(a).

(d) Ground water shall be protected in accordance with legally applicable Federal and State standards.

(e) Access to a property and use of onsite material contaminated by residual radioactive material should be controlled through appropriate administrative and physical controls such as those described in 40 CFR Part 192. These controls should be designed to be effective to the extent reasonable for at least 200 years.

(2) Other Radionuclides. Long-term management of other radionuclides shall be in accordance with Chapters II, III, and IV of DOE 5820.2A, as applicable.

7. SUPPLEMENTAL LIMITS AND EXCEPTIONS. If special specific property circumstances indicate that the guidelines or authorized limits established for a given property are not appropriate for any portion of that property, then the Operations Office may request that supplemental limits or an exception be applied. The responsible Operations Office shall document the decision that the subject guidelines or authorized limits are not appropriate and that the alternative action selected will provide adequate protection,

giving due consideration to health and safety, the environment, costs, and public policy considerations. The Operations Office shall obtain approval for specific supplemental limits or exceptions from Headquarters as specified in paragraph IV.5, and shall provide to the Headquarters Program Element those materials required by Headquarters for the justification as specified in this paragraph and in the FUSRAP and SFMP protocols and subsequent guidance documents. The Operations Office shall also be responsible for coordination with the State and local government regarding the limits or exceptions and associated restrictions as appropriate. In the case of exceptions, the Operations Office shall be responsible for coordinating with the State and/or local governments to ensure the adequacy of restrictions or conditions of release and that mechanisms are in place for their enforcement.

a. Supplemental Limits. Any supplemental limits shall achieve the basic dose limits set forth in Chapter II of this Order for both current and potential unrestricted uses of a property. Supplemental limits may be applied to any portion of a property if, on the basis of a specific property analysis, it is demonstrated that

   (1) Certain aspects of the property were not considered in the development of the established authorized limits for that property; and

   (2) As a result of these certain aspects, the established limits either do not provide adequate protection or are unnecessarily restrictive and costly.

b. Exceptions to the authorized limits defined for a property may be applied to any portion of the property when it is established that the authorized limits cannot reasonably be achieved and that restrictions on use of the property are necessary. It shall be demonstrated that the exception is justified and that the restrictions will protect members of the public within the basic dose limits of this Order and will comply with the requirements for control of residual radioactive material as set forth in paragraph IV.6.

c. Justification for Supplemental Limits and Exceptions. The need for supplemental limits and exceptions shall be documented by the Operations Office on a case-by-case basis using specific property data. Every reasonable effort should be made to minimize the use of supplemental limits and exceptions. Examples of specific situations that warrant DOE use of supplemental standards and exceptions are

   (1) Where remedial action would pose a clear and present risk of injury to workers or members of the public, notwithstanding reasonable measures to avoid or reduce risk.

(2) Where remedial action, even after all reasonable mitigative measures have been taken, would produce environmental harm that is clearly excessive compared to the health benefits to persons living on or near affected properties, now or in the future. A clear excess of environmental harm is harm that is long-term, manifest, and grossly disproportionate to health benefits that may reasonably be anticipated.

(3) Where it is determined that the scenarios or assumptions used to establish the authorized limits do not apply to the property or portion of the property identified, or where more appropriate scenarios or assumptions indicate that other limits are applicable or appropriate for protection of the public and the environment.

(4) Where the cost of remedial action for contaminated soil is unreasonably high relative to long-term benefits and where the residual material does not pose a clear present or future risk after taking necessary control measure. The likelihood that buildings will be erected or that people will spend long periods of time at such a property should be considered in evaluating this risk. Remedial action will generally not be necessary where only minor quantities of residual radioactive material are involved or where residual radioactive material occurs in an inaccessible location at which specific property factors limit its hazard and from which it is difficult or costly to remove. Examples include residual radioactive material under hard-surfaced public roads and sidewalks, around public sewer lines, or in fence-post foundations. A specific property analysis shall be provided to establish that the residual radioactive material would not cause an individual to receive a radiation dose in excess of the basic dose limits stated in paragraph IV.3, and a statement specifying the level of residual radioactive material shall be provided to the appropriate State and/or local agencies for appropriate action, e.g., for inclusion in local land records.

(5) Where there is no feasible remedial action.

8. SOURCES.

a. Basic Dose Limits. Dosimetry model and dose limits are defined in Chapter II of this Order.

b. Generic Guidelines for Residual Radioactive Material. Residual concentrations of radium and thorium in soil are defined in 40 CFR Part 192. Airborne radon decay products are also defined in 40 CFR Part 192, as are guidelines for external gamma radiation. The surface contamination definition is adapted from NRC (1982).

c. Control of Radioactive Wastes and Residues. Interim storage is guided by this Order and DOE 5820.2A. Long-term management is guided by this Order, 40 CFR Part 192, and DOE 5820.2A.

APPENDIX B

POTENTIAL RESPONSE ACTIONS AND TECHNOLOGIES FOR ENVIRONMENTAL MEDIA AT THE MAYWOOD SITE

TABLE B.1 Potential Response Actions and Technologies for Soil/Sludge

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
No action	No action	Not applicable	Not applicable	This is retained as a potential response to provide a baseline for comparison with action alternatives.
Minimize potential exposure to external gamma radiation; minimize potential exposure to chemical contaminants via direct contact; minimize potential exposure to radio-active and chemical contaminants via ingestion; minimize potential exposure to radio-active and chemical contaminants via inhalation; minimize potential biouptake of radio-active and chemical contaminants; minimize potential migration of radio-active and chemical contaminants that could (further) contaminate surface water, groundwater, and other soils/sludges.	Institutional controls	Access restrictions	Fences and guards	These varied institutional controls are not typically effective in controlling the source or migration of contaminants and are generally used only to support other response actions.
		Ownership and deed restrictions	Legal titles and deeds	
		Monitoring	Groundwater wells and air, surface water, and soil/sludge samplers	

TABLE B.1 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
Minimize toxicity, mobility, and/or volume of contaminated material (and as for institutional controls)	In-situ containment	Surface controls/ diversion	Graded contours, swales and berms, and vegetation	Surface controls and capping can limit contaminant mobility and can mitigate potential exposures, biouptake, and migration (via air, surface water, and groundwater) by attenuating gaseous emissions (e.g., radon) and controlling particulate resuspension, surface water runon and runoff, and precipitation-enhanced percolation and leaching. These processes can be implemented with conventional equipment.
		Capping	Soil (clay) and vegetation or rip rap; asphalt or cement; synthetic membrane material; and multilayer, multimedia material	
		Lateral barriers	Slurry wall, grout curtain, and sheet piling	Lateral barriers and bottom sealing can limit contaminant mobility and can mitigate potential exposures by limiting migration to other soils/ sludges, groundwater, and surface water (e.g., via groundwater recharge). These processes can be implemented with conventional equipment but can be constrained by site-specific geologic conditions and are not typically used unless the substrate water content is high.
		Bottom sealing	Grout layer injection and block displacement	
As for in-situ containment	Removal	Excavation	Dragline, backhoe, bulldozer, scraper, and front-end loader	Excavation and pumping can limit contaminant mobility and can mitigate potential exposures and biouptake by controlling the contaminant source. These technologies can be implemented with conventional equipment.
		Pumping (sludges or slurried soils)	Various pump types, including positive displacement and Moyno (progressing cavity) pumps	
		Injection and extraction	Injection/extraction wells	These technologies can limit the mobility of contaminated material (e.g., soil containing volatile organic compounds [VOCs]) and can mitigate potential exposures (e.g., via inhalation) and biouptake/biotranspiration by controlling the contaminant source. However, because they are typically considered together with treatment systems, they are discussed under the "Treatment/pretreatment" general response action in this table.

TABLE B.1 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment:	Physical:		
	In situ	Dewatering/drying	Solar evaporation, pumping, and gravity drainage trenches	Dewatering/drying can limit the mobility and volume of contaminated materials and mitigate potential exposures, migration, and biouptake. These processes can be implemented using conventional methods.
		Nonthermal extraction	Air injection, vacuum extraction, and soil flushing (water only), using wells and surface application	Nonthermal extraction in situ can reduce the toxicity, mobility, and volume of contaminated soil/sludge and can limit potential exposures, biouptake, and migration by controlling the contaminant source. Air injection and vacuum extraction can be used to treat soil/sludge contaminated with VOCs but these processes are generally ineffective for treating low-volatile organics and cyanides, metals, and other inorganics. The primary action associated with soil flushing with water is a physical "sweeping" to accelerate contaminant migration by injection or spraying/ponding; hence it is being discussed as a physical technology. Water alone is typically a poor flushing solution, and this process is generally ineffective for complex wastes in soils of high organic content and low permeability.
		Thermal extraction	Steam/hot water injection, steam/hot air extraction, radio frequency (RF) heating, and electroacoustic soil decontamination (ESD), using wells, conductors, and electrodes	Thermal extraction in situ achieves remedial action objectives in a manner similar to nonthermal extraction under similar constraints. Steam and hot water can be injected into a soil/sludge contaminated with oils to enhance their displacement to the surface. Steam and hot air can be used to treat soil/sludge contaminated with VOCs by enhancing their evaporation and upward migration. The RF process can be used to treat soil/sludge contaminated with hydrocarbons. The ESD process enhances liquid transport (i.e., dewatering/leaching) via soil particle double layer boundary effects; heavy metals may also be leached or precipitated by this process, which has been demonstrated only on a pilot scale for waste treatment applications.

TABLE B.1 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Physical (cont'd):		
	In situ (cont'd)	Thermal destruction	In-situ vitrification (ISV), using electrodes	Thermal destruction in situ can reduce the toxicity, mobility, and volume of contaminated soil/sludge and can limit potential exposures, biouptake, and migration by controlling the contaminant source. In ISV, an electric current is used to melt the soil/sludge and destroy organic compounds by pyrolysis and combustion; upon cooling, a glassy, durable matrix is formed that incorporates inorganic contaminants (including radionuclides) and other nonvolatile compounds. Field-scale demonstration of ISV has been limited, and it remains in the advanced developmental stage for waste treatment.
	Following removal	Dewatering/drying	Rotary drum, vacuum, and belt filtration; drying beds; filter press; automatic pressure filtration; gravity thickening; centrifugation; and evaporation	As for dewatering/drying in-situ.
		Solids separation	Classification (mechanical/nonmechanical); soil sorting, sand sifting (grizzlies) and screening (wet/dry); flotation and gravity concentration/centrifugation; magnetic and paramagnetic separation; and electrostatic separation	Solids separation processes can limit the toxicity, mobility, and volume of contaminated materials and mitigate potential exposures, migration, and biouptake. Although certain solids separation processes have been used to extract radionuclides from ores, they are generally ineffective for separating relatively low concentrations of contaminants from soil/sludge. This technology often serves as a pretreatment step for primary treatment processes and is considered developmental for waste treatment applications.

TABLE B.1 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Physical (cont'd):		
	Following removal (cont'd)	Size reduction	Impact crushers, shredders, and tumbling hammer mills	These processes can reduce the size/volume of waste materials, which is often required as a pretreatment step for primary treatment processes (e.g., chemical extraction and thermal destruction processes). Size reduction can be achieved using conventional methods.
		Nonthermal extraction	Soil washing (water only), using a reactor vessel	Nonthermal extraction following removal achieves remedial action objectives in a manner similar to nonthermal extraction in situ. Soil/sludge can be mixed with water in a contact vessel to wash contaminants from the waste matrix but water alone is typically ineffective as a washing solution.
		Thermal extraction/ destruction	Low-temperature thermal stripping; rotary kiln and fluidized bed incineration; pyrolytic incineration/ electric pyrolysis, advanced electric reactor, and high-temperature fluid wall reactor; circulating bed and molten salt combustion; plasma arc torch and infrared (IR) thermal destruction; wet air and supercritical water oxidation; and vitrification (joule-heated ceramic melter)	Thermal treatment following removal achieves remedial action objectives in a manner similar to thermal treatment in situ. The various process options typically produce a solid (e.g., ash, char, or glass), liquid (e.g., scrubbing water, brine, or condensate) and gaseous (e.g., volatilized organics and metals and innocuous gases) effluent. Thermal destruction processes are typically used to destroy organics, and while some are commonly used in waste treatment (e.g., incinerators), others are developmental (e.g., IR and supercritical water oxidation) and have been demonstrated only on a pilot scale.

TABLE B.1 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Chemical:		
	In situ	Soil flushing	Acid/base, surfactant, chelating agent, and organic solvent solutions via surface application and injection/extraction wells	In-situ flushing can reduce the toxicity, mobility, and volume of contaminated soil/sludge via desorptive reactions and can limit potential exposures, biouptake, and migration by controlling the contaminant source. This technology can remove VOCs from permeable soils (although migration control can be difficult), and it can be used as an initial treatment step to leach contaminants from a waste matrix (e.g., via solution mining). The solubility of hydrocarbons, metals, and radionuclides can be enhanced by solvent application, and the reagent solution can be sprinkled or ponded over the contaminated zone for aggressive treatment. Because this technology is very contaminant-specific and the selection of a suitable flushing fluid is difficult, it is ineffective for complex wastes. Mobile units are available, but full site cleanup has not yet been demonstrated by these processes.
		Chemical addition/ detoxification	Hydrolysis, redox reactions, neutralization, precipitation, and solidification using drills, augers, and paddles for chemical addition	Chemical detoxification can achieve remedial action objectives in a manner similar to in-situ soil flushing via chemical reactions that alter the toxic nature of the contaminants or solidify them to limit mobility; however, in contrast to soil flushing, these reactions can increase the total volume of contaminated material following chemical addition (e.g., for precipitation and solidification processes). Chemical agents can be dispensed through a shaft and mixed via an up/down drill motion or by augers and hydraulically driven paddles; reagents are typically selected for treatment specificity. This technology is developmental for waste treatment applications and must be evaluated on a site-specific basis.

TABLE B.1 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Chemical (cont'd):		
	In situ (cont'd)	Stabilization/ fixation	Lime- and Portland cement-based pozzolanic reactions, asphalt-based thermoplastic microencapsulation, and catalyzed polymerization using drills, augers, and paddles for chemical introduction	In-situ stabilization/fixation processes can achieve remedial action objectives in a manner similar to in-situ chemical detoxification. This technology is typically used to treat soil/sludge contaminated with heavy metals and high molecular weight organics by binding the contaminants in place in an insoluble matrix or in a matrix that minimizes the surface exposed to potential solvents. Field demonstration of this technology in waste treatment applications has been limited.
	Following removal	Contact extraction	Soil washing (non-water), amine extraction, critical fluid (liquefied carbon dioxide and/or propane) solvent extraction, and other solution extractions (as for in-situ soil flushing) using a reactor vessel	Chemical extraction following removal achieves remedial action objectives in a manner similar to in-situ soil flushing. Various solutions can be used to separate oils, other organics, radionuclides, and metals from soil/sludge in an agitated reactor vessel. Amine extraction can be used to remove organics, and pH adjustment required for pretreatment may also precipitate heavy metals. Critical fluid solvent extraction can separate oils and organics from sludge/slurried soil and has been used to treat PCB-contaminated sludge but is inappropriate for removing heavy metals or inorganic compounds.
		Chemical-specific reaction	Glycolate dechlorination and redox reactions (which may be enhanced by electrolysis, catalysis, or irradiation) using a reactor vessel	Chemical-specific reactions following removal can achieve remedial action objectives in a manner similar to chemical detoxification in situ. Glycolate dechlorination can be used to dehalogenate volatile and semivolatile organics, PCBs, and pesticides by mixing contaminated soil/sludge with a glycolate solution in a heated reactor vessel; this process has been tested on PCB-contaminated soil. Redox (reduction and oxidation) processes can treat chlorinated organics and unsaturated hydrocarbons, metals, inorganic cyanides, and reactive contaminants in sludges/slurried soils. This process may be widely applicable as a treatment step, but care must be taken to select reagents specific to the reaction required and to avoid unwanted secondary reactions.

TABLE B.1 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Chemical (cont'd):		
	Following removal (cont'd)	Stabilization/ fixation	As for the in-situ application, but using a reactor vessel	As for the in-situ application, except that process effectiveness is less constrained because various pretreatment options are available (e.g., dewatering and crushing). Following implementation, the wastes could be replaced in the area from which they were removed. This technology has been demonstrated for hazardous waste treatment applications.
	Treatment/pretreatment (cont'd):	Biological:		
	In situ	Bioreclamation (enhanced biodegradation)	Nutrient/microbial injection and other system modifications	In-situ bioreclamation can reduce the mobility and volume of contaminated materials (and the toxicity of limited chemical contaminants) in a soil/sludge and can limit potential exposures, biouptake, and migration by controlling the contaminant source. In this process, oxygen, water, nutrients, and microbes can be applied to the surface of a contaminated soil/sludge or can be injected into the contaminated zone to enhance the natural biodegradation of contaminants. In addition, pH and temperature can be adjusted to improve reaction conditions. Bioreclamation can be used to treat highly biodegradable material but is generally ineffective for (and can be adversely affected by) inorganics, including heavy metals and radionuclides. This process is developmental for waste treatment applications (e.g., to treat pesticides and PCBs) and must be evaluated on a site-specific basis.
		Surface impoundment	Constructed stabilization pit, lagoon, or wetland	Surface impoundments can achieve remedial action objectives in a manner similar to in-situ bioreclamation under similar constraints. In this process, an impoundment can be constructed in situ to promote natural geochemical and biological reactions for removal of surface contamination (including metals). This technology is developmental for waste treatment applications and must be evaluated on a site-specific basis.

TABLE B.1 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Biological (cont'd):		
	Following removal	Composting	Open and static windrows and reactor vessels	Composting following removal can achieve remedial action objectives in a manner similar to in-situ bioreclamation under similar constraints. Organic degradation can be achieved using open windrows, consisting of long piles of the waste that are aerated by tearing down and rebuilding; in static windrows that are aerated by forced air; and in reactor vessels that are aerated by tumbling, stirring, and forced air. Composting is not widely used but may be applicable to the treatment of highly biodegradable materials and structurally firm wastes (e.g., contaminated wood chips; see discussion for structural material/debris).
		Contact digestion	Activated sludge reactor and digestors	Digestion following removal can achieve remedial action objectives in a manner similar to in-situ bioreclamation under similar constraints. System conditions can be optimized (and co-metabolites can be added) more easily in a reactor vessel than in situ. These processes are commonly used in conventional wastewater/sludge treatment and are developmental for hazardous waste treatment applications but may be useful for treating pesticides and PCBs.
		Attached growth	Rotating biological contactor and trickling filter	Attached growth reactions following removal can achieve remedial action objectives in a manner similar to digestion following removal under similar constraints. These processes are not suitable for inorganic-contaminated material but have been demonstrated for sludges containing biodegradable organics.
		Surface impoundment	As for the in-situ application	As for the in-situ application, but system construction/control and optimization of treatment conditions is less constrained. For example, a lined treatment bed can be constructed with a leachate collection system and an overhead spray irrigation system to distribute nutrients and microbes. Although developmental for hazardous waste treatment applications, this technology could be used to treat wastes containing pesticides, PCBs, and oils.

TABLE B.1 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Biological (cont'd):		
	Following removal (cont'd)	Land application	Land farming	Land application can achieve remedial action objectives in a manner similar to composting under similar constraints. In this process, a waste is applied to and mixed with surface soil to enhance natural geochemical and biological processes. Although developmental for hazardous waste treatment applications, this technology could be used to treat wastes containing pesticides, PCBs, and oils.
As for in-situ containment	Temporary storage	On-site or off-site facility	Engineered structure	Temporary storage can reduce the mobility and volume of contaminated materials and can limit potential exposures, biouptake, and migration by controlling the contaminant source. This option requires the engineering of a storage facility and is implemented as an interim measure while a permanent remedy is developed. Constraints include technical (engineering) and socio-political (acceptability) issues.
As for in-situ containment	Disposal	On-site or off-site	Engineered structure (on land) or ocean disposal	Disposal can reduce the mobility and volume of contaminated materials and can limit potential exposures, biouptake, and migration by controlling the contaminant source. (Disposal often follows the treatment of contaminated materials, so toxicity reduction is often inherent in the overall management scheme.) This option requires either the engineering of a disposal facility (land-based) or the permission for implementing ocean disposal. In addition to engineering requirements, constraints include issues such as site suitability; transportation, including routes, risks, and costs (for the off-site options); and regulator/community acceptance.

TABLE B.2 Potential Response Actions and Technologies for Surface Water

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
No action	No action	Not applicable	Not applicable	This is retained as a potential response to provide a baseline for comparison with action alternatives.
As for soil/sludge under institutional controls	Institutional controls	Access restrictions	Fences and guards	These varied institutional controls are not typically effective in controlling the source or migration of contaminants and are generally used only to support other response actions.
		Ownership and deed restrictions	Legal titles and deeds	
		Monitoring	Groundwater wells and air, surface water, and soil/sludge samplers	
Minimize toxicity, mobility, and/or volume of contaminated material (and as for institutional controls)	In-situ containment	Surface controls/ diversions	Graded contours, swales, dikes, and berms	Surface controls can limit contaminant mobility and can mitigate potential exposures, biouptake, and migration by controlling surface water runon and runoff. These processes can be implemented with conventional equipment.
		Lateral barriers	Grout layer injection and block displacement	Lateral barriers and bottom sealing can limit contaminant mobility and can mitigate potential exposures by limiting migration to underlying soils, surface water, and groundwater. These processes can be implemented with conventional equipment, but field applications can be constrained by site-specific geologic conditions.
		Bottom sealing	Slurry wall, grout curtain, and sheet piling	
As for in-situ containment	Removal/collection	Interception and pumping	Interceptor channels and dynamic (centrifugal), reciprocating, and positive displacement pumps	Runoff interception and pumping can limit the toxicity, mobility and volume of contaminated material at the surface water location, thereby mitigating potential exposures, biouptake, and migration by controlling the contaminant source. This technology can be implemented with conventional equipment and is typically followed by a treatment scheme to reduce contaminant toxicity, mobility, and volume in the collected water.

TABLE B.2 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Removal/collection (cont'd):	Skimming and "sinker" collection	Floating boom and siphon dam	These in-situ processes can reduce the toxicity, mobility, and volume of contaminated surface water and can limit potential exposures, biouptake, and migration by controlling the contaminant source. They can be implemented with conventional methods and are typically used to remove floating oils or dense ("sinking") contaminants from surface waters (primarily streams).
As for in-situ containment	Treatment/pretreatment:	Physical:		
	In situ	Nonthermal extraction	Photolysis, density separation (clarification and flotation), and flocculation (via agitation)	These in-situ processes can reduce the toxicity, mobility, and volume of contaminated surface water and can limit potential exposures, biouptake, and contaminant migration by controlling the contaminant source. Such methods include ultraviolet irradiation, enhanced sedimentation (using a settling agent and air bubbling), and mixing with blades and air. They can be implemented with conventional methods and are typically used to treat suspended solids contamination, although dissolved organics and inorganics may also be treated by nonthermal extraction in situ.
		Thermal extraction	Solar evaporation	This thermal process can achieve remedial action objectives in a manner similar to nonthermal extraction in situ. Natural irradiation can be enhanced with covers and condensate collection to expedite treatment, and although this process can be implemented with conventional equipment, its application is constrained by site-specific climatic conditions.
	Following removal	Nonthermal extraction	Density separation (centrifugation), flocculation, filtration, adsorption, osmosis, reverse osmosis/ultrafiltration, electrolysis, electrodialysis, and freeze crystallization	These nonthermal extraction processes following removal can achieve remedial action objectives in a manner similar to nonthermal extraction in situ, but with fewer constraints and greater control of reactions and products. The processes can generally be implemented with conventional equipment, and many are used to treat suspended solids. Certain processes have been used in industrial wastewater treatment, but their demonstration in hazardous waste treatment has been limited.

TABLE B.2 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Physical (cont'd):		
	Following removal (cont'd)	Thermal extraction/ destruction	Stripping, vapor recompression/distillation, wet air oxidation, supercritical water oxidation, liquid-injection incineration, and chlorinolysis	Thermal extraction and destruction processes can reduce the toxicity, mobility, and volume of contaminated surface water and can limit potential exposures, biouptake, and migration by controlling the contaminant source. These processes are typically used to destroy organics and can be operated with a liquid feed. Although certain destruction processes have been used in industrial applications, their demonstration for hazardous waste treatment has been limited.
	Treatment/pretreatment (cont'd):	Chemical:		
	In situ	Chemical addition	Hydrolysis, redox reactions (including ozonation and chlorination), dechlorination, chelation, neutralization, and precipitation	Chemical addition can reduce the toxicity, mobility, and volume of contaminated surface water and can limit potential exposures, biouptake, and contaminant migration by controlling the contaminant source. This is achieved via chemical reactions that alter the toxic and/or physical nature of the contaminants. Chemical reagents such as surfactants, acids/bases, chelating agents, precipitants, and coagulant/flocculant aids can be mixed into a surface water by mechanical means (e.g., paddles and blades) or aeration. These processes can be implemented with conventional methods to treat both organics and inorganics and are common in wastewater treatment applications (although much more so following removal than in situ); their application for hazardous waste treatment has been limited.
	Following removal	Contact extraction	Solvent extraction	This process can reduce the toxicity, mobility, and volume of contaminated soil/sludge and can limit potential exposures, biouptake, and migration by controlling the contaminant source. Solvent extraction is typically used to remove organics from aqueous solutions and can be implemented with conventional methods. Application for hazardous waste treatment has been limited.

TABLE B.2 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Chemical (cont'd):		
	Following removal (cont'd)	Chemical addition	As for the in-situ application, with additional processes (e.g., ion exchange and adsorption beds) and using a reactor vessel	As for the in-situ application, but the reaction system can be better controlled and process effectiveness can be optimized. Chemical addition can treat both organic and inorganic contaminants and can be implemented with conventional methods. Its use is common in wastewater treatment applications, but its application for hazardous waste treatment has been limited.
	Treatment/pretreatment (cont'd):	Biological:		
	In situ	Bioreclamation (enhanced biodegradation)	Nutrient/microbial injection and other system modifications	In-situ bioreclamation can reduce the mobility of contaminated materials (and the toxicity of limited chemical contaminants) in surface water and can limit potential exposures, biouptake, and migration by controlling the contaminant source. In this process, oxygen, nutrients, and microbes can be introduced to the water system and pH can be adjusted (with chemical addition) to improve reaction conditions. Mixing is typically required to enhance degradation. Bioreclamation can be used to treat highly biodegradable material but is generally ineffective for (and can be adversely affected by) inorganics, including heavy metals and radionuclides.
	Following removal	Contact digestion	Activated sludge reactor and digestors	As for soil/sludge following removal.
		Attached growth	Rotating biological contactor and trickling filter	Attached growth reactions following removal can achieve remedial action objectives in a manner similar to in-situ bioreclamation under similar constraints. These processes are not suitable for inorganic-contaminated material but could be useful for solutions containing biodegradable organics.

TABLE B.2 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Biological:		
	Following removal (cont'd)	Surface impoundment	Constructed lagoon or wetland	Surface impoundments can achieve remedial action objectives in a manner similar to in-situ bio-reclamation under similar constraints. This process would be similar to the original condition of the surface water, except that the system could be constructed for better control and optimized for better removal efficiency. (See the related discussion for soil/sludge.)
		Land application	Spray irrigation	Spray irrigation can achieve remedial action objectives in a manner similar to surface impoundments and can be achieved using conventional equipment. This process can be used to treat organics but is generally ineffective for inorganics, and its implementation could be constrained by site-specific geological conditions.
As for in-situ containment	Disposal	On-site	Groundwater injection or discharge on land or to other surface water	On-site disposal can reduce the toxicity of contaminated surface water (by dilution) following direct discharge and can limit mobility, volume, potential exposures, bio-uptake, and migration at the original location by controlling the contaminant source. Surface water can be directly injected into the ground or discharged on land (e.g., via spraying) or to another surface water on-site (e.g., by pipe or gravity drainage) following collection, but it is not typically released before being treated. When used in conjunction with treatment, disposal can reduce the toxicity, mobility, and volume of contaminated surface water and limit overall exposures, biouptake, and migration.
		Off-site	Groundwater injection or discharge on land, to publicly owned treatment works (POTW), or to other surface water	Off-site disposal can achieve remedial action objectives in a manner similar to on-site disposal, with an additional option (i.e., piping to a POTW). This option must often be preceded by some type of treatment and requires permission from the operator. As for on-site disposal, surface water is not typically disposed of directly off-site; rather, it is often released only after being treated.

TABLE B.3 Potential Response Actions and Technologies for Groundwater

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
No action	No action	Not applicable	Not applicable	This is retained as a potential response to provide a baseline for comparison with action alternatives.
As for soil/sludge under institutional controls	Institutional controls	Access restrictions	Fences at well/point of recharge	These varied institutional controls are not typically effective in controlling the source or migration of contaminants and are generally used only to support other response actions. An alternate water supply is typically an interim measure used to ensure human health while a permanent remedy is developed.
		Ownership and deed/ use restrictions	Legal titles and deeds/ decrees	
		Monitoring (e.g., of natural attenuation)	Groundwater wells and air and surface water samplers	
		Alternate water supply	Piped/transported water or water from a separate (uncontaminated) source (groundwater aquifer or surface water/municipal supply)	
Minimize toxicity, mobility, and/or volume of contaminated material (and as for institutional controls)	In-situ containment	Lateral barriers	Slurry wall, grout curtain, and sheet piling	Lateral barriers can limit contaminant mobility and can mitigate potential exposures by limiting migration (e.g., to uncontaminated groundwater and to surface water via recharge). These processes can be implemented with conventional equipment, but their effectiveness is constrained by site-specific hydrogeological conditions. (Note that insofar as surface controls can limit contaminant migration to groundwater, they may be addressed for groundwater control; see discussion of surface controls for soil/sludge.)
		Bottom sealing	Grout layer injection and block displacement	Bottom sealing can achieve remedial action objectives in a manner similar to lateral barriers under similar constraints. This technology may be useful for containment of lenses or perched aquifers, but its application is constrained by site-specific geologic conditions and it is not typically effective for deep groundwater systems.

TABLE B.3 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Removal/collection	Interception and pumping	Subsurface drains and interceptor trenches; and wellpoints, suction wells, ejector wells, and deep wells	Groundwater removal by pumps and trenches can limit the toxicity, mobility, and volume of contaminated material at that location, thereby mitigating potential exposures, biouptake, and migration by controlling the contaminant source. This technology can be implemented with conventional equipment and is typically followed by a treatment scheme to reduce contaminant toxicity, mobility, and volume in the collected water.
As for in-situ containment	Treatment/pretreatment:	Physical:		
	In situ	Extraction	Air/steam stripping	This process can reduce the toxicity, mobility, and volume of contaminants in groundwater and can limit potential exposures, biouptake, and migration by controlling the contaminant source. Stripping can be used to remove VOCs from groundwater but is typically associated with a removal/collection system. Insofar as many other treatment systems also involve groundwater capture (and upgradient reinjection), see discussion of in-situ treatment for soil/sludge for related information.
	Following removal	Nonthermal extraction	As for surface water following removal	As for surface water following removal.
		Thermal extraction/destruction	As for surface water following removal, and solar evaporation (see discussion for surface impoundment following removal)	As for surface water following removal.
	Treatment/pretreatment (cont'd):	Chemical:		
	In situ	Chemical injection	As for chemical addition for surface water in situ	As for chemical addition for surface water in situ, except that mixing cannot be enhanced by mechanical means.

TABLE B.3 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Chemical (cont'd):		
	In situ (cont'd)	Contact reaction system	Permeable treatment beds, with pumps or French drain systems	Permeable treatment beds can reduce the toxicity, mobility, and volume of contaminated groundwater and can limit potential exposures, biouptake, and migration by controlling the contaminant source. This process is used in conjunction with collection (e.g., pump/drain). Bed media can range from crushed limestone and activated carbon to glauconitic green sands and synthetic ion exchange resins. Implementation of this process is constrained by site-specific hydrogeologic conditions.
	Following removal	Extraction	As for surface water following removal	As for surface water following removal.
		Chemical addition	As for surface water following removal	As for surface water following removal.
	Treatment/pretreatment (cont'd):	Biological:		
	In situ	Bioreclamation (enhanced biodegradation)	Nutrient/microbial injection	As for surface water following removal, except that mechanical mixing is not an option.
	Following removal	Contact digestion	As for soil/sludge following removal	As for soil/sludge following removal.
		Attached growth Land application	As for surface water following removal	As for surface water following removal.
		Surface impoundment	As for surface water following removal	As for surface water following removal (except that the process does not mimic original conditions).
As for in-situ containment	Disposal	On-site	Reinjection or discharge on land or to surface water	As for surface water following removal.
		Off-site	Reinjection or discharge on land, to POTW, or to surface water	As for surface water following removal.

TABLE B.4 Potential Response Actions and Technologies for Structural Material

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
No action	No action	Not applicable	Not applicable	This is retained as a potential response to provide a baseline for comparison with action alternatives.
As for soil/sludge under institutional controls	Institutional controls	Access restrictions	Fences and guards	These varied institutional controls are not typically effective in controlling the source or migration of contaminants and are generally used only to support other response actions.
		Ownership and deed restrictions	Legal titles and deeds	
		Monitoring	Groundwater wells and air, surface water, and soil/ sludge samplers	
Minimize toxicity, mobility, and/or volume of contaminated material (and as for institutional controls)	In-situ containment	Release controls	Surface sprays (sealer paints and emulsions)	Release controls can limit contaminant mobility and can mitigate potential exposures, biouptake, and migration by controlling the contaminant source. These processes can be implemented with conventional equipment.
As for in-situ containment	Removal	Demolition	Wrecking equipment (balls and cranes)	Demolition can remove a contaminated structure from its current location and can be implemented with conventional equipment. Decontamination processes can reduce the toxicity, mobility, and volume of contaminated structures (via transfer to the decontamination residue) and can limit potential exposures, biouptake, and migration by controlling the contaminant source. Decontamination can be used to remove organics and inorganics (including removable [i.e., non-fixed] radionuclides) from structural surfaces. These processes can be implemented with conventional equipment. (Insofar as decontamination removes contaminants from a medium, it is included in the "Removal" category; see also the "Treatment/pretreatment" discussion.)
		Decontamination	Aggressive vacuuming, solvent wiping, foam/ emulsion application, steam and high-pressure water washing, and carbon dioxide pellet and abrasive grit blasting	
As for in-situ containment	Treatment/pretreatment:	Physical:		
	In situ	Decontamination/ extraction	Vacuuming, wiping, washing, and blasting	As for decontamination under removal (because these processes can be considered under both removal and treatment, they are listed under both response actions).

TABLE B.4 (Cont'd)

Remedial Action Objectives	General Response Action	Potential Technology Type	Potential Process Option	Comments
As for in-situ containment	Treatment/pretreatment (cont'd):	Physical (cont'd):		
	Following removal	Size reduction	Impact crushers, shredders, and tumbling and hammer mills	These processes can reduce the size/volume of contaminated structures and debris and can be implemented with conventional equipment.
		Decontamination/ extraction	As for the in-situ application	As for the in-situ application.
		Thermal treatment	Incineration and melting/ thermal destruction in kilns and furnaces	Thermal treatment processes can reduce the toxicity, mobility, and volume of contaminated structural debris and can limit potential exposures, biouptake, and migration by controlling the contaminant source. These processes can destroy organics and retain inorganics in the solid residue. Although certain thermal processes have been used in industrial applications, their demonstration for structural debris contaminated with hazardous waste has been limited.
	Treatment/pretreatment (cont'd):	Chemical:		
	In situ	Decontamination/ extraction	Solvent washing and foam/emulsion application	As for physical decontamination in situ.
	Following removal	Decontamination/ extraction	Solvent washing, foam/ emulsion application, and chemical (e.g., acid) bath extraction	As for physical decontamination in situ.
	Treatment/pretreatment (cont'd):	Biological:		
	Following removal	Composting	As for soil/sludge	As for composting of soil/sludge; may be effective for organic debris.
As for in-situ containment	Temporary storage	On-site or off-site facility	Engineered structure	As for temporary storage of soil/sludge.
As for in-situ containment	Disposal	On-site or off-site	Engineered structure (on land) or ocean disposal	As for disposal of soil/sludge.

APPENDIX C

SCOPING PROCESS

APPENDIX C

SCOPING PROCESS

C.1 SUMMARY OF THE SCOPING PROCESS

C.1.1 Notice of Intent

On November 16, 1990, a notice of intent (NOI) was published in the *Federal Register* that formalized the intention of DOE to initiate the scoping phase of the environmental review process and to evaluate alternatives for the long-term management of radioactive wastes and residues remaining at the Maywood site. The NOI presented pertinent background information on the proposed scope and content of the Maywood site RI/FS-EIS and initiated a formal 30-day comment period to solicit comments and suggestions from members of the public, agencies, and other interested groups for consideration in preparation of the RI/FS-EIS (DOE 1990). As part of the public scoping process, public participation was solicited — particularly regarding the range of remedial action alternatives to be evaluated, significant issues to be addressed, and issues to be eliminated from further detailed study.

C.1.2 Preliminary Identification of Alternatives

The primary purpose of an RI/FS-EIS is to define and analyze the reasonable alternatives for the remedial action and to evaluate the environmental effects to be expected from each alternative. As background for public comments and suggestions concerning reasonable alternatives to be considered, DOE tentatively identified in the NOI a broad range of alternatives that would be analyzed in the RI/FS-EIS: (1) no action; (2) treatment and disposal of wastes either on-site or off-site (off-site disposal would be considered generically, not specifically); and (3) containment or institutional control alternatives that control the threats posed by the hazardous substances and/or prevent exposure. A no-action alternative is developed because it is required under CERCLA and NEPA and it provides a useful baseline for comparing the costs and effects of the other alternatives being considered.

C.1.3 Preliminary Identification of Issues

The purpose of the scoping process was to solicit comments and suggestions for consideration in preparation of the RI/FS-EIS. As background for public comment, the NOI listed those environmental issues that have been tentatively identified for analysis in the RI/FS-EIS. This list was not intended to be all-inclusive nor to imply any predetermination of effects. Comments received as a result of the public meeting were combined with the NOI list and are included under "Primary Issues" in Section C.2.1 of this appendix.

C.1.4 Scoping Meeting

As part of the scoping/planning process, a public scoping meeting was held at the Fairmont Elementary School in Hackensack, New Jersey, on December 6, 1990, to solicit public comment on the scope of the CERCLA/NEPA process and the range of alternatives to be considered. Nine persons made statements at the public meeting and four letters were received (from three individuals and one state agency) during the formal comment period, which ended December 17, 1990. Table C.1 is a summary of the comments by subject area, and Table C.2 is a list of participants at the public meeting. All topics highlighted through the scoping process will be addressed in the RI/FS-EIS — including a thorough review of data, available studies, and pertinent literature on the effects of the project on human health. A responsiveness summary — addressing comments, questions, and public concerns expressed in the public meeting and in written comments — has been prepared as part of the scoping/planning process and is included as Appendix D.

C.1.5 Evaluation of Scoping Process Input

During the scoping meeting, the primary concerns expressed by members of the community were opposition to ultimate disposal at the Maywood Interim Storage Site, a strong desire to dispose of the wastes without delay at the Envirocare of Utah site (Clive, Utah), concern about site radioactive emissions and groundwater contamination by chemicals, and concern that past plant releases had increased the cancer incidence along West Central Avenue. Primary concerns expressed in written comments were a belief that the review process was too long, a preference for consolidating the related site reviews for Wayne, Middlesex, and New Brunswick into one document, a desire that the wastes be disposed of without delay at the Envirocare of Utah site, and concern that past plant releases had increased the cancer incidence along West Central Avenue.

DOE has reviewed all scoping comments, both verbal and written, and believes that the task descriptions presented in Section 5.0 of this WP-IP do not require revision as a result of the scoping input. All issues raised in this input are expected to be adequately addressed through implementation of tasks described in this WP-IP and accompanying plans.

C.2 ISSUES TO BE ADDRESSED IN THE RI/FS-EIS

The issues to be addressed in the RI/FS-EIS were developed on the basis of public and technical input, including those arising out of the scoping process. Some issues deal with potential public health impacts, whereas others involve disposal options. The issues have been separated into two categories: primary issues to be discussed in general terms in this section with an in-depth analysis to be provided in the RI/FS-EIS, and secondary issues that will be discussed in this section to the extent possible and then analyzed in the RI/FS-EIS to a degree less than that of the primary issues.

TABLE C.1 Summary of Public Scoping and Written Comments Related to the Environmental Impacts of the CERCLA Response Actions at the Maywood, New Jersey, Site

Issue No.	Subject/Question
1	Wastes should not be disposed of on-site but off-site; many cementers suggested the Envirocare of Utah, Inc., site in Clive, Utah. Envirocare requested to meet with DOE on this issue.
2	Off-site disposal should be initiated before the expiration on May 8, 1992, of the EPA's national capacity variance on land disposal of mixed waste.
3	Off-site disposal should not be discussed generically.
4	Disposal of the Maywood wastes at a New Jersey facility or overseas should be considered.
5	Radioactive and chemical materials are alleged to be contributing to environmental contamination, exceedance of guidelines, and excess cancers in the region of West Central Avenue and Ecclestone Place in Maywood. Reference was made to the New Jersey Department of Health's recent Maywood area health assessment.
6	The proposed schedule for the remedial investigation/feasibility study–environmental impact study is considered to be too long. The process needs to be accelerated. If the schedule is too long, use of the Utah site may be foreclosed.
7	Environmental reviews for Maywood, Wayne, Middlesex, and New Brunswick should all be accomplished in one document.
8	Only realistic options for disposal should be considered in the feasibility study.
9	Assurance was requested that neither the Maywood Chemical Works nor the Stepan Chemical Company had contracts with the Atomic Energy Commission to provide thorium.
10	The DOE's authority for FUSRAP activity in Maywood and Wayne was questioned.
11	Admiral Watkins, Secretary of the Department of Energy, was requested to initiate an investigation of personnel involved with the Maywood site.
12	Can local property taxes, lost when the federal government bought the MISS, be retrieved?
13	Is funding allocated for the treatment and disposal of the Maywood wastes?
14	Are removal actions being considered while remedial actions are going on?
15	What are the status of the work plans for the Stepan Company and for the Wayne site? Where are the Stepan test results?
16	Will DOE consider buying homes on West Central Avenue?
17	With regard to the waste pile at the Maywood Interim Storage Site, what is under it, has it increased the contaminant levels off-site, and is another pile being planned?
18	Why is DOE in Wayne and Maywood but not Montclair?

TABLE C.2 Participants in the Scoping Process

Oral Comments

John Tamburro, Maywood resident; Member, Maywood Board of Health
Louise Ponce, Maywood resident
Gregory Allen, D.T. Allen Contracting, Franklin Lakes, New Jersey
Paul Contillo, Senator, New Jersey State Senate
John Steuert, Mayor, Borough of Maywood
Ruth Bahto, Maywood resident
Robert Breslin, Maywood resident
Charles Judd, Envirocare of Utah, Inc.
Dr. George Brush, Maywood resident; Chair, Maywood Planning Board

Written Comments

John Tamburro, Maywood resident; Member, Maywood Board of Health
Bob Stern, Chief, Bureau of Environmental Radiation, New Jersey Department of Environmental Protection
Peter Torell, Treasurer, IAM-AFL/CIO
Louise Torell, Secretary, Concerned Citizens
Micheal J. Nolan, Chairman, Concerned Citizens-Maywood

C.2.1 Primary Issues

The primary issues raised during the scoping process in the public comment period that will be analyzed in the RI/FS-EIS are as follows:

1. Potential radiological impacts in terms of both radiation doses and resulting health risks:

    - On people, including workers and the public, i.e., individuals and the total population, children and adults, present and future generations;
    - Along transportation routes and near other sites relevant to the proposed alternatives;
    - Associated with routine operations and accidents;
    - Associated with various pathways to humans, including surface waters, groundwaters, gases, dusts, particulates, and biota;
    - Due to natural forces such as erosion and flooding; and
    - Associated with human intrusion into the contaminated materials.

2. Potential chemical impacts in terms of doses and resulting health risks:

    - On people, including workers and the public; i.e., individuals and the total population, children and adults, present and future generations;
    - Along transportation routes and near other sites relevant to the proposed alternatives;
    - Associated with routine operations and accidents;
    - Associated with various pathways to humans, including air, soil, surface waters, groundwaters, and biota;
    - Due to natural forces such as erosion and flooding; and
    - Associated with human intrusion into the contaminated materials.

3. Potential engineering and technical issues:

   - The most reasonable engineering options for each type of waste/residue;
   - Probable duration of isolation;
   - Rates and magnitude of loss of containment;
   - Related to site-specific geohydrology and ecology;
   - Related to site-specific wind dispersion patterns; and
   - Site characterization and research and development work necessary before the decision or before actual implementation of an alternative.

4. Potential issues relative to mitigative measures and monitoring:

   - Health physics procedures for workers; and
   - Control measures for erosion, gases, and dusts.

5. Potential institutional issues:

   - Identification of potential sites for long-term disposal, including in-state, out-of-state, overseas, commercial, regional compact, and governmental sites;
   - Project-specific criteria for decontamination, effluents, environmental concentrations, and release of a site for use without radiological restrictions;
   - Future institutional controls (monitoring and maintenance); and
   - Institutional issues that need to be resolved before an alternative can be implemented.

6. Potential socioeconomic issues:

   - Effects on land uses, values, and marketability; and
   - Effects on local transportation systems.

7. Cumulative impacts associated with issue categories 1-6 above for the remedial actions proposed to be taken or reasonably foreseeable at the Maywood, Wayne, Middlesex, and New Brunswick sites and at the Lodi well field.

8. Issues related to the CERCLA criteria for selection of a remedial action:

   - Overall protection of human health and the environment;
   - Compliance with applicable or relevant and appropriate requirements;
   - Long-term effectiveness and permanence;
   - Reduction of waste toxicity, mobility, and volume through treatment;
   - Short-term effectiveness;
   - Implementability;
   - Cost;
   - State acceptance; and
   - Community acceptance.

C.2.2 Secondary Issues

Secondary issues are those deemed through the scoping process to be important, but to a lesser degree than primary issues. Secondary issues include:

- The precise definition of Maywood site radioactive material, whether naturally occurring radioactive material (NORM) or by-product material as specified in Section 11e(2) of the amended Atomic Energy Act;
- The extent to which DOE Order 5820.2A restricts disposal options (this Order states DOE wastes are to be disposed of at the site at which they were generated or, if not possible, at another DOE facility); and
- The extent to which the EPA's Land Disposal Restrictions in Title 40, Part 268, of the Code of Federal Regulations will restrict disposal options (this section would require, after May 8, 1992, that chemical contaminants in mixed waste be treated before land disposal).

C.3 ISSUES BEYOND THE SCOPE OF THE RI/FS-EIS

DOE has determined that the following issues are beyond the scope of the RI/FS-EIS:

- Psychological impacts -- In light of the U.S. Supreme Court case ruling involving the proposed restart of one of the Three Mile Island reactors (Metropolitan Edison Company v. People Against Nuclear Energy [PANE] 103 S. Ct. 1556 [1983]), DOE considers in an EIS only psychological impacts that bear a close causal relationship to the physical environment.

- Impacts of past operations of the site -- The impacts of the various alternatives on the existing environment will be assessed in the RI/FS-EIS. In the above-mentioned Supreme Court decision, it was stated that "NEPA is not directed at the effects of past accidents and does not create a remedial scheme for past federal actions." Therefore, a detailed analysis of past operations, beyond that necessary to characterize the existing environment, is considered to be beyond the scope of the RI/FS-EIS.

APPENDIX D

RESPONSES TO PUBLIC SCOPING COMMENTS

APPENDIX D

RESPONSES TO PUBLIC SCOPING COMMENTS

Comment letters on the work plan-implementation plan were received from the individuals listed in the following table. Each of these letters has been assigned an identification code, and specific issues within each letter have been identified with a number. For example, the letter (document) from John Tamburro is Letter A; issues (comments) identified within Letter A are labeled A-1, A-2, and so forth; and the respective responses to these comments are labeled Response A-1, Response A-2, and so forth. A copy of each letter (document) is reproduced in this section, and the responses to identified comments are presented following the respective comments. Attachments to the letters are also reproduced; the quality of reproduction was affected by the quality of the original and the problems associated with reprinting colored materials in a black-and-white format.

Exhibit A

073733

CANCER CLUSTER STUDY FOR WEST CENTRAL AVENUE AND ECCLESTONE PLACE
MAYWOOD, NEW JERSEY, 8/86, UPDATED 12/90.

Though, only one of these homes is designated for remedial action and is part of the Maywood Site, the rest of the homes in this area are directly affected by dangerous chemicals and heavy metals in the soil and water in the area. These residents are also exposed to high levels of radiation emanating from Stepan Company property, the MISS property, and the Susquehanna Railroad property.

Prepared by John Tamburro
Member of the Board of Health of Maywood, N.J.

A-1 This document was prepared to show that the residents around portions of the Maywood site, which includes commercial, federal, state, and municipal properties in Maywood, Rochelle Park, and Lodi, N.J., are being exposed to dangerous levels of radiation, carcinogenic chemicals, and heavy metals. The portion of the Maywood site referred to is the MISS, Stepan Company property, and portions of Sears and vicinity properties. The residential portion where the danger is the greatest runs from West Magnolia Lane, east along West Magnolia Avenue to Ramapo Avenue, south to the Susquehanna Railroad, west to Ecclestone Place, and north to West Magnolia Lane (See FIGURE 1) (1). This area has a very high water table,
A-2 and is very close to the source of the radiation. The ground water here is contaminated with dangerous chemicals, heavy metals, and radioactive elements (2). During heavy rains the water level rises up to the foundations of homes. Some basements flood, but most residents have sump pumps which keeps the water from rising above the foundations. A few basements do not flood because they are water sealed, however, chemicals can still volatize into these basements from the ground water. Puddling occurs in many yards when the water table rises, and remains from one to several days depending on the location and weather (3).

FIGURE 9 shows the relationships of portions of the Maywood site to the afflicted homes. The sites are Sears and vicinity properties, Stepan Company, the MISS, and the Susquehanna Railroad.

A-3 To see the radiation danger refer to FIGURES 7, 8, 10, 15, and 16. They show the high amount of radiation residents of West Central Avenue and Ecclestone Place were exposed to since 1950 - (when most of these homes were built). The radiation lines were drawn from the document, "An Aereological Survey of the Stepan Chemical Company and Surrounding Area. Maywood, New Jersey. Date of survey: 26 January 1981" (4). FIGURE 10 is a blow-up of one of the radiation profiles in the report. This survey was performed by the Energy Measurements Group (EE&G) for the United States Regulatory Commission in response to an accident on Rt. 17, involving radioactive material. The radiation detected is from thorium, uranium, and other radioactive materials buried in the soil on Stepan, MISS, and surrounding properties (5). It is not from the accident. These radioactive materials were present in the area since the late 1800's when the Maywood Thorium Works, later becoming Maywood Chemical Company, processed the radioactive materials to make gas lanterns (6). The figures also show the flood zone (7), and the high water table, which causes surface water run-off and puddling during heavy rains, in that area
A-4 (8). One of the main aquifers supplying water to wells in the area is contaminated

A-4 with many chemicals and radiologics, some showing the same profile as the Stepan property wells. It is extremely possible that the entire ground water in the area is contaminated with radiologics and chemicals (9). Some of these dangerous and carcinogenic chemicals are benzene, trichloroethylene, tricholro-chloroethylene, 1,1,1-trichloroethylene, 1,2-dichloroethane, and 1,2-trans-dichloroethylene (10). The radiologics include thorium 232, uranium 238, and their "daughters" - radioactive elements and isotopes produced from thorium and uranium present in the area (11) (see FIGURES 12 and 13). There are other "unknown" chemicals present as well as dangerous levels of heavy metals such as mercury and lead (12). It is not known how long these chemicals existed. The flood zone and high ground water level, (see FIGURES 7 - 9 and 14 - 17), encompass the above mentioned properties and all of the homes in the cancer cluster study.

A-5 The majority of scientists agree that the majority of cancers are envronmentally caused (13). The following facts are very important for understanding the seriousness of the problem:

A. Radioactive contamination:

1. When a radioactive element breaks down, the cheif particles released are alpha particles, beta particles, and gamma rays. All three are referred to as radiation. Alpha particles are the largest, and deadliest, if you are comparing ONE alpha particle to ONE beta particle to ONE gamma ray. This is because the alpha particle is very large and very potent. Once it enters the body, it can irradiate much larger areas of the body with it's deadly potency. However, because of its large size, it usually cannot travel very far, and therefore, its victims, such as the workers at Stepan, have to be within very close range to the alpha paricles for them to sustain any damage. Beta particles also move slowly, and are intermediate between alpha particles and gamma rays. On a ONE to ONE comparison, beta particles are the second deadliest. They travel faster than alpha particles, slower than gamma rays, rank second in size and potency, and can pass through some materials. Gamma rays are the least deadliest when compared on a ONE to ONE basis with alpha and beta particles. They are very small and travel extremely fast. Therefore, the chance of ONE gamma ray irradiating a cell in the human body is very unlikely.

The major problem, however, is gamma radiation, because of the large amount emitted from the Maywood site. To understand, say there is a man with a basketball on the Stepan site, a man with 10 softballs on the Stepan site, and a high-powered gun with 10 million needles in it on the Stepan site. The basketball man represents alpha radiation. The man with the softballs represents beta radiation. The high-powered gun with 10 million needles represents the gamma radiation. When the man with the basketball throws it, it does not travel very far, and is stopped by anything in it's way. If a person in the vicinity of the basketball inhaled it, the basketball would cause extreme damage to the lungs, or if ingested, extreme damage to the digestive organs. When the man with the softballs throws them, they travel further and are stopped by many things. If a person inhales or ingests the softballs, the lungs and digestive organs would be damaged, but not to the extent that the basketball causes. If the gun with 10 million needles in it goes off, the needles would travel great distances, pass through almost anything with great velocity, and hit many people with high concentrations of needles, and damage many organs because of their high number.

To sum it all up, alpha particles are dangerous only to people in close proximity to them. They are very potent, but cannot travel very far, and can't pass through most materials. Beta particles are dangerous to people fairly close to them. They are somewhat large and potent, but cannot travel very far. The concentrations of either is irrevelent, unless you are close to them, or if they are carried into residential areas by aerosols, wind, water, radon or thoron gas.

Gamma radiation, in high concentrations, is deadly because the rays can pass through almost anything (lead is one material they cannot pass through), and they travel at great speeds and for great distances. Because of these properties, high concentrations of gamma rays can easily irradiate many organs in the body, and can easily cause serious damage in many people. Referring to our analogy, one needle going through your body would not cause as much damage as 10,000 needles, which is just a small portion of the 10 million fired, going through your body.

When measuring radiation, it is the gamma rays that are measured. In all the figures showing radiation lines, they were all mapped out by machines that measure amounts and strengths of gamma rays.

2. The principal radioactive contaminants at the Maywood site are thorium-232, (Th-232), and uranium-238 (U-238). They produce many other radioactive elements and isotopes when they decay (14). The natural isotope, thorium-232, has a half-life of 14,000,000,000 years, which means it takes that many years for it to lose 1/2 of it's radiation. It is the source of radon gas, which is also A-6 very toxic, highly radioactive, and has a very fast half-life. The uranium series produces radon-222, which is thoron gas. Thoron is almost as dangerous as radon. The natural isotope thorium-234 (Th-234) has a half-life of 24.1 days, also breaking down quickly. Thorium also produces other "daughters" such as radium-228, thorium-228, radium-224, polonium-216 (the element in cigarette tobacco believed to cause lung cancer) (15), and others. Refer to FIGURES 12 and 13.

A-7 3. The West Central Avenue/Ecclestone Place area is in a highly radioactive zone as shown in "An Aerial Radiologic Survey of the Stepan Chemical Company and surrounding area. Maywood, New Jersey. Date of survey: 26 January 1981"(16). As stated previously, the survey measures gamma radiation only. However, high gamma radiation also means high alpha and beta radiation. All residents in the area are being exposed to high levels of gamma radiation. Residents on the south side of West Central Avenue are also being exposed to alpha and beta radiation because the Susquehanna Railroad embankment is highly radioactive (17), and abuts all these properties (see FIGURES 15 and 16). It is very easy for these residents to contact alpha and beta particles. In reference (Z), (see references at back of report), it gives no distance between homes to the north of the Susquehanna Railroad, only for the homes to the west (18). Also, building 76, which is highly radioactive just to it's east, and beneath it (19), and was a burial site for radioactive waste, and possibly other contaminants, is only several hundred feet away from homes on the south side of West Central Avenue, and is directly behind my home (John Tamburro).

All of the radioactive elements present on parts of the Maywood site are present in the afflicted area, and all have different ages, so at any one time, different amounts of radiation, some deadly, are being emitted. Just because these radioactive elements, thorium-232 and uranium-238, have a long half-life, does not by no means infer they are safe. Any particle of these radioacitves could be 14,000,000,000 years old, (TH-232's half-life), or 4,500,000,000 years old, (U-238's half-life), and break down, producing daughter radioactives that could break down much faster, depending on the daughters produced. Also, processed radioactive materials break down quickly due to the by-products they produce, such as all of the daughter radioactive elements. When any radioactive material breaks down, it emits radiation in the form of alpha, beta, and gamma particles. The aerial radioactive survey shows that high amounts of radiation are in the area referenced by this report (20).

Thorium, uranium, and their daughters can cause internal irradiation, ionizing organs and tissue, (meaning they strip electrons from atoms in the human body, causing damage to organs and tissue which can lead to cancer, anemia, cataracts, genetic damage, and other afflictions (21)), via inhalation, ingestion, or direct contact with these radioactive elements. Gases and aerosols, (minute dust and water particles), from the site could contain alpha and beta particles. They can threaten the referenced area by being blown into the residential area, or carried in by high humidity or fog (22).

A-8 4. The levels of radiation emitted from Stepan property and the surrounding area were higher between 1950 and 1980, than it was when the radiologic survey was performed in 1981. However, the MISS site, added after the NRC study, increases the amount of radiation coming from that area now. Keep in mind the heavy areas of radiation emanate from Stepan property. Much of this is due to burial sites of radioactive waste (23). Neither of these radioactive areas have been cleaned up or stabilized (24).

7. The residents afflicted were exposed to somewhat higher doses of gamma, (and alpha and beta radiation as well, depending on how close to the source of radiation the residents were), between 1950 and 1980 than the amounts of radiation being detected in the NRC study because thorium, uranium and their related radioactive elements constantly decay (half-life). The radiation was higher in the 1950s than it is now. However, the radiation is greater than the amount of radiation detected in the NRC study because the MISS site was not present at the time of the study.

The material in the MISS came from properties in Lodi, Rochelle Park and Maywood and did not involve any soil from the Stepan/DOE properties (25). The radiation emitted from the MISS ranges from 5,000 counts per minute to 994,000 counts per minute on the surface. The DOE guide is 11,000 counts per minute. Subsurface measurements ranged from 2,000 counts per minute to 4,300,000 counts per minute. The DOE guide here is 40,000 counts per minute. Counts per minute measure gamma radiation (26) (see FIGURE 3). So, the MISS radiation is in addition to the
A-9 radiation detected in the NRC study. The more radioactive materials added to the MISS, the higher the radiation emitted from the site will be.

A-10 6. As the amount of thorium, uranium, and other radioactive materials, heavy metals, and dangerous chemicals are increased, the danger increases. With radioactivity, more radioactive particles are emitted. This is why there is much opposition to storing radioactive materials at the MISS. The DOE put the site

A-10 in an area where residents already had a lot of exposure to radiation and carcinogenic chemicals (27). Now they are being exposed to that much more radiation from the MISS (28). The MISS now contains 35,000 cubic yards of mixed
A-11 radioactive materials (29). At least another 250,000 plus cubic yards are to be added (30) putting all residents in that area in great danger.

A-12 7. All of the types of cancers contracted by the residents in the West Central Avenue/Ecclestone Place area can be caused by gamma radiation (31). Lung cancer was not detected, however, alpha radiation is primarily responsible for radiologically induced lung cancer (32). I should note that many people argued, "Well, none of the workers at Stepan developed cancer!" In "The Shopper", November 14th, 1990, there is an article entitled, "Attorney Urges Additional Study". David Tykalsker, an environmental and labor law specialist in Newark, won a case against Stepan for a widow who alleged that her husband died from lung cancer caused by ionizing radiation. A state judge ordered Stepan to compensate her for causing her husband's death. Mr. Tykalsker has two more clients suing Stepan for similar reasons. These men worked on Stepan property, were exposed to alpha radiation, developed lung cancer, and died. The victim in the first case, Mr. George Finley, did not smoke (33) (see FIGURE 11).

B. Carcinogenic and poisonous chemical and heavy metal contamination (see FIGURE 6):

A-13 1. Because many carcinogenic chemicals exist in the ground water, the surface water, and soils on the Maywood site portion in question, it is very likely residents are being exposed to these chemicals (34) (see FIGURES 6 and 17).

2. Carcinogenic chemicals can have detrimental effects on the body via ingestion, direct contact with contaminated water and soil, and inhalation of organic volitiles (benzene, tetrachloroethylene, etc...) trapped in basements, in sump pump tanks, and emanating from yards in residences in the high water table area (see FIGURES 6 and 17).

3. Chemicals can cause cancer by physically changing a normal cell into a cancerous cell. The action is chemical, not radiological. Ionization of cells does not occur with chemically induced cancer (35).

A-14 4. Poisonous chemicals and heavy metals poison the body. They may or may not cause cancer, but they still can kill. Lead poisoning, mercury poisoning, and arsenic poisoning are three examples. These metals have been found in large quantities on the Maywood site (36) (see FIGURES 6 and 16).

5. Most of the basements in the area get water, or contact the underground water, when the water table rises. Many have sump pumps, and the holes in which the pumps are placed contain the contaminated ground water. The chemicals evaporate and are trapped in the basements. Some homes have just a simple drain hole through which chemical evaporation into the basement occurs.

6. When the water table rises high enough, it creates small ponds in yards, which contain the chemicals, and floods some basements if the rain is heavy.

A-15 C. The same residents that are still being exposed to high levels of radiation are also being exposed to carcinogenic chemicals and dangerous heavy metals. It is only logical that the cancer rate in this area is almost double the normal for the state.

A-16 People exposed to carcinogenic chemicals, and low-level radiation in their younger years do not develop adverse health effects until their later years, depending on the strength of the carcinogen or radiation. Take note of the age span of the people that contracted cancer, when they were exposed, (paragraph D-1), and the age span when they contracted or discovered cancer (paragraph D-7) (37).

D. The study of the West Central Avenue area and its control group was done as follows:

A-17 I obtained cancer statistics from death certificates between 1978 and 1983, and the amount of cancer drops off moving away from the afflicted site (38). (See also FIGURES 2-1, 2-2, 2-3). I also obtained cancer information from the residents on West Central Avenue and Ecclestone Place directly, since I knew most of them all of my life. The statistics also show "hot spots" such as the south end of Maywood Avenue, near Essex Street and the side streets on the south end of town. It was found that out of 485 residents, 120 died from cancer, or had cancer as a secondary or tertiary disease when they died. Their names and addresses are listed in the report (FIGURES 2-1 and 2-2). 365 did not have any form of cancer when they died. 24.7% of the Maywood residents, excluding those on West Central Avenue and Ecclestone Place, developed cancer. This is very close to the cancer risk for all of Bergen County, 24.4%, which shows my statistics to be quite accurate. (Meaning I agree with the State Health Department's conclusion that Maywood/Saddle Brook/Lodi/Rochelle Park have about
A-18 the same cancer risks as for the whole state of New Jersey - which, by the way, is the highest in the United States (39). On West Central Avenue and Ecclestone Place, west of Ramapo Avenue, south of West Magnolia Avenue, east of the PSE&G substation, which emits dangerous electromagnetic radiation, and north of the Susquehanna Railroad, there are 27 residences. Out of these 27, 11 were not
A-19 included in this study because information could not be gathered on these homes, there was a rapid change-over of residents. Out of the remaining 16 homes, the following was taken into consideration:

1. A total of 36 residents lived in these homes for at least a 15 year span, and were between the ages of 20 and 40 when first moving in. (Children were not considered since they were all born at different times and are now relatively young, with longterm radiation effects not yet showing up, or just starting to. For example, my two sisters lived there from 1950 to 1970 and I from 1956 to present. Recently, all three of us began deveoping tumors and cysts, which could lead to cancer in the future. I also developed polycythemia vera, too many red blood cells, and still have this disorder, as well as a chemical imbalance causing depression (40).

2. None of these cancers were related to cigarette smoking (41).

3. All involved residents who lived in the area at least 15 years (42).

A-19 4. Some homes had several owners, and those residents living there more than 15 years have had incidences of cancer in their families (43).

5. The afflicted residents had safe jobs (with respects to exposure to carcinogens) and many were house wives who stayed at home (44).

6. Other radiologically induced afflictions such as anemia, cataracts, and shortened life span were not included, (though they existed in some of the residents). Neither were birth defects due to lack of that information (45).

7. Out of 36 residents, 17 developed cancer while living in the area. 11 died and 6 are in remmision or cured. (The control group included secondary and tertiary cancers for this reason.) All were in their late 50's or early 60's when the cancer was detected and the ones that died were in the same age span, well below the average age of death - 75 years old.

8. Nine of the afflicted were housewives with non-hazardous or no occupations. They remained home most of the time. The men did not have any added cancer risks from their jobs (46).

9. All were healthy people until the cancer developed (47).

A-20 10. The residents in the afflicted area developed cancers that could be caused by contaminants in the air - aerosols carrying alpha and beta particles, wind-blown radioactive materials (48), gamma rays shooting through the air with little resistance, volitile organic chemicals floating in the air, by water - ingestion of home-grown fruits and vegetables which could contain irradiated water (49), direct contact with the contaminated water during heavy rains, chemicals trapped in basements due to the high water table and flooding of contaminated water, and by direct contact with soil containing contamination which can migrate via flooding and a high water table (50). Contaminants encompass all radioactive materials found on the Maywood site, semi-volatile and volatile organic chemicals, and the dangerous heavy metals.

A-21 11. It is known that the railroad embankment, bordering the homes on the south side of West Central Avenue, is highly radioactive. This is shown in the radiologic studies performed on my home, (see FIGURE 3), and other radiological studies performed around the Stepan and MISS site (51).

12. In the two skin cancer cases, both men, my father and my neighbor, worked outdoors in their back yards for long periods of time, but were not exposed to a lot of sun since the back yards are heavily shaded by large trees.

13. Pets also died from cancer (my dog was one of the victims - bone cancer - which is not inherent in Dalmatians).

15. Out of the 36 residents, 47% developed cancer. This is much higher than the 24.7% rate for the rest of Maywood.

16. The State Health Department did not study this group of people in south-western Maywood (52).

17. In FIGURES 7 and 8, the red squares represent homes where residents developed

A-21 cancer, and they all fall within the higher radiation lines and within the area of the contaminated ground water. White homes in the figures, with zeroes, are homes where no cancer developed. All white homes are not included due to lack of information on them, or rapid change-overs of owners.

A-22 D. I should also note that the State Health Department also did a cancer study on Lodi, Saddle Brook, Maywood, and Rochelle Park. They did it on cancer incidences. HOWEVER, RECORDING OF CANCER INCIDENCES DID NOT START UNTIL AFTER MOST OF THE RESIDENTS IN THE WEST CENTRAL AVENUE AREA CONTRACTED, OR DIED, FROM CANCER. ALSO, THEY COMPARED ALL OF LODI, MAYWOOD, SADDLE BROOK, AND ROCHELLE PARK TO THE REST OF NEW JERSEY (THE STATE WITH THE HIGHEST CANCER RATE IN THE NATION) (53). THEY DID NOT GO DOOR TO DOOR, AS I DID, DID NOT ASK ANYONE IN SOUTHWESTERN MAYWOOD ABOUT CANCER, OR OTHER RADIOLOGICALLY INDUCED DISEASES AND DID NOT COMPARE THE WEST CENTRAL AVE./ECCLESTONE PLACE CANCER INCIDENCES TO THE REST OF MAYWOOD. FOR THIS REASON, THEIR STUDY DOES NOT PROVE MY STUDY TO BE INACCURATE. IT IS LIKE COMPARING APPLES TO ORANGES. THE STATE HEALTH DEPARTMENT DID NOT SURVEY SOUTHWESTERN MAYWOOD. THEY COMPARED MAYWOOD/LODI/SADDLE BROOK/ROCHELLE PARK TO THE REST OF NEW JERSEY. IF YOU SEE MY STATISTICS, I FOUND AN OVERALL CANCER INCIDENCE OF 24.7% FOR ALL OF MAYWOOD, (EXCLUDING EXTREME SOUTHWESTERN MAYWOOD), WHICH IS VERY CLOSE TO THE STATE HEALTH DEPARTMENT'S FIGURE OF 24.4% FOR ALL OF BERGEN COUNTY.

A-23 E. People raised a point that persons in Maywood that had thorium removed from their property did not develop any adverse health effects. Therefore, people on West Central Ave./Ecclestone Place should not have any adverse health effects. So, I included FIGURE 10 to show that the people on West Central Ave./Ecclestone Place were exposed to much greater amounts of radiation over the same time span as those residents in other parts of Maywood who had thorium tainted soil on, and removed from, their properties. The adverse health effects would be much greater for the residents of West Central Ave./Ecclestone Place, than for people in other parts of town.

EXPLANATION OF FIGURES

FIGURE 1: Shows southwestern Maywood, the portion of the Maywood site referred to in this report, and the area where the residents are in immediate danger.

FIGURE 2-1 & 2-2: Lists the residents of Maywood that died from cancer or had cancer when they died from other causes and excludes those on West Central Avenue and Ecclestone Place. 2-1 is sorted by street. 2-2 is sorted by location.

FIGURE 2-3: Lists residents of the West Central Avenue/Ecclestone Place zone that contracted, or died, from cancer.

FIGURE 3: Shows the results of gamma ray measurements taken on 142 West Central Avenue (my home) in December 1985.

FIGURE 4: Shows the results of soil gas testing performed on my property in November 1985.

FIGURE 5: Explains the dangers of radition.

FIGURE 6: Lists some of the worst contaminants found on the Maywood site portion referred to in FIGURE 1.

FIGURE 7: Description of FIGURES where radiation lines are drawn and where the high water table is. Latter part is a map of the area.

FIGURE 8: Blow-up of figure 7.

FIGURE 9: Shows relationships of portions of Maywood site to the afflicted homes.

FIGURE 10: Blow-up of radiation contour map from the aereological survey - reference K.

FIGURE 11: Newpaper article about a non-smoker who died from lung cancer caused by radiation on Stepan Company property.

FIGURE 12: Decay chain for THORIUM-232.

FIGURE 13: Decay chain for URANIUM-238

FIGURE 14: Topography, and other information, for last 3 homes on the south side of W. Central Ave. to use as examples for the residential danger zone.

FIGURE 15: Radiation profile of area from FIGURE 3 and reference (Z) - pp. 29-32.

FIGURE 16: Shows how chemical and heavy metal contamination can effect homes in the area.

FIGURE 17: Shows how radiation effects homes in the area.

FIGURE 18: DOE's radiation standard of 100 mrem/yr.

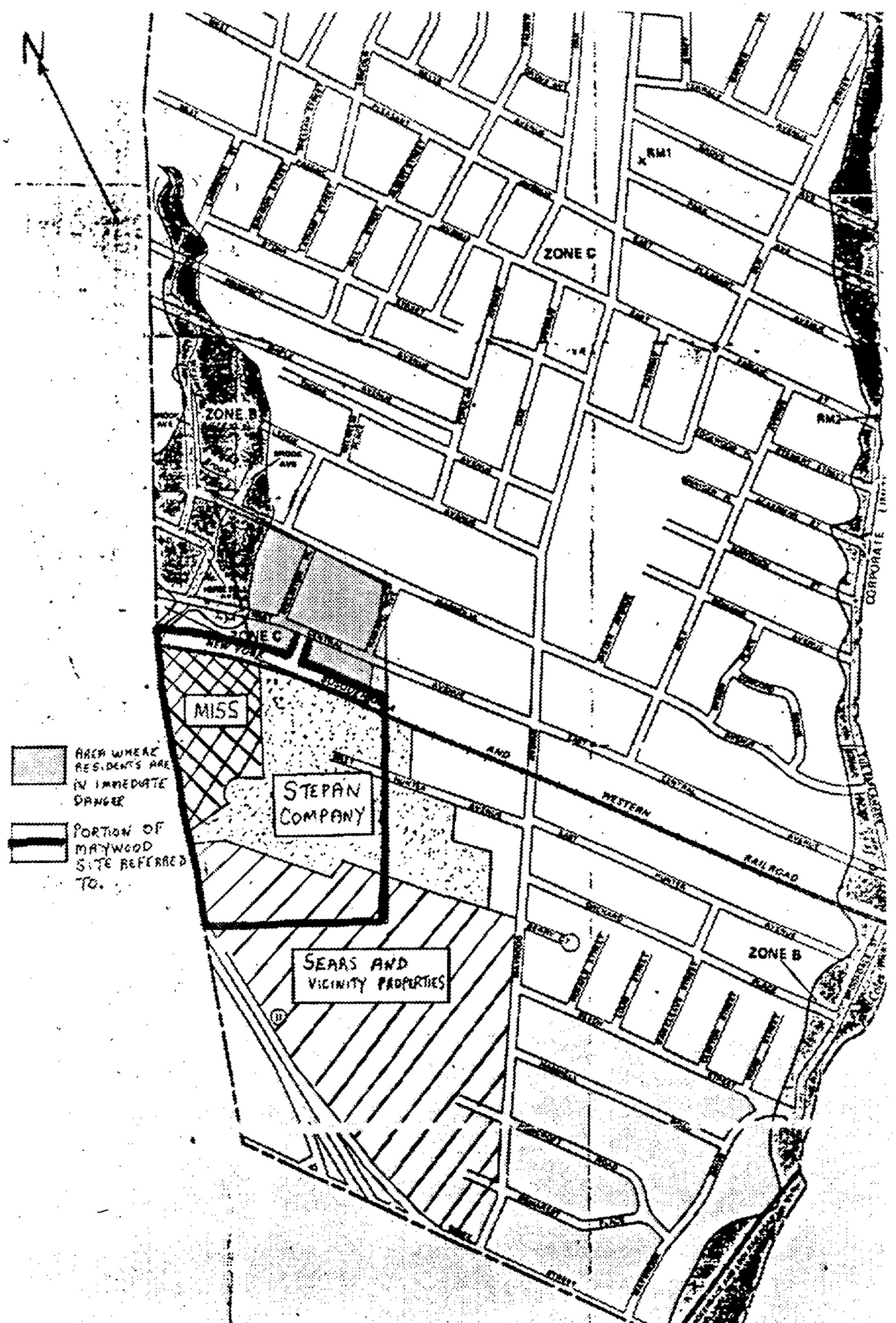

N
ZONE C
ZONE B
ZONE C
MISS
STEPAN COMPANY
SEARS AND VICINITY PROPERTIES
AREA WHERE RESIDENTS ARE IN IMMEDIATE DANGER
PORTION OF MAYWOOD SITE REFERRED TO.
ZONE B
RAILROAD
WESTERN
CORPORATE LIMITS

FIGURE 1

Residents of Maywood, N.J. who died from cancer or had cancer as a secondary or tertiary disease when they died. Statistics are from 1978 to 1983. (Sorted by street)

Names and house numbers have been removed to protect the privacy of relatives, friends and associates.

NAME	ADDRESS	CANCER	AGE AT DEATH	MAYWOOD LOCATION
		Lung	74	?
	Ackerman	Bowel	72	SE
	Beech	Breast	59	SW
	Beech	Colon	68	SW
	Briafcliff	Pancreas	72	NW
	Briafcliff	Brain	66	NW
	Briarcliff	Lung	60	NW
	Brookdale	Lung	71	SW
	Brookdale	Cancer	84	SW
	Brookdale	Cancer	84	SW
	Byron	Liver	68	SW
	Clinton	Cancer	?	SW
	Clinton	Metastasis	69	SW
	Cumming	Pancreas	55	NW
	Demarest	Lymphoma	87	SW
	Demarest	Breast	62	SW
	Demarest	Lung	65	SW
	Demarest	Pancreas	63	SW
	DeSoto	Metastasis	76	NW
	E. Central	Pancreas	66	SW
	E. Central	Metastasis	76	SW
	E. Central	Pancreas	66	SW
	E. Fairmont	Breast	48	NE
	E. Farimont	Lung	72	NE
	E. Passaic	Mycoma	72	SE
	E. Passaic	Prostate	73	SE
	E. Pleasant	Lymph	85	SE
	E. Pleasant	Liver	85	SE
	E. Pleasant	Breast	78	SE
	E. Pleasant	Cancer	73	SE
	E. Pleasant	Lymph	63	SE
	E. Spring Valley	Leukemia	84	NE
	Edel	Cervix	56	NE
	Edel	Pancreas	80	NE
	Edel	Bladder	69	NE
	Edel	Cancer	56	NE
	Edel	Cancer	48	NE
	Edel	Metastasis	63	NE
	Edel	Lung	67	NE
	Elizabeth Ct.	Cancer	31	SE
	Elm	Ovarian	?	SE
	Essex	Duodenal	60	SW
	Essex Ct.	Brain	84	SW
	Fairmount	Bladder	72	NE
	Golf	Bowel/Thro.	71	SE
	Golf	Stomach	74	SW
	Grant	Breast	62	NE
	Hammel	Breast	67	SW
	Hammel	Cancer	86	SW
	Hammel	Metastasis	83	SW

FIGURE 2-1

Residents of Maywood, N.J. who died from cancer or had cancer as a secondary or tertiary disease when they died. Statistics are from 1978 to 1983. (Sorted by street)

Names and house numbers have been removed to protect the privacy of relatives, friends and associates.

NAME	ADDRESS	CANCER	AGE AT DEATH	MAYWOOD LOCATION
	Hampton Ct.	Metastasis	75	SW
	Hartwich	Lung	61	SE
	Hartwich	Metastasis	72	SE
	Hill	Breast	61	NW
	Hill	Lung	40	NW
	Howcroft	Lung	60	SW
	Jaeger	Lung	63	SW
	Jersey	Colon	70	NE
	Lafayette	Bladder	75	NE
	Lafayette	Cancer	83	NE
	Lenox	Bladder	83	SW
	Lincoln	Lung	64	NE
	Lincoln	Breast	89	NW
	Lincoln	Brain	66	NE
	Locust	Cancer	69	NE
	Loughlin Place	Cancer	54	?
	Marlboro Ct.	Prostate	93	SW
	Marlboro Ct.	Bladder	82	SW
	Marlboro Ct.	Liver	65	SW
	Maywood	Lung	78	NE
	Maywood	Liver	86	NE
	Maywood	Colon	81	NE
	Maywood	Lung	58	NE
	Maywood	Colon	84	NE
	Oak	Cancer	?	NE
	Oak	Lung	63	NE
	Oak	Pancreas	74	NE
	Oak	Cancer	73	NE
	Oak	Breast	58	NE
	Oak	Cancer	56	NE
	Oak	Breast	78	NE
	Oak	Colon	81	NE
	Orchard	Pancreas	76	SW
	Orchard	Lung	?	SW
	Orchard	Uterine	94	SW
	Orchard	Leukemia	29	SW
	Orchard	Rectal	76	SW
	Orchard	Metastasis	72	SW
	Palmer	Brain	64	NE
	Palmer	Pancreas	66	NE
	Palmer	Kidney	60	NE
	Park	Cancer	?	SE
	Parkway	Cancer	55	NW
	Parkway	Leukemia	74	NE
	Parkway	Pharynx	60	NW
	Poplar	Brain	57	SW
	Prospect	Ovarian	62	NW
	Sanzari	Sarcoma	62	NE
	Sanzari	Lung	53	NE
	Sanzari	Brain	50	NE

FIGURE 2-1

Residents of Maywood, N.J. who died from cancer or had cancer as a secondary or tertiary disease when they died. Statistics are from 1978 to 1983. (Sorted by street)

NAME	ADDRESS	CANCER	AGE AT DEATH	MAYWOOD LOCATION
Names and house numbers have been removed to protect the privacy of relatives, friends and associates.	Spring Valley Rd.	Lymphosarc.	66	NE
	Spring Valley Rd.	Gall Blad.	69	NE
	Spring Valley Rd.	Breast/Liv.	67	NE
	Stelling	Lung	67	NE
	Stelling	Prostate	76	NE
	Stelling	Lung	84	NE
	Stewart	Cancer	77	SE
	Stone	Brain	73	NW
	Stone	Colon	64	NW
	Thoma	Cancer	84	NW
	Van Cleve	Lung	64	SW
	W. Central	Breast	46	SE
	W. Magnolia	Prostate	75	SE
	W. Magnolia	Lung	49	SE
	W. Passiac	Liver	83	NW
	W. Pleasant	Prostate	72	NE
	W. Spring Valley	Lung	59	NE
	W. Spring Valley	Brain	44	NE
	Woodland	Colon	54	NE
	Wyoming	Prostate	78	NE
	Wyoming	Pancreas	73	NE

FIGURE 2-1

Residents of Maywood, N.J. who died from cancer or had cancer as a secondary or tertiary disease when they died. Statistics are from 1978 to 1983. (Sorted by location)

Names and house numbers have been removed to protect the privacy of relatives, friends and associates.

NAME	ADDRESS	CANCER	AGE AT DEATH	MAYWOOD LOCATION
		Lung	74	?
	Loughlin Place	Cancer	54	?
	E. Fairmont	Breast	48	NE
	E. Farimont	Lung	72	NE
	E. Spring Valley	Leukemia	84	NE
	Edel	Cervix	56	NE
	Edel	Pancreas	80	NE
	Edel	Bladder	69	NE
	Edel	Cancer	56	NE
	Edel	Cancer	48	NE
	Edel	Metastasis	63	NE
	Edel	Lung	67	NE
	Fairmount	Bladder	72	NE
	Grant	Breast	62	NE
	Jersey	Colon	70	NE
	Lafayette	Bladder	75	NE
	Lafayette	Cancer	83	NE
	Lincoln	Lung	64	NE
	Lincoln	Brain	66	NE
	Locust	Cancer	69	NE
	Maywood	Lung	78	NE
	Maywood	Liver	86	NE
	Maywood	Colon	81	NE
	Maywood	Lung	58	NE
	Maywood	Colon	84	NE
	Oak	Cancer	?	NE
	Oak	Lung	63	NE
	Oak	Pancreas	74	NE
	Oak	Cancer	73	NE
	Oak	Breast	58	NE
	Oak	Cancer	56	NE
	Oak	Breast	78	NE
	Oak	Colon	81	NE
	Palmer	Brain	64	NE
	Palmer	Pancreas	66	NE
	Palmer	Kidney	60	NE
	Parkway	Leukemia	74	NE
	Sanzari	Sarcoma	62	NE
	Sanzari	Lung	53	NE
	Sanzari	Brain	50	NE
	Spring Valley	Lymphosarc.	66	NE
	Spring Valley Rd.	Gall Blad.	69	NE
	Spring Valley Rd.	Breast/Liv.	67	NE
	Stelling	Lung	67	NE
	Stelling	Prostate	76	NE
	Stelling	Lung	84	NE
	W. Pleasant	Prostate	72	NE
	W. Spring Valley	Lung	59	NE
	West Spring Valley	Brain	44	NE
	Woodland	Colon	54	NE

FIGURE 2-2

Residents of Maywood, N.J. who died from cancer or had cancer as a secondary or tertiary disease when they died. Statistics are from 1978 to 1983. (Sorted by location)

Names and house numbers have been removed to protect the privacy of relatives, friends and associates.

NAME	ADDRESS	CANCER	AGE AT DEATH	MAYWOOD LOCATION
	Wyoming	Prostate	78	NE
	Wyoming	Pancreas	73	NE
	Briafcliff	Pancreas	72	NW
	Briafcliff	Brain	66	NW
	Briarcliff	Lung	60	NW
	Cumming	Pancreas	55	NW
	DeSoto	Metastasis	76	NW
	Hill	Breast	61	NW
	Hill	Lung	40	NW
	Lincoln	Breast	89	NW
	Parkway	Cancer	55	NW
	Parkway	Pharynx	60	NW
	Prospect	Ovarian	62	NW
	Stone	Brain	73	NW
	Stone	Colon	64	NW
	Thoma	Cancer	84	NW
	W. Passiac	Liver	83	NW
	Ackerman	Bowel	72	SE
	E. Passaic	Mycoma	72	SE
	E. Passaic	Prostate	73	SE
	E. Pleasant	Lymph	85	SE
	E. Pleasant	Liver	85	SE
	E. Pleasant	Breast	78	SE
	E. Pleasant	Cancer	73	SE
	E. Pleasant	Lymph	63	SE
	Elizabeth Ct.	Cancer	31	SE
	Elm	Ovarian	?	SE
	Golf	Bowel/Thro.	71	SE
	Hartwich	Lung	61	SE
	Hartwich	Metastasis	72	SE
	Park	Cancer	?	SE
	Stewart	Cancer	77	SE
	W. Central	Breast	46	SE
	W. Magnolia	Prostate	75	SE
	W. Magnolia	Lung	49	SE
	Beech	Breast	59	SW
	Beech	Colon	68	SW
	Brookdale	Lung	71	SW
	Brookdale	Cancer	84	SW
	Brookdale	Cancer	84	SW
	Byron	Liver	68	SW
	Clinton	Cancer	?	SW
	Clinton	Metastasis	69	SW
	Demarest	Lymphoma	87	SW
	Demarest	Breast	62	SW
	Demarest	Lung	65	SW
	Demarest	Pancreas	63	SW
	E. Central	Pancreas	66	SW
	E. Central	Metastasis	76	SW
	E. Central	Pancreas	66	SW

FIGURE 2-2

Residents of Maywood, N.J. who died from cancer or had cancer as a secondary or tertiary disease when they died. Statistics are from 1978 to 1983. (Sorted by location)

NAME	ADDRESS	CANCER	AGE AT DEATH	MAYWOOD LOCATION
	Essex	Duodenal	60	SW
	Essex Ct.	Brain	84	SW
	Golf	Stomach	74	SW
	Hammel	Breast	67	SW
	Hammel	Cancer	86	SW
	Hammel	Metastasis	83	SW
	Hampton Ct.	Metastasis	75	SW
	Howcroft	Lung	60	SW
	Jaeger	Lung	63	SW
	Lenox	Bladder	83	SW
	Marlboro Ct.	Prostate	93	SW
	Marlboro Ct.	Bladder	82	SW
	Marlboro Ct.	Liver	65	SW
	Orchard	Pancreas	76	SW
	Orchard	Lung	?	SW
	Orchard	Uterine	94	SW
	Orchard	Leukemia	29	SW
	Orchard	Rectal	76	SW
	Orchard	Metastasis	72	SW
	Poplar	Brain	57	SW
	Van Cleve	Lung	64	SW

Names and house numbers have been removed to protect the privacy of relatives, friends and associates.

FIGURE 2-2

Residents of West Central Ave. and Ecclestone Place who had cancer or died from cancer. Statistics are from 1974 to 1983.

NAME	ADDRESS	CANCER	AGE AT DEATH OR CANCER DETECTION	MAYWOOD LOCATION
	Ecclestone Place	Stomach	Early 60's	SW
	? Ecclestone Place	Throat	Mid 50's	SW
	Ecclestone Place	Bladder	Early 60's	SW
	Ecclestone Place	Stomach	Late 60's	SW
	Ecclestone Place	Brain	Late 50's	SW
	W. Central Avenue	Bladder	Mid 50's	SW
	W. Central Avenue (previous owner)	Metastasis	Late 60's	SW
	W. Central Avenue	Ovarian	Early 60's	SW
	W. Central Avenue	Skin	Early 50's	SW
	W. Central Avenue	Colon	Early 60's	SW
	W. Central Avenue	Skin	Early 50's	SW
	W. Central Avenue	Breast	Late 50's	SW
	W. Central Avenue (previous owner)	Breast	Late 40's	SW
	W. Central Avenue (previous owner)	Breast	Early 50's	SW
	W. Central Avenue	Intestinal	Late 50's	SW
	W. Central Avenue	Breast	Late 50's	SW
	W. Central Avenue	Brain	Mid 60's	SW

Names and house numbers have been removed to protect the privacy of relatives, friends and associates.

FIGURE 2-3

JOHN TAMBURRO, 142 WEST CENTRAL AVENUE, MAYWOOD, NEW JERSEY 07607

Mr. Jay Davis, of Eberline Analytical Corporation, came to my house in December of 1985 to do gamma readings (radiation measurement). The outside readings exceeded the federal guide.

a). The federal guide to determine the maximun radiation any one person can be exposed to in one year, takes into consideration other sources of radiation, such as chest x-rays, dental x-rays, and natural radiation.

A-24 b). Anyone stepping out of my house gets exposed to radiation exceeding the federal guide. This is too hazardous.

I live in a valley, as opposed to Stepan and the MISS. The grading between my property and the MISS is the railroad embankment. In my section of West Central Avenue, the embankment rises about 8 feet. Half way up the embankment, the gamma readings climbed to almost 3 X the federal guide.

Also, the readings done by Mr. Davis indicated that the radiation levels were higher ABOVE my property (in-line with Stepan and the MISS), than at ground level (below Stepan and the MISS).

Also, as Mr. Davis moved closer to the pile with his monitor 8 feet above ground, the gamma readings increased.

My soil was tested for radionuclides by the state, and negligible amounts were found. This shows that the excess radiation is comimg from the railroad embankment, the MISS, and Stepan property. The following is the result of the gamma testing:

A-25

	Microroentgens per hour.	Millirems per year	Body + med.
OUTSIDE 8' ABOVE GROUND	26	227.8	293.8
OUTSIDE GROUND LEVEL	20	175.2	241.2
OUTSIDE HALF-WAY UP RAIL-ROAD EMBANKMENT	28	508.1	574.1
INSIDE	18	157.7	223.7
FEDERAL GUIDE	* 11.4	* 100.0	
MAYWOOD BACKGROUND	8.0	70.1	

NOTE: This testing was preliminary, and more tests were supposed to have been taken, but never were.

The third column includes the natural radioactive potassium in our bodies - 26 mrem/yr. plus the average medical component of 40 mrem/yr.

A-26 * At the time of the survey, the federal guide was 19.4 uR/hr. or 170 millirems/yr. The guide is now 11.4 uR/hr or 100.0 millirems/yr.

FIGURE 3

JOHN TAMBURRO
142 WEST CENTRAL AVENUE
MAYWOOD, N.J. 07607

A-27 My property was tested for chemical contamination in November 1985. This testing was soil-gas testing, to see if the soil was contaminated with carcinogenic chemicals. The ground water was NOT tested, only the soil.

Benzene, Stepan's most-used chemical today, and Ethyl Acetate were TENTATIVELY identified. Large amounts of several "UNKNOWNS" were found also.

Their results:

"Two compounds TENTATIVELY identified: Benzene and Ethyl Acetate. Since organics were only found in low levels in the soil..." (this does not include the UNKNOWNS found) "...it is unlikely" (But not positively) "that any human exposure is taking place." Note it says low levels IN THE SOIL. No one knows what is in the groundwater under my property - (about 2' under the yard and about 1' under my house, judging by the level of water in my sump pump tank).

The actual report follows this page.

FIGURE 4

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WASTE MANAGEMENT
HAZARDOUS SITE MITIGATION ADMINISTRATION
CN 028, Trenton, N J 08625

MARWAN M SADAT P E
DIRECTOR

JORGE H BERKOWITZ PH D
ADMINISTRATOR

07 FEB 1986

Mr. John Tamburro
142 W. Central Avenue
Maywood, NJ 07607

Dear Mr. Tamburro:

Enclosed is the report on soil gas testing performed at your home on November 18, 1985. Please accept my apologies for the delay in sending the report to you; it appears that a clerical error resulted in me not receiving the report for over eight weeks.

As stated in the last line of the report, the inspectors found that the low levels of organics present do not represent a health threat. Further information on possible soil contamination in the vicinity will be developed during the Superfund investigations scheduled later this year.

Please call me at (609)984-2990 if you would like to discuss the report further.

[illegible]

Very truly yours,

David A. Paley not working for

David A. Paley, P.E. D.E.P.
Site Manager 12-1-86 -

HS80:jb:lm

Enclosure

cc: Dr. Jorge H. Berkowitz, HSMA
Robert Predale, BSM
Tom McNevin, BEERA

8/13/86 sending report. Mr. Ed Kaup Site manager -
1-609-633-1497

12-1-86 -
No Report -

Hot Line -

FIGURE 4

New Jersey Is An Equal Opportunity Employer

3. The quantitative standard of benzene was placed in the photovac memory on initial startup by photovac using a 10ppm standard for benzene. Therefore the quantalation for benzene, 2CE (Methylene Chloride) and n-hexane give only a rough estimate figure of actual concentration.

4. Other compounds in the photovac library are calibrated for relative retention time to bezene qualitative only. This is the reason for a result of 0.000ppm given in the report.

5. Some library abbreviations are as follows:

MEOH - Methanol
2CM - Methylene Chloride
1,1,2CE - 1,1.2 - Trichloroethane
1,2 CE4 - 1,2 - Dichloroethylene (cis and trans)
1,1,2,2 - 4CE4 - 1,1,2,2 - Tetrachloroethylene
MEK - Methyl Ethyl Ketone
C2H2 - Acetylene
Freon 12 - Dichlorodifluoromethane
MIBK - Methyl Isobutyl Ketone
Freon 22 - Monochlorodifluoromethane
11-CE4 - 1,1 - Dichloroethylene

6. The concentration estimates of .3ppm for benzene in run #306 is probably close. The OVA did not pickup benzene in the chromatographic mode. The OVA limit of detection is about 1ppm for direct injection of benzene.

Conclusions:

Photovac GC data indicates that low levels of organics appear to be migrating through the soil at 142 W. Central Ave., possibly volitilizing from groundwater.

Two compounds tentatively identified: Benzene and Ethyl Acetate.

Since organics were only found in low levels in soil, it is unlikely that any human exposure is taking place.

cc: Dr. Jorge Berkowitz
Marja Van Ouwerkerk
Al Pleva
Stephen Borgianini

FIGURE 4

MEMO

NEW JERSEY STATE DEPARTMENT OF ENVIRONMENTAL PROTECTION

TO Dave Paley, Site Manager DATE NOV 20 1985

FROM Robert Kunze, Acting Assistant Chief, Site Evaluation Unit RK

SUBJECT Work Request, 142 W. Central Ave., Maywood, NJ

On November 18, 1985 Al Pleva, Richard Gervasio and myself conducted a site visit at 142 W. Central Ave., Maywood, NJ. The purpose of this site visit was to evaluate soil gas at the above property.

Instrumentation:

The following monitoring equipment was used by the sampling team:

1. Organic vapor analyzer (Foxboro) - a portable gas chromatagraph with a flame ionization detector.

2. HNU - portable photoionization detector equipped with a 10.2 probe.

3. Photovac portable gas chromatagraph 10S50.

Procedures:

Using a slam bar and a brass tipped probe, a hole would be made from 2.5 feet - 4 feet below the surface. Upon pulling the probe from the hole, readings were taken using both the HNU and the OVA (survey mode). Areas of the yard showing positive results (see attached diagram) were then resampled using photovac portable GC. Calibration checks were run at the site using benzene.

Results (See attached Chromatagraphs):

1. Run #305: Shows the background readings of the air in the yard taken at 3-4 ft. above ground.

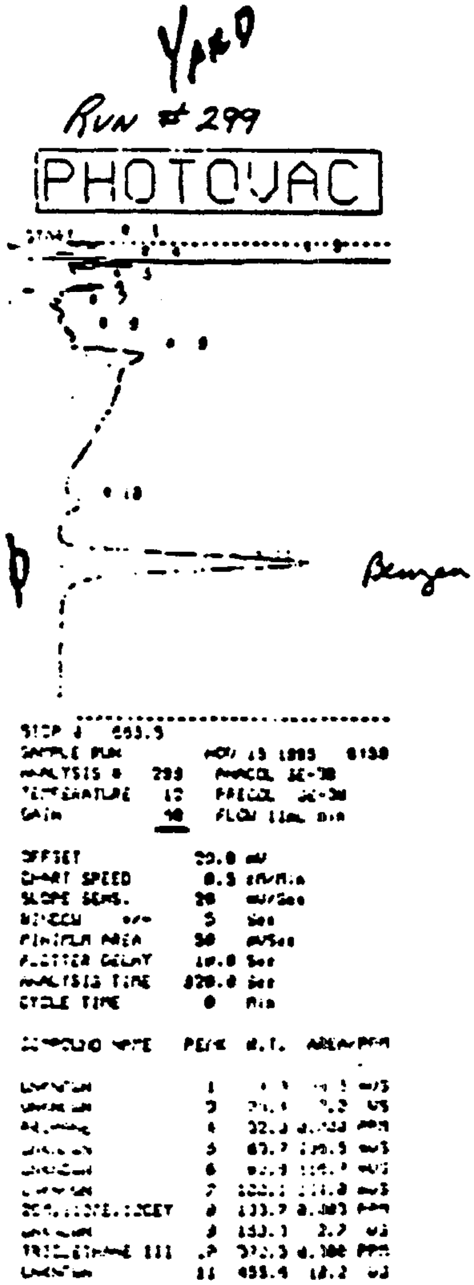
2. Run #299, #302 and #306: Are taken from soil gas at various points around the yard according to the procedure described above.

Notes:

1. Air temperature was dropping during the period of analysis so on many of the runs peak #11 was not identified as benzene see Run #299, #302 and #306. (the photovac does not have a heated column)

2. Calibration standard (qualitative only) of benzene was run at intervals to observe the increasing retention time due to the cold.

FIGURE 4


Run #299
PHOTOVAC
Benzen
OFFSET
CHART SPEED
CYCLE TIME

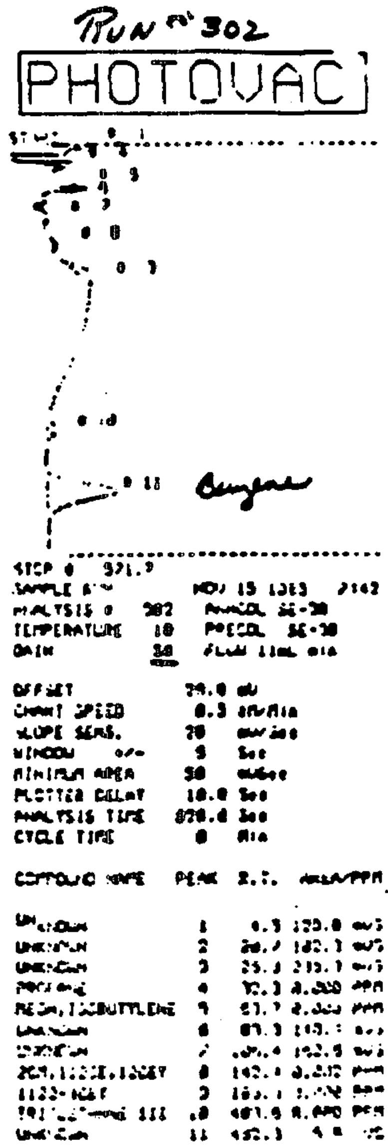

Run # 302
PHOTOVAC
Benzene
TEMPERATURE
OFFSET
CHART SPEED
SLOPE SENS.
CYCLE TIME

FIGURE 4

PHOTOVAC

Calibrated Report #306

CALIBRATED PEAK 11,BENZENE, CCL4

SAMPLE RUN [illegible]
ANALYSIS # 305 ANACOL SE-30
TEMPERATURE 0 PRECOL SE-30
GAIN 50 FLOW [illegible]

OFFSET 20.0 mV
CHART SPEED 0.5 cm/min
SLOPE SENS. 20 mV/Sec
WINDOW +/- 5 Sec
MINIMUM AREA 50 mVSec
PLOTTER DELAY 10.0 Sec
ANALYSIS TIME 720.0 Sec
CYCLE TIME 0 Min

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	4.1	[illegible]22.3 mVS
UNKNOWN	2	21.1	[illegible] mVS
UNKNOWN	3	34.2	1.3 VS
UNKNOWN	4	33.0	[illegible] mVS
BUTANE	5	61.5	[illegible] PPM
UNKNOWN	6	84.1	312.7 mVS
UNKNOWN	7	[illegible]	[illegible] mVS
N-PENTANE MEOH	8	[illegible]	[illegible] PPM
UNKNOWN	9	1[illegible].4	3.3 VS
ETHYL ACETATE	10	447.0	[illegible] PPM
BENZENE, CCL4	11	541.4	[illegible] PPM

List of Current Library

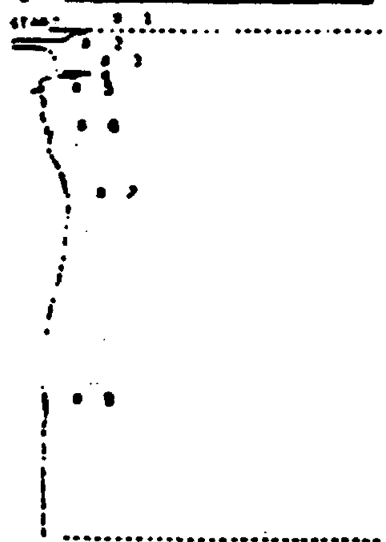
PHOTOVAC

COMPOUND	ID #	R.T.	LIMIT
DCM,11DCE,12CLT?	1	155.4	50.00 PPM
N-HEXANE, 11CLT?	2	345.0	50.00 PPM
BENZENE, CCL4	3	541.0	10.00 PPM
TRICLETHANE 111	4	482.8	0.000 PPM
1122-?	5	219.3	0.000 PPM
TRICLETHYLENE	6	753.4	0.000 PPM
TOLUENE	7	1478.3	0.000 PPM
CHLOROFORM	8	390.5	0.000 PPM
ISOOCTANE	9	789.4	0.000 PPM
ETHYL ACETATE	10	467.3	0.000 PPM
TRICLFLUOROL METH?	11	174.8	0.000 PPM
MIBK	12	1250.2	0.000 PPM
FREONS12,22,CDM2?	13	46.7	0.000 PPM
BUTANE	14	62.5	[illegible] PPM
PROPANE	15	41.2	0.000 PPM
MEOH, ISOBUTYLENE	16	71.5	0.000 PPM
CYCLOHEXANE	17	573.0	0.000 PPM
METHYLACRYLATE	18	416.3	0.000 PPM
METHMETHACRYLATE	19	1003.3	0.000 PPM
ACETONE, ETHANOL	20	228.6	0.000 PPM
N-HEPTANE	21	887.5	0.000 PPM
MEK	22	472.5	0.000 PPM
N-PENTANE MEOH	23	145.9	0.000 PPM
1122TETRACLETHAN	24	314.4	0.000 PPM
1-PROPANOL	25	330.8	0.000 PPM

BKG AIR

RUN #305

PHOTOVAC



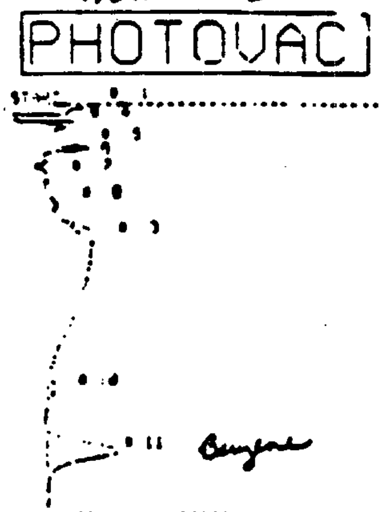
STOP @ 704.[illegible]
SAMPLE RUN NOV 15 1985 0131
ANALYSIS # 305 ANACOL SE-30
TEMPERATURE 0 PRECOL SE-30
GAIN 50 FLOW [illegible]

OFFSET 20.0 mV
CHART SPEED 0.5 cm/min
SLOPE SENS. 20 mV/Sec
WINDOW +/- 5 Sec
MINIMUM AREA 50 mVSec
PLOTTER DELAY [illegible] Sec
ANALYSIS TIME [illegible] Sec
CYCLE TIME 0 Min

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	3.3	31.4 mVS
BUTANE	2	30.[illegible]	[illegible] PPM
MEOH, ISOBUTYLENE	3	[illegible]	[illegible] PPM
UNKNOWN	[illegible]	[illegible]	[illegible] mVS
UNKNOWN	6	154.9	91.0 mVS
UNKNOWN	7	217.7	[illegible] mVS
CYCLOHEXANE	8	[illegible]	[illegible]

FIGURE 4

Run # 302



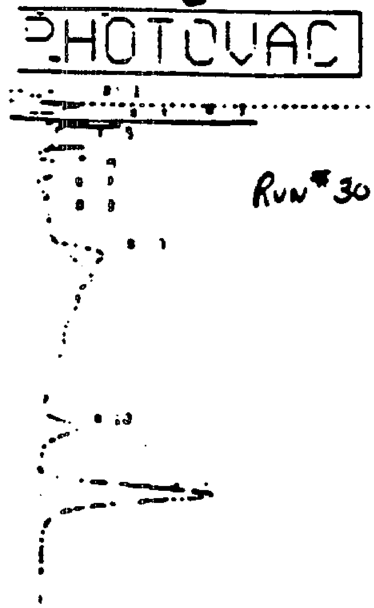
STOP @	571.7		
SAMPLE AIR		NOV 15 1983	2142
ANALYSIS #	302	ANACOL SE-30	
TEMPERATURE	10	PRECOL SE-30	
GAIN	50	FLOW 11mL min	

OFFSET	29.0	mV
CHART SPEED	0.5	cm/min
SLOPE SENS.	20	mV/Sec
WINDOW +/-	5	Sec
MINIMUM AREA	50	mVSec
PLOTTER DELAY	10.0	Sec
ANALYSIS TIME	870.0	Sec
CYCLE TIME	0	Min

COMPOUND NAME	PEAK	R.T.	AREA/PPM	
UNKNOWN	1	6.3	133.0	mVS
UNKNOWN	2	20.7	182.3	mVS
UNKNOWN	3	25.3	235.3	mVS
[illegible]	4	32.3	0.000	PPM
[illegible], ISOBUTYLENE	5	53.7	0.000	PPM
UNKNOWN	6	87.3	193.3	mVS
UNKNOWN	7	109.4	192.9	mVS
[illegible]	8	142.4	0.000	PPM
[illegible]	9	183.1	[illegible]	PPM
[illegible]	10	401.5	0.000	PPM
UNKNOWN	11	452.3	5.0	mVS

Run at Rear of House

Run # 306



STOP @	633.3		
SAMPLE BLK		NOV 15 1985	0100
ANALYSIS #	308	ANACOL SE-30	
TEMPERATURE	5	PRECOL SE-30	
GAIN	50	FLOW 11mL min	

OFFSET	28.0	mV
CHART SPEED	0.5	cm/min
SLOPE SENS.	20	mV/Sec
WINDOW +/-	5	Sec
MINIMUM AREA	50	mVSec
PLOTTER DELAY	10.0	Sec
ANALYSIS TIME	870.0	Sec
CYCLE TIME	0	Min

UNCALIBRATED RUN

COMPOUND NAME	PEAK	R.T.	AREA/PPM	
[illegible]	1	6.1	120.5	mVS
[illegible]	2	21.1	[illegible]	[illegible]
[illegible]	3	26.2	1.5	[illegible]
[illegible]	4	33.4	0.000	[illegible]
[illegible]	5	51.5	[illegible]	[illegible]
[illegible]	6	91.3	[illegible]	[illegible]
[illegible]	7	[illegible]	[illegible]	[illegible]
[illegible]	8	[illegible]	[illegible]	[illegible]
[illegible]	9	[illegible]	0.000	PPM
[illegible]	10	443.2	2.3	[illegible]
[illegible]	11	[illegible]	[illegible]	[illegible]

10 - Ethyl Acetone
11 - Benzene

FIGURE 4

HOW RADIATION RELEASED FROM TH-232 AND U-238 DECAY CAN RESULT IN HEALTH PROBLEMS

X-rays and gamma rays are electromagnetic - properties similar to visible light, only they are much more penetrating.

Alpha and beta emissions are particulate - they are small particles.

All types of radiation lose energy by absorption when passing through matter. The process of absorption results in ionization - electrons are stripped from atoms of the absorbing material which comes in contact with the radiation. It is this process of ionization that produces damage in living tissue (cancer) and damage to chromosomes (birth defects in current and FUTURE generations), when the absorbing material is a human body.

Alpha particles, the most serious type of radiation once inside of the body CANNOT be detected on the external surfaces of the body (58). Beta radiation cannot be directly measured either. Only gamma rays are measurable with devices currently used in the nuclear field.

Alpha particles are heavy, slow moving, and expend their energy in a relatively short path. They have a high specific ionization - they ionize many more atoms along their path of penetration inside a living body. Alpha particles cannot easily penetrate a body, but if they got inside via inhalation or ingestion, they would come in contact with and damage many more cells because of their large size. Also, they would NOT exit the body since they haven't any force to push them out - therefore, they remain in the body until they break down, causing more damage (59). Externally, they travel only short distances, but there are are other ways alpha particles can reach the population:

1). Radon and Thoron gases are alpha emitters. If these gases float from the site into residential areas they can emit alpha particles directly into the population.
2). Alpha particles can attach to aerosols (dust, water droplets) in the air and retain their energies and be carried by the aerosols into residential areas.
3). Contaminated soil particles carried from the site by wind, water, animals, or people can decay and relese the alpha particles among the people (60).

Gamma rays have a low specific ionization - they ionize only a few atoms along their path of penetration through the body or other matter. However, they travel great distances and are extremely penetrating and many of them can ionize many atoms and produce severe tissue damage (61). They can enter the residential areas the same ways as alpha particles. But because they have such high energies they can also reach residents from their origin at the Maywood site - they can pass through rubber, trees, houses, and people with little loss of energy, and in large numbers, can ionize many cells.

Beta particles are intermediate between alpha particles and gamma rays, and can be just as damaging as alpha or gamma radiation (62).

Alpha particles primarily cause lung cancer through inhalation. But they can also be ingested through contaminated food, or other objects put in the mouth, and can cause cancers of the digestive tract or any other organ they contact.

FIGURE 5

Beta and gamma radiation primarily cause skin cancer, cancer in fatty tissues, cancer of the digestive tract, and of the urinary tract.

However, ANY type of cancer can occur depending on how the person was irradiated.

Critical organs, organs usually destroyed first by radiation, are the lungs, the organs of the gastrointestinal tract, muscle tissue, fatty tissue, the thyroid, kidneys and blood-forming organs (bone marrow).

The five principle damaging effects of ionizing radiation are (63):

1). Superficial injuries such as skin damage or erythema.
2). General effects on the body, particularly the blood-forming organs, and non-specific shortening of one's life span.
3). Induction of cancer.
4). Miscellaneous effects such as cataracts or impaired fertility.
5). Genetic effects (birth defects for many generations).

See FIGURE 12 for the thorium-232 decay chain and FIGURE 13 for the uranium decay chain.

FIGURE 5

THIS IS A LIST OF THE RADIOACTIVE ELEMENTS, SOME OF THE DANGEROUS CHEMICALS, AND EXCESSIVE DANGEROUS HEAVY METALS FOUND IN THE SOIL AND/OR SURFACE OR GROUND WATER IN THE PORTION OF THE MAYWOOD SITE SHOWN IN FIGURE 1. ASTERISKS DENOTE KNOWN CARCINOGENS.

A-28

DANGEROUS CHEMICALS

NITROBENZENE
PHENOL
POLYNUCLEAR AROMATICS
TETRACHLOROETHYLENE *
TOLUENE
TRANS 1,2-DICHLOROETHANE *
TRICHLORO BENZENE
TRICHLOROETHYLENE *
VINYL CHLORIDE *
XYLENE
2,4-DICHLOROPHENOL
CYCLOHEXENE
ACETONE
CHLOROFORM *
INDENO (1,2,3-ca) PYRENE *
BENZENE *
BENZO(a)ANTHRACENE *
BENZO(a)PYRENE *
BENZO(b)FLUORANTHENE *
BENZOIC ACID
BENZYL ALCOHOL
CHRYSENE *
METHYLENE CHLORIDE *
CHLOROBENZENE *

DANGEROUS HEAVY METALS

ANTIMONY
ARSENIC *
BARIUM
CADMIUM *
CHROMIUM *
COPPER
LEAD *
MERCURY
NICKEL *
SELENIUM *
SILVER
THALLIUM
ZINC

RADIOACTIVE ELEMENTS

ACTINIUM-228 *
PROTACTINIUM-234m *
RADIUM-226 *
RADIUM-228 *
THORIUM-230 *
THOROIM-232 *
THORIUM-234 *
URANIUM-234 *
URANIUM-238 *

FIGURE 6

REFER TO MAPS DESIGNATED FIGURES 7, 8, and 10 for AREAS B, C, D, E, and F

A-29 These numbers represent the amount of radiation people living in areas B, C, D, E, and F were being exposed to in 1981. Numbers would be progressively higher dating back to 1950 when these residents first moved in, since thorium constantly decays. The numbers would also be progressively higher now than in 1981 because the MISS site was constructed in 1984 and this radiological study was performed in 1981. The average American receives about 130 mrems/yr from natural background sources.

	Microroentgens per hour.	Millirems per year
B	7.5 - 11	65.7 - 96.4
C	11.0 - 17.0	96.4 - 148.9
[illegible]	17.0 - 25.0	148.9 - 219.0
[illegible]	25.0 - 40.0	219.0 - 350.4
F	40.0 - 70.0	350.4 - 613.2

A-30 26 mrems/yr come from radioactive elements in the body, such as potassium. The other 104 mrems/yr come from external sources - about 60 mrems/yr from cosmic rays and 44 mrems/yr from natural background radiation.
We also get between 100 and 190 mrems/yr from man-made sources such as X-rays. The typical man-made dose is about 40 mrems/yr. (55). In the Maywood area, our background + cosmic radiation is from 53 mrems/yr to 66 mrems/yr.(56). Including the radioactive potassium in our bodies, 26 mrems/yr, and an average medical dose of 40 mrems/yr, most Maywoodians receive about 125 mrems/yr of normal radiation. The numbers in the chart above only include the cosmic ray/background radiation component. They do not include the 26 mrems/yr of radioactive potassium in our bodies, nor the medical component, 40 mrems/yr from radiopharmeceuticals and X-rays. If these figures are included, residents in the area of Stepan Company and the MISS site, actually receive higher amounts of radiation as shown in the table below.

	Millirems per year.
B	131.7 - 162.4
C	162.4 - 214.9
[illegible]	214.9 - 285.0
[illegible]	285.0 - 416.4
F	416.4 - 679.2

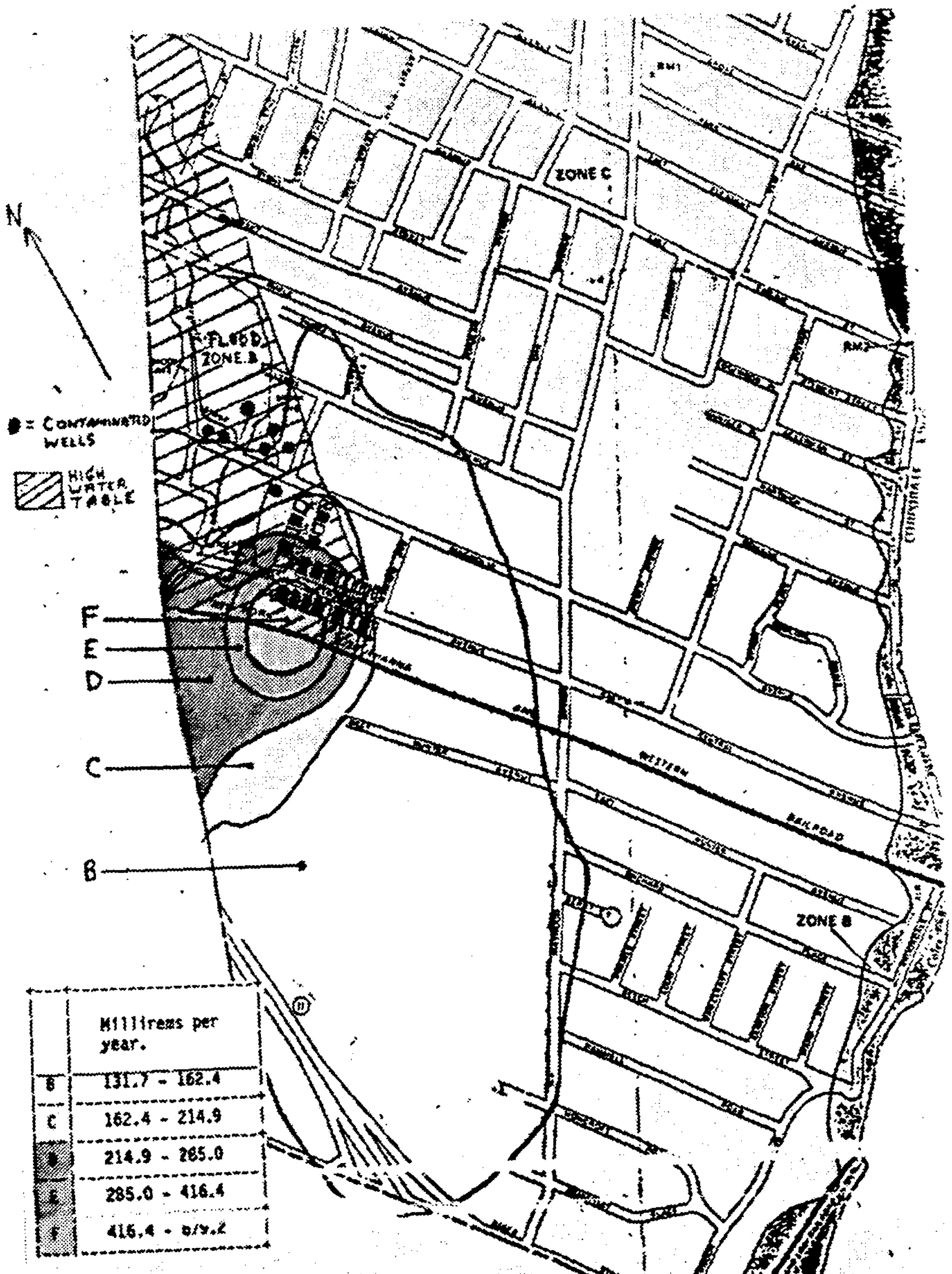
The radiation protection standard, set by the DOE, that any one person should be exposed to during any year is 100 millirems per year. (see FIGURE 18.) However, there is no real radiation level below which biological damage will not occur (57).

The cross-hatch lines in FIGURES 7, 8, and 9 show the flood zone and the high water table where wate comes up from the ground into basements, or in yards, during heavy rains. This is the same water beneath the portion of the Maywood site referred to in this report.

Residents living near Stepan were exposed to far greater amounts of radiation because of the thorium, uranium and other radioactive elements present all over the Maywood site.

In FIGURES 7 and 8 the red squares represent homes where residents developed cancer, and they all fall within the higher radiation lines and within the area of contaminated ground water. White homes in the figures, with zeroes, are homes where no cancer developed. All white homes are not included due due to lack of information on them, or rapid change-overs of owners.

FIGURE 7



MAP SHOWING RADIATION IN SOUTHWESTERN MAYWOOD BEFORE MISS SITE WAS PLACED. RADIATION PROFILE INCREASES AS MORE RADIOACTIVE MATERIAL IS ADDED TO MISS. ALSO SHOWS CONTAMINATED (CHEMICAL) GROUND WATER.

FIGURE 7

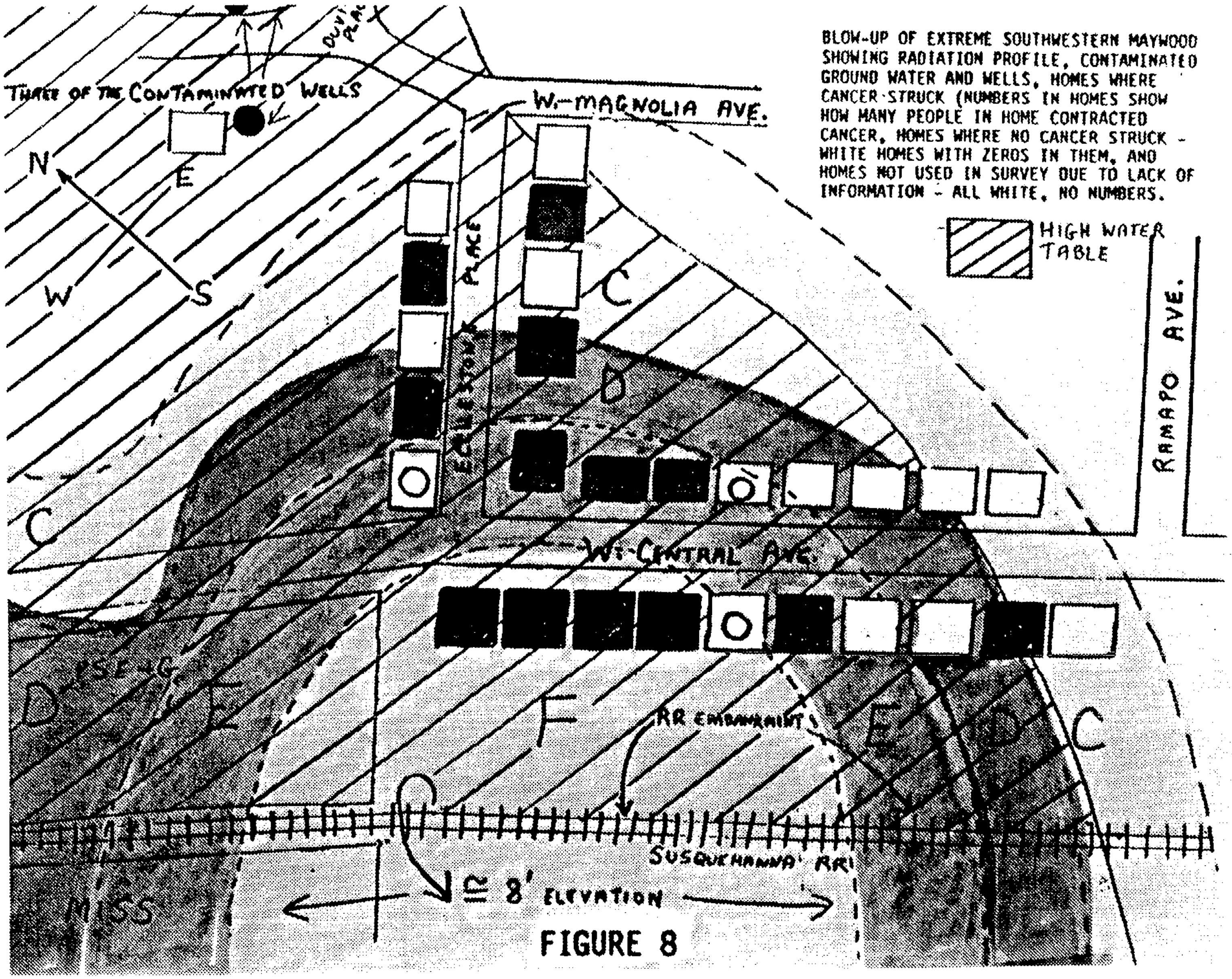
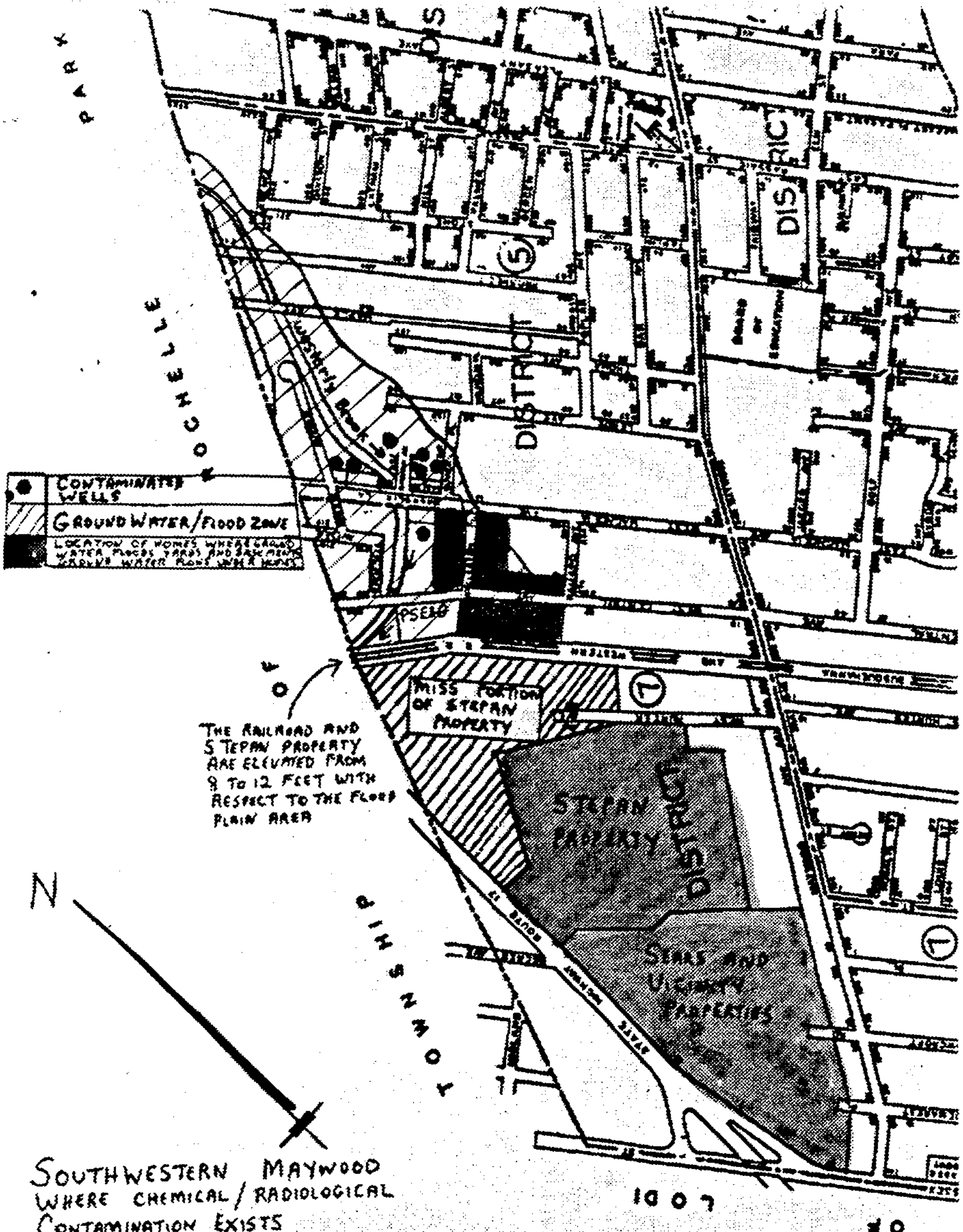
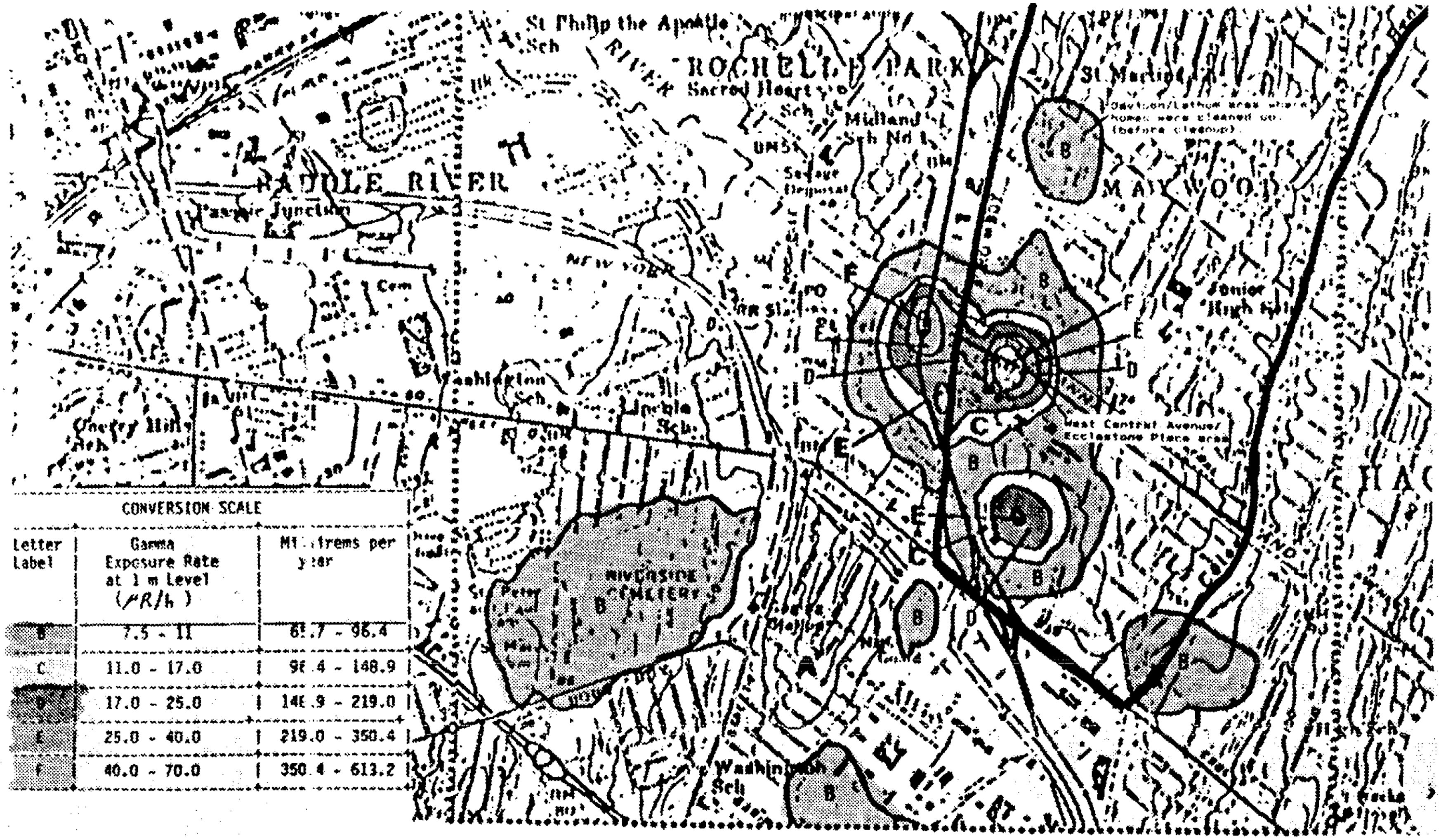

BLOW-UP OF EXTREME SOUTHWESTERN MAYWOOD SHOWING RADIATION PROFILE, CONTAMINATED GROUND WATER AND WELLS, HOMES WHERE CANCER STRUCK (NUMBERS IN HOMES SHOW HOW MANY PEOPLE IN HOME CONTRACTED CANCER, HOMES WHERE NO CANCER STRUCK - WHITE HOMES WITH ZEROS IN THEM, AND HOMES NOT USED IN SURVEY DUE TO LACK OF INFORMATION - ALL WHITE, NO NUMBERS.
HIGH WATER TABLE
THREE OF THE CONTAMINATED WELLS
W. MAGNOLIA AVE.
N
E
W
S
W. CENTRAL AVE.
RAMAPO AVE.
PSE&G
RR EMBANKMENT
SUSQUEHANNA RR
≅ 8' ELEVATION
MISS

FIGURE 8



PARK
ROCHELLE
OF
TOWNSHIP
LODI
OF
DISTRICT
CONTAMINATED WELLS
GROUND WATER/FLOOD ZONE
LOCATION OF HOMES WHERE GROUND WATER FLOODS YARDS AND BASEMENTS
PSE&G
MISS PORTION OF STEPAN PROPERTY
STEPAN PROPERTY
SEARS AND VICINITY PROPERTIES
THE RAILROAD AND STEPAN PROPERTY ARE ELEVATED FROM 9 TO 12 FEET WITH RESPECT TO THE FLOOD PLAIN AREA
N
SOUTHWESTERN MAYWOOD WHERE CHEMICAL/RADIOLOGICAL CONTAMINATION EXISTS

FIGURE 9



CONVERSION SCALE

Letter Label	Gamma Exposure Rate at 1 m Level ($\mu R/h$)	Millirems per year
B	7.5 - 11	6[illegible].7 - 96.4
C	11.0 - 17.0	9[illegible].4 - 148.9
D	17.0 - 25.0	14[illegible].9 - 219.0
E	25.0 - 40.0	219.0 - 350.4
F	40.0 - 70.0	350.4 - 613.2

FIGURE 10

Attorney urges additional study

by Chris Neidenberg

MAYWOOD — While a federal agency asks for calm, a lawyer who has handled three legal actions against Stepan Chemical Company over contamination is urging a further area study for possible health risks.

David Tykulsker, an environmental and labor law specialist in Newark, successfully represented the widow of a worker who died of lung cancer. Tykulsker's client alleged on-site ionizing radiation contributed to the death of George Finley. He handled radioactive materials. A state judge ordered Stepan to compensate her for causing his death.

Tykulsker said two weeks ago he has already filed papers representing another client for similar reasons, and plans to file court papers for a third client also upset with Stepan.

Officials with the U.S. government's Agency For Toxic Substances and Disease Registry (ATSDR) plan to meet in the agency's Atlanta office tomorrow (Nov. 15) to consider doing further "health effects studies" on area residents, as recommended in a federally-funded state report. Gregory Ulirsch, ATSDR New Jersey technical officer, said Atlanta officials will link via phone with a state health department official to review data. Ulirsch predicted a final decision will come in about week or two.

Louise Fabinski, an ATSDR spokeswoman, stressed three weeks ago that the state's preliminary findings will not definitely trigger a further study. ATSDR will first seek input from state, federal and local health agencies, including the U.S. Environmental Protection Agency and state Department of Environmental Protection.

"This site is being considered (for further study) along with a number nationally. But it doesn't mean we expect people to have health problems," Fabinski said.

Fabinski added ATSDR might conclude there is not enough available scientific data for a fact-based study. Some factors which must be considered, Fabinski said, are the time over which residents have been exposed, the types of pollutants they have been exposed to, and whether the body stores the chemicals at issue so health effects can be studied. She explained using cancer deaths to conclude there are health risks depends on the specific cancers occurring in a polluted area.

Tykulsker, however, contended the U.S. government already has ample data to do a further Maywood probe, and to periodically check residents for health problems.

"Does Maywood have a problem meriting further study?" he asked rhetorically. "I say yeah and I'll go even further. I really think there's this bizarre idea that you need dead bodies to study. When will this (thinking) stop?

"We know carcinogenic chemicals and ionizing radiation have existed on this site," Tykulsker continued. "We know the site has been handled in a less than exemplary manner, that ionizing radiation knows no boundaries and has killed at least one worker (Finley).

"To say there's no reasonable chance that area residents have also been exposed puts hope above logic," he said. "The alarm — if any — is not undue."

The lawyer, who cited the presence of the carcinogen benzene on the Maywood Superfund site, insisted the U.S. government can do more to help residents. He agreed with Fabinski that to do a cancer study, one must link "specific exposures to specific types of cancer."

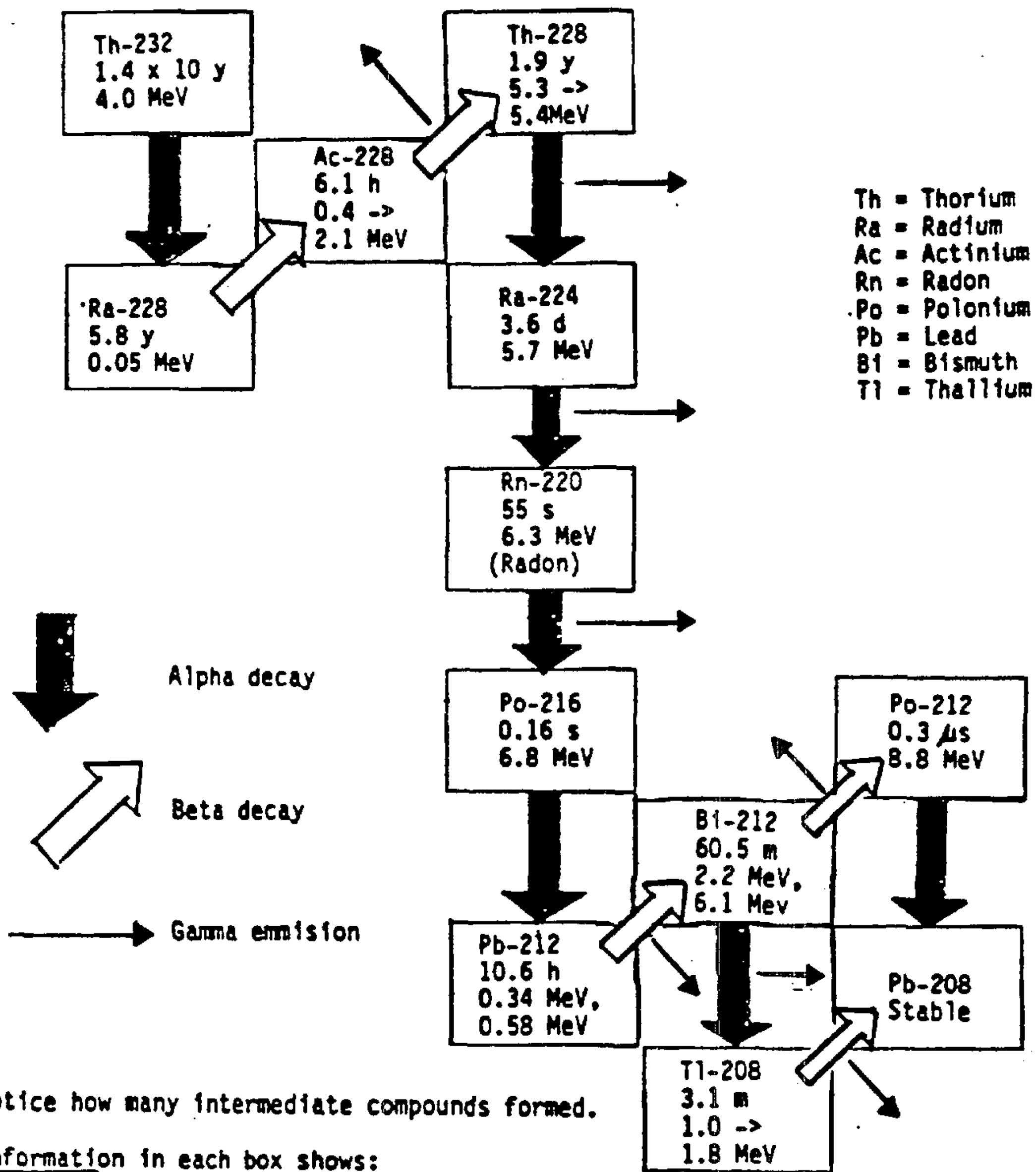
"That's why I'm upset with the notion that you need dead bodies before studying," Tykulsker complained.

Tykulsker said the federal government should also "closely monitor the health status" of residents, citing lung cancer (which killed non-smoker Finley) as an example.

"Lung cancer is fatal unless it's caught real early," he explained. "The only way you can is to look for it on a consistent basis."

FIGURE 11

PRINCIPAL DECAY CHAIN OF THE THORIUM-232 SERIES



Notice how many intermediate compounds formed.

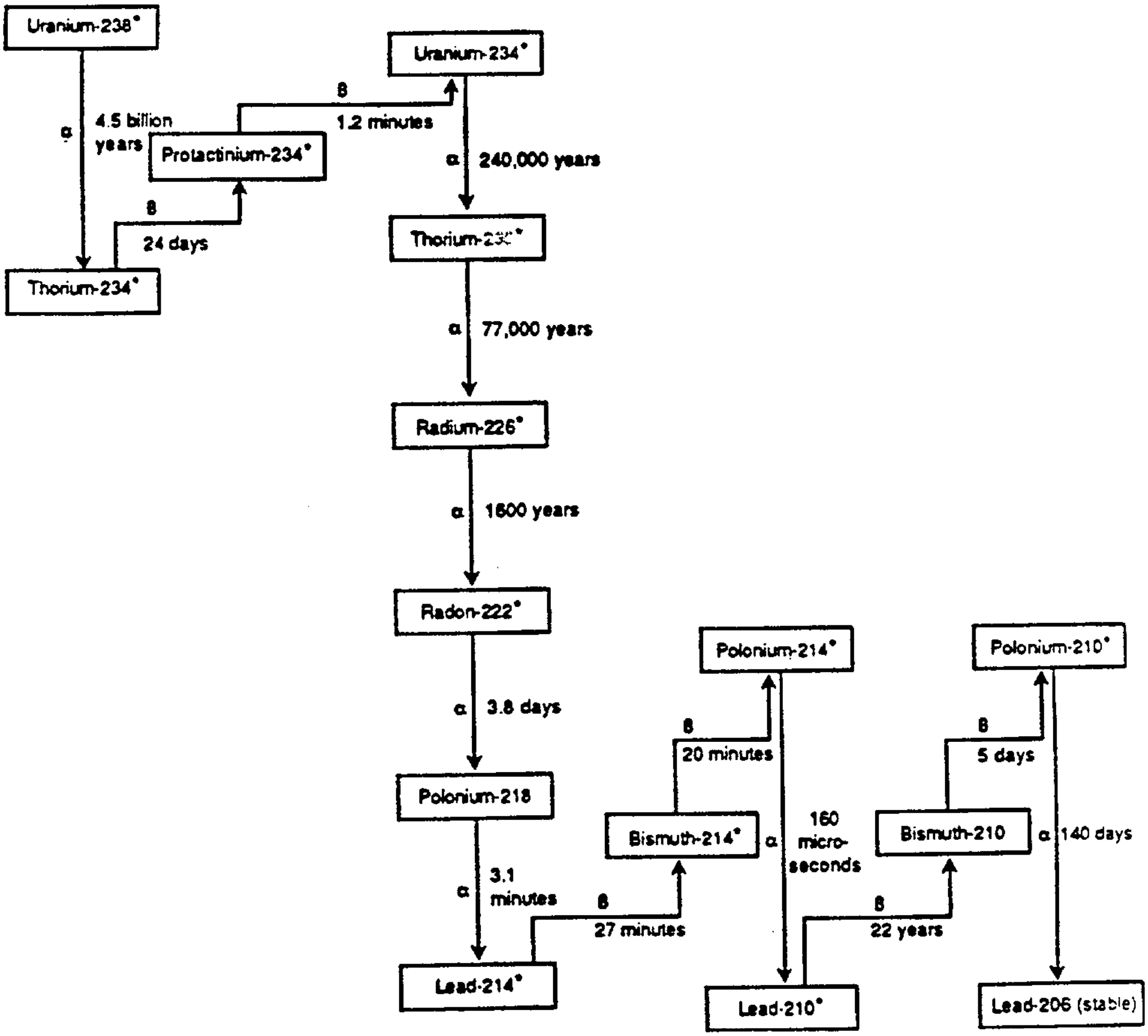
Information in each box shows:

Rn-220 -> The element formed. This one is Radon-220
55s -> The time it takes for the element to decay. This one is 55 seconds.
6.3 MeV -> The energy released during decay. 6.3 megavolts in this case.

y = years d = days h = hours m = minutes s = seconds µs = microseconds

Gamma emission - a secondary process following rapidly after alpha or beta decays. Gamma rays have no mass or charge, but are the most penetrating of the three. Gamma emissions occur throughout thorium decay.

FIGURE 12



NOTES:
Only the dominant decay mode is shown.
The times shown are half-lives.
The symbols α and β indicate alpha and beta decay.
An asterisk indicates that the isotope is also a gamma emitter.

FIGURE 17 Uranium-238 Radioactive Decay Series

FIGURE 13

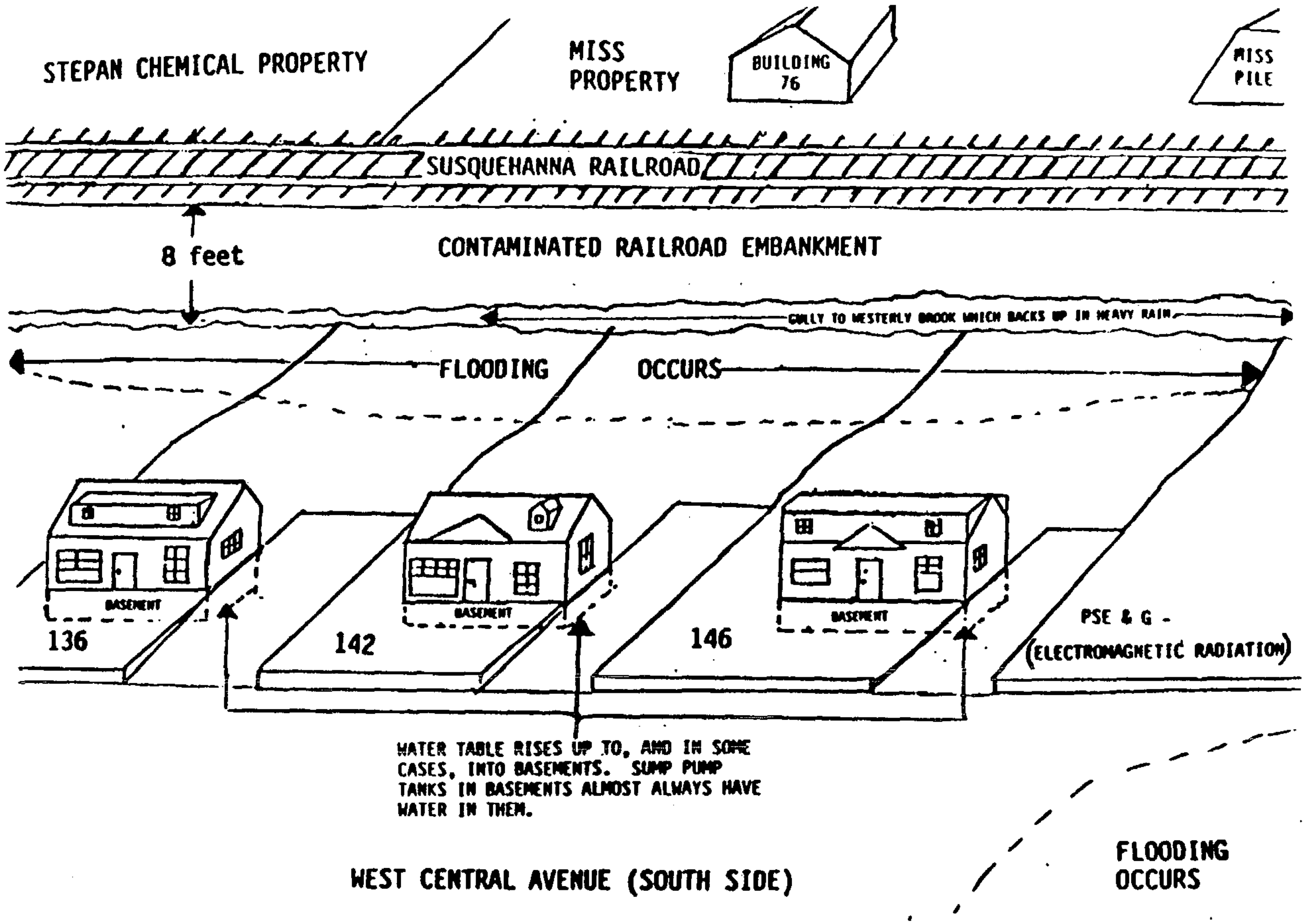

STEPAN CHEMICAL PROPERTY
MISS PROPERTY
BUILDING 76
MISS PILE
SUSQUEHANNA RAILROAD
8 feet
CONTAMINATED RAILROAD EMBANKMENT
GULLY TO WESTERLY BROOK WHICH BACKS UP IN HEAVY RAIN
FLOODING OCCURS
BASEMENT
BASEMENT
BASEMENT
136
142
146
PSE & G - (ELECTROMAGNETIC RADIATION)
WATER TABLE RISES UP TO, AND IN SOME CASES, INTO BASEMENTS. SUMP PUMP TANKS IN BASEMENTS ALMOST ALWAYS HAVE WATER IN THEM.
WEST CENTRAL AVENUE (SOUTH SIDE)
FLOODING OCCURS

FIGURE 14

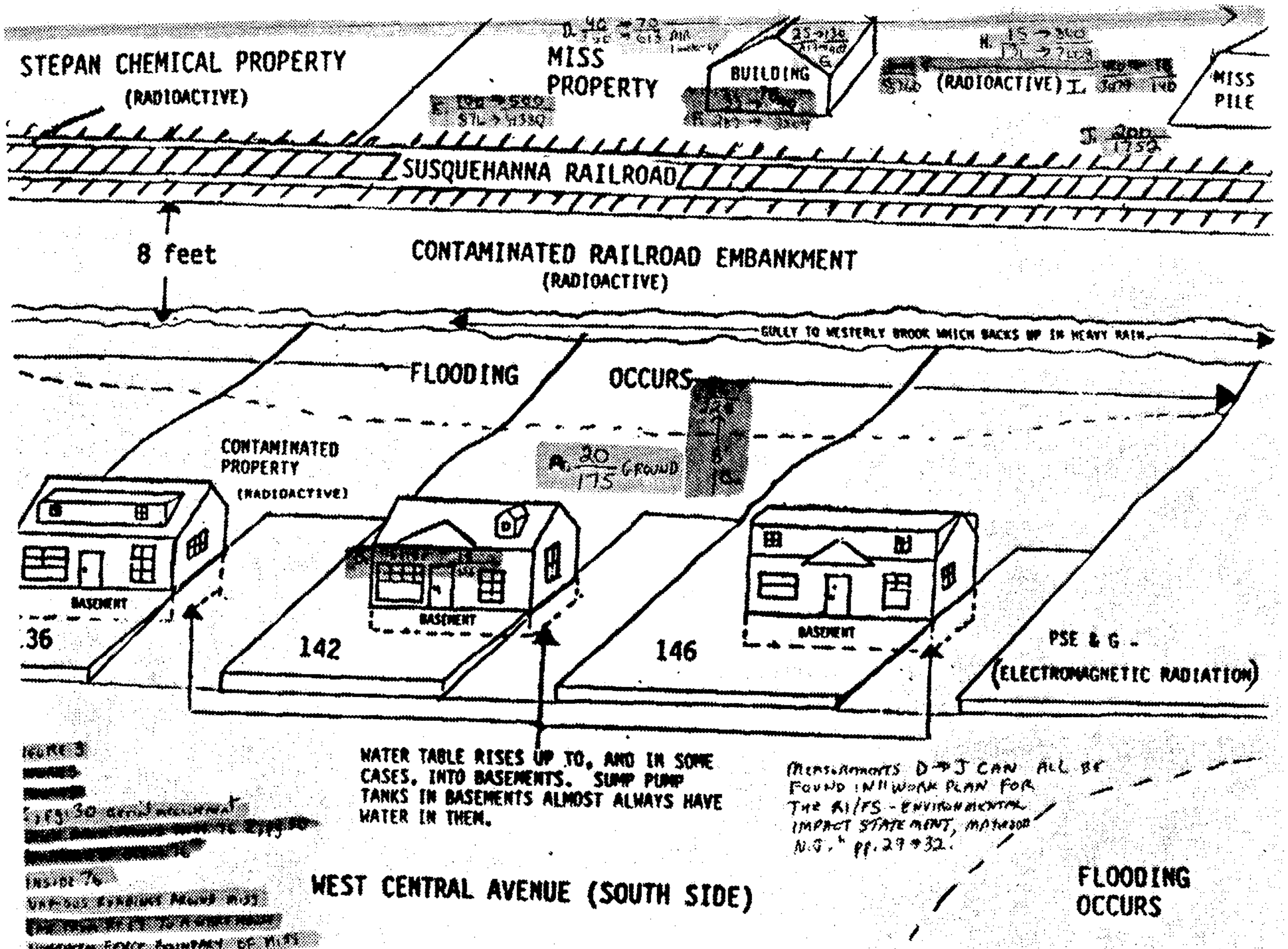
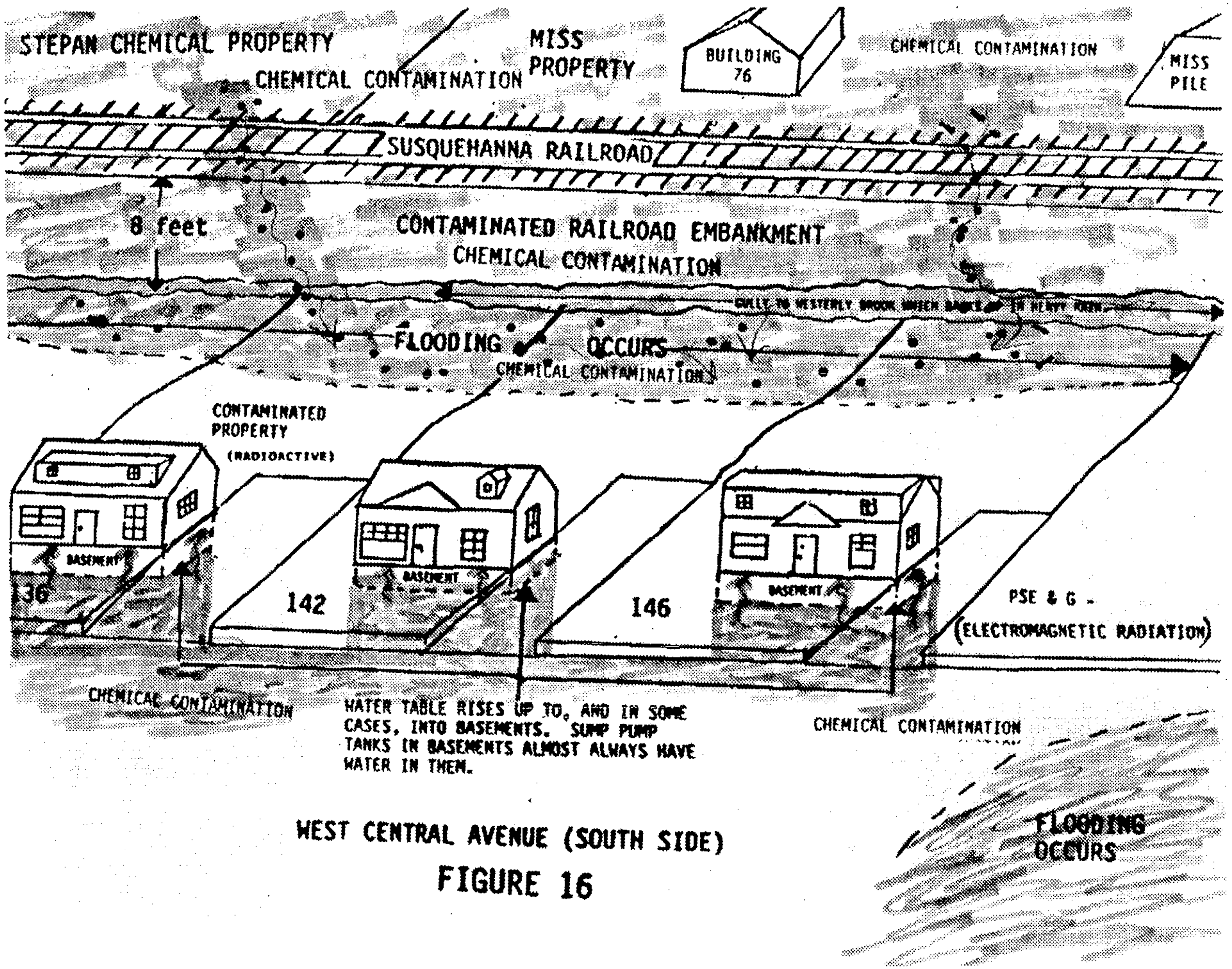


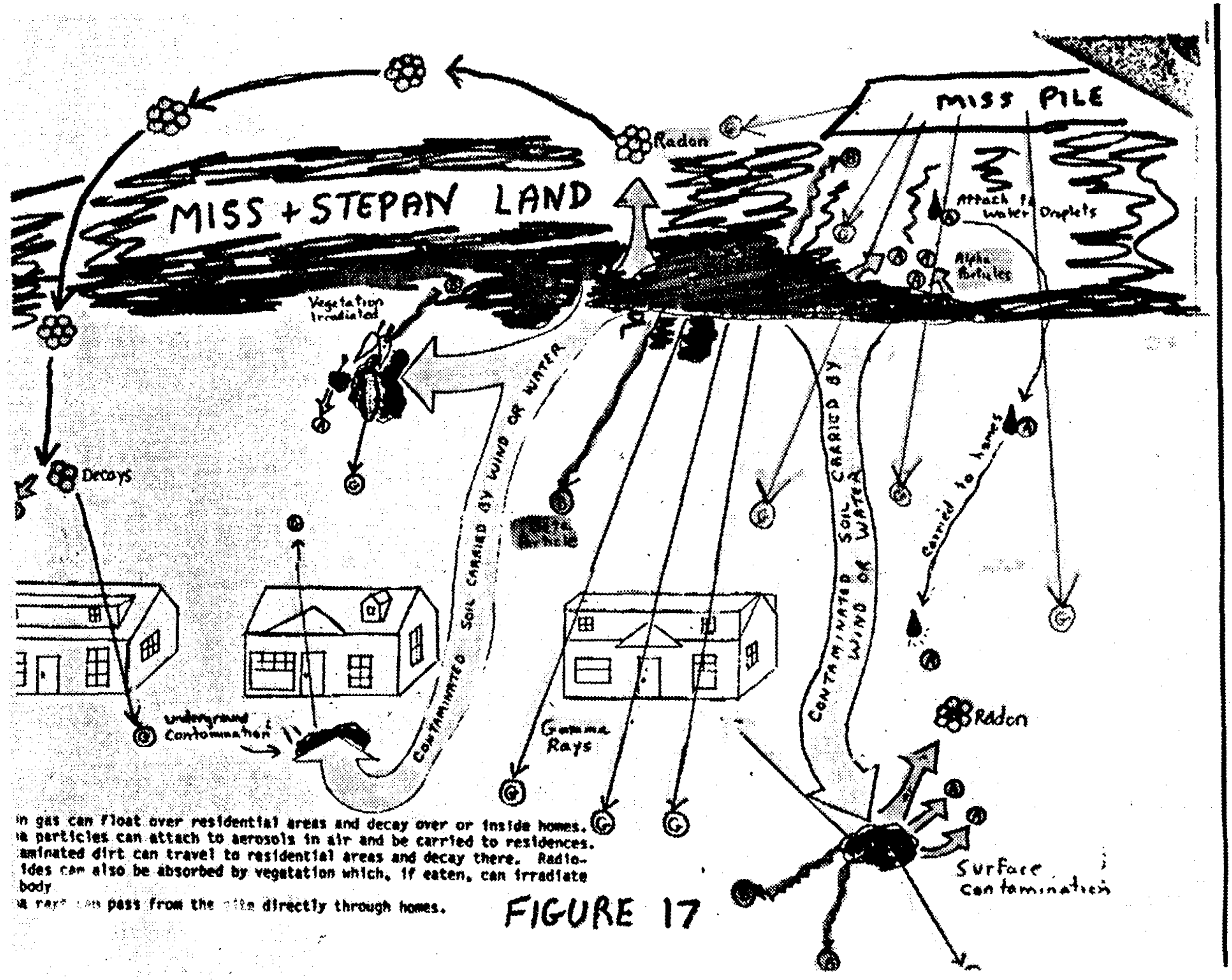
FIGURE 15

…MBER IS µR/hr
…TTOM NUMBER IS mrem/yr.



WEST CENTRAL AVENUE (SOUTH SIDE)

FIGURE 16



n gas can float over residential areas and decay over or inside homes.
a particles can attach to aerosols in air and be carried to residences.
aminated dirt can travel to residential areas and decay there. Radio-
ides can also be absorbed by vegetation which, if eaten, can irradiate
body
a rays can pass from the pile directly through homes.

FIGURE 17

REFERENCES

To use the reference corresponding to the footnote, match the number of the footnote in report to the same numbered footnote, in the footnote section following, get the page numbers and the letter by the footnote, match the letter to the book/reference here, and look up the page, table, or figure. The books can be found in any of the libraries in Bergen County, I used Maywood, and Johnson libraries, and the documents are all in the borough hall files.

(A) Adler, Irving, Inside the nucleus, The John Day Co., N.Y., N.Y., 1974.

(B) Aqua Associates Inc., "Analysis Report of Zechmeister Bros.", West Magnolia Ave., Maywood, N.J., March 23, 1987.

(C) Bartlett, Donald L. and Steele, James B., Forevermore, Nuclear Waste in America, W.W. Norton and Company, N.Y., London, 1985

(D) Bechtel National In,., "Field Sampling Plan for the RI/FS Environmental Impact Statement for the MISS", prepared for the US DOE, Oak Ridge Operations, Oak Ridge, Tenn., June 1900.

(E) Bechtel National Inc., "Health and Safety Plan for the RI/FS Study - Environmental Impact Statement for the Maywood Site, Maywood, N.J.", prepared for the US DOE, Oak Ridge Operations, Oak Ridge, Tenn., June 1990.

(F) Bechtel National Inc., "Maywood Interim Storage Site Annual Site Environmental Report", Calendar year 1985, prepared for the US DOE, Oak Ridge Operations, Oak Ridge, Tenn., May 1986.

(G) Boyle, Robert H. and Environmental Defence Fund, Malignant Neglect, Alfred A. Knopf, N.Y.,.N.Y., 1979.

(H) Coombe, R.A., An Introduction to Radioactivity for Engineers, St. Martin's Press, N.Y., N.Y., 1968.

(I) Ebasco Services Inc., "Final Report for the Maywood Chemical Site: Sears and vicinity properties", N.Y., N.Y., February 1987.

(J) Ebasco Services Inc., "Draft Report for the Maywood Chemical Site: Stepan Company Property" N.Y., N.Y., February, 1988..

(K) EG&G Measurements Group, "An Aereologic Survey of the Stepan Chemical and Surrounding Area, Maywood, N.J.", NRC-8109, prepared by EG&G, for the US Regulatory Commission, Oak Ridge, Tenn., April 1981.

(L) General Testing Corporation, "Maywood Municipal Pool Groundwater Analysis, Maywood, N.J.", April 7, 1987.

REFERENCES CONTINUED ...

(M) General Testing Corporation, "Ramirez, Hadrava, Pouch Well Water Analysis, West Magnolia Avenue, Maywood, N.J.", March 1987.

(N) Goffman, John W., M.D., Ph.D., Radiation and Human Health, Sierra Club Books, 1981.

(O) Hazardline Databank, Occupational Health Services, 400 Plaza Ave., Secaucus, N.J.

(P) Maugh, Thomas H. II., and Marx, Jean L., Seeds of Destruction. The Science Report on Cancer Research, Plenum Press, N.Y. and London, 1985.

(Q) Maywood Borough Map.

(R) Maywood Election District Map.

(S) Maywood Flood Zone Map.

(T) Nader, Ralph and Abbots, John, The Menace of Atomic Energy, W.W. Norton and Co., Inc., N.Y., N.Y., 1979.

(U) Neidenberg, C., The Shopper Newspaper, "Attorney Urges Additional Study", November 14, 1990.

(V) New Jersey Department of Environmental Protection, and Environmental Health Service, New Jersey Department of Health, "Health Assessment, Maywood Chemical Sites, Bergen County, Maywood, N.J.", prepared for Agency for Toxic Substances and Disease Registry, July 1990.

(W) N.J. Department of Health, division of occupational and environmental Health, "Report on the Investigation of Cancer Incidence in Municipalities Adjacent to the Stepan Chemical Co./MISS in Maywood, Bergen County, N.J.", July 1987.

(X) N.J. DEP, Apr. 1986, "Whitaker Well Water Analysis, West Magnolia Ave., Maywood, N.J.", Feb. 1987.

(Y) N.J. DEP, Nov. 1985, "Work Request, 142 W. Central Ave., Maywood, N.J.", Feb. 7, 1986.

(Z) Oak Ridge National Laboratory, 1990, "Work Plan for the Remedial Investigation/Feasibilty Study. Environmental Impact Statement for the Maywood Site, Maywood, N.J.", US DOE, Oak Ridge Operations, Oak Ridge, Tenn., July 1990.

(AA) Prescott, David N., and Flexer, Abraham S., Cancer - the Misguided Cell, Sinauer Assoc., Inc., Sunderland, Mass., 1982.

REFERENCES CONTINUED ...

(BB) Price, William J., Nuclear Radiation Detection, McGraw-Hill Book Co., 1964.

(CC) Sax, Irving, N., Dangerous Properties of Industrial Materials, Van Nostrand Reinhold Co., 1975.

(DD) Sobel, Lester A. (Editor), Cancer and the Environment, Facts on File, N.Y., N.Y., 1978.

(EE) Spruch, Grace Marmor and Spruch, Larry, The Ubiquitous Atom, Charles Scribner's Sons, N.Y., N.Y., 1968.

FOOTNOTES

(1) - S
- E pg. 5

(2) - V pg. 8, pg. 12, pg. 15, pg. 17, pg. 56
- Z pg. 40, pg. 42, pg. 56
- J Table 4

(3) - Z pg. 27;
- E pg. A-1
- I pg. 9, pg. 38
- F pg. 5
- D pg. 23

(4) - K: FIGURE 3

(5) - V pg. 10
- Z pg. 3, 19-20, pg. 25, pg. 47
- I pg. 6

(6) - F pg. 6
- I pp. 15-16

(7) - S

(8) - Z pg. 21
- F pg. 5
- I pg. 9

(9) - Z pg. 40, pg. 56, pg. 65
- V pg. 2, pg. 8, pp. 12-15, pg. 15, pg. 17
- J TABLE 3 -> TABLE 9

(10) - F: TABLE 4-1
- B
- L
- M
- X
- Y

(11) - Z pp. 35 -> 42, pg. 56, pg. 71
- V pg. 10
- G pg. 26

(12) - FIGURE 4
- F pg. 40
- V pg. 7
- I pg. 13
- I pg. 37

(13) - G pg. 3

(14) - Z pg. 32, pg. 35, pg. 56, pg. 60: Fig. 16, pg. 61: Fig. 17

FOOTNOTES continued...

(15) - Z pg. 60: Fig. 16, pg. 61: Fig. 17
AA pp. 145-146.

(16) - K: FIGURE 3

(17) - K: FIGURE 3
- Z pg. 14 - Table 1
- E pg. 11 Table 1-1, pg. 5: FIGURE 1-3

(18) - Z pg. 11

(19) - Z pp. 30-31

(20) - K: FIGURE 3

(21) - CC: pp. 151-152

(22) - CC: pg. 146

(23) - K: FIGURE 3
- Z pp. 30-35, pp. 19-20
- F pp. 9-10

(24) - Z p. 14: Table-1, pp. 30 -> 33

(25) - D pp. 13-15
- E pp. 3-6
- G pg. 11

(26) - V pg. 6
- Y

(27) - B
- Y
- M
- L
- K: FIGURE 3
- V pg. 2, pp. 12-13.

(28) - V pg. 6

(29) - Z p. 11

(30) - W pg. 3

(31) - AA pg. 181
- C pg. 289

(32) - AA pp. 145-146, pp. 182-183

(33) - FIGURE 9, U

FOOTNOTES continued...

(34) - X pp. 16-17

(35) - K pp. 139-140

(36) - Z pp. 49-55
- I pg. 13, pg. 14, pg. 39

(37) - W pg. 6

(38) - Q

(39) - G pg. 18

(40) - Y pg. 1
- G pg. 6

(41) - W pg. 6

(42) - W pg. 6

(43) - W pg. 6

(44) - W pg. 6

(45) - C pp. 298-299

(46) - W pg. 6

(47) - W pg. 6

(48) - CC: pg. 146

(49) - Z: pg. 29

(50) - Z: pg. 65

(51) - Z pg. 14
- F pg. 11 FIGURE 1-3

(52) - W pg. 1

(53) - G pg. 18

FOOTNOTES continued...

(54) - J: Tables 3 and 4
F: pg. 29, pg. 38
Z: pg. 25, pg. 49, pp. 51-53, pg, 54, og, 56, pp. 57-59, pg. 62
pg, 63, pp. 75-76
AA: pg. 147, pp. 152-153, pp. 164-167
E: pg. A-5

(55) - W pg. 40

(56) - K pg. 7

(57) - CC: pg. 457, pg. 473

(58) - CC: pg. 474

(59) - CC: pg. 142

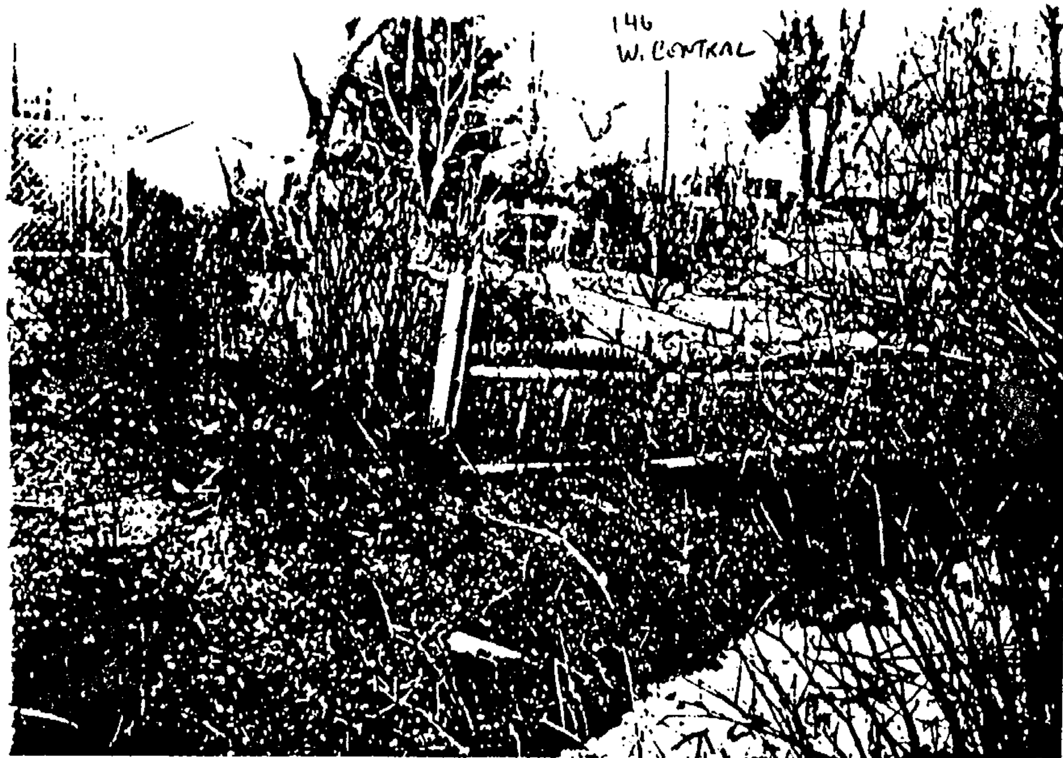
(60) - CC: pg. 142

(61) - CC: pg. 180

(62) - CC: pg. 142

(63) - CC: pg. 152

(64) - F pg. 34

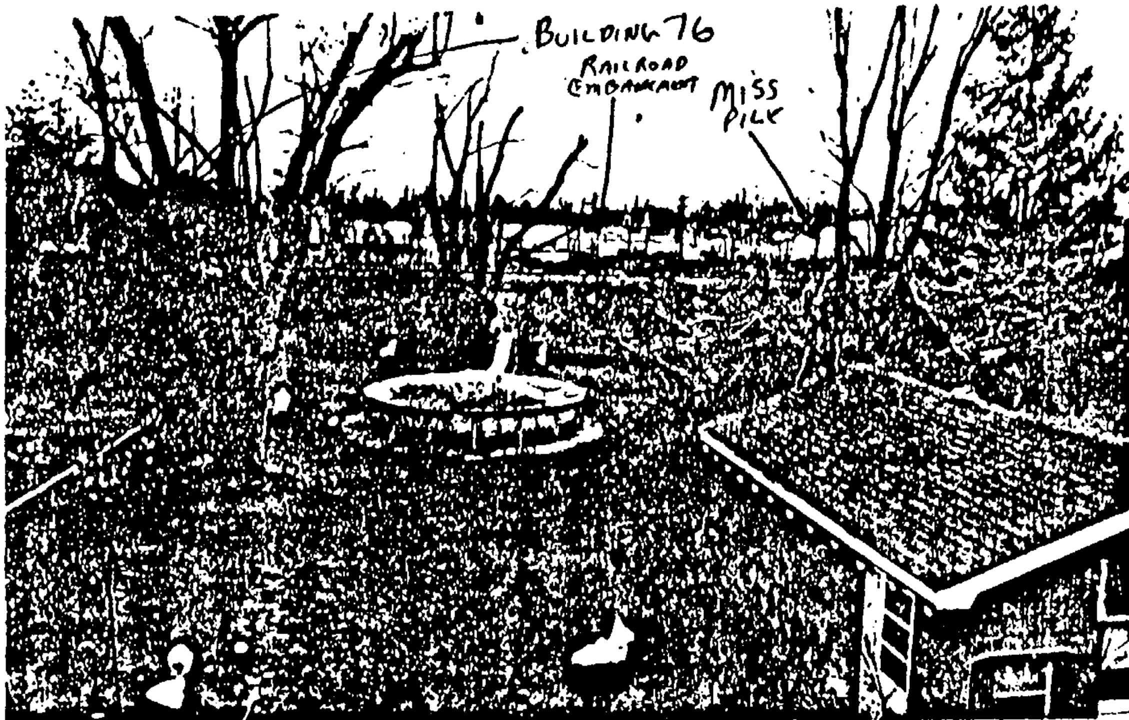


COPY OF PHOTO
TAKEN FROM RAILROAD

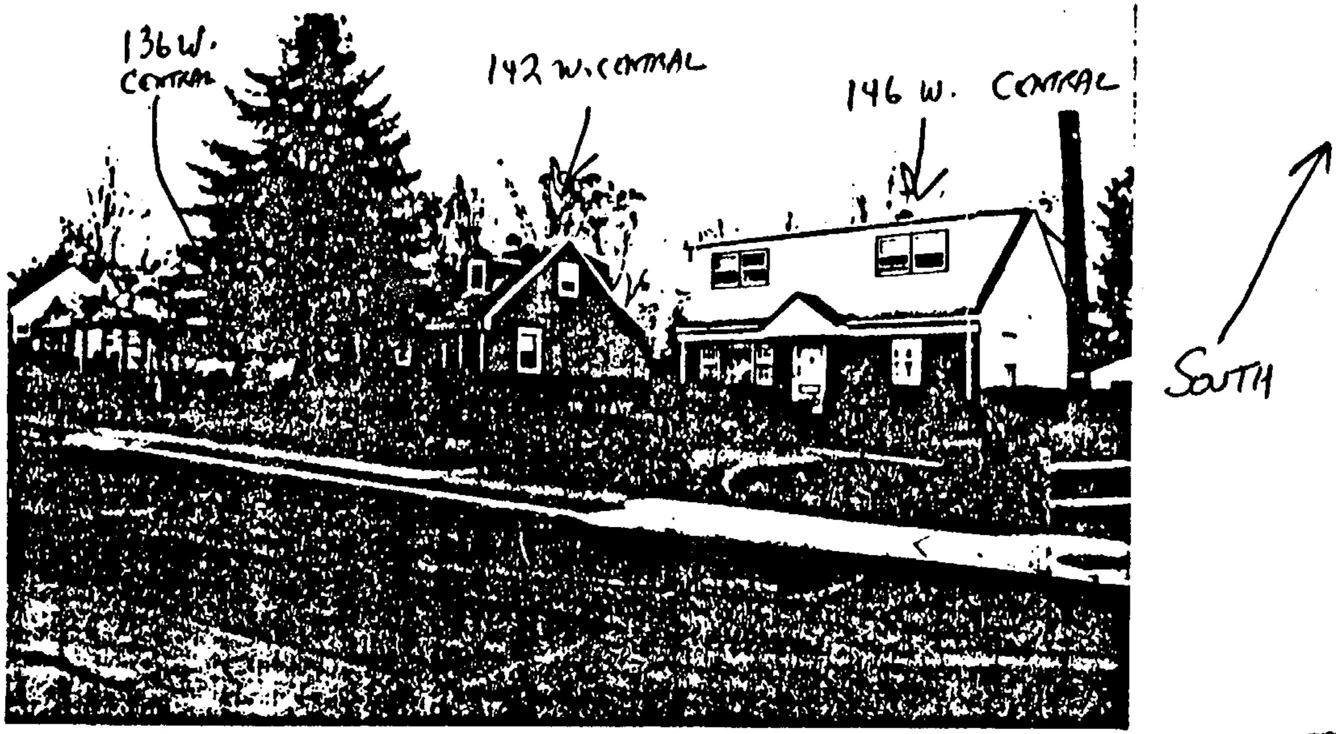
NORTH

GULLY

GULLY



TAKEN FROM UPSTAIRS WINDOW
142 W. CENTRAL AVE.



Taken FROM W. CENTRAL AVE. - NORTH SIDE

TAKEN FROM 142 W. CENTRAL
BACK YARD.

TAKEN FROM RAILROAD

Property Lines

Gully

Railroad Embankment

NORTH

UIC
The University of Illinois at Chicago

Epidemiology-Biostatistics (M/C 925)
School of Public Health
Box 6998, Chicago, Illinois 60680
(312) 996-8860

January 18, 1991

Mr. Larry Jensen
Argonne National Laboratory
9700 S. Cass Avenue
308 TR2
Argonne IL 60439

Dear Mr. Jensen;

I am enclosing my comments on the document as requested. A brief biographical sketch outlining my credentials is enclosed for your information.

I do hope this will be helpful to you.

Sincerely,

Faith Davis PhD
Associate Professor
Epidemiology and Biostatistics

Comments on the Document Entitled "Cancer Cluster Study for West Central Avenue and Ecclestone Place Maywood, New Jersey"

By

Dr. Faith Davis PhD
Associate Professor
Epidemiology and Biostatistics
School of Public Health
University of Illinois at Chicago

It has been clearly established that radiation causes cancer, but different types of radiation cause different types of tumors and different rates of cancer are apparent at different dose levels and in different age and sex groups which may be more susceptible to the cellular damage caused by radiation. Most human data has been established in populations with high dose exposures and it becomes extremely difficult to assess health effects in low dose populations unless they are very large.

In assessing the current report it is important to understand the known health effects of the two exposures at issue, thorium and uranium.

The information which we have about thorium exposure comes from studies in Germany, Portugal, Denmark and Japan where patients were injected with a substance consisting of 25 percent thorium dioxide to assist in x-ray procedures. A clear excess of liver cancer and leukemias has been observed in these studies at high doses (824 rads and 939 rads in the liver in Germany and Japan, respectively; 3087 rads in the bone marrow in Germany). The average time to liver cancer development was 30 years and the earliest leukemia was observed five years after the exposure.

The majority of what we know about uranium health effects comes from mining populations which have been studied in the United States, Czechoslovakia and Canada. These studies are complicated in that uranium exposure is often accompanied by other alpha emitting sources such as radon or radium. Animal studies suggest that bone sarcomas are the most likely result of pure uranium exposure, tumors which have been observed in human populations exposed to other alpha emitting sources. Mining groups have experienced elevated risks of lung cancer in both smokers and nonsmokers, which has been attributed to the radon daughter exposure which seems to have a carcinogenic effect on lung tissue in addition to the effect of smoking. The lowest exposure for which an excess of lung cancer has been observed is 4-9 rads to the lung in the Canadian miners. It also takes at least 10 years following exposure for excess lung cancers to appear. Given these observations, studies are currently underway to assess the effects of low level radon exposures in homes.

Given these studies we would expect to see an excess of leukemia within approximately five to ten years of exposure, an excess of lung cancer within ten to thirty years of exposure and and excess of liver cancer within forty years of exposure in a population exposed to thorium and uranium at levels high enough to initiate the carcinogenic process. It is also important to recognise that chemicals which are carcinogenic may induce some of these same tumors (ie benzene and leukemia).

To understand the pattern of disease in a community, rates of disease which are estimated by counting the observed number of individuals with disease in a specified time interval and region and dividing this by an estimate of the total number of individuals who lived in that region for the same time interval. This is similar to estimating percentages which include an element of time, except that cancer occurs relatively infrequently (the US mortality rates for 1983: lung cancer 44.3/100,000, leukemias 6.5/100,000 and liver cancer 2.2/100,000). A fundamental difficulty in assessing the current report is that minimal population data is provided, preventing the estimation of rates within the four regions for which death counts are provided.

A second difficulty in evaluating this data is in the definition of disease. Information is provided for deaths which list cancer as a primary, secondary or tertiary cause of death which is not comparable to the way cancer deaths are counted in published data, so numbers from this information cannot be compared to numbers reported in cancer registry or vital statistics data.

A third difficulty in assessing this data is that the time interval for Figure 2-1 and 2-2 (deaths from Maywood between 1978 and 1983) is not comparable to the time interval reported in Figure 2-3 (deaths within a small area of Maywood from 1974 to 1983). It is surprising that none of the deaths appearing in Figure 2-3 show up in Figure 2-1 or 2-2 which suggests that the source of data used for Figures 2-1 and 2-2 was inaccurate or that all of the individuals reported with cancer in Figure 2-3 are still alive and not included in the vital statistics records. Based on the statement page 6, number 8, one would expect 11 of these 17 to appear in Figure 2-2.

This leads to the fourth difficulty in understanding this material. New cases (incident cases) are not distinguished from prevalent (all living) or mortality (death) cases. Therefore, the 17 cancers in the 36 residents seems to measure prevalence which is not comparable to the death percent (mortality rate) discussed on page 5. In general, prevalence rates are higher than incidence rates which are higher than mortality rates for the same disease in the same region over the same time interval.

A fifth difficulty in interpreting this document is that the definition of region is not clearly made. Therefore it is difficult to comment on the statement that cancer drops off moving away from the primary site (page 5).

The following comments refer to specific points made in the document.

The document states that 120 cancer deaths occurred in 485 Maywood residents or 24.7% which is comparable to the 24.4% rate in Bergen county (page 5). I would expect the Bergen county rate is an annual rate which includes only those deaths with cancer listed as the primary cause of death. If we took out the secondary and tertiary causes of death included in the Maywood rate it would become lower than the Bergen rate. As such, it may be inappropriate to compare the two rates.

The absence of information on 40 percent of the homes in the West Central Avenue and Ecclestone Place area seriously compromises the ability to use this data (page 6). For example, if we assume that 2 individuals lived in each of the homes that were not included and that no cancers were diagnosed in individuals in these homes, the proportion of cancer in the region would become

17(17+0)/58(36+22) or 29% in contrast to the 17/36 or 47% reported. This 29% prevalence figure is modestly higher than the 24% mortality rate (which one might expect as all prevalent cases do not die of cancer). We do know that individuals who are sick have a tendency to participate in surveys of this type, creating potential biases in the data as this example suggests.

While it is clear that many important considerations were made in generating this document, the inconsistencies cited above make it difficult to interpret the text on page 5 and 6. While limited, there may be some usefulness in reassessing the information presented in Figure 2-2. As this data has been collected in a comparable manner it can be used to make comparisons within the four regions. Table 1 was developed to compare the SW region (closest to the exposures) of Maywood to the other three regions of Maywood (NE, NW, SW) to assess whether or not the types of cancer observed are consistent with what we know about the exposures of interest and whether or not the proportions are similar in these subregions. The first three cancer sites listed were selected because they might be expected to appear in excess in a radiation exposed population, the last three were selected because of their potential to appear in excess in a chemical exposed population.

Table 1

The number and proportion of deaths between 1978 and 1983 from Maywood, New Jersey defined using primary, secondary and tertiary causes of death by cancer sites of primary interest. (Using data from Figure 2-2)

	NE		NW		SE		SW	
	#	%	#	%	#	%	#	%
Lung	10	20	2	13	2	11	6	17
Leukemia	2	4	0	0	0	0	1	3
Liver	1	2	1	7	1	6	2	6
Brain	4	8	2	13	0	0	2	6
Kidney/Bladder	5	10	0	0	0	0	2	6
Other	28	54	10	67	15	83	23	64
All Cancers	50		15		18		36	

There is little to suggest that there might be an excess of any of these types of cancer based on the report or on Table 1. However, the nature of the exposure and the known carcinogenic effects of these exposures suggest that a standard epidemiologic analysis be conducted in the area, although the small population exposed will limit the ability to assess anything ~~by~~ but very large effects.

References

The Effects on Populations of Exposure to Low Levels of Ionizing Radiation: 1980. Committee on the Biological Effect of Ionizing Radiations, National Research Council, National Academy Press, 1980.

Health Risks of Radon and Other Internally Deposited Alpha-Emitter. BEIR IV. Committee on the Biological Effects of Ionizing Radiations, National Research Council, National Academy Press, 1988.

Cancer Statistics Review 1973-1986. National Cancer Institute May, 1989.

CURRICULUM VITAE

FAITH G. DAVIS, Ph.D

HOME ADDRESS

OFFICE ADDRESS

Program in Epidemiology and Biostatistics
School of Public Health
University of Illinois at Chicago
Box 6998, Chicago, IL 60680
(312) 996-5019

DATE OF BIRTH

September 20, 1949

PLACE OF BIRTH

Wainwright, Alberta, Canada

CITIZENSHIP

Canadian

PERMANENT RESIDENCE

United States

EDUCATION

1980-84 Department of Epidemiology and Public Health, Yale University. MPhil and PhD in Chronic Disease Epidemiology.

1977-80 School of Public Health, Harvard University. MPH in Occupational and Environmental Health (1980). MSc in Cancer Epidemiology (1978).

1976-77 J.F. Kennedy School of Government, Harvard University. MPA in Public Administration.

1967-70 University of Alberta, B.Sc. in Household Economics.

PROFESSIONAL EXPERIENCE

1990- Associate Professor - Program in Epidemiology and Biostatistics - School of Public Health, University of Illinois at Chicago (UIC).

1984-90 Assistant Professor - Program in Epidemiology and

	Biostatistics - School of Public Health, UIC.
1985-88	Epidemiologist - Illinois Cancer Council, Chicago.
1983-84	Research Associate - Department of Medicine - Harvard Medical School.
1983-84	Research Associate - Occupational Medicine Program - Department of Internal Medicine - University of California at Davis.
1978-84	Research Associate - Department of Epidemiology - School of Public Health - Harvard University.
1982-83	Lecturer - Occupational Health Service - Family and Community Medicine - University of Massachusetts Medical Center.
1977	Research Assistant - Program in Epidemiology - Laboratory Centre for Disease Control - Health and Welfare, Ottawa, Canada.
1974-76	Supervisor/Research Assistant - Calgary Cancer Clinic - Alberta Cancer Hospitals Board, Edmonton, Canada.
1970-74	Research Assistant - Dr. W.W. Cross Cancer Institute - Alberta Cancer Hospitals Board, Edmonton, Canada.

PEER REVIEW JOURNAL PUBLICATIONS

Handler A, Kisten N, DAVIS F: Cocaine Use During Pregnancy: Perinatal Outcomes. In Press, American Journal of Epidemiology, 1991.

VanEenyk J, DAVIS F, Bowen P: Carotenoids and Cervical Intrepithelial Neoplasia. In Press, International Journal of Cancer, 1991.

Boice JD, Preston D, DAVIS FG, Monson RR: Frequent Chest X-ray Fluoroscopy and Breast Cancer Incidence Among Tuberculosis Patients in Massachusetts. In Press, Radiation Research, 1990.

Inskip PD, Monson RR, Wagoner JK, Stovall M, DAVIS FG, Kleinerman R, Boice JD: Cancer Mortality Following Radiotherapy for Uterine Bleeding. Radiation Research 123:331-344, 1990.

DAVIS FG, Grace MG, Hershfield N: Inflammatory Bowel Disease - Incidence and Prevalence in a Regional Canadian Population. Canadian Journal of Gastroenterology 4(5): 187-192, 1990.

Inskip P, Monson R, Wagoner J, Moloney W, DAVIS F and Boice J: Leukemia Mortality Following Radiotherapy for Uterine Bleeding. Radiation Research 122:107-119, 1990.

Persky V, DAVIS F, Barrett D, Ruby E, Sailer C, Levy P: Recent Time

Trends in Uterine Cancer. American Journal of Public Health 80: 935-939, 1990.

DAVIS FG, Boice JD, Hrubec Z, Monson RR: Cancer Mortality in a Radiation Exposed Cohort of Massachusetts Tuberculosis Patients. Cancer Research 49: 6130-6136, 1989.

Furner SE, DAVIS FG, Nelson RL, Haenszel W: A Case-Control Study of Large Bowel Cancer and Hormone Exposure in Women. Cancer Research 49: 4936-4940, 1989.

Handler A, DAVIS F, Ferre C, Yeko T: The Relationship between Smoking and Ectopic Pregnancy. American Journal of Public Health 79: 1239-1242, 1989.

DAVIS FG, Furner SE, Persky V, Koch M: The Influence of Parity and Exogenous Female Hormones on the Risk of Colon Cancer. International Journal of Cancer 43: 587-590, 1989.

DAVIS FG, Chung MW, Mallin KM: Substance Data Bases and Right to Know Laws: Application to Occupational Epidemiology. American Journal of Industrial Medicine 13: 717-724, 1988.

DAVIS F, Boice J, Kelsey J, Monson R: Cancer Mortality After Multiple Fluoroscopic Examinations of the Chest. Journal of the National Cancer Institute 78:645-652, 1987.

Levy B, DAVIS F, Johnson B: Respiratory Symptoms Among Glass Bottle Makers Exposed to Stannic Chloride Solution and Other Potentially Hazardous Substances. Journal of Occupational Medicine 27: 277-282, 1985.

Jain M, Cook GM, DAVIS FG, Grace MG, Howe GR, Miller AB: A Case-Control Study of Diet and Colo-Rectal Cancer. International Journal of Cancer 26: 757-768, 1980.

Miller AB, Barclay T, Choi N, Grace M, Wall C, Plante M, Howe G, Cinader B, DAVIS F: A Study of Cancer, Parity and Age at First Pregnancy. Journal of Chronic Diseases 33: 595-605, 1980.

DAVIS F, Grace M, MacDonald R: Follow-up Care of Patients with Cancer, Canadian Journal of Public Health 68: 403-406, 1977.

Finchman SM, Grace M, Taylor WC, Skakun EN, DAVIS FG: Paediatric Candidate's Attitudes to Computerized Patient Management Problems in a Certifying Examination. Medical Education 10: 404-407, 1976.

Weir B, Rothberg C, Grace M, DAVIS F: Relative Prognostic Significance of Vasospasm Following Subarachnoid Hemorrhage. The Canadian Journal of Neurological Sciences 109-114, May 1975.

Nelson R, Persky V, DAVIS F: Letter to the editor. New England Journal of Medicine 322: 7, 472, 1989.

Poole C, Lanes S, DAVIS F, Pearce N, Cohen A, Shalot S, Savitz D, Morgenstern H, Greenland S: 'Occurrence Rates' for Disease, Letter to the Editor. American Journal of Public Health 80: 5, 622, 1990.

BOOK CHAPTERS and REPORTS

Ferre C, Persky V, DAVIS F: Cancer Incidence in Hispanics and Non-Hispanic Whites in Cook County, Illinois. Report to the Division of Epidemiologic Studies IDPH, August 1989.

Sukavachana O, Persky V, DAVIS F: Cancer Incidence by Region of Birth among Blacks in Cook County. Report to the Division of Epidemiologic Studies IDPH, August 1989.

Sylvester J, DAVIS F: An Assessment of Dietary Changes in a Cohort of Illinois Residents Participating in the Cancer Prevention Survey, 1982-1986. ACS Report, Illinois Division. June 1989.

Taylor J, DAVIS F, Pabst H, Carteret P, Shey-Ngafi, and Devine R: Serological Study of Measles in Northwest Province, Tuba District, Cameroon. Report to the Canadian International Development Agency. February 1988.

Chung Mia, DAVIS F: Evaluation of a Department of Labor Data Base Generated In Response to the Illinois Right to Know Law For Application to Occupational Epidemiology. A Report of the Illinois Cancer Council. December 1986.

DAVIS F, Gaedke H, Grace M: Alberta Cancer Statistics - 1974. Quarterly Statistical Review, Alberta Health and Social Development, Research and Planning Division, Edmonton, Alberta. April-June 1976.

Grace M, DAVIS F: Data Adequacy, Validity, Reliability, and Accuracy. Section 10, National Cancer Institute Manual, 259-266, 1976.

Critique of "Cancer Cluster Study for West Central Avenue and Ecclestone Place, Maywood, New Jersey, 8/86, Updated 12/90," John Tamburro, Author.

By:

Katherine Mallin, Ph.D.
Associate Director, Epidemiology
Illinois Cancer Council*
Chicago, Illinois

January 1991

*For identification purposes only. The critique represents the views of Dr. Mallin, and not necessarily those of the Illinois Cancer Council.

SUMMARY

The study of cancer risk by Mr. John Tamburro for Maywood, New Jersey and southwestern Maywood contains a number of basic errors and methodological flaws that render the data meaningless and uninterpretable. The basic premise of his study is that cancer risk in southwestern Maywood is higher than in the rest of Maywood, and that the higher risk is due to higher exposure to radiation among these residents. The study found that 47% of southwestern Maywood residents died or developed cancer compared to 25% of the rest of Maywood. However, these percentages are based on flawed data and so do not present an accurate portrayal of cancer risk in these two populations. Major errors in his analysis include (1) incorrect methods of ascertaining cancer deaths and cancer prevalence, (2) different case finding methods in the study and control populations, and different time periods of study in the two populations, (3) lack of a definition for the populations at risk, and use of percentages instead of rates, (4) lack of adjustment for differences in age and sex in the two populations, (5) lack of documentation of specific cancer diagnoses for some residents, (6) collection of data by a resident who has a vested interest in the findings, suggesting bias (whether intended or unintended) towards finding an excess in the study neighborhood (southwestern Maywood). Due to these and other problems, no conclusions regarding the cancer risk in these two populations can be reached. Additional studies of cancer incidence and/or mortality would be required to adequately assess whether southwestern Maywood's risk of cancer is higher than that of Maywood or other similar populations.

Study Methods

The methods Mr. Tamburro used to evaluate cancer risk in this town are not clearly described in his report. However, I will briefly summarize and critique the methods as he described them.

Documentation of cancer deaths and/or prevalence in Maywood, New Jersey excluding southwestern Maywood

The study states that cancer statistics were obtained from death certificates between 1978 and 1983, presumably for deaths occurring among residents of the town of Maywood. He does not indicate how he obtained these death certificates. That is, did he obtain them from the state or county health departments? Were death certificates selected by computer, or were they selected by Mr. Tamburro himself? If they were selected by Mr. Tamburro, who has a vested interest in the study findings, can we be sure that all cancer as well as non-cancer deaths were included in both populations? What were the criteria used for selecting deaths?

Mr. Tamburro's classification of a cancer case included any cancer death listed as an underlying, 'secondary' or 'tertiary' cause. I assume that by secondary or tertiary Mr. Tamburro means cancers that were listed as 'other significant conditions' that were not related to the cause of death. These causes could have occurred at any time prior to the year of death. Including conditions not related to the death itself confuses the definition of a case, since this information will only be included for some deaths but not others. The listing of cancer as an other significant condition not contributing to the cause of death is arbitrary and depends on whether the physician filling out the death certificate is aware of the decedent's history of cancer, and whether or not the physician thinks it important enough to be included on the death certificate. Decedents who were successfully treated for cancer may not have cancer listed anywhere on their death certificate if they died from some other disease, particularly if the cancer occurred several years before the death occurred. In a study in northwestern Illinois for example, residents known to have been diagnosed with bladder cancer often did not have bladder cancer listed anywhere on their death certificate when they died from another disease (K. Mallin, unpublished data). There is no way to assess whether the cancers listed as 'other significant conditions' were more or less likely to be listed for decedents in the study population as compared to the control population.

Another problem with using cancers listed as 'other significant conditions' is that these cancers could have occurred many years before the person died. In this study, deaths between 1978 and 1983 were included for Maywood residents. If two residents were first diagnosed with cancer in 1975, for example, but one died before 1978, and one died between 1978 and 1983, only the latter would be included in the study, <u>even though both were diagnosed with cancer in the same year.</u> Residents diagnosed with fatal cancers, for example, would have a smaller chance of being included in the study because they would have died before the study period. For this reason, the use of other significant conditions is a biased method of determining cancer risk.

The cancer data collected for this study do not, therefore, measure cancer incidence (new cases of cancer), but instead measure cancer deaths and <u>some</u> cancer prevalence data. Prevalence data include a cross-sectional count of cancer survivors and cancer incident cases. Even if prevalence data were available for all residents, it would not provide an accurate measure of the risk of contracting cancer. Prevalence is determined by cancer incidence <u>and</u> cancer survival. Since cancer survival depends on several factors, including the type of cancer, the kind of treatment available at the time the person was diagnosed, the age of the person at diagnosis, and the stage at which the cancer was diagnosed, differences in cancer prevalence statistics can be influenced by all of these factors as well as by differences in actual cancer risk. Therefore, the data collected by Mr. Tamburro are not an accurate representation of the risk of developing or dying of cancer.

Errors and inconsistencies in cancer data listed.

If cancer deaths for the town of Maywood were obtained only from cancer death certificates, it is unclear why, in Figure 2-1, there were at least two cancer deaths that were listed twice (Laccia/Lacchia and Travelin). These are obviously duplicates, as they have the same names (except for one minor misspelling), the same address, same age at death, and same kind of cancer listed. These two residents did not reside in the two streets (West Central Ave. and Ecclestone Place) for which Mr. Tamburro obtained information from local residents. Possible explanations include: (1)Mr. Tamburro could have mistakenly pulled the same death certificate twice (2)the state or county mistakenly had two death certificates for the same person, (3)the person listing the deaths mistakenly listed the same person twice (4)Mr. Tamburro obtained information from sources other than death certificates, or, other unknown reasons.

The fact that these two individuals were listed twice suggests that data either were not collected carefully, or were not carefully edited, or both. In addition, it suggests that other sources not mentioned may have been used to collect the cancer data for Maywood. If the two duplicate cases are included in the total number of deaths, then the total number of cases listed in Figure 2-1 and 2-2 is 121. In the text, Mr. Tamburro states that there were 120 deaths. The discrepancy is not explained in the text. Eliminating the two known duplicates would result in 119 cases, not 120.

Other unexplained problems with the cases listed in these two figures include: (1) seven residents were listed by last name only (2) two had no name listed, and (3)one had no address listed. Death certificates are required to include this information. These problems also make it difficult to ascertain any persons that may have been listed more than once. To adequately assess if duplicate cases are listed, full names and addresses are required.

The missing information suggests that data were collected from sources other than death certificates. However, the report does not indicate that any other methods were used, except for the study population residing on West Central Avenue and Ecclestone Place. The author does not explain why some data are missing.

Documentation of cancer cases on West Central Avenue and Ecclestone Place (Study Population)

The same errors in data collection described above also apply to the data collection methods for West Central Avenue and Ecclestone Place. However, Mr. Tamburro also obtained additional information for residents of this area. In addition to the previously described methodological problems, a major problem with this study is the bias introduced by the different data collection methods for the two areas. Mr. Tamburro used more intensive case finding methods for the 'study area' than for the 'control area', which bias the results towards finding a higher risk in the study area. A basic tenet of epidemiologic and other scientific research is that the same procedures should be used to identify cases among study and control groups. Otherwise the results are biased and the results meaningless.

The procedures used to define the population at risk and define a case are inherently flawed. The death certificates obtained for residents of the control area, were presumably also obtained for the study area. These were stated to be for the years 1978 to 1983. Mr. Tamburro states that he also obtained data from the residents themselves, <u>including data for residents who no longer lived in the area</u>. Similar data were not collected for the 'control' area. This information also included <u>prevalent cases</u>, that is residents who had cancer but were still living or died of another disease. These data were collected from residents themselves, not death certificates as in the 'control' area. The data are also from a different time period, 1974-1983, not 1978-1984, according to Figure 2-3. Hence these data are not comparable.

Another major error is that information was not collected for every household in the study area. Mr. Tamburro states that he could only obtain information for 11 of 27 homes in this area. Potential bias introduced by this selective criteria is not addressed. For example, residents in the excluded homes may have had lower cancer rates than residents in the homes that were surveyed, producing an artificially inflated cancer rate among these residents.

Mr. Tamburro states that the 11 homes were excluded because information could not be collected from them or because there was rapid turnover. No information is provided as to the number of residents in the missing households during the period in question (1974-1983), and the number of years lived in the missing households by each resident. Even though the missing homes account for 41% of the residences in the area, no evidence is provided that the remaining residences included in the study are representative of the study area as a whole. It is more likely that the residences included are not representative since they are individuals known to Mr. Tamburro. Since Mr. Tamburro is not an unbiased observer, he is more likely to have pursued information for residents who he knew or heard of as having cancer. In addition, residents with cancer would be more likely to have participated in the study than residents without cancer, if they believed their cancer was related to exposure to radiation in the area.

No information is provided as to the total number of individuals who lived in the entire southwestern Maywood area for the time period of the study (1974-1983), so the population at risk of contracting cancer is unknown. Cancer information was collected for <u>some</u> residents who no longer lived in the area. However, we are not told how many prior residents did <u>not</u> contract cancer. If prior residents are going to be included in the study, then information must be included for <u>all</u> prior residents, not just residents who had cancer. The criteria can be restricted to residents with a minimum number of residence years in the study area, but all such residents should be followed to determine the number who developed cancer.

Mr. Tamburro also states that the 36 residents in the homes studied lived in the area for at least 15 years; he also states that the study included residents who lived in the area at least 10 years. It is not clear which residents he is referring to in these two statements. The relevant information, not included however, is the time interval between first moving into the area and the initial diagnosis of cancer. Were the cases diagnosed with cancer shortly after moving in, or 10 to fifteen years later? If the latency period between exposure and disease is not available for all residents of the study and control populations, then this information will be biased and should not be used.

Finally, information regarding cancer diagnoses must be verified either from death certificate or preferably medical record information. Reports of cancer diagnosis provided by informants is not very accurate, particularly in regards to the primary cancer site. Cancers that metastasize to other organs may be misreported as to the site of origin. The reliability of any cancer reported by informants is questionable when not verified by medical data. Hence, this information must be interpreted with caution.

In sum, the major problems with the study procedures in the southwestern Maywood area are (1)case finding methods were different from those used for the control area, (2) data were not collected for every household in the study area, (3)cancer data provided by residents were not verified by medical record data. Also, the same problems related to the use of "other significant conditions' from death certificates that were previously discussed also apply. For these reasons, these data cannot be used to evaluate cancer risk in this southwestern Maywood with any degree of reliability.

Statistical methods

Age, sex, and race adjustments

Even if the cancer data collected for this study were accurate, the method used to compare cancer risks in the two areas does not take into account differences in the age and sex distributions of the two populations. Cancer risks generally increase with age for most kinds of cancer, and also vary for males and females (Gloeckler-Ries, 1990). Therefore, any comparison of cancer risks must take into account any differences in the age and sex distribution of the populations under study. Cancer risks also vary by race, so unless racial distributions are similar in the two populations, differences in rates for whites, blacks and other races also need to be taken into account in the analysis.

For example, if the actual cancer risks are similar in two areas, but one area has a larger percentage of older people, than cancer rates which are not adjusted for age differences will be higher in the area with the older population. If age differences are accounted for in the calculation of rates, then the age adjusted rates will be similar, as they should be. In comparing risks for any populations, it is important to know whether any differences found are due to underlying differences in risk, or whether these differences are due to differences in age, sex or race distributions. This was not done in the study of Maywood, so we have no way of assessing the differences in risk not explained by these factors.

<u>Calculation of percentage differences instead of population based rates</u>

The preferred method of assessing cancer risk is to calculate a population based rate. That is, for the population at risk, i.e., all residents of Maywood at a particular point in time, what is the cancer rate? Since cancer is a relatively rare disease, rates are usually expressed per 100,000 population. Rates can then be compared for two or more populations.

In order to calculate rates, the population at risk must be determined according to age, sex and race, for each year of the study period. Cancer incidence and/or death rates can then be calculated for these populations. When the populations to be studied are small, as in this study, it is preferable to compare the populations to another standard population, such as the state of New Jersey or the United States. Sex and age specific rates from this standard population can then be applied to the population(s) in question to generate expected number of deaths or incident cases. The number of observed cases is compared to the number expected to form a Standardized Mortality Ratio (SMR). Ratios above one represent more cases then expected, and ratios below one represent fewer cases then expected. Statistical methods are then used to assess the significance of any departure from one. SMRs can be generated for all cancers combined and for individual cancers.

In this study, however, percentages were calculated instead of rates. Since the underlying population at risk was not identified, it was not possible to calculate rates. In some cases, the population at risk was any one who died while living in the area. In other instances the population at risk included a subset of former residents. Rates can only be calculated when the populations at risk are appropriately identified, and are defined using similar criteria.

When the population at risk cannot be assembled or is not known, it is possible to undertake a Proportional Mortality Ratio (PMR) study, which compares percentage distributions according to cause of death. This method is useful for surveillance studies, but is not able to assess the actual risk of disease because it is based on deaths only, not the population at risk.

The percentage distribution of disease differences among populations may be compared with this method, <u>under certain conditions.</u> The same adjustments for age, sex, race and calendar year of death or incidence must be used that are used in the calculation of rates, since most diseases are related to these factors. The percentage distributions can then be compared to distributions in another standard population, such as the state of New Jersey or the United states. In addition, PMR comparisons for two or more populations will be unbiased only if the overall mortality rate from all deaths are similar in the populations being compared (Wong and Decoufle, 1982). Since PMRs compare percentages, results for one disease will be biased if the mortality rates for all causes are different in the two populations being compared. Since the sum of the proportion of deaths from each cause must equal one, a large deficit from a single cause of death will produce an excess from other causes. For example, if there is a large deficit of deaths from cardiovascular disease in the study population, then percentage distributions from other causes of death such as cancer may be artificially increased. This results from using proportions instead of rates. Only when the age specific death rates from all causes are similar in the populations being compared will proportional mortality studies yield unbiased results.

In sum, the percentage comparisons in the Maywood study did not take into account differences in age, sex or race when comparing the two populations, and also did not use percentage distributions from a larger standard population to assess differences. In addition, no information was provided regarding different overall mortality rates in the two populations, so that the potential for bias in cancer percentage distributions could not be evaluated.

Analysis according to cancer type

Cancer is not one disease but many different diseases with many different causes. For many kinds of cancer, causes are well established, but for many others, causes are not well understood (Doll and Peto, 1981). However, in order to evaluate associations between exposure and disease, evaluation of cancer rates should include an analysis for each kind of cancer. If a single exposure is thought to be related to a cancer excess, then one would expect to find excess risks for those cancers but not for all kinds of cancer. Smoking for example, is known to be associated with cancer of the lung, oral cavity, esophagus, bladder, pancreas, larynx, and kidney (Wynder and Hoffmann, 1982). Therefore, if excess rates were found for only smoking related cancers in a particular community, one would suspect that residents of this community were more likely to have been smokers than residents of a comparison community. In the Maywood study however, no attempt was made to analyze data according to cancer type. The small number of cancers in this study would have precluded a detailed analysis, but some minimal attempt at analyses according to cancer type would provide useful information. In order to conduct such an analyses, however, more precise information regarding specific kinds of cancers would need to be provided.

Assessment of cause and effect

Mr. Tamburro makes a number of statements in his report regarding radiation as the probable cause of the cancers in southwestern Maywood. Even though the study data are in error and cannot be used to assess cancer risk for this town, the same problems in assessing cause and effect would hold regardless of the findings. Therefore, I will briefly comment on some of the statements made in the report regarding possible causes and non-causes of the cancers found.

Some researchers have suggested that thirty percent of all cancer deaths are due to smoking, thirty five percent are due to diet, four percent are due to occupation, two percent to pollution, and the remainder to a variety of other causes (Doll and Peto, 1981). The statement that most cancers are environmentally caused as mentioned by Mr. Tamburro usually refers to all of these previously mentioned exposures, not just pollution. The only cancers not related to the environment in this sense are those that have a genetic component.

Mr. Tamburro did not take into account any non-radiation exposures in his study that might be related to the cancers found. For example, no information on smoking histories, diet histories, alcohol use, drug use, medical histories, occupational histories, reproductive histories, or other factors were collected from residents with and without cancer. Some statements are made which rule out non-radiation exposures with no evidence to back up these statements.

For example, Mr. Tamburro states that the 'afflicted residents had safe jobs.' However, he did not conduct a complete occupational history of every resident in the area, including a list of exposures on the job. He also assumes that housewives were not exposed to carcinogens other than radiation. However, breast cancer, which is the most frequent type of cancer among U.S. women (Silverberg and Lubera, 1988), is associated with reproductive factors, such as a late age at first birth, and is also thought to be associated with high fat diets (Petrakis et al, 1982). However, none of these factors were taken into account in this study.

In another statement, Mr. Tamburro asserts that all of the cases were healthy people until the cancer developed. This statement is meaningless and has no bearing on which factors may be related to cancer risk among these residents.

The statement that none of the cancers among Southwestern Maywood residents were related to cigarette smoking is erroneous. Both bladder and larynx cancer are related to cigarette smoking, as has been shown in numerous epidemiologic studies (Wynder and Hoffmann, 1982).

Alternative methods of assessing cancer risk for the time period prior to 1984

Cross sectional incidence study

Cancer incidence data, which include persons who survive cancer, are superior to mortality data in assessing the risk of acquiring cancer, particularly for those cancers with favorable survival rates. However, incidence data are difficult to obtain unless there is a population based cancer registry. The cancer registry in New Jersey apparently did conduct an incidence study of the Maywood area, but the study was done after the time period of interest to Mr. Tamburro, and did not study the southwest Maywood area that he is concerned about. Since I do not have a copy of the study done by the New Jersey Cancer Registry I cannot comment on it. An incidence study would be extremely difficult to conduct for the time period before the cancer registry began collecting data, unless the residents of the area did not move out of the area for most of the time period under study and were diagnosed in medical facilities in close proximity to the study area. Since I am not familiar with this geographic area, I cannot comment on the feasibility of undertaking such a study.

Mr. Tamburro's assertion that the study conducted by the New Jersey Cancer Registry was flawed because most of the residents of southwestern Maywood contracted cancer before the time period included in the cancer registry cannot be evaluated. Since Mr. Tamburro's study did not include all residents of southwestern Maywood, we do not know what percentage of residents in this area developed cancer before 1984. We do know that not all residents of the area developed cancer before 1984, so that cancer incidence rates could be calculated for the time period covered by the state cancer registry.

An accurate estimate of the southwestern Maywood population for the time period in question would be required to calculate these rates. However, intercensal population estimates for small areas tend to be inaccurate unless there is very little migration in and out of the area of interest. Without additional information, I cannot properly evaluate the feasibility of the New Jersey Cancer Registry conducting analyses in southwestern Maywood.

Cohort study

In order to correctly assess the risk of cancer for long term residents of the area, it would be necessary to assemble a cohort of all residents who lived in the area during the time period of interest. Although not an impossible task, it would require a number of resources. For example, all prior residents for a certain time period could be assessed through real estate, tax, utility records, and other methods. All of these individuals would have to be traced until the end of the study period to determine who was alive at the end of the study period. Death certificates would be obtained for those who died, cause of death determined, and cancer death rates calculated. Similar methods would be used for a non-exposed control population.

To track incident cases among these residents would be much more difficult, particularly for those years in which the New Jersey Cancer Registry did not exist. Each resident or their next of kin would have to be traced to determine if they were ever diagnosed with cancer. For those who responded affirmatively, permission to abstract their medical records would have to be obtained in order to verify the diagnosis. Tracing of residents who moved out of the area would be extremely difficult and expensive, depending on the mobility of the population in question, and the number of residents who would have to be traced. It is not likely that such a study could be easily undertaken.

Cross sectional mortality study

A death certificate cancer mortality study of residents who lived in the area for the time period in question could be done relatively easily. Data from the 1980 census could be used to determine the population at risk, and death certificates for the five year period 1978-1982 used to determine underlying cause of death. Age and sex adjusted Standardized Mortality Ratios could then be calculated using 1980 population figures and rates from a standard population, such as New Jersey or the United States. Once 1990 census data become available, it would also be possible to calculate rates after 1982, using the best available methods to estimate the intercensal population. However, the small size of the populations in question may make these estimates unreliable. Demographers, local officials and urban planners would need to assess the ability to accurately assess intercensal estimates.

The advantage of this kind of study is that it is relatively simple to do. However, the disadvantages are that it would not include residents who moved out of the area during the time period under study, and would include residents with both short and long term exposures. The mobility of the population in question could be evaluated to assess the extent to which cross-sectional rates would be useful.

Conclusions

No conclusions regarding cancer risk in either of the two populations studied can be drawn from the report by Mr. Tamburro because of the biases and flaws discussed in this critique. The cancer risk among residents of southwestern Maywood may or may not be higher than that of its neighbors or of another comparable population--we have no way of knowing from Mr. Tamburro's study. Sound methodological studies would be required to determine the actual cancer risk for the time period of interest.

Confidentiality Problems

Although not directly related to the issue of cancer risk, I am very concerned that individuals names and addresses were listed in this report. These individuals obviously could not give consent to have their names published since they are deceased. Did their next of kin provide consent to have these names released to the public? Name and address information on death certificates are confidential data which are not usually released without strict guarantees regarding confidentiality. Unless permission is obtained from next-of-kin, names and addresses should not be published. If Mr. Tamburro obtained death certificates from the state or county health departments, were confidentiality restrictions required before releasing the data? If Mr. Tamburro obtained death certificates from next-of-kin, perhaps they gave him permission to release names. Even if this were the case, I see no scientific reason to publish the names in the report.

References

Doll R, Peto R: The Causes of Cancer. London, Oxford Press, 1981.

Gloeckler-Ries LA, Hankey BF, Edwards BK: Cancer Statistics Review, 1973-1987. National Cancer Institute (NIH Pub. No. 90-2789), Bethesda, 1990.

Petrakis NC, Ernster VC, Kin MC: Breast, Chapter 49 in D. Schottenfeld and JF Fraumeni Jr., eds. Cancer Epidemiology and Prevention, W.B. Saunders, Philadelphia, pp. 855-870, 1982.

Silverberg E, Lubera JA: Cancer statistics, 1988. Ca-A Cancer Journal for Clinicians. 38:5-22, 1988.

Wong O, Decoufle P: Methodological issues involving the standardized mortality ratio and proportionate mortality ratio in occupational studies. J Occup Med 24:299-304, 1982.

Wynder EL, Hoffmann D: Tobacco. Chapter 15 in D. Schottenfeld and J.F. Fraumeni, Jr., eds. Cancer Epidemiology and Prevention, W.B. Saunders, Philadelphia, pp. 277-292, 1990.

Response A-1

Two radiation issues are expressed in this concern: (1) the measured levels are high and (2) they are above a danger threshold. With respect to the first issue, the levels measured on Mr. Tamburro's property, as given in his public comment (Figure 3),* are as follows:

Outside, ground level	20 microroentgen per hour (μR/h)
Outside, 8 feet above ground	26 μR/h
Outside, half-way up the railroad embankment	28 μR/h
Inside his house	18 μR/h

Off his property, the background level measured in Maywood was 8 μR/h.

Similarly, Oak Ridge National Laboratory issued a report in June 1989, giving the results of a survey of this property. The major results are:

Maximum gamma exposure rate from all sources on and off the property, including background, measured at 1 meter above the ground — 20 μR/h

Maximum soil concentration, including background —

Radium-226	2.9 picocuries per gram (pCi/g)
Thorium-232	4.9 pCi/g
Uranium-238	Less than 6.0 pCi/g

The measured background levels were 8 μR/h for the gamma exposure rate and 0.9 pCi/g for each of the three radionuclides.

These data indicate that the gamma exposure rates measured on Mr. Tamburro's property are elevated but not high. The highest measurement, 28 μR/h, is 3.5 times the background level, or 20 μR/h over the background level. This was measured off the residential property. The highest measurement on the property, in an area accessible to people, was 20 μR/h, or 12 μR/h over background. Within the house, the level was 10 μR/h over background. The U.S. Department of Energy (DOE) guidelines, based upon U.S. Environmental Protection Agency (EPA) uranium and thorium tailings standards, require that exposures within homes be controlled to 20 μR/h or less over background and that they meet the 100 millrem per year (mrem/yr) basic dose limit. (For gamma radiation, the exposure unit of roentgen (R) and the dose equivalent unit of rem are equal numerically.

---

*The figures referred to in responses to Letter A were submitted as attachments to the letter and are reproduced following the text of the letter.

In terms of subunits, each hour of exposure to 1 μR/h will give a dose equivalent of 0.001 mrem.) Thus, the highest measurement, off the property just meets the 20 μR/h guideline. On the property, the guideline was not exceeded. As will be shown below, the basic dose limit is not likely to be exceeded either.

The soil concentrations exceed background — by about 2 times for radium, by about 4 times for thorium, and by no more than about 6 times for uranium. Neither the radium nor the thorium values exceed DOE cleanup guidelines. The DOE has not developed uranium guidelines for the Maywood site. Weighed against criteria, this property would not qualify for cleanup in accordance with current criteria and standards.

To answer the second concern, let us first determine the dose a person might receive on this property and compare that to the DOE guideline of 100 mrem/yr. From the material Mr. Tamburro submitted (Figure 3), the highest exposure rate that was measured on his property, in an area where people could actually be exposed, was 20 μR/h, or 12 μR/h over the background level. This is 12/1000 = 0.012 milliroentgen per hour (mR/h). If he were exposed at this spot for 24 hours per day, 365 days per year, he would receive $0.012 \times 24 \times 365 = 105$ mrem/yr. Of course, it is improbable that he would stand at this one spot for an entire year. He would probably spend 8 hours at work. Then only 16 hours a day would be available to stand at this spot. His estimated dose would drop to $0.012 \times 16 \times 365 = 70$ mrem/yr. Within his house, where he is more likely to spend much of the 16 hours, the measured level was 10 μR/h over background. This would be $10/1000 \times 24 \times 365 = 58$ mrem/yr. Realistically, he would move around on his property, going to spots of higher and lesser exposure, and he would leave his property, going where the excess exposure is zero. Even 58 mrem/yr might be too high a dose estimate.

The conclusions from this rather long set of calculations are twofold: (1) DOE does recognize that Mr. Tamburro is receiving more than a background level radiation dose, but (2) that dose, under a realistic scenario, appears to be below EPA and DOE criteria. The DOE's long-term commitment is to find a solution to the Maywood waste problem so that excess doses will be as near zero as possible.

With regard to the chemical contaminants, insufficient data are presented in this report to support the conclusion that area residents are being exposed to "dangerous levels of carcinogenic chemicals." Nevertheless, as part of the remedial investigation/ feasibility study (RI/FS) being conducted by DOE for the Maywood site, samples were collected from the MISS in the fall and winter of 1990 and are currently being analyzed for various organic and inorganic parameters. The results from this sampling will be evaluated along with other characterization information and evaluated in the baseline risk assessment; this assessment will be conducted following EPA guidelines and will be used to evaluate health impacts attributable to site contaminants. In addition, chemical information as presented in Mr. Tamburro's study is insufficient to support the conclusion that there are adverse health impacts due to groundwater sources when flooding in basements or puddling in yards occurs.

The concentrations of chemicals found in the groundwater need to be established before an analysis of health impacts or a comparison to applicable guidelines can be made. See also Response A-27.

Response A-2

A summary of groundwater data for the years 1985 through 1989 in the latest environmental report for the Maywood Interim Storage Site (BNI 1990) shows that the highest radium-226 concentration was 2.7 picocuries per liter (pCi/L) over background levels. The EPA Interim Primary Drinking Water standards are 5 pCi/L for combined radium-226 and radium-228 levels. Technically, the standard is for municipal water supplies, not private wells, but for illustrative purposes we will make the comparison. Although there are no radium-228 data reported with the radium-226 data for these wells, the latest measurements on the nearby Stepan Company site (in 1989) show maximum radium-228 concentrations less than 14 pCi/L, including background. As a result, the combined radium-226 plus radium-228 level would be something less than 16.7 pCi/L. However, even if the water in this aquifer did not meet EPA drinking water standards, local residents use municipal water, not well water from this aquifer, for their drinking water and, thus, they could not be exposed.

There are no drinking water standards for total uranium or thorium-232. However, estimated maximum annual doses were calculated from EPA intake levels (2 liters per day, 365 days per year), EPA dose conversion factors (Eckerman et al. 1988), and the highest measured well values. The estimated doses are about 40 mrem/yr for total uranium and about 6 mrem/yr for thorium-232. Although these levels would not meet a 4 mrem/yr EPA drinking water standard (not enforceable for uranium or private wells), it should be noted that so long as residents are relying upon municipal water for drinking water, these doses cannot actually occur.

Response A-3

It should be noted that the original survey report by EG&G should be consulted for exposure rates. Figures 7, 8, and 10 in Mr. Tamburro's study incorrectly locate the New York, Susquehanna and Western Railroad line and West Central Avenue in relationship to the concentric exposure regions identified in Figure 3 of the EG&G report. Specifically, Region E does not cross West Central Avenue. Using Figures 7, 8, and 10 would lead to an overestimate of the exposure rates in the neighborhood.

Response A-4

For radioactive contaminants, the following comparison was made between Stepan Company groundwater data (unpublished) and MISS groundwater data (from annual environmental monitoring reports [BNI 1990]).

		Range of Groundwater Measurements[a] (pCi/L)	
Year	Contaminant	MISS	Stepan Company Property
1987	Total Uranium	0.2 - 98.8	1.1 - 23.9
	Radium-226	<0.1 - 0.8	<0.1 - 10.4
	Thorium-232	<0.8	0.5 - 13.1
1988	Total uranium	0.6 - 12.2	0.6 - 126.9
	Radium-226	0.3 - 4.3	0.3 - 7.1
	Thorium-232	<0.2 - 1.9	<0.2 - 7.8
1989	Total uranium	<0.6 - 10.1	0.6 - 57.1
	Radium-226	0.4 - 2.1	0.3 - 3.4
	Thorium-232	<0.2 - 0.9	<0.2 - 1.5

[a]A less than symbol (<) means that the value is less than the stated number, e.g. <0.6 means that the measured value is less than 0.6 pCi/L.

These data show that, except for total uranium in 1987, the Stepan Company data were generally higher than those for the MISS, the low end of the ranges being similar. If we assume that the MISS groundwater is like the groundwater under West Central Avenue, then it cannot necessarily be said that West Central Avenue groundwater shows the same profile as that for the Stepan Company.

The list of chemicals that are considered to be "dangerous and carcinogenic" by Mr. Tamburro, if verified in the area groundwater, would be classed as "dangerous" only above specific concentrations; therefore, as in Response A-1, data establishing the concentrations of these chemicals in the groundwater would be necessary before conclusions could be made regarding health impacts. Furthermore, most of the compounds listed are common industrial chemicals and could be found normally in industrial areas such as the vicinity of Maywood. If these chemicals are not attributable to the processes conducted at the Maywood Chemical Works, the problem would not fall under DOE's FUSRAP responsibilities as set forth in the Federal Facility Agreement with EPA Region II (DOE 1990). See also Response A-27.

Response A-5

Refer to Dr. Mallin's critique of this assertion (page 9 of critique; reproduced following Letter A and attachments).

Response A-6

Radon-222 gas is one of the decay products of the uranium series and is commonly referred to as "radon." Radon-220 gas is one of the decay products of the thorium series and is commonly referred to as "thoron."

Response A-7

Refer to the Responses A-1 and A-3. The levels are elevated but not high. The levels may be perceived to be higher than actuality because of errors in Figures 7, 8, and 10. Alpha and beta radiation from distant structures like Building 76 will not raise the exposure levels in the surrounding neighborhood because of the very short range of these emissions in air. The most powerful alpha particles for the Maywood site contaminants will travel no more than about 3 inches in air, and beta particles no more than about 3 feet. Gamma radiation will be detectable off-site, with the level diminishing quickly with distance.

Response A-8

If the radiation levels are lower now than between 1950 and 1980, it would not be due to radioactive decay. It would have to be due to other causes, primarily because the plant is no longer operating and handling radioactive material. By way of explanation, uranium-238 has a half life of 4.5 billion years, about the age of the earth, and thorium-232 has a half-life of about 14 billion years, about the age of the universe. Thus, even after 1 million years, only 15-thousandths of 1% of the uranium would have radioactively decayed and only about 5-thousandths of 1% of the thorium would have decayed. In the short span of years since 1950, much less than a few-thousandths of 1% of these materials would have decayed. Effectively, the uranium and thorium levels have not changed.

However, the waste materials contain many radionuclides, all with shorter half-lives than uranium-238 or thorium-232, that would show distinct changes in emissions over 40 years. Both increases and decreases in radiation levels due to radioactive ingrowth and decay are possible. The net impact of all the changes in the radionuclide levels since the early 1950s is complex to calculate, but will be part of the analyses in the baseline risk assessment and the feasibility study.

Response A-9

The assertion that adding more materials to the MISS pile will increase the exposure rate cannot be conclusively answered because of the shortage of data for residential radiation levels on West Central Avenue before the pile was created. However, the aerial radiological survey conducted by EG&G in 1981 showed this area to range from 17 to 25 μR/h, including a cosmic ray contribution of 3.7 μR/h. This gives a maximum level of about 25 - 4 = 21 μR/h over background. The maximum measurement in Mr. Tamburro's yard, as reported in his public comment (Figure 3), was 20 μR/h. A recent survey by Oak Ridge National Laboratory (1989) gave similar results.

In addition, the large volume of dirt can act as a shield, keeping down emissions from the ground below the pile and from material on the bottom of the pile. In effect, the stronger emissions from below are reduced by shielding and the weaker emissions from within the pile may not compensate. Total emissions could actually decrease. The gamma exposure rate measurements tabulated in the annual monitoring reports do not resolve this issue, as can be seen from the data for the three monitoring stations (3, 4, and 5) nearest West Central Avenue.

Monitoring Station	Gamma Exposure Rate (mrem/yr)					
	1984	1985	1986	1987	1988	1989
3	196	27	38	29	21	29
4	182	130	91	69	109	112
5	368	272	172	121	186	154

Material was last placed on the pile in 1985. Annual levels since then have not remained constant. However, in late 1987, a layer of clean fill was placed along the site boundary specifically to help reduce gamma emissions, but measurements in 1988 actually increased at two out of three stations. Beginning in 1988, monitors giving more representative tissue doses replaced the monitors used up to that time. Their reading error was ± 25%. Within this reading range, the 1988 and 1989 results are in agreement. Nevertheless, it is difficult to say conclusively whether adding material to the pile has increased or decreased the total emissions.

Response A-10

See Response A-9.

Response A-11

There are no plans under way to add more material to the MISS pile, with the exception of material from one residence designated as a time-critical removal action. In deciding whether or not to add more material to the MISS, DOE would weigh the public health benefit of removing contaminants from some people's property against any potential public health detriment that might result due to increased emissions on properties adjacent to the MISS. The job of determining the means to achieve the most overall benefit is not always easy and the results may not please all parties.

Response A-12

Determining the cause of a specific cancer in an industrial region like Bergen County is impossible because there are many agents in the environment that can cause cancer, some of them natural and some of them industrial, some of them chemical and some of them radioactive. At best we can compare the statistical chances of competing agents in causing cancers.

Response A-13

Just the presence of carcinogens in the environment is insufficient to establish a firm case that these are the cause of an alleged increase in cancer cases. If the levels are too minute, the statistical chances might be insignificant.

The nature and extent of chemicals present at the Maywood site is currently being investigated by DOE. Until chemical contaminants are identified and the concentrations of each are established, it would be difficult to support this conclusion. Chemical concentrations will determine the probability of adverse effects and the degree of any effects. See also Responses A-1 and A-4.

Response A-14

See Response A-13.

Response A-15

See Response A-18.

Response A-16

The period of time between the exposure and the appearance of a health effect (the latency period) varies with the organ exposed. Some organs are radiosensitive and others are very insensitive. The level of exposure will not change the latency period.

Response A-17

Mr. Tamburro did a considerable amount of work in collecting data on cancers in Maywood and in performing an analysis on these data. Although it is true that the radioactive materials and some of the chemicals found on and near the MISS are classed as carcinogens, a definite linkage could not be established between these materials and the excess cancer alleged in Mr. Tamburro's cancer cluster study by two separate, independent epidemiologists who were asked to review this study: Dr. F. Davis, Associate Professor, Epidemiology and Biostatistics, School of Public Health, University of Illinois at Chicago; and Dr. K. Mallin, Associate Director, Epidemiology, Illinois Cancer Council, Chicago. Their reviews are reproduced verbatim following Letter A and attachments. As noted by Mr. Tamburro, the New Jersey Department of Health also did an investigation and failed to show that cancer statistics in Maywood, Lodi, and Rochelle Park exceed those of the rest of the state of New Jersey. Nevertheless, even if the evidence indicated a positive correlation, it would not alter DOE's commitment to remediate the Maywood site.

Mr. Tamburro submitted two slightly different versions of his cancer cluster study during the public comment period. Dr. Davis and Dr. Mallin were given the earlier of these two because, at the time, it was not known another version had been submitted. The later document is included here. A word-by-word comparison was made of the two versions, and it was apparent that they differed somewhat in text and arrangement but not in substance. The reviews of Dr. Davis and Dr. Mallin appear to be applicable to either version. In Dr. Davis' review, four of the page references did not coincide and these have been modified to fit the text included here.

Also, upon the recommendation of Dr. Mallin, we have removed the names and house numbers of residents Mr. Tamburro identified in Figures 2-1, 2-2, and 2-3 as having had or died of cancer. This was done to maintain confidentiality.

Response A-18

The DOE does not regulate public exposure to electromagnetic radiation. Moreover, this is not a contaminant connected with the operations of the former Maywood Chemical Company. State or other federal agencies that regulate electromagnetic radiation should be consulted if it is believed that there is a health hazard connected with the substation.

Response A-19

See Response A-17.

Response A-20

A calculation was performed to estimate the radiological dose a person might receive from eating food grown in a garden on West Central Avenue. The calculation was biased high by using the maximum soil levels actually measured in a property on the street and by being generous in estimating the amount of food eaten from the garden. The result was an estimated dose of about 25 mrem/yr. When combined with the maximum external exposure measured on the property, the DOE 100 mrem/yr guideline would be exceeded only if the person stood at the maximum exposure point for 60% of the day (about 14 hours per day) for 365 days per year.

For a response on the chemical aspects of the assertion, see Response A-13.

Response A-21

See Response A-17.

Response A-22

Limitations can be found in both the Tamburro and the New Jersey Department of Health studies. The New Jersey Department of Health had to rely upon cancer registry data that covered a much broader area than that immediately adjacent to the site. Only a few cancer registry data were available at the time. Mr. Tamburro's door-to-door technique was more painstaking and specific, yet he was not able to produce data on 40% of the residents. Debate over study limitations is not necessary, however, because DOE is already convinced that the site represents a problem needing remediation. The Maywood site is a part of DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP). The Superfund remedial action process is already under way.

Response A-23

See Response A-17.

Response A-24

As Response A-1 explains, it does not appear that the DOE 100 mrem/yr guideline could realistically be exceeded on Mr. Tamburro's property.

Response A-25

The interpretation of the numbers in the column labeled millirem per year must include recognition that this is for exposure every hour of the year. Realistically, individuals do not stand in the same spot for one whole year.

The column labeled "Body + med." infers that exposures from natural radioactive materials in the body and from medical exposures are to be added to exposures attributable to Maywood site contaminants before comparing the total to the DOE guideline. This is incorrect. The DOE guideline applies only to exposures attributable to site contaminants.

Response A-26

The statements here that the federal exposure rates are also stated in hours is incorrect. The federal guidelines are based upon annual exposure only.

Response A-27

A soil gas analysis was performed on Mr. Tamburro's property by the New Jersey Department of Environmental Protection, as stated in the letter in Mr. Tamburro's study. Although the inspectors concluded that the results do not represent a health threat, DOE agrees that direct measurements of the groundwater and in-home air are preferable to indirect measurements like soil gas testing. Because chemical contamination of the groundwater is strictly under the jurisdiction of the state of New Jersey and the U.S. Environmental Protection Agency, we are forwarding the expressed concern to these parties.

Response A-28

Just the presence of the listed radioactive materials in the soil, surface water, or groundwater is not sufficient to designate a hazardous situation. The listed materials, although part of the ores used at the Maywood Chemical Works, are also normally present in the environment. The concentrations of the materials must be determined before the presence and degree of any hazard can be assessed.

Response A-29

See Responses A-8 and A-25.

Response A-30

See Responses A-8 and A-25.

Exhibit B

Let's protect our earth

073784

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF ENVIRONMENTAL QUALITY
CN 415
Trenton, N.J. 08625-0415
(609) 987-6402
Fax (609) 987-6390

'90 DEC 20 PM 2:40

Jill Lipoti, Ph.D., Assistant Director
Radiation Protection Programs

December 13, 1990

Lester K. Price, Director
Technical Services Division
U.S. Department of Energy,
Oak Ridge Operations Office
PO Box B, Oakridge Tennessee 37831

Dear Mr. Price:

This is in response to your request for comments on the Notice of Intent (NOI) to prepare a Remedial Investigation/Feasibility Study-Environmental Impact Statement (RI/FS-EIS) for the Maywood Formerly Utilized Sites Remedial Action Program (FUSRAP) materials.

B-1 As you know, we have long sought an expedited response from the Department of Energy (DOE) for the FUSRAP materials in New Jersey. We are pleased that the analysis of options has begun, but at the same time concerned that it has taken so long to begin, and that 2 1/2 years is projected for its completion.

Many of our comments below are directed toward making this document a directed analysis of realistic alternatives and not a dissertation on remote or speculative possibilities, and through that approach expediting its completion.

NEPA-CERCLA DOCUMENTS

B-2 We are glad to see that current DOE management has endorsed the policy of preparing a single document to satisfy both the National Environmental Policy Act (NEPA) & Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements, but are somewhat confused by the last paragraph under "Environmental Review Process". That paragraph appears to infer that NEPA does not apply to remedial actions under CERCLA where DOE is the lead agency. We see no basis for that, but if it is DOE policy, it should be clarified and the reasons for such a position explained.

B-3 The NOI discusses follow-on CERCLA/NEPA documents for the other 3 FUSRAP sites. It is our position that the complete environmental review for Maywood, Wayne, Middlesex, and New Brunswick can, and in fact should, pursuant to federal NEPA regulations; 40 CFR 1508.25, be accomplished in a single document since, as mentioned in the NOI, the contaminants and environmental

073784

B-3 issues are similar for all the sites. This will also avoid delay in implementing a solution for all the sites.

LACK OF SPECIFICITY AND ESTABLISHED REASONABLENESS OF ALTERNATIVES

B-4 The NOI mentions that off-site disposal will be dealt with as an option but only in a generic fashion. The RI/FS EIS should not deal with disposal sites that are speculative or hypothetical. Only realistic site options should be analyzed in depth. A generic discussion will not in our view adequately present the advantages of the specific option of disposal at the Envirocare facility in Utah. Such a specific analysis is necessary to assess the true feasibility of the option; including costs, availability, and timeframes for implementation, as well as the specific environmental impacts at this disposal site. In this regard, we prepared and presented to the DOE on September 14, 1989 a detailed analysis of the feasibility of this option (attachment A). We hope that that information will be used in RI/FS-EIS.

B-5 The NOI mentions treatment as an option element. We are not aware of any available technology that can adequately deal with the volumes in question in a reasonable timeframe. Unless DOE can define reasonable treatment processes, we suggest that treatment be removed from detailed consideration in the RI/FS-EIS.

In general, we hope that alternatives will be more specifically defined in the RI/FS workplan and EIS implementation plan to follow and that we will be afforded the opportunity to comment on these documents.

TIMEFRAMES

B-6 The NOI presents mid-summer 1993 as a target date for completion of the RI/FS-EIS. We believe that two and a half years to prepare this document is excessive and does not demonstrate a DOE commitment to an expedited solution to this long standing issue. Considerable waste characterization and environmental

B-7 impact data for on site activities in New Jersey is already available and disposal site impacts for similar materials have already been amply addressed in the final EIS on Remedial Action At The Former Vitro Chemical Company Site South Salt Lake, Salt Lake County Utah, July 1984. The disposal of FUSRAP materials at the Clive site would only represent a modest addition (approx. 500,000 cubic yards) compared to the 2,500,000 cubic yards addressed in that document, and an environmental impact analysis simply should not take long to do. In this regard, an analysis of those incremental effects is attached for your use (Attachment B).

I hope you will find these comments constructive. If you have any questions please call myself 609-987-2101 or Ed Kaup in the Division of Hazardous Waste Management 609-633-1455.

Sincerely,

Bob Stern

Bob Stern, Chief
Bureau of Environmental Radiation

Attachments
c: Assistant Director Lipoti
Ed Kaup, Division of Hazardous Waste Management

ATTACHMENT A

073784

BRIEFING TO THE

U.S. DEPARTMENT OF ENERGY

ON THE

ENVIROCARE OF UTAH FACILITY

FOR DISPOSAL OF WASTES

FROM THE

FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

SITES IN NEW JERSEY

SEPTEMBER 14, 1989

PREPARED BY THE

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

(UPDATED DECEMBER 19, 1989)

073784

NEW JERSEY FUSRAP ACTIVITIES

STATUS (9/14/89)

- Substantial volumes of thorium and/or radium contaminated wastes from prior defense activities currently stored in Wayne, Maywood, and Middlesex, N.J.
- Residential remediation efforts halted/impeded.
- RI/FS process commencing to analyze disposal options.
- Present U.S. Department of Energy (DOE) schedules call for Records of Decisions on the Maywood and Wayne FUSRAP sites in 1992 and 1993.
- Explore alternate expeditated removal option to available out-of-state site.
- Outlook for in-state site: protracted analytic/siting exercise with outcome undertain, at best.
- DOE's Five Year Plan and Site-Specific Plans for FUSRAP were reviewed by DEP and comments sent to DOE.
- Governor has written to the Secretary of Energy urging the DOE to give the DEP proposal careful consideration.

073784

ENVIROCARE OF UTAH DISPOSAL SITE IN CLIVE, UTAH

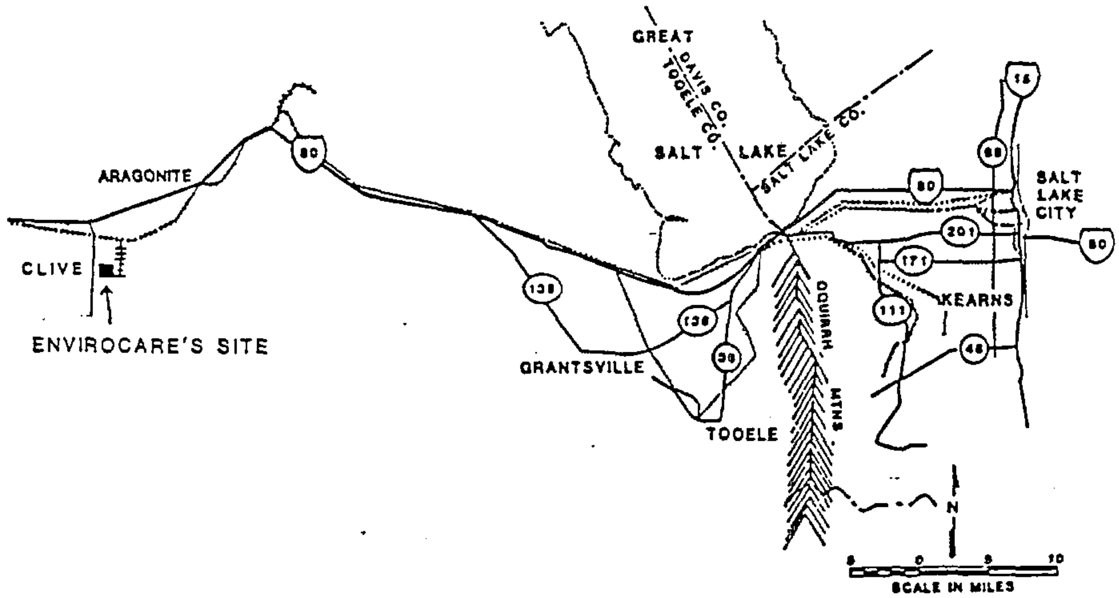
Owned and operated by: Envirocare of Utah.

Licensed as: A Naturally Occurring Radioactive Materials (NORM) disposal facility by the State of Utah's Bureau of Radiation Control since February 1988.

Approved cell design capacity: 3-million cubic yards.

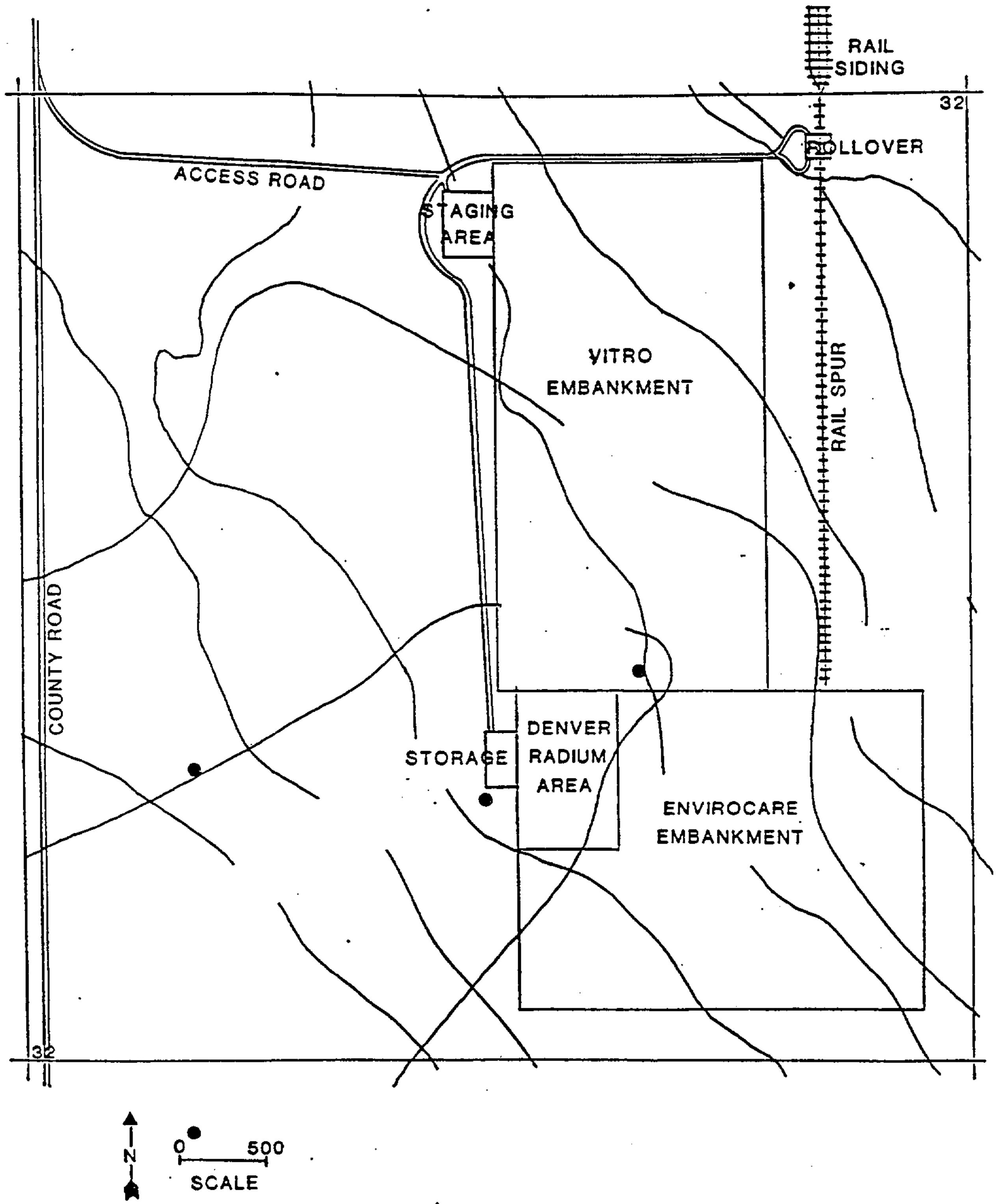
Waste already received: NORM waste from private and public sectors.

073784

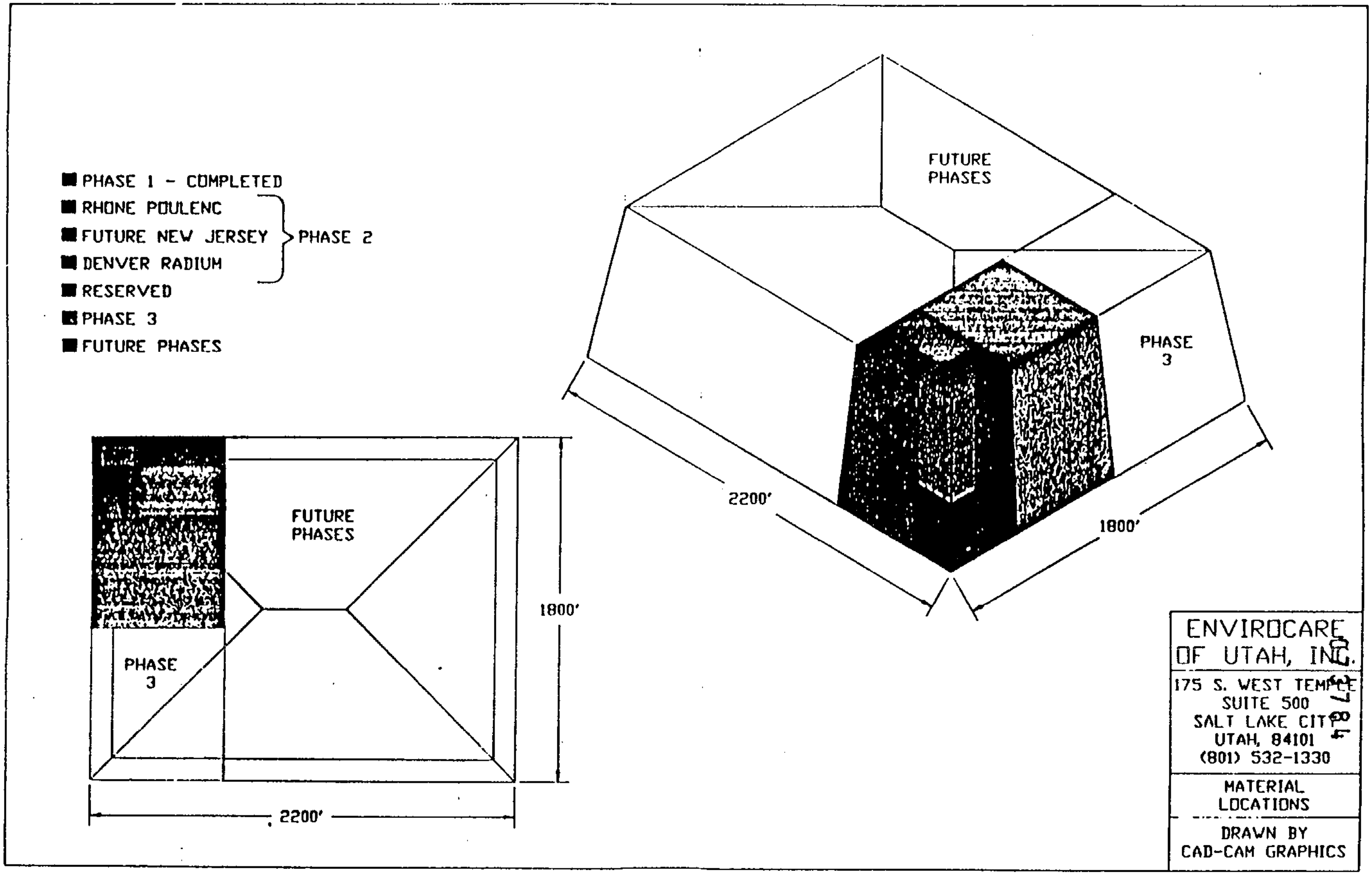


ENVIROCARE'S SITE LOCATION

073784



ENVIROCARE OF UTAH, INC

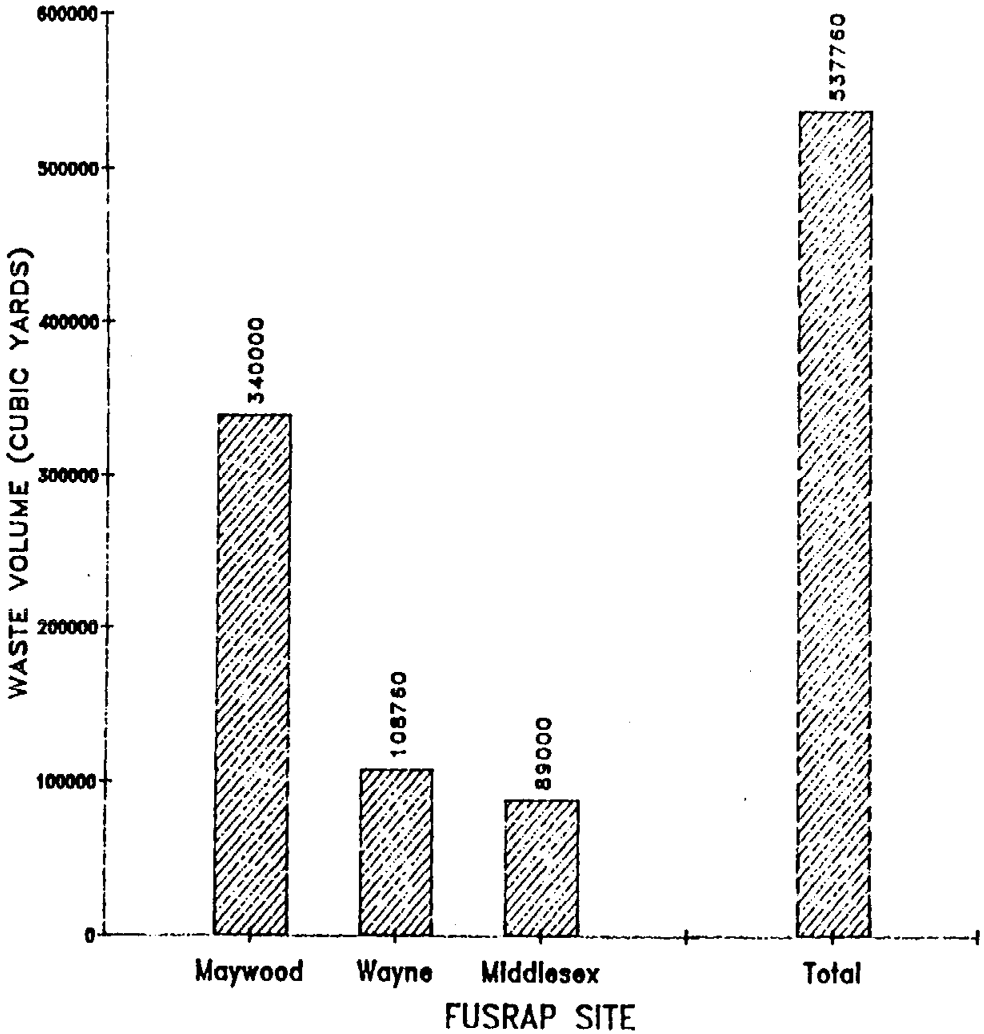

PHASE 1 - COMPLETED
RHONE POULENC
FUTURE NEW JERSEY
DENVER RADIUM
PHASE 2
RESERVED
PHASE 3
FUTURE PHASES
FUTURE PHASES
PHASE 3
2200'
1800'
FUTURE PHASES
PHASE 3
1800'
2200'
ENVIROCARE OF UTAH, INC.
175 S. WEST TEMPLE
SUITE 500
SALT LAKE CITY
UTAH, 84101
(801) 532-1330
MATERIAL LOCATIONS
DRAWN BY
CAD-CAM GRAPHICS

073784

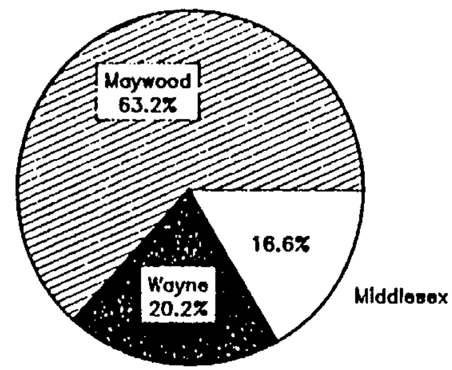
ENVIROCARE LICENSE CONDITIONS APPLICABLE TO NJ FUSRAP WASTE

Present Lic. Condition	Anticipated Lic. Change	NJ FUSRAP
Covers NORM material.	None	54% of the NJ FUSRAP volume is NORM material.
Source, byproduct, or special nuclear materials are not included in the current license.	NRC not the regulator: State of Utah can amend Envirocare's license to cover these materials.	46% of FUSRAP material technically is source material.
RCRA wastes are not currently included in the license.	Envirocare has applied for a permit to dispose of certain mixed waste.	Waste is in process of being characterized. Unlikely to find land banned waste.
Maximum Ra-226 concentration is 2000 pCi/g per shipment.	None	Maximum Ra-226 concentration is 280 pCi/g.
Waste stockpiling prior to disposal cannot exceed 300,000 cubic yards.	None	NJ FUSRAP project will be shipped in phases.

ESTIMATED WASTE VOLUMES
AT NEW JERSEY FUSRAP SITES



NJ FUSRAP WASTE
DISTRIBUTION



073784

073784

ESTIMATED TIME FRAME
FOR DISPOSAL AT THE ENVIROCARE OF UTAH SITE IS 10 YEARS

ACTIVITY	DURATION
DECISION PROCESS	2 YEARS
Remedial Investigation/Feasibility Studies (1 year)	
Interim Records of Decision based on focussed feasibility studies (0.5 year)	
NEPA Assessment (EIS already done for Clive site; if needed, supplemental analysis can be done prior to the Records of Decision).	
Disposal/Transportation Contract Negotiations (0.5 year)	
DISPOSAL	8 YEARS[1]
Transportation	
Disposal	

EXPLANATION

1 = BASED ON NJDEP ESTIMATED SCHEDULE FOR SOIL REMOVAL

073784

PROPOSED REMOVAL SCHEDULE FOR ENVIROCARE OF UTAH OPTION

SOIL REMOVAL YEAR ONE

Transport the Maywood Interim Storage Pile (34,871 yd^3).

Begin excavation of Lodi (14,000 yd^3). Transport to Envirocare of Utah facility as soon as it is excavated.

SOIL REMOVAL YEAR TWO

Transport the Wayne Interim Storage Pile (38,460 yd^3).

Continue excavation of Lodi (20,000 yd^3), Scanel (8,000 yd^3) and remaining Ballod (6,000 yd^3) properties. Transport to Envirocare of Utah facility as soon as it is excavated.

SOIL REMOVAL YEAR THREE

Transport the Middlesex Interim Storage Pile (66,000 yd^3).

Complete the excavation of the Lodi (20,000 yd^3). Transport to Envirocare of Utah facility as soon as it is excavated.

SOIL REMOVAL YEAR FOUR

Excavate the Wayne (former W.R. Grace) property (70,000 yd^3). Transport to Envirocare of Utah facility as soon as it is excavated.

Excavate the Pequannock railroad siding (300 yd^3). Transport to Envirocare of Utah facility as soon as it is excavated.

Begin excavation of the Sears and associated properties (20,000 yd^3). Transport to Envirocare of Utah facility as soon as it is excavated.

SOIL REMOVAL YEAR FIVE

Excavate the Middlesex Sampling Plant property (23,000 yd^3). Transport to the Envirocare of Utah facility as soon as it is excavated.

Continue excavating the remaining Sears and associated properties (40,000 yd^3). Transport to Envirocare of Utah facility as soon as it is excavated.

SOIL REMOVAL YEAR SIX

Begin excavation of the Maywood/Rochelle Park (former interim storage site) property (37,129 yd^3). Transport to Envirocare of Utah facility as soon as it is excavated.

Excavate the remaining Sears and associated properties (24,000 yd^3). Transport to Envirocare of Utah facility as soon as it is excavated.

SOIL REMOVAL YEAR SEVEN

Excavate the remaining Maywood/Rochelle Park (former interim storage) property (50,000 yd^3). Transport to Envirocare of Utah as soon as it is excavated.

SOIL REMOVAL YEAR EIGHT

Excavate the Stepan property (40,000 yd^3). Transport to Envirocare of Utah as soon as it is excavated.

Excavate underneath Route 17 (20,000 yd^3). Transport to Envirocare of Utah as soon as it is excavated.

Excavate underneath Maywood and Lodi railroad siding (6,000 yd^3). Transport to Envirocare of Utah as soon as it is excavated.

Excavate underneath Black Oak Ridge Road and Pequannock Road in Wayne (??? yd^3). Transport to Envirocare of Utah as soon as it is excavated.

073784

ESTIMATED TIME FRAME FOR IN-STATE DISPOSAL SITE IS 25 YEARS

ACTIVITY	DURATION
SITE SELECTION, ASSUMING VOLUMES OF MIXED WASTE ARE MINOR Siting Process (5 years) criteria development site screening field characterization work analysis NEPA (2 years) Final Design and Construction (2 years)	9 YEARS[1]
DISPOSAL OPERATIONS	10 YEARS[2]
DISPOSAL SITE CLOSURE	2 YEARS
DISPOSAL SITE OBSERVATION	4 YEARS
DISPOSAL SITE MONITORING	200+ YEARS[3]

EXPLANATION

1 = SCHEDULE PROVIDED BY DOE AT MEETING WITH NJDEP IN JUNE 1987.

2 = BASED ON DOE/OR/20722-79, ENGINEERING EVALUATION OF DISPOSAL ALTERNATIVES FOR RADIOACTIVE WASTE FROM REMEDIAL ACTIONS IN AND AROUND MAYWOOD, NEW JERSEY.

3 = BASED ON 40 CFR 192 REQUIREMENTS.

073784

ESTIMATED COST FOR IN-STATE DISPOSAL SITE
(for 550,000 cubic yards)

Site Selection[1]:	$ 10 million
CERCLA/SARA/NEPA[2]:	10 million
Site Acquisition/Preparation[3]:	21 million
Community Compensation[4]:	20 million
Waste Loading Operations[5]:	10 million
Transportation[6]:	26 million
Disposal[7,8]:	58 million
Closure[9]:	5 million
Institutional Control/ Environmental Monitoring[10]:	50 million
PRESENT VALUE COST (0-25+ years)	**$ 210 million**
TIME VALUE COST (0-25 years), assumes cost escalation rate of 6% per year	$ 386 million

EXPLANATIONS; NOT INCLUDED ARE COSTS FOR EXCAVATION, REMEDIAL ACTION MONITORING AND DESIGN, AND RESTORATION OF REMAINING OFF-SITE PROPERTIES AND THE INTERIM STORAGE SITES THEMSELVES. THESE COSTS WILL BE THE SAME REGARDLESS OF THE DISPOSAL SITE CHOSEN.

1 = UNIT COST OF $2-MILLION PER YEAR FOR CRITERIA AND SITING PROCESS DEVELOPMENT, AND IMPLEMENTATION OF SITE SELECTION PROCESS.

2 = COST FOR PREPARING RI/FSS AND RODS FOR MAYWOOD, MIDDLESEX AND WAYNE, AS WELL AS, A NEPA DOCUMENT FOR THE DISPOSAL SITE.

3 = COST BASED ON LLW ECONOMICS MODEL FOR SLB. COSTS COVER ADMINISTRATION, BASELINE MONITORING, CONSTRUCTION, CONSTRUCTION EQUIPMENT, CONSTRUCTION MANAGEMENT, CONTINGENCIES, ENGINEERING AND DESIGN, GENERAL SUPPLIES, LEGAL FEES, PERMITS, SITE CHARACTERIZATION AND SITE ACQUISITION.

4 = COST FOR HOST COMMUNITY BENEFITS OF $2-MILLION PER YEAR DURING THE TEN YEARS OF DISPOSAL OPERATIONS.

5 = UNIT COST OF $1-MILLION PER YEAR FOR LOADING AND PACKAGING OF SOIL FOR SHIPMENT TO IN-STATE DISPOSAL SITE.

6 = COST FOR TRANSPORTING SOIL TO A SITE 100 MILES FROM THE INTERIM STORAGE SITES. BASED ON TRUCK TRANSPORTATION COST CONTAINED IN DOE/OR/20733-79, TABLE 4-1, ENGINEERING EVALUATION OF DISPOSAL ALTERNATIVES FROM RADIOACTIVE WASTE FROM REMEDIAL ACTIONS IN AND AROUND MAYWOOD, NEW JERSEY.

7 = COST IS BASED ON DISPOSAL COST CONTAINED IN DOE/OR/20722-79, TABLE 4-1.

8 = FOR COMPARISON AND AS AN UPPER BOUND ON THE COST, IT COSTS THE DOE $10 PER CUBIC FOOT TO DISPOSE FEDERAL LLW AT THE NEVADA TEST SITE OR $148-MILLION FOR 550,000 CUBIC YARDS.

9 = COST BASED ON LLW ECONOMICS MODEL FOR SLB.

10 = BASED ON SETTING ASIDE SUFFICIENT FUNDS (AT A REAL RATE OF RETURN OF 4% PER YEAR) TO GENERATE $2-MILLION ANNUALLY FOR PERPETUAL INSTITUTIONAL CARE (MONITORING, MAINTENANCE AND PAYMENTS IN LIEU OF TAXES) FOR AN IN-STATE DISPOSAL SITE.

073784

COMPARISON OF ENVIROCARE OF UTAH AND IN-STATE SITES

	ENVIROCARE OF UTAH	IN-STATE
Site availability	high	low
Transportation accidents	4.6[a]	7.4[b]
Time to complete project	10 years	25 years
Cost in present value dollars	$ 206-million	$ 210-million
Cost in time value dollars[c]	$ 280-million	$ 386-million
Public acceptance	high-medium	low

EXPLANATIONS

A = TRANSPORTATION BY RAIL. ACCIDENT RATE IS 1.5×10^{-6} PER RAIL CAR AFFECTED PER TRIP MILE (BASED ON NUREG-0170, FES ON THE TRANSPORTATION OF RADIOACTIVE MATERIALS BY AIR AND OTHER MODES). TRIP MILAGE IS 2200 MILES EACH WAY AND 140 TRAIN TRIPS ARE NEEDED FOR 550,000 CUBIC YARDS.

B = TRANSPORTATION BY TRUCK. ACCIDENT RATE IS 1.8×10^{-6} PER TRUCK PER TRIP MILE (BASED ON NUREG-0170). TRIP MILEAGE IS 100 EACH WAY AND 41,400 TRUCK TRIPS ARE NEEDED FOR 550,000 CUBIC YARDS (BASED ON DOE/OR/20733-79, ENGINEERING EVALUATION OF DISPOSAL ALTERNATIVES FROM RADIOACTIVE WASTE FROM REMEDIAL ACTIONS IN AND AROUND MAYWOOD, NEW JERSEY.

C = TAKES INTO ACCOUNT COST ESCALATION AT A RATE OF 6% PER YEAR.

073784

ITEMS REQUIRING RESOLUTION

FOR DISPOSAL AT ENVIROCARE OF UTAH

Agreement with EPA on CERCLA procedures for an expedited removal process - Focused Feasibility Study

Determination of any mixed FUSRAP waste under Utah's requirements and the adequacy of Envirocare's amendment to its Utah license to include certain mixed wastes.

Amendment to Envirocare's license may be needed for the 46% source material. Authority is expected to be granted by Utah early in 1990.

Determination of the level of NEPA review required. There is an existing Environmental Impact Statement for the Envirocare site.

FOR DISPOSAL IN-STATE

Determination of the likelihood of ultimate success in establishing a disposal site in New Jersey.

Determination of the impact of mixed wastes on the siting and design of a disposal facility.

NEXT STEPS

Seek support of affected communities.

Secure DOE agreement on the expedited removal approach.

Meet with EPA on the expedited removal process.

NJDEP will provide technical support for pursuing the use of the Envirocare disposal site.

073784

Proposal for Remediation of New Jersey FUSRAP Sites

New Jersey Department of Environmental Protection (Department) is proposing Focussed Feasibility Studies (FFS) for the Several New Jersey FUSRAP sites that will lead to interim remediations, specifically removals, in advance of the complete CERCLA feasibility studies.

FFS's are proposed because:

- Specific FUSRAP operable units have been identified and secured;
- Significant amounts of investigatory data are currently available on the operable units (ou) which will allow alternative screening and remediation planning, while further necessary investigations are undertaken;
- a remediation that will fulfill Record of Decision (ROD) requirements is obvious (soils removal);
- An apparently uniquely-qualified waste receptor has been identified; and
- Early commencement of the remediations will save money on the overall project.

The NJDEP (Department) believes that a FFS with an RI focussed on soils removal can be completed through the Record of Decision process in less than a year and that removal arrangements for the wastes at the focussed site could begin at that time.

A time-requirement-breakdown of CERCLA tasks is shown on the FFS schedule below. The two schedules are (1) for a combination of the Maywood (Sears and vicinity properties) RI work plan and the actual time for the Picatinny Arsenal ROD, and (2) for the MISS site. The improved FUSRAP schedule is attributed to experience attained in processing the PTA ROD and to advanced knowledge of the sites and the remediation.

The example of a Focussed Feasibility Study at federal facility case is the Picatinny Arsenal (PTA) Interim GW Plume Remediation and it has been applied to the remediation of the Maywood Interim Storage Site.

PTA has been working with the USGS and has identified the existence of a contaminated GW plume. Although the plume has been identified its full scope is not known and will be further investigated independent of this interim remediation which was undertaken to prevent the migration of the plume to a surface water receptor.

As with the Maywood ISS full investigation of the contamination problem(s) was not completed when interim removal action was deemed to be appropriated. It was felt, however, there was sufficient justification to

073784

proceed with a interim remediation because the movement of the plume threatened Green Pond Brook and the action would certainly be included in the final remediation. Carrying out a portion of the remediation early would be in the best interests of human health and of the environment and consistent with federal laws.

Focussed Feasibility Study

	Maywood/PTA	FUSRAP
Subcontractor Arrangements (Preparations and mobilization)	12 wks	12 wks
Soil Investigation (borings and analytical work)	21	21
Basic Risk Assessment	6	6
Focussed Feasibility Study Propn.	16	12
ROD Schedule (Attached) (PTA Interim Removal Action)	24	16
	69 wks	47 wks

Next Step - Design of removal action and removal work

073784

Attachment B

Analysis of Incremental Environmental Impacts of Disposal of NJ FUSRAP Waste at the Clive Site

Environmental impacts on the South Clive region resulting from the disposal of Vitro wastes at the South Clive (Envirocare) site, as extracted from information contained in the Environmental Impact Statement for remedial actions at the former Vitro Chemical Co. site in Salt Lake City , were not significant. Incremental effects of disposal of NJ FUSRAP wastes at the Clive site, as discussed below, would not be significant.

Comparison of NJ FUSRAP and Vitro Wastes

Additional impacts of disposal of NJ FUSRAP wastes at the Clive site, can in part, be qualitatively assessed by comparing the NJ FUSRAP and Vitro waste characteristics. As shown in the table below, the NJ FUSRAP waste volume is only 20 percent of the Vitro waste volume. The concentration of uranium-238 series radionuclides (thorium-230 and radium-226) is 23 times higher in the Vitro waste than the FUSRAP waste indicating that exposure to radon-222 and associated lung cancer risks from the FUSRAP waste will be negligible in comparison. Radon-220 from the thorium-232 decay chain is not likely to result in substantial lung doses due to its much shorter half life (lower transport) and the lower estimated dose conversion factor for its decay products.

Gamma exposure rates from the combined contribution of thorium-232 and the radium-226 in the FUSRAP waste would be expected to be 70 percent lower than gamma exposure rates from the Vitro wastes.

Comparison of NJ FUSRAP and Vitro Wastes

Parameter	Vitro waste	NJ FUSRAP waste
Volume (cu yds)	2,500,000	540,000
Average Radionuclide Concentration* (pCi/g)		
U-238	40	30
Th-230	560	27
Ra-226	560	27
Th-232	-	147

* Radionuclide concentrations are volume-weighted averages for Middlesex, Wayne and Haywood wastes.

Radiological Impacts on the Clive Population

Short and long term radiological impacts on the Clive population were considered in the EIS for disposal of Vitro waste at the Clive site. No projections were made because the natural characteristics of the Clive site together with its sparse population and low potential for development prevent population exposure during waste disposal activities and provide for long term isolation of wastes. The South Clive area is arid desert with poor quality ground water and soils. Depth to the water table at the site is about 20 feet. The nearest well is 3 miles from the site. An analysis of ground water transport rates indicated that in 1,000 years ground water would travel only 600 feet from the site. Precipitation averages 5 inches per year, indicating the potential for infiltration of rain water into the disposal units and leaching of wastes to be low. Exposures from the ground water pathway are thus highly unlikely. The nearest person is 15 miles from the site and potential for future development is low.

The low radionuclide content of the FUSRAP wastes the facility and large distance to the nearest residents provide for adequate protection. No significant incremental effects of NJ FUSRAP waste disposal at the site are likely.

Radiological Impacts to the Workforce

Radiological impacts to the workforce during the site preparation and Vitro waste emplacement activities at the Clive site are also not substantial; 0.006 excess lung cancer deaths from radon decay product inhalation and 0.013 cancer deaths from gamma exposure were estimated. Lung cancer deaths from inhalation of radon-222 decay products would be largely absent since, as discussed above, the estimated radium concentration in the FUSRAP waste is much lower than in the Vitro waste. Gamma exposures from the combined thorium-232 and radium-226 components of the NJ FUSRAP waste would also be substantially lower than from the Vitro wastes.

Non-Radiological Impacts of Occupational Accidents

Occupational accidents among remedial action workers were estimated in the EIS for activities at Clive and in Salt Lake City at the Vitro site. A conservative estimate for accidental deaths at only the Clive site, which includes the transportation accidents along the route from the Vitro site to the Clive site, is 0.07.

Although the rail distance from the Vitro site to the Clive disposal site is only 85 miles as compared to a distance of 2300 miles from the NJ FUSRAP sites to the Clive site, the additional accidental deaths resulting from the longer travel distance would be offset by the lower volume to be moved and the fewer construction activities needed for disposal at the established Envirocare facility as compared to initial site development which was required for disposal of the Vitro waste.

073784

Energy use

Energy use including electricity and engine fuel would be more for transportation of FUSRAP waste over a longer distance but would be offset by fewer construction activities as discussed above.

Other Impacts

No other major incremental impacts are evident.

Response B-1

The DOE would also like a shorter schedule but feels bound to adhere to the requirements of the Superfund process. Once the schedule negotiated with EPA under the Federal Facility Agreement is finalized, DOE will comply with it.

Response B-2

The statement referred to reads as follows: "Nothing in this NOI or in other documents to be prepared is intended to represent a statement on the legal applicability of NEPA to remedial actions under CERCLA." This statement regarding application of one law — the National Environmental Policy Act (NEPA) — to removal actions governed by another law — the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) — merely reflects DOE's position that its compliance with NEPA in these remedial actions should not be interpreted as an admission by DOE that it is legally compelled do so. In any case, as the notice of intent (NOI) indicates, DOE intends to fully comply with NEPA.

Response B-3

As stated on page 5, paragraphs 2 and 3, of the work plan-implemenation plan, DOE is intending to use the remedial investigation/feasibility study–environmental impact statement (RI/FS-EIS) for the Maywood site as the lead document for NEPA compliance. Common issues for Maywood, Wayne, and Middlesex will be addressed therein, as will site specific issues for Maywood. Separate documents will be prepared for Wayne and Middlesex but only to the extent necessary to handle site-specific issues. Issues common to these three sites will not be duplicated but will be referenced back to the lead document. The New Brunswick site will also be included in this procedure.

Response B-4

The response to this concern was covered in Section 3.4.3 of the work plan-implementation plan. A commitment was made within the RI/FS-EIS to first identify existing facilities that meet the criteria for effective disposal of the Maywood site wastes. These sites would be screened and a preferred site identified. If existing sites were unsuitable, it is also possible that a new site would have to be created. If so, a separate EIS for site assessment and selection would be prepared. Flexibility within this commitment may be restrained because DOE policy, as provided in DOE Order 5820.2A (DOE 1988), states that "DOE low-level waste shall be disposed of on the site at which it is generated, if practical, or if on-site disposal capability is not available, at another DOE disposal facility."

Response B-5

This option was included for thoroughness. All options will be screened in the feasibility study and those that are infeasible will be eliminated before the most promising ones are evaluated in depth. The New Jersey Department of Environmental Protection will certainly be accorded an opportunity to comment upon the RI/FS-EIS documents. Such comments will be appreciated.

Response B-6

See Response B-1.

Response B-7

As discussed above, DOE will, to the extent possible, consider all feasible disposal options within the limitations of existing DOE policy. One of these limitations may be the ability of the Clive, Utah, Envirocare site to accept, under its current license, by-product material that fits the definition in Section 11e(2) of the amended Atomic Energy Act. The U.S. Nuclear Regulatory Commission (NRC) issued a notice in the *Federal Register* on January 25, 1991, that they had received a request from Envirocare of Utah, Inc., to allow them to accept 11e(2) by-product material and that the NRC would accept petitions for a hearing on the issue. Until a decision is delivered on the request, it appears the Utah site, within the limits of its license, is unable to accept material of the type involved at the Maywood site.

Exhibit C

073699

International Association of Machinists and Aerospace Workers

1990 DEC 14 PH 4: 26

Lodge 1018

LA GUARDIA AIRPORT — FLUSHING, NEW YORK

475 Bergen Avenue
Maywood, NJ 07607
December 09, 1990

Mr. Lester K. Price, Director
Technical Services Division
U.S. Department of Energy
Oak Ridge Operations
Post Office Box 2001
Oak Ridge, Tennessee 37831-8723

Dear Mr. Price:

Having been out of the country and unable to attend your December 6, 1990 meeting in Hackensack, NJ instead of Maywood, please be informed that we would have been outside carrying signs. There was no need for another meeting with DOE representatives. They have all the documentation they need to know from us and which they continue to ignore. They set a meeting for September, then October or November, and finally set a date for a month after the election, so that it doesn't appear that it's immediately after the election. We do not trust the DOE. We will not allow them to dictate to our residents to accommodate Lodi or any other town's contamination. There is not one individual in our continuing survey that wants a fraction of an ounce brought to the MISS. If the DOE would inform the public of only accurate and true facts, we guarantee the public would be out in full force. But we reiterate: The DOE representatives have not kept the public fully informed of said true facts as it concerns health risks posed. We have every document to prove it.

Further, the DOE has not practiced what they preached. See "Response to Public Comments" brochure (DOE - June 1990) regarding improving their credibility. In fact, we believe it is even worse.

At our IAM-AFL/CIO Legislative Conferences in Washington each year, we have fought long and hard for passage of the Right-to-Know Law that protects workers and the public who live near hazardous waste industries and sites. That Law should not protect the industries.

Our attempts to see Admiral Watkins by phone and in writing - when we made a personal visit in August of 1989 - resulted in a clerk picking up our documents in the lobby. Every effort we made to just have a short talk with him was denied us. When the Admiral was newly appointed, our Union Representatives met with him and gave him a high rating. We therefore are suspicious and skeptical that the literature we presented never got to him personally.

C-1 We therefore request that you contact Admiral Watkins to call for a full investigation before the highest Ethics Committee for all his personnel involved in this crucial issue since we believe it is time for this case to go also to the Attorney General to investigate.

12/09/90
L. Price

C-2 Enclosed are just some of the communications and newsarticles for your information. We request that this letter to you and all documents enclosed herein be published in your public comments brochure with your reply to us.

Pages 175,176,177,178,179,181,182 and 183 from USDOE Public Comments (June 1990)
Stop Cooperating with the D.O.E. - 2 sides - literature distributed by Concerned Citizens
Excerpts from Health Assessment for Maywood (1988) Re: Ingestion of chemicals
and groundwater chemical contamination at MISS, etc.
8/28/87 ltr Ahrends (DOE) to Panos - concerns of groundwater at MISS and elevated levels
12/20/86 Shopper News article Planners say 'NO' to Feds
11/04/90 - public comment to R.J. Wing (EPA) re: chemicals, health problems w/attachments. /R. Bahto
12/27/89 - Shopper News article Towns, DEP, unite on "Utah Plan' re: 12/19/90 meeting.
2/01/89 - Record newsarticle -$109,000 to chemical worker's widow
7/05/89 - Shopper News article Maywood says 'no' to Lodi
6/07/90 - Borough communication Richards to Torricelli - urging legislators to
move Maywood's contamination to Utah as was done with Montclair.
Shopper News article DOE letter criticized re; Watkins to Kean
10/17/90 - Newsarticle -Borough residents demand thorium action
11/14/90 - Shopper News article Attorney urges aditional study

The above should give you some idea of only some information you might review. There is much, much more.

Again, we request that each document is placed in your public comments brochure. Also please send us a communication regarding the investigation we request.

Sincerely,

Peter T. Torell, Treas.-IAM-AFL/CIO

Louise Torell, Secretary
Concerned Citizens

Encs: As stated above

cc: Adm. J. Watkins
US Attorney General
Concerned Citizens

073699 2 sides

Though some longtime residents of Maywood believe Maywood Chemical was involved in the project that developed the first atomic bomb, the commission says no firms in Bergen County are part of the extensive program to clean up sites used in the Manhattan Project. The cleanup, labeled FUSRAP — Formerly Utilized Sites Remedial Action Program — does include sites in Middlesex County, New Brunswick, Princeton, Bloomfield, and West Orange.

STOP "COOPERATING" WITH THE D.O.E.

DOE intention regarding amounts to be stored, violate also the NJDEP's Permit which called for 180,000 cu. yds. including waste buried before DOE involvement. Maywood, of course, should oppose any additional amounts - NOT ANOTHER OUNCE!

Lodi's 50,000 cu. yds. is more than the Wayne Site storage - - Lodi is entitled to their own interim storage site.

Mayor and Council should notify all vicinity property owners that they are in violation for having contaminated wastes on their property which should be cleaned up promptly as with the VOIT Corp.

Similarly, DOE has violated NJDEP's Storage Permit which does not authorize chemical and heavy metals. State could be asked to rescind permit.

Opinion chose to quote the Congressional Record to prove Congress authorized clean up of vicinity properties, but omitted that the funds were added to initiate the work for Site and vicinity properties IN Wayne/ Pequannock, IN Maywood, NEAR Albany and AT Latty Ave., Hazelwood, Missouri (Cotter Corp).

Clearly, the Judge called for improvement of the environmental conditions of the locality and this must be carried out in a way that protects local interests. Also that DOE proceed in a speedy fashion, and our our elected officials should be solicited without delay.

* ARE MAYWOOD'S HAZARDOUS WASTES A THREAT TO YOUR FAMILY'S HEALTH??? *

U73699

YOU BE THE JUDGE!!!

READ THE FOLLOWING EXCERPTS FROM 1988 REPORT!

Health Assessment for

FINAL DRAFT HEALTH ASSESSMENT
MAYWOOD CHEMICAL COMPANY SITES
BERGEN COUNTY
MAYWOOD, NEW JERSEY
October 14, 1988
(Revised December 14, 1988)

Prepared by:
Division of Science and Research
New Jersey Department of Environmental Protection (NJDEP)

Prepared For:
Agency for Toxic Substances and Disease Registry (ATSDR)

COMMUNITY CONCERNS This site is generally considered by concerned citizens to be an ongoing and active threat to the public health and safety.

At a recent meeting (July 1987), that was conducted by NJDOH, the following issues of concern were identified:

* Residents called for the termination of additional storage at the MISS to prevent further contamination of the site. Residents perceive the site as a continuous and growing hazard.
* The identification of areas within the Stepan property which were utilized for final disposal of hazardous wastes.
* The identification of areas outside the Stepan Chemicals property which were utilized for the disposal of process wastes.
* Determination of the nature and extent of eight known buried waste deposits associated with the site.
* The identification and remediation of buried drummed wastes cited by members of the community.

CONCLUSIONS AND RECOMMENDATIONS It is essential that remedial and characterization projects currently underway incorporate off-site evaluation and assessments of the potential effects these contaminated sites have on the surrounding population.

Based on the information in this assessment, it appears that an undetermined portion of the local community may have been exposed to chemicals from the Maywood sites. When additional exposure information, as described above, is provided, a decision will be made as to whether a feasibility health study is warranted.

Distributed as public service by Concerned Citiz

073699

EVALUATION AND DISCUSSION

Human exposure to these contaminants may occur from a variety of routes. Exposure via ingestion is possible through contaminated drinking water supplies. Dermal contact may occur with soils and surface/pool/bathing waters. Inhalation of radiologically contaminated dust particles, volatilized chemicals during showering, and volatilized gases released from contaminated groundwater are all possible exposure routes. These potential exposure routes for the nearby populations have not been appropriately investigated and represent a significant gap in the assessment work for the Maywood sites.

The Stepan Co. site has not been fully investigated for potential radiologic and chemical contamination even though this area was the original location of the pollution source. It is unclear why characterization efforts have been so delayed for this site, especially since there is a significant working population on-site. The preliminary survey results from the EPA and the DOE on contamination in this area should be included in the Health Assessment as soon as it is available.

For the MISS, monitoring wells around the site indicate that extensive chemical and heavy metal contamination of the groundwater is occurring in that area. Methylene chloride, benzene, trans-1,2-dichloroethylene, and zinc were detected at the highest levels, all of which exceeded NJ drinking water standards. It is uncertain as to how far this contaminant plume has migrated into the aquifer and how the drinking water supply of local communities may have been affected. The environmental data available for both the Sears and the MISS sites focuses only on on-site conditions; off-site contamination information is essentially nonexistent.

Even though the Maywood Superfund site consists of numerous properties around the town, there is no overall summary, report, or characterization of the environmental effect this site has had on the nearby and surrounding communities via air, groundwater, or surface water contamination.

Maywood Municipal Pool

Because of the concern about contaminated groundwater supplies in Maywood, the NJDEP received a request from the Maywood Board of Health in 1986 to test the Maywood Municipal Pool during its annual multi-day filling process. While no radiologic contamination was found in the water being piped into the pool, three volatile organic compounds were detected: tetrachloroethene (42 ppb); trans-1,2-dichloroethene (3.7 ppb); and trichloroethene (3.9 ppb).

475 Bergen Avenue
Maywood, NJ 07607
November 27, 1989

CRR 435-121-391

Mr. R.P. Whitfield
Office of Defense Waste and
Transportation Management
DP-112 Attn: Five Year Plan
Department of Energy
Washington, D.C. 20545

Dear Mr. Whitfield:

#1 Your "Five Year Plan" (5 x 5) is almost as bad as your statement that "If DOE is to maintain credibility with the communities, cleanup must continue. "DOE HAS NO CREDIBILITY IN MAYWOOD.

#2 All we have seen is arrogance, lies, unethical collusion with certain local officials including deceiving the public, soliciting Maywood Borough Attorney for his suggestions prior to submitting draft proposal to Maywood officials and refusing even under the Freedom of Information Act to furnish their attorney solicitation letter alleging it to be interagency.

Lies: (A) R. Atkin (DOE) Executive Work Session- Maywood Mayor/Council, March, 1988 DID HE NOT STATE:

1. Did not know vicinity properties contained chemicals. (Despite Ebasco 1987 Report?)

2. Did not know Volt Co., a vicinity property had allegedly been cleaned up via ECRA (NJ).

3. Did not know NJPDES Permit NJ 0054300 limited storage on MISS to 180,000 cu. yds. including contaminated soil present at site prior to USDOE involvement. (And there goes your 5 year plan). There is 130,000 cu. yds. stored now.

4. More than once, publicly, including the Rochelle Park Planning Board that Congress had mandated DOE ownership of the MISS which Maywood vehemently opposed. (But James W. Vaughan, Acting Asst. Secretary, DOE, June 12, 1986, exposed that lie when he wrote Senator Bradley advising there has been no Congressional direction concerning the acquisition of a portion of the Stepan Co. for use as MISS. Even former Mayor Panos said DOE should agree to a fixed lease).

(B) Peter Gross, DOE, 2/19/88 to N.J. Nolan/Peter Torell
He said, "We did not find chemical contamination at the Ballod property".

1. Joyce Feldman, EPA, (6/12/86) to Mr. R. Atkin, DOE, "DOE is authorized to analyze soils at DOE sites for radiological characteristics only...No authority exists for DOE to certify chemical decontamination of a property, according to our discussions". Where are Gross's test results???

2. Joyce Feldman, EPA, 5/5/87 to N.J. Nolan

"Mr. Trela addressed question you raised inconnection with removal of chemical contamination from the Ballod property prior to construction of the nursing home...All soils removed by DOE have been stored at the MISS". But J. Wagoner II, DOE, insists they are not in violation of the Memo of Understanding with Maywood that only allows radiological storage. The State permit does not authorize chemical/heavy metals either.

175

pg.2 - Mr. Whitfield, DOE
11/22/89

3. James W. Stanley, Dept. of Labor, OSHA to Peter Torell (5/18/87)

"...That employees working at the Maywood construction site (Ballod property) were not being exposed to the contaminants (thorium & organic solvents that were present before the remediation".

4. David Paley (NJDEP) to Schepisi & McLaughlin (12/5/85) re: Ballod Property

"Results indicated contamination present in southern portion of property at approximately 100 parts per million - groundwater has not yet been investigated. When investigationis performed there is strong possibility of encountering contaminated groundwater - because of known radioactivity, possibility cannot be ruled out of radon gas eventually beingdetected,especially in basement of a future home (nursing home?) Ballod and Rochelle Park are not included in your 1st 5 year plan. Which 5 year plan would they be in?

5. John J. Trela (NJDEP) 12/2/86 to Peter Torell

"With regard to Ballod property nursing home - The Dept. has monitored closely both the radioactive and chemical contamination at the site."

Would you say your Mr. Gross was more than grossly in error? Why hide the presence of chemicals/heavy metals that EPA knew were present in 1981. What was his reason?

6. Then there was P. Brezanski, USEPA, to MTW Campbell, USNRC (1981) with test results showing arsenic, chromium, copper, lead, hydrocarbons, etc.

DECEIT: R. Atkin (DOE) meeting with Maywood Mayor and Attorney - August 5, 1985

Wherein DOE is asked to furnish letter stating that current volume estimate of Lodi residential is 300 yds^3. Estimate was actually much higher. But a small volume would be easier to sell to Maywood residents.

In a letter of August 26, 1985, E.L. Keller, DOE, not only complies but includes a draft press release for Mayor to use stating 350 cu. yds would be moved. This figure was used in the local newspaper but DOE already had approval (see 8/26/85 letter) before the issue came before the Mayor & Council. In New Jersey there is something known as the Sunshine Act. Lodi estimate for 1985 actually was 3000 yd^3 and is now about 25,000 $yd.^3$.

Do you expect us to trust the DOE? and especially your first 5 yr plan of at least 25 years?

For a finale, refer to George B. Breznay (DOE) letter of April 13, 1987 to Peter Torell and read his Decision and Order. It is enclosed. Pages 1, 2, and 3 should be enough. He admits he consulted with Borough's Attorney for his comments before making a settlement proposal in final form to the Borough which would be an attempt to end litigation challenging DOE's title to the property. Was not the DOE using the attorney hoping to sell the Borough whose interests should be the attorney's concern?

To top it off - Mr. Breznay had the gall to call it an inter agency communication! Then we were denied copy of R.S. Wittenauer's (DOE attorney) 7/24/86 solicitation letter to Maywood attorney in which he submitted the draft seeking any comments, changes, etc. that the Borough attorney may have.

Finally we received a copy of the July 24, 1986 letter showing the first two paragraphs and the rest, blank. (copy enclosed). *

* see pg. 177 and 178

D-123

073699

Mr. Whitfield
Pg.3 - 11/22/89

Ask Mr. Watkins if he approves of these unbelievable actions of DOE officials or will he call for a GAO investigation?

In a letter of April 25, 1989 to me, Gordon Binder, Chief of Staff, USEPA, stated, quote - "I wish I could have broken through all obstacles in one fell swoop but this matter is now interagency which means we've got to work with DOE."

#3 Certainly this should be changed. The USEPA and NJDEP should handle the Utah Disposal Plan with proper enforcement against the responsible party/parties.

Sincerely,

Louise Torell, Secretary
Concerned Citizens

Encs.
cc: Admiral J.D. Watkins, Secy (DOE)
Congressman Florio
Congressman Courter
Congressman Roe
Senator Lautenberg
Mayor & Council, Maywood
Wm. Reilly, Administrator (USEPA
Senator Bradley

176

B

Department of Energy
Washington DC 20585

CERTIFIED MAIL
RETURN RECEIPT REQUESTED APR 13 1987

Mr. Peter T. Torell
425 Bergen Avenue
Maywood, New Jersey 07607

Re: Case No. KFA-0054

Dear Mr. Torell:

The Department of Energy has considered the Freedom of Information Act Appeal filed by you. As the enclosed Decision and Order indicates, the DOE has determined that your submission be denied.

If you have any questions regarding this Decision and Order, please contact Richard T. Tedrow, Deputy Director, Office of Hearings and Appeals, Department of Energy, Washington, D.C. 20585, telephone number (202) 586-8018.

Sincerely,

George B. Breznay
Director
Office of Hearings and Appeals

Enclosure

D-124

073699

For one year we have attempted to obtain Rupp's letter from your legal dept.

Department of Energy
Washington, DC 20585

APR 13 1987

DECISION AND ORDER OF THE DEPARTMENT OF ENERGY

Appeal

Name of Petitioner: Peter T. Torell

Date of Filing: March 3, 1987

Case Number: KFA-0084

On March 3, 1987, Peter T. Torell (Appellant) filed an Appeal from a determination issued to him on January 29, 1987, by the Director of the Office of Remedial Action and Waste Technology of the Department of Energy (Director). That determination denied in part the Appellant's request for information pursuant to the Freedom of Information Act (FOIA), 5 U.S.C. § 552, as implemented by the Department of Energy (DOE) in 10 C.F.R. Part 1004. The Appeal, if granted, would require the Director to release the withheld documents. 177

The FOIA requires that documents held by federal agencies generally be released to the public upon request. The FOIA, however, lists nine exemptions that set forth the types of information which may be withheld at the discretion of the agency. These nine exemptions are repeated in the DOE regulations implementing the FOIA. 10 C.F.R. § 1004.10(b). The regulations further provide that documents exempt from mandatory disclosure under the FOIA shall nonetheless be released to the public unless the DOE determines that disclosure is contrary to federal law or the public interest. 10 C.F.R. § 1004.1.

I. Background

On July 28, 1986, the Appellant filed a FOIA request seeking all communications between the DOE and the Borough of Maywood, NJ (Borough) concerning the DOE's use of property in Maywood as an interim storage site for thorium-contaminated earth. 1/ The FOIA

1/ The property, which comprises part of the site of the former Maywood Chemical Company (Maywood Chemical), was given to the

(cont'd)

request specifically sought a draft of a final DOE settlement proposal that was made in connection with litigation between the Borough and the DOE. The DOE had provided the draft settlement proposal to the Borough's attorney, William Rupp, for his comments before making the settlement proposal in final form to the Borough. The DOE's settlement offer represents an attempt to end litigation in which the Borough is challenging the DOE's title to the Maywood property.

In the January 29, 1987 determination, the Director released the final version of the settlement proposal but withheld the draft under Exemption 5 of the FOIA. Exemption 5 shields from mandatory disclosure predecisional and deliberative internal agency communications. 5 U.S.C. § 552(b)(5); 10 C.F.R. § 1004.10(b)(5). In withholding the requested material, the Director found that the draft proposal was a provisional statement of an agency position that was prepared by a DOE employee for review by the appropriate DOE officials and was therefore a predecisional and deliberative intra-agency document. 1.

The Appellant challenges the Director's determination that the withheld communication is exempt from mandatory disclosure. 2/ The Appellant also asserts that policy considerations strongly favor release of all documents connected with an agency's storage of potentially hazardous material.

(cont'd)

DOE by the Stepan Chemical Company. Maywood Chemical had used the site to store ore from which thorium had been extracted. Apparently over several decades, thorium-contaminated earth from the Maywood Chemical site was carried by various means to the property of other landowners in and near Maywood. The DOE has been using the Maywood property to temporarily store soil from Maywood and other towns that became contaminated with thorium as a result of Maywood Chemical's operations. The DOE's use is part of a long-term effort to clean up the property. 2.

2/ The Appellant also indicates that the Director has not released information pertaining to a letter and a DOE subsurface investigation of the Maywood site that the Appellant listed in the FOIA request. However, the Director informed the Appellant, in a letter dated November 19, 1986, that the requested letter cannot be located and the subsurface report has not yet been issued.

D-125

073699

II. Analysis

To determine the purpose of the draft proposal, we spoke with the Manager of the DOE Office of Remedial Action and Waste Technology (Manager). That individual has informed us that the draft was an early statement of the terms, regarding the DOE's management of the Maywood Interim Storage Site (MISS) for thorium-contaminated soil, that the DOE had contemplated offering the Borough in return for the Borough's dismissal of its suit challenging the DOE's title to the MISS. The Manager stated that the DOE sent a copy of the draft to William Rupp, attorney for the Borough, with a transmittal letter requesting his comments and suggestions. According to the Manager, after Mr. Rupp's reply and further consideration of the proposal by the agency, the DOE submitted its final version of the settlement proposal to the Borough. The Manager informs us that the proposal has not yet been accepted by the Borough and remains the subject of ongoing settlement negotiations.

Exemption 5 protects "inter-agency or intra-agency memorandums or letters which would not be available to a party other than an agency in litigation with the agency." 5 U.S.C. § 552(b)(5); 10 C.F.R. § 1004.10(b)(5). Exemption 5 incorporates every civil discovery privilege which the government enjoys under statutory and case law. United States v. Weber Aircraft Corp., 465 U.S. 792, 799 (1983), FTC v. Grolier, 462 U.S. 19, 26-27 (1983) Renegotiation Board v. Grumman Aircraft & Engineering Corp., 421 U.S. 164, 184 (1975). Therefore, any communication that is privileged in civil discovery is also shielded from mandatory disclosure under Exemption 5. Id. Accordingly, if the requested documents fall within a civil discovery privilege, they may be withheld under Exemption 5.

178

The draft settlement offer falls within Exemption 5 on two grounds. First, the document is withholdable under the privilege for settlement negotiation papers incorporated within Exemption 5. The communication that the Appellant seeks is a settlement negotiation document that was exchanged among officials of the DOE and the Borough. Federal courts ruling squarely on the issue have held that such documents are privileged from discovery. In Olin Corp. v. Insurance Co. of North America, for example, 603 F.Supp. 445, 449 (1985), the court ruled that documents revealing the settlement terms discussed by adversarial parties and the final settlement accord are privileged not only from admission into evidence by the opposing party on the basis of Rule 408, Federal Rules of Evidence (Fed. R. Evid) but also from examination by any non-party to the settlement agreement. Olin, 603 F.Supp. at 449-50. The court held that this broad privilege for settlement documents exists to "encourage full and frank disclosure between the parties in order to promote settlements rather than protracted

---

Department of Energy
Washington, DC 20585

July 24, 1986

Mr. William F. Rupp, Esq.
Attorney for the Borough of Maywood
Rupp and Ten Hocve
9 Kansas St.
Hackensack, NJ 07601

Re: Borough of Maywood v. U.S. et al., Civ No. 85-5745, U.S. Dist. Ct. for District of New Jersey; proposal letter

Dear Mr. Rupp,

As per our recent conversations, I have enclosed a draft letter from the DOE FUSRAP Program setting forth those remedial actions that DOE is willing to undertake to resolve the outstanding concerns of your client and settle the ongoing litigation regarding this matter.

Anticipating that you would wish to comment and suggest changes before presentation to your client, we submit this as a draft proposal and invite your response. Once you have reviewed it, any agreed changes can be made promptly and a final, signed proposal transmitted to you. After acceptance by your client of the final proposal, it is our understanding that a Stipulation of Dismissal without prejudice will be filed to close the present litigation.

DOE DID NOT WANT US TO READ PP'S HERE.

D-126

073699

To: Mr. K.R. Whitfield - DP-12, Attn: Five Year Plan, Dept. of Energy, Washington, D.C. 873699

Section 1—November 15, 1984 THE SHOPPER NEWS — 1-3

Local news — Mr. Whitfield: These are our comments!

Utah supports thorium move

Governor's rep sees 'no problem'

by Chris Nebbenburg

MAYWOOD — A spokesman for a Utah congressman, whose district has the Envirocare storage site, said recently that the lawmaker will not oppose New Jersey's plan to move thorium there — if it can be done safely.

"As of now, we don't have a problem with this," said Rick Golden, press secretary to Rep. James Hansen, a Republican who represents the state's first district. "That's what the facility is built for. Until we're given a good reason to oppose that, we certainly have an open mind towards what New Jersey wants to do."

Hansen's view runs counter to that stated by Utah Democratic Rep. Wayne Owens. Owens, who serves the second district (which does not have Envirocare), opposes New Jersey's proposal.

The state Department of Environmental Protection suspects its plan would cost less than building an in-state site, and is trying to get the U.S. Department of Energy, which oversees Maywood and two other state nuclear waste sites, to favor the plan.

In a statement to the Utah press issued in October, Owens questioned the propriety of his state's becoming storage sites for outside waste.

"It seems that every few weeks, we hear of new plans to ship some type of waste to Utah," reads the statement, issued Oct. 5. "I am here to say that Utah will not sit still for the Waste-of-the-Month."

Owens questioned the wisdom of New Jersey's proposal, asking, "Does Utah want to be known nationwide as the crossroads of the waste?"

"Mr. Owens should realize that he doesn't speak for all of Utah," Golden said. "He represents the second district. Congressman Hansen represents the first district."

Golden launched a scathing attack against Owens for making the statement when, he said, Owens did not call Hansen. Golden said he should have called as a courtesy, since Envirocare is in Hansen's district. He also faulted Owens, lone Democrat in Utah's five-man congressional delegation, for attacking defeated gubernatorial candidate Rep. James Courter (R-Warren). Courter supports sending waste to Envirocare — if testing proves that is feasible.

Owens criticized Courter in an Aug. 2 letter, where he claimed Courter's initial proposal to ship thorium waste to Plateau Resources Unlimited in Ticaboo (also in Hansen's district) was not first discussed with Utah or Plateau officials.

"We consider Mr. Owens letter a cheap maneuver against Congressman Courter," said Golden. "The fact is that he's kept us apprised every step of the way on this issue."

Ari Kingdom, Owens' press secretary, conceded agreements between both states could eventually be reached leading to disposal. A spokesman for Utah's GOP governor has said his state will take waste if it's compatible with Envirocare.

"Regardless of what's in the soil, he (Owens) just thinks it's bad public policy to have Utah seen as a site for nuclear waste," said Kingdom. "We're fully aware that these tailings (thorium waste) may be sent there, but he wants the state to consider his position."

Kingdom added waste disposal is an issue in sparsely populated Tooele County (site of Envirocare), since it could create jobs.

Golden acknowledged Tooele residents see Maywood's waste as a possible jobs producer. But he also said they are used living near chemical and nuclear storage sites, among a large number of chemical weapons stored in the area.

"They (Envirocare officials) went through an extensive hearing process to set up the site," said Golden. "If Mr. Owens had objections, he shouldn't be raising them now, given the money and time they have invested into the facility."

Hansen's position contradicts that which has been stated by Congressman Robert Torricelli (D-9). In a July letter to Courter, Torricelli stated there was no way Utah officials would take such a high volume of waste (about 350,000 cubic yards) from the three state sites. Maywood Mayor John Steuert said his understanding is that Owens is "a lone voice" among Utah officials.

AND SO DO WE!! AND NOW!

NAME	ADDRESS	NAME	ADDRESS
[illegible]	96 [illegible] St.	Michael [illegible]	[illegible]
Mary Beth Nolan	69 [illegible]	[illegible]	11 North Broad [illegible]
[illegible]	476 [illegible] Ave		

[illegible]

Once you have reviewed the draft proposal letter, please contact me to discuss any comments, changes, etc., that you may have.

I appreciate your patience in this regard and await your call.

Yours very truly,

Robert D. Wittenauer
Attorney, Special Litigation Division
Office of General Counsel
U.S. Department of Energy

cc: J. Baublitz
J. Wagoner
R. Marra

International Association of Machinists and Aerospace Workers

Lodge 1018

LA GUARDIA AIRPORT — FLUSHING, NEW YORK

RRC-P-053-706-094

475 Bergen Avenue
Maywood, NJ 07607
November 22, 1989

Mr. R.P. Whitfield
Office of Defense Waste and
Transportation Management
DP-112 Five Year Plan
Department of Energy
Washington, D.C. 20545

Dear Mr. Whitfield:

#1 The DOE and EPA should adopt the NJDEP Utah Disposal Plan now, if not, what is your ulterior motive?

Enclosed is "Our Town" clipping 12/23/82 saying EPA had listed 418 sites but only two dealt with radiation – Maywood and Orange. Why is DOE in Maywood but not in Orange ? And note how they omitted the presence of chemicals!

181 . Also 6/22/89 (O.T) quoting your Messrs. Atkin and Wagoner that ongoing testing shows no chemicals whatsoever. Compare their comments with the 1988 MISS Annual Report (pg. 63) and 1987 report (pg. 48) and the NJDEP December, 1988 Health Assessment for Maywood. Should they still be on the project? How can we trust them or any of their reports? Has the new secretary taken the time to look at the DOE actions

#2 in Maywood? How about the new EPA Administrator?

I am enclosing just one sample of Mr. Atkin's political pressure activities, by-passing the Mayor & Council and using coercion via the Our Town editor and his "Hot Line" member of the Council. Your plan has the guts to mention DOE credibility?

Your Plan, no doubt, is the same as your Ballod property clean up - take out the chemicals with any radiological soil, and dump it on the MISS. You certainly would include Lodi Brook wherein Stepan has been discharging for years. Ask Lodi! If you preempt again, then plan on using Lodi's Motor Vehicle Site for excavated wastes. Maywood storage is closed and will be blocked, if necessary. We have had

#3 it with the DOE!!! Your "Shell Game" clean up plan contrary to SARA is over.

In 1985, DOE was asked, "Who is responsible and liable for the contamination and subject to suit for damages and loss?" DOE responded that they are not regulatory or law enforcement agency and would not involve itself to determine responsibility or illegalities? Did DOE burn ORO-777?

However, John E. Baublitz, DOE (9/13/85) wrote that " the cooperative agreement between DOE and the Stepan Co. does not relieve the Stepan Co. of any liabilities they may have had prior to DOE undertaking the project."

DOE's Fusrap ORO-777 (page 10) states restitution to the government for costs of remedial action would be provided for if the identity of any person having local responsibility to clean up a site could be determined.

#3 The fact is the USEPA identified Stepan Co. a responsible party in January, 1985 for radiological clean up. But DOE changed this responsible party identity to "Donator of" their burial pits area for waste pile storage and $500,000. Another $3,000,000. promised to Congress never was paid. Do you want proof?

In exchange, of course, DOE agreed to use taxpayer funds for cost of total clean up. Did you not make a similar deal with W.R. Grace in Wayne, New Jersey?

And our Congressmen approve of this rape of the taxpayers? Whatever happened to concern for the federal deficit? Congress should take a close look as to why the polluter is not paying!

Sincerely,

Peter T. Torell, Treasurer
IAM, AFL-CIO

Enclosures

cc Congressman Roe
Congressman Florio
Admiral Watkins (DOE)
Wm. Reilly, USEPA
C. Daggett, NJDEP
President Bush

P.S. Please include all other enclosed newsarticles as part of the public comment. They are additions to DOE INCREDIBILITY!!!

Whom? Not the Mayor + Council!

Another threat!

M/C received nothing. No word directly. Had to read Joe's favorite newspaper.

Stamp inside

DOE Connection...

At the time this editorial was being developed by the Our Town staff, on Wednesday, members of the Maywood Mayor and Council were preparing to meet in special session later that evening to discuss what options were left in the borough's struggle to rid itself of the thorium mountain now inside the borough.

The DOE (Department of Energy), the federal unit owning the land on which the thorium is stored, had given what can be described as an ultimatum. "Take the soil from the homes in Lodi or we will discontinue our efforts in Maywood and utilize the dedicated funds elsewhere."

As a result of a public meeting the week before last, at which sentiment from both the public and a pronounced majority of the borough council was strongly opposed to the DOE demand, a DOE spokesman announced several days later that it was doing just that — stopping work in Maywood and utilizing the available funds and capabilities elsewhere.

A door was left swinging: "Should the Maywood council vote to accept the proposed cleanup plan for 1989 (which gives priority to the Lodi homes and would produce an additional 2500 cubic yards at the site), the DOE would be willing to reassess the situation."

[illegible] night, (Wednesday, June 14), the council met to discuss the turn in events, this time with a new reality.

Our Town, in its 41 years of publication, cannot recall having wrestled with a position requiring such intensive deliberation. Since the debate over Senior Housing in the borough, no issue has polarized the community as thorium has. The only point on which everyone can agree is that it must be removed from Maywood.

We are well aware that many have accepted the "Not another grain of dirt from outside Maywood" slogan. "No More Dirt" is a banner easy to wave but, in our opinion, it will fly against Maywood's welfare in the long run.

Our Town believes that the DOE offer should be accepted, that to take any other course would be to seal

(Continued on page 10)

DOE/Our Town Agreement 1.0

OUR TOWN

MAYWOOD-ROCHELLE PARK, N.J.

Thursday, June 15, 1989

When?

Threat

Thorium

by Kathy [illegible]

No word from DOE

The Department of Energy's (DOE) decision to halt the cleanup of Maywood's thorium contamination gave rise to another discussion on the topic at last week's work session of the Maywood Mayor and Council.

Mayor John Steuert reacted angrily to newspaper accounts outlining the DOE's plans, [illegible] formed [illegible] their publication. The work session, he noted, was the council's first opportunity to discuss the issues raised at the meeting previously held with the DOE.

[illegible] decision was based on comments made during the meeting by members of the council and the public causing the DOE to conclude that [illegible]

[illegible] DOE [illegible] was willing to reverse its decision in the event the council was to vote in favor of accepting the soil, but action should take place as soon as possible.

Threat!

Steuert remarked that he had no way of knowing how the DOE [illegible] that [illegible] council members [illegible] reconsider their stance was a possibility that must be considered, he said.

In the lengthy discussion, that followed [illegible] have appeared [illegible] their original positions, with the exception of [illegible] Joseph Pezzano who stated he had become convinced that refusing to accept the Lodi soil would add to the delay in the designation of a permanent site.

Councilman Tom Richards explained the [illegible]

Special Note

[illegible]

No longer!

memorial school...

DOE's favorite Councilman!

"No More Lodi Dirt"

No More Lodi dirt...

Dirt From Lodi

Maywood officials [illegible]

Don't Contribute, Don't Criticize

OUR TOWN, Maywood

MAYWOOD-ROCHELLE PARK, N.J.

Letters...

Torells Attend Conference

[illegible]e editor

[illegible]

ε 9 · 372
073699

Department of Energy
Oak Ridge Operations
P.O. Box 2001
Oak Ridge, Tennessee 37831— 8723

June 2, 1989

RECEIVED
JUN - 8
BORO OF MAYWOOD
MNC
Michael Rolage

Arnold Schiffman
Water Quality Management
New Jersey Department of Environmental
Protection
Division of Water Resources, CN-029
Trenton, New Jersey 08625

Dear Mr. Schiffman:

EMERGENCY NJPDES/DGW PERMIT NO. 0054500 FOR THE U.S. DEPARTMENT OF ENERGY'S MAYWOOD INTERIM STORAGE SITE, APRIL MONITORING REPORT

In accordance with the subject permit, enclosed is the monitoring report for April 1989.

Please be advised that certain volatile organic compounds were found in three wells at the Maywood Interim Storage Site. The wells and the volatile organic compounds are listed below.

Well	Volatile Organic Compound	Concentration (ug/l)
1B	Tetrachloroethylene	10
2B	Benzene	70
4B	Vinyl Chloride	750
	1, 2 - Dichloroethene	1000
	Benzene	140
	Toluene	5

At this time, there is no definitive explanation as to the origin of these compounds; therefore, the above wells are scheduled to be resampled and a subsequent report will be submitted as soon as the data are available.

f you have any questions regarding this matter, please contact .teve Oldham at (615) 576-7070.

Sincerely,

for Bryan D. Walker, Acting Director
Technical Services Division

Enclosure:
As stated

cc: P. Allison, Clerk, Borough of Maywood, w/e
I. McDermott, Town Clerk, Rochelle Park, w/e
W. VanPelt, Ph.D., President,
Wesley R. VanPelt and Associates, w/e
J. Eng, NJDEP, w/e
E. Kaup, NJDEP, w/e
R. Robertson, BNI, w/o
K. Lewis, BNI, w/o

073699 Maywood

Let's protect our earth

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
METRO BUREAU OF REGIONAL ENFORCEMENT
2 BABCOCK PLACE
WEST ORANGE, NEW JERSEY 07052

GEORGE G. McCANN, P.E.
DIRECTOR

DIRK C. HOFMAN, P.E.
DEPUTY DIRECTOR

January 13, 1988

Mr. Ronald Targan, President
Malt Products Corporation
121 East Hunter Avenue
Maywood, New Jersey 07607

Re: Well Water Analytical Results

Dear Mr. Targan:

Analysis of the well water sample collected by a representative of the Division of Water Resources (DWR) on November 5, 1987 has yielded the following results:

Volatile organic Chemical Analysis

Chloroform	1.6 part (S) per billion (ppb)
1,1 Dichloroethane	1.6 ppb
trans 1,2 Dichloroethane	3.4 ppb
Methylene Chloride	2.3 ppb
1,1,1, Trichloroethane	7.8 ppb

It is understood that the well water is not used for potable purposes.

Since DWR is currently conducting a groundwater investigation in this area, it is anticipating that further monitoring information will be necessary from the on-site well. If you have any questions, please contact Mr. Steven Ciambruschini at this office at (201) 669-3900.

Very truly yours,

Thomas B. Harrington

Thomas B. Harrington
Supervisor, Compliance
Monitoring Unit
Metro Bureau of
Regional Enforcement

A7:G26

D-133

073699

178 East Central Ave.
Maywood, NJ 07607

October 4, 1990

Mr. James Pasqualo
Environmental Health Department
CN 360 Room 706
Trenton, NJ 08625-0360

Dear Mr. Pasqualo:

On 11/09/89 I mailed you a communication regarding an ongoing problem of soot which comes on my property and swim pool caused by the Malt Factory located on East Hunter Avenue behind my property.

When I was not answered, Mrs. L. Torell, Secretary of Maywood Concerned Citizens mailed you a copy of that letter. On 6/07/90, she wrote you a follow-up letter requesting your answer. On 6/29/90 you wrote to Mr. Carmine Cappucio, Maywood's Health Inspector to evaluate this situation. He answered you on 7/09/90 stating he was unable to reach me. However he did visit the Malt Works and states that Ms. P. VanOrden inspected the Malt facility on 4/16/90, giving them a satisfactory status. You then informed Mrs. Torell in a communication 7/11/90 that should the problem reoccur to call you. See Harrington to Targan letter 1/13/88 regarding 11/5/87 Chemical Analysis results on Malt wells. Please send all subsequent test results. Mr. Capuccio has never called or visited me, but visited the facility.

I request also copies of all reports of Ms. Van Orden's visit to Malt on 4/16/90.

Please be informed of the serious effects this situation has caused my family.

1. Since both of my children were infants they have and still are experiencing recurring upper respiratory problems.
2. My husband gets bronchitis several times yearly.
3. My sister had a miscarriage last year and her 6year old suffers from bronchitis and asthma.
4. My father had 5 bypasses, 2 strokes and part of hiskidney removed.
5. My brother - since a child - still suffers upper respiratory problems,contracting pneumonia easily.
6. I suffer terribly from migraine headaches.
7. My aunt had surgery for removal of cancerous breast.
8. My mother was deceased from cancer last year.
9. My uncle has skin cancer and suffered many strokes requiring constant care.
10. My nephew was born well underdeveloped with nerve cuttings and asthma.

For years when the brook overflowed, all my family would have to bail out the water from the basement and the brook is contaminated. Another great concern of mine is that we would like to make a den in the basement but fear the contamination.

I am requesting a full investigation into this crucial health matter and also ask that the Coles Brook, Malt wells, all my grounds and basement be tested for chemicals. Also, please answer me directly with a copy to Mrs. Torell. Please comply.

Sincerely,

Ruth Bahto

Enc: 1/13/88 letter
Harrington to Targan (Malt)
6/2/89 - Walker to Schiffman

cc: Dr. F. Dunston, Comm. (DOH)
Judith Yaskin, Comm. (NJDEP)
W. Nelson, ATSDR

M. C. Chas
Atty Chell
Bd of Health

2 5

073699

Department of Energy
Oak Ridge Operations
Post Office Box E
Oak Ridge, Tennessee 37831

RECEIVED
AUG 31 1987
BORO OF MAYWOOD

August 28, 1987

Honorable James Panos, Mayor
Borough of Maywood
459 Maywood Avenue
Maywood, New Jersey 07607

Dear Mayor Panos:

STATUS REPORT ON DEPARTMENT OF ENERGY ACTIVITIES IN MAYWOOD

The purpose of this letter is to provide you with a status report on the Department of Energy's (DOE) activities in the Maywood area. We are, as you know, continuing to take quarterly samples for the annual environmental monitoring report. We are also making regular inspections of the Maywood Interim Storage Site (MISS) to ensure proper maintenance. In addition to these routine activities, two other tasks are in progress.

The first is installation of monitoring wells to determine whether radiological contamination is migrating through groundwater. Some wells have already been completed on the Stepan Company property, and additional wells will be installed in the near future on other surrounding properties. We are in the process of contacting property owners to obtain permission to install wells. Consequently, this activity should continue for several weeks.

The second activity involves shielding a few areas at the MISS that exhibit elevated levels of surface radioactivity. These areas have been present for many years as a result of past waste disposal practices by the former Maywood Chemical Works. Corrective actions in these areas will eliminate any exposure to the site workers and reduce any potential for surface migration. As part of the effort, it is necessary to cover these areas with clean fill material to provide the shielding and stabilization at these locations. Trucks hauling this material on-site will continue until all areas have been shielded. This activity should be completed in the next few weeks.

If you or other members of the Council have any questions about DOE's activities in the Maywood area, please contact Mr. Robert Atkin at (615) 576-1826.

Sincerely,

for Lowell F. Campbell
S. W. Ahrends, Director
Technical Services Division

cc: Ms. Pat Allison, Borough Clerk
Members of Borough Council

Celebrating the U.S. Constitution Bicentennial — 1787-1987

073699

THE SHOPPER NEWSPAPERS, Saturday, December 20, 1986 L-5

Planners say 'No' to Feds

by Rachel Sawyer
Correspondent

MAYWOOD — Fearing approval may make Maywood a permanent toxic waste disposal site, the Planning Board has denied a subdivision which would permit federal ownership of the interim thorium storage site on Stepan Chemical property.

Planning Board Chairman George Brush advised members to deny the subdivision, which would have cleared the way for a federal takeover of the site and he said approving the application would be tantamount to putting a seal of approval on an illegal act.

The borough has two suits pending against the subdivision: one in Municipal Court charging Stepan with illegally transferring the land — a criminal offense — and one in Federal District Court to block the transfer of the land. These suits had been put on hold pending the outcome of the application at the planning board.

Another suit, brought by Stepan against the Rochelle Park Planning Board, is currently in Bergen County Superior Court. Planning Board attorney John Lamb feels that a similar action will be taken against Maywood.

"The quickest way is the best way," Lamb contends. "The Department of Energy (DOE) can't give us an answer when. But this is the type of lawsuit that's gonna kick around for awhile. It will be a further delay if everybody is waiting for the end of the lawsuit before action is taken. This issue is ripe for litigation."

The subdivision application has been before the Maywood Planning Board for several months, during which testimony in favor of the application came from representatives of Stepan, DOE and Congressman Robert Torricelli while some residents opposed the plan.

Brush told the board that granting the subdivision would strengthen the hand of the DOE. "We still have to fight against becoming a permanent site," said Brush. "It doesn't take much, just another resolution by Congress, and Maywood will be changed from an interim to a permanent storage site like that (snap)."

Charlotte Panny, chairman of the subdivision committee, was concerned that denying the subdivision would affect future funding for cleanup of the site. "Not true," refuted Brush, adding that there was a mandate from Congress to cleanup the site, not for federal ownership.

Brush opposed the application because the board could not impose a time limit on DOE's removal of the thorium. "The idea of an interim site for 25 years disturbs the hell out of me," he said.

The board voted against the subdivision 6-2, only board members John Fick and Frank Lichtenberger voted in favor of granting the subdivision.

178 East Central Avenue
Maywood, New Jersey 07607

073699

November 9, 1990

Robert J. Wing
Federal Facilities Section
U.S. Environmental Protection Agency
Region II
26 Federal Plaza, Room 2930
New York, N.Y. 10278

Dear Mr. Wing:

As my public input for your Community Relations Plan please document any communications attached herein and this letter as my comments.

This situation is a most dastardly one that all persons, agencies and officials, elected and otherwise - have allowed me, my family, my relatives, my children and friends, together with the people of Maywood- to suffer and will continue to suffer horrible sicknesses. (See 10/4/90 Bahto to Pasqualo(EHD)

Children are born deformed, people have died of cancer, more people are getting cancer in one form or another. My friend moved out of town whose child is very, very ill. She does not have time to write a letter.

If people want to move out of town, we must take abominable losses on our homes.

There is very much more.

Why are politicians and department heads allowing this???when the NJDEP finally came up with a solution. Take it to Utah, Environcare representatives want to take, it is cheaper. Why must taxpayers foot the bill. There are many more industries around the Stepan area to investigate. Are they hushed up? I will be kind and not give you names for now of the persons who are pushing the DOE Plan. However, when the time comes, I will be glad to speak out only when I can confront these people.

You are not fooling us; you just want to stymie us. WE WILL NOT LET THAT HAPPEN!!!

And now for the clincher: - - See ltr 1/13/88 Harrington (NJDEP) to Targen (Malt Products) - those chemicals are some of the same at the MISS; and 6/2/89 letter to Schiffman (NJDEP) signed by(DOE) Mr. Wing, forBrian Walker (DOE-Oak Ridge) on wells. We have documentation of one resident who has 96 parts* in her well. If it wasn't for the Concerned Citizens efforts, those people would still be using those wells.

Although, as before, I said there is much, much more, I think you get the message for now.

Sincerely,

Ruth Bahto
Ruth Bahto

*Tetrachlorothylene
Encs: As above
cc: Ms. J. Yaskin(NJDEP)
Concerned Citizens

12/27/89

December 27, 1989, The SHOPPER NEWS-L-27

Towns, DEP unite on 'Utah plan'

by Chris Neidenberg

MAYWOOD — A Dec. 19 West Paterson meeting between state and municipal officials has produced unanimous agreement for a proposal to permanently dispose thorium-tainted soil in Utah, according to the state's commissioner for environmental protection.

Borough Attorney Richard Fiore and members of Concerned Citizens of Maywood attended the closed session, which was called by the state Department of Environmental Protection (DEP). Others attending included DEP Commissioner Christopher Daggett, municipal officals from Lodi, Rochelle Park, Wayne, Pequannock and Middlesex, representatives for Congressman Robert Torricelli (D-9) and Governor-elect James Florio, as well as area state lawmakers. The group discussed a DEP plan to ship waste to the Envirocare storage facility over a 10-year period.

The state is trying to solicit support from the U.S. Department of Energy (DOE), which has jurisdiction over temporary storage sites in Wayne, Maywood and Middlesex, for its proposal. The DEP contends out-of-state removal could be $106 million cheaper (for a total cost of $280 million) and take 15 fewer years than implementing a DOE plan. That plan calls for building a permanent state

See GROUPS, Page 9

Continued from Page 1

Catherine Kaliniak, a DOE spokeswoman in Washington, said Thursday that Watkins has read the letter. She added the DOE was in the process of drafting a response, which the secretary must approve.

"But it won't contain a 'Yes we can do it' type of response because there are regulations the department must follow before any waste can be moved," said Kaliniak.

She cited regulations which fall under the National Environmental Policy Act (NEPA) and the revised Superfund law, enforced by the U.S. Environmental Protection Agency (EPA). She explained NEPA requires the DEP to do an "environmental impact" study, while Superfund requires a "remedial" study on the DEP proposal.

Kaliniak added the DOE must consider if there are "safer alternatives" to the Utah proposal. Typically, she said, the DOE study period lasts from 18 months to two years.

But under the DEP's plan, Trela said, the disposal process could conceivably start within a year to 18 months — if testing proves waste stored at Maywood and area properties in Rochelle Park and Lodi can go to Envirocare.

Larry Anderson, director of Utah's Bureau of Radiation Control, said last week he anticipates his state will rule on Envirocare's application to store "mixed waste" (which contains nuclear and hazardous waste) in the spring. Trela said talks with the DOE are ongoing to develop a testing plan for Maywood waste.

"They (Envirocare) are apparently well on their way to getting their license," said Fiore.

Speaking at last week's Borough Council meeting, he added Florio appears to support the DEP's plan "in principle."

For Louise Torell, secretary for Concerned Citizens of Maywood, the meeting marked a significant development in her 4½-year battle to remove thorium waste.

"It shows that our (Citizens') work has been very fruitful over the years," said Torell. "Considering the cost and time savings which come with this proposal, the news is very encouraging."

Mayor John Steuert and even Councilman Thomas Richards, who has been skeptical about chances for out-of-state removal, hailed news of last week's meeting. Richards said he was encouraged when an Envirocare official recently told him he thought the DEP plan was workable.

Rick Frost, Torricelli's spokesman, said the congressman is still urging the DEP to search for a state storage site while the DOE studies New Jersey's plan. He added Torricelli is concerned that "misleading promises" might have been made to Maywood residents in the past election campaign.

Daggett differed with Torricelli's contention that the state is obligated to find storage sites for waste within its borders.

"We have no obligation," he said. "This is a DOE problem. These are federal facilities."

Trela and Mike Nolan, head of Concerned Citizens, said federal elected officials must now work to obtain funds for the cleanup. Trela said he was "hopeful" such funding could be obtained. He noted that members of the state's Congressional delegation sit on key environmental committees, and have a "strong voice" on national environmental policy.

Local news

DOE letter criticized

by Chris Neidenberg

MAYWOOD — A state Department of Environmental Protection (DEP) official last week criticized U.S. Secretary of Energy James Watkins' reponse to a DEP plan for permanently dumping thorium-tainted soil in Utah.

Last Thursday, the DEP received from Watkins a one-page response to Governor Thomas Kean's letter pushing a proposal to truck roughly 550,000 cubic yards of dirt in Maywood and five other towns to the Envirocare storage site. Watkins' letter urges the state to negotiate with the U.S. Department of Energy (DOE) and federal Environmental Protection Agency (EPA) to remove the soil. John Trela, assistant DEP commissioner, contends the state is not obligated to do so.

The DEP plan calls for shipping dirt via rail over a 10-year-period. Department officials contend doing so will take 15 fewer years than siting and building a permanent in-state dump, as the DOE has suggested. The DOE is studying the proposal.

Kean's letter, sent to Watkins in October, states New Jersey's plan "could save the taxpayers in excess of $100 million over the life of the project." DEP estimates place removal costs at $280 million for the period, as opposed to a $386 million price tag it has estimated for the in-state option.

Watkins' response criticizes New Jersey for failing to negotiate a "federal facility agreement (FFA)," according to the U.S. government's revised Superfund law, administered by EPA.

"An FFA would provide the framework from which affected parties may participate effectively in the identification and evaluation of potential storage options," states Watkins. "Although EPA has repeatedly requested the state of New Jersey to negotiate such an agreement, the state ... has thus far declined to do so."

Watkins adds he believes the agreement "would provide the best mechanism to assure that an environmental review is performed as quickly as is reasonably possible."

Trela charged Friday that Watkins chose to evade the state's report.

"The DOE's response was that it had no response," he said. "This letter does not answer Tom Kean's letter. What he (Watkins) is saying is it's our fault."

Trela reiterated the state's position that the U.S government is obligated to clean up federal facilities. Such sites under the DEP's proposal are in Maywood, Wayne and Middlesex. Waste also lies in three other area towns.

Mike Nolan, head of Concerned Citizens of Maywood, agreed. He cited a 1984 letter from a DOE official to a U.S. congressional committee where the DOE pledged to work on finding and building storage areas for waste at federal sites in New Jersey and New York.

"Will Mr. Watkins please explain why he opposes a program which is $100 million cheaper than his department's plan?" he asked.

Trela pointed out any DOE plan will take longer to complete the cleanup process.

"Under their scenario, by the time they (DOE) start to dig, we will have it cleaned up," he said.

D-138

073699

Borough residents demand thorium action

by Chris Neidenberg

MAYWOOD — Residents, fearing their health has been jeopardized by borough contamination, are demanding that local officials protect their interests in any discussions with the federal government.

Members of one family whose parents lived on a West Central Avenue home for about 20 years attended the Borough Council's Oct. 9 meeting to urge that it not allow further outside contamination into the Maywood Interim Storage Site (MISS).

Members of the Tamburro family blame area chemical and radiation contamination for causing the death of their parents and family dog. Some also complained of health problems. Family members noted that other relatives who lived with them are also concerned.

Louise Ponce of Elm Street lived with her parents in the one-family home near the MISS for roughly 20 years. She spoke of the loss of her mother and father at early ages. Ponce cited the fact that her father suffered skin cancer and died at the age of 64 (though not from that disease), when 10 other siblings living away from the site lived into their 80s and 90s. As for her mother, Ponce said she died of ovarian cancer at the age of 60. According to Ponce, the form of cancer is known to be caused by low-level radiation. Her dog, she said, also died of cancer. Ponce has also suffered health problems, though she declined to detail them.

"I have seen everyone on that street (West Central Avenue) ill," Ponce said.

Her brother, John Tamburro, a health board member, still lives in the same house where his parents died. Tamburro complained of suffering from a chemical imbalance which has caused him depression, and noted he once contracted an ailment where he had too many red blood cells. Tamburro said most neighbors agree that the state and federal governments must do more to rid of the contamination.

"A neighbor living on one side of me pretends there's nothing wrong," Tamburro said. "But many others are very concerned about it. The older neighbors, in their 60s and 70s, tell me, 'We're glad we don't have to raise children living with this.' "

Family members praised Concerned Citizens of Maywood for their work in bringing attention to the problem.

"It's not just Louise Torell and Mike Nolan," insisted Ponce's sister, Marie Pelissier, who blames the pollution for producing cysts she had removed.

"All my neighbors are interested," she said. "But it's a matter of getting them out and showing strength. The mayor and council don't realize what they're up against."

Mayor John Steuert assured that the council is doing all it can in negotiating with the various agencies.

"If they don't think we're doing anything, they should come to Borough Hall and look at the files," he said.

Steuert told Ponce the issue is "beyond local competence," and requires that Maywood "reach out to the state and federal governments."

As to why more area residents have not consistently pressured government officials, Ponce reasoned that many do not want to generate bad press should they decide to sell homes.

"And elderly neighbors with health problems figure if I'm 65 or 75 years old, what's the sense of fighting this," she said.

After last week's meeting, Councilman Thomas Richards criticized Ponce's council appearance.

"Every year these people come out at the same time and say the same thing," Richards charged, citing the upcoming election. "It's easy for them to criticize because they don't have the reponsibility for making decisions."

But Ponce denied the charge.

"He's absolutely wrong," she said. "I've attended all the meetings involving the council and Department of Energy when thorium was the topic."

She continued, "As far as I'm concerned, Councilman Richards has been a detriment to this community when it comes to getting it cleaned up."

Pelissier blamed the problem on Rep. Robert Torricelli (D-9). Responding for the congressman, Washington spokesman Rick Frost said any future action on the DOE cleanup must be decided by the council.

D-139

073699

Attorney urges additional study

by Chris Neidenberg

MAYWOOD — While a federal agency asks for calm, a lawyer who has handled three legal actions against Stepan Chemical Company over contamination is urging a further area study for possible health risks.

David Tykulsker, an environmental and labor law specialist in Newark, successfully represented the widow of a worker who died of lung cancer. Tykulsker's client alleged on-site ionizing radiation contributed to the death of George Finley. He handled radioactive materials. A state judge ordered Stepan to compensate her for causing his death.

Tykulsker said two weeks ago he has already filed papers representing another client for similar reasons, and plans to file court papers for a third client also upset with Stepan.

Officials with the U.S. government's Agency For Toxic Substances and Disease Registry (ATSDR) plan to meet in the agency's Atlanta office tomorrow (Nov. 15) to consider doing further "health effects studies" on area residents, as recommended in a federally-funded state report. Gregory Ulirsch, ATSDR New Jersey technical officer, said Atlanta officials will link via phone with a state health department official to review data. Ulirsch predicted a final decision will come in about week or two.

Louise Fabinski, an ATSDR spokeswoman, stressed three weeks ago that the state's preliminary findings will not definitely trigger a further study. ATSDR will first seek input from state, federal and local health agencies, including the U.S. Environmental Protection Agency and state Department of Environmental Protection.

"This site is being considered (for further study) along with a number nationally. But it doesn't mean we expect people to have health problems," Fabinski said.

Fabinski added ATSDR might conclude there is not enough available scientific data for a fact-based study. Some factors which must be considered, Fabinski said, are the time over which residents have been exposed, the types of pollutants they have been exposed to, and whether the body stores the chemicals at issue so health effects can be studied. She explained using cancer deaths to conclude there are health risks depends on the specific cancers occurring in a polluted area.

Tykulsker, however, contended the U.S. government already has ample data to do a further Maywood probe, and to periodically check residents for health problems.

"Does Maywood have a problem meriting further study?" he asked rhetorically. "I say yeah and I'll go even further. I really think there's this bizarre idea that you need dead bodies to study. When will this (thinking) stop?

"We know carcinogenic chemicals and ionizing radiation have existed on this site," Tykulsker continued. "We know the site has been handled in a less than exemplary manner, that ionizing radiation knows no boundaries and has killed at least one worker (Finley).

"To say there's no reasonable chance that area residents have also been exposed puts hope above logic," he said. "The alarm — if any — is not undue."

The lawyer, who cited the presence of the carcinogen benzene on the Maywood Superfund site, insisted the U.S. government can do more to help residents. He agreed with Fabinski that to do a cancer study, one must link "specific exposures to specific types of cancer."

"That's why I'm upset with the notion that you need dead bodies before studying," Tykulsker complained.

Tykulsker said the federal government should also "closely monitor the health status" of residents, citing lung cancer (which killed non-smoker Finley) as an example.

"Lung cancer is fatal unless it's caught real early," he explained. "The only way you can is to look for it on a consistent basis."

Merlach

D-140

073699

Sports Inside!

Vol. 19, No. 22
Wednesday,
July 5, 1989

the shopper NEWS

25 cents
LODI
HASBROUCK HEIGHTS
WOOD-RIDGE
MAYWOOD
ROCHELLE PARK

An independently edited member of Suburban Newspapers of Northern New Jersey

Maywood says 'no' to Lodi

by Chris Neidenberg.

MAYWOOD — With Mayor John Steuert casting the tie-breaking vote, the Borough Council rejected calls to move thorium-tainted soil from six Lodi homes on June 26, halting the borough's own cleanup program until at least 1991.

The 4-3 vote assures Lodi residents on Long Valley Road and Branca Court must continue living near 2,500 cubic yards of thorium soil for the near future. At the same time, the decision kills chances for a 1989 cleanup in Maywood of 8,000 cubic yards of thorium dirt, stored behind an Essex Street car wash. The soil would have been moved to the Maywood Interim Storage Site (MISS) off West Hunter Avenue.

The vote followed a three-hour special meeting attended by about 35 residents. A majority who spoke urged members to reject the plan, as outlined by the U.S. Department of Energy (DOE). Joining Steuert were Republican council members Jim Smith, Peg Earley and William Grunstra. Supporting the DOE's plan were Republicans Anthony Napoli, Joseph Preziosi and Democrat Thomas Richards.

Related story page 3

Despite the vote, James Wagoner, head of the DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP), said the department will continue working with Maywood.

"We're not leaving," he said after the meeting, referring to critics' charges that the DOE tried threatening the borough. "It's our preference to work with the community and to address their concerns any way we can. We will continue to have a dialogue with Maywood."

Wagoner said that as a result of the vote, a third of the $8 to $10 million earmarked for borough cleanup efforts over the next two years will be diverted to another FUSRAP site. He said two-thirds of the funds will be applied to the DOE's Remedial Investigation Feasibility Study of contamination

See MAYWOOD, Page 5

D-141

073699

D-142

073699 L.

CLERK
MARY ANNE RAMPOLLA
(201) 845-6655

BOROUGH OF MAYWOOD

459 Maywood Avenue, Maywood, NJ 07607

June 7, 1990

Hon. Robert Torricelli
Court Plaza
25 Main Street
Hackensack, NJ 07601

Dear Sir:

In light of the recent decision by the Department of Environmental Protection Agency to transport the radon contaminated soil in Montclair and surrounding communities to a storage site in Utah, I would urge all our legislature representatives, both federal and state, to immediately proceed with whatever means are necessary to ensure that Maywood's project is transported to a similar site in Utah.

Apparantly, Montclair is moving in the right direction; we should do the same.

Respectfully,

Thomas H. Richards
Councilman

mr
cc Mayor & Council
Atty. DeLorenzo

Letters also mailed to:
1. Sen. Paul Contillo
2. Assy. Patrick J. Roma
3. Assy. William P. Schuber
4. Hon. Bill Bradley
5. Hon. Frank Lautenberg

6/12/90 - Mike Nolan

D-143

073699

Record 2/9/89

BERGEN COUNTY UTILITIES AUTHORITY INDUSTRIAL PRETREATMENT PROGRAM PUBLIC NOTICE

In accordance with the General Pretreatment Regulations for Existing and New Sources of Pollution (40CFR Part 403), the following is a list of Industrial Users of the Bergen County Utilities Authority who significantly violated an applicable Pretreatment Standard or other Pretreatment Requirement during the twelve-month period ending December 31, 1988, as defined in 403.8 (f)(2)(vii):

Amsco Wire Products Corp., Ridgefield
Beacon Looms, Inc., Teaneck
Bridgeview Auto Laundry, Leonia
Carlton Cooke Plating Corp., Carlstadt
Cart-Wright Industries Inc., Englewood
Engleherdt Brothers t/a Ferris Plating, Moonachie
Fort Lee One Stop Cleaning, Fort Lee
H & W Show Supplies Co., Inc., Northvale
Main Camera, Hackensack
Major Products, Little Ferry
Montvale Car Wash, Montvale
Northvale Car Wash, Northvale
One Hour Film Developing, Paramus
Perma Chrome Specialty Corp., South Hackensack
Pharmachem Laboratories, Inc., South Hackensack
Plate Masters, East Rutherford
R. H. Haynes Inc., Hackensack
Regency Car Wash, South Hackensack
Rinaldi Transportation, Closter
Spear Packing Corp., Carlstadt
Stepan Chemical Co., Maywood
Techniques, Inc., Englewood
Top Notch Metal Finishing Co., East Rutherford
Town Offset, Div. of Sterling Regal, Carlstadt
Union Hill Printing, Ridgefield
Zenith Laboratories Inc., Northvale
Feb. 9—Fee: $45.92 (56)

2/1/85 Record

$109,000 to chemical worker's widow

By Colleen Mancino
Correspondent

The widow of a former Maywood resident who was exposed to thorium at a chemical company in the borough has won $109,000 and $91 a week for the rest of her life in settlement of a worker's compensation claim, her attorney said Tuesday.

David Tykulsker, who represented Helen Finley and the estate of her husband, George Finley, said the settlement appears to be the first stemming from exposure to thorium, a radioactive element, at Stepan Chemicals.

George Finley died Aug. 17, 1984, from a form of lung cancer that doctors attributed to exposure to thorium at the plant, where he worked for 40 years. Tykulsker said part of Finley's job involved cleaning out buildings where thorium had been stored. He never wore protective gear. He retired in 1978 and was diagnosed with cancer in 1982.

Tykulsker said he believed the settlement represents the first time an employee's death has been proved to be related to exposure to thorium at the company. He said he did not know how many employees worked at Stepan before 1981, when the thorium was discovered, or how many other employees might have been exposed to the material. He also said that he was unaware of any similar suits against Stepan.

John O'Brien, the company's plant manager, said this is the first such suit he has heard of regarding the thorium.

Helen Finley sued the company last year for compensation, and a decision was handed down Dec. 6 by Judge R. Richard Kushinsky, who presides over cases for the state Department of Labor's Division of Compensation. Tykulsker said he did not learn of the award until Tuesday.

The thorium on the site was left over from the old Maywood Chemical Works Company, which processed thorium from 1916 to 1957 for lanterns and ammunition. The property was later purchased by Stepan Chemical, which produces detergents, oils, and other products.

George Finley worked at the Maywood Chemical Works and moved to Stepan when the property was sold.

The thorium is now being kept in temporary storage on the Stepan property, which is on the federal Superfund list and is slated to be cleaned up by the U.S. Department of Energy. The work is not expected to be finished until the 1990s, the department has said.

Response C-1

The DOE believes that its staff has acted in a professional and ethical manner with regard to response actions at the Maywood site. Nothing presented in Mr. and Mrs. Torell's letter indicates otherwise. Without substantiation for the allegations made, there is no basis for an investigation.

Response C-2

All documents submitted by commenters, including Mr. and Mrs. Torell, are reprinted in this work plan-implementation plan. Where the material speaks for itself, no additional comments are necessary.

Exhibit D

07367D

69 Lenox Avenue
Maywood, NJ 07607
December 11, 1990

Mr. Lester K. Price, Director
Technical Services Division
U.S. Department of Energy
Oak Ridge Operations
Post Office Box 2001
Oak Ridge, Tennessee 37831-8723

Dear Mr. Price:

D-1 Enclosed are (12) photos of the signs carried by concerned citizens of Maywood and Wayne who picketed the DOE Scoping Meeting of December 6, 1990.

Please read the comments on the signs and provide with your responses.

One sign is missing. It states "Admiral Watkins - It's time to set the Roe boat adrift".

D-2 We look forward to your responses and please ask Mr. Kaup (NJDEP) to assure you that there were no AEC contracts for thorium with MCW or Stepan. And no DOE authority for Fusrap activity in Maywood and Wayne, thus P.L. 98-50 was conjured.

Sincerely,

Michael J. Nolan

Michael J. Nolan
Chairman
Concerned Citizens-Maywood

cc: Admiral J. Watkins (DOE)
Robert Wing (EPA)
J. Yaskin (NJDEP)
Wm. Reilly (EPA)

P.S. ALSO ENCLOSED IS SHOPPER NEWS COVERAGE OF YOUR DEC. 6TH MEETING

Response D-1

Signs are not submitted as part of the record of the scoping mmeeting. Therefore, copies of the signs enclosed with Mr. Nolan's letter are not included, and no response to them is required.

Response D-2

The Manhattan Engineer District and the Atomic Energy Commission both purchased thorium from the Maywood Chemical Works, a commercial thorium processor. Stepan Chemical Company (now Stepan Company) was never in the business of handling radioactive materials and, thus, had no thorium contracts with the federal government.

The DOE's authority for action at the Maywood site derives from a specific authorization by Congress under the Energy and Water Authorization Act of 1984 to conduct a decontamination research and development project at the Maywood and Wayne sites. The DOE assigned the project to FUSRAP.

Issues Raised at the Public Meeting,
December 6, 1990
Hackensack, New Jersey

Issues Raised at the Public Meeting, December 6, 1990 Hackensack, New Jersey

Because of the length of the transcript, it was decided that it would not be included in this Responsiveness Summary. Issues raised will be summarized and responded to. A complete copy of the transcript can be found in the administrative record at the Maywood Public Library or can be obtained, if desired, by writing a request to Mr. Lester Price at the address given in Response D-1. The following is a summary of the issues raised, identified by the person who raised the issue.

Comments of John Tamburro

Issue. Mr. Tamburro described the elements of his cancer cluster study.

Response. Mr. Tamburro's testimony at the public meeting covered his study and the issues raised in this written submittal. Responses to his study were provided in Responses A-1 through A-30.

Comments of Louise Ponce

Issue. Ms. Ponce questioned the long period of the study.

Response. See Response B-1.

Issue. The issue was raised regarding whether mixed waste could be disposed of 2 years from now.

Response. Under EPA's Land Disposal Restrictions, Title 40, Part 268, of the Code of Federal Regulations, a variance was granted until May 8, 1992, on the prohibition for land disposal of mixed wastes (those that contain radioactive materials and also contain specific hazardous chemicals). Until that deadline, it is possible to dispose of mixed wastes without prior treatment. What will happen when this deadline is reached is conjecture, but, it must be assumed for the time being, that EPA will follow the regulation and require pretreatment of these wastes after May 8, 1992.

Issue. Will DOE move the Maywood waste to the Envirocare site in Utah?

Response. This option will receive the same consideration as other disposal options in the Feasibility Study. There has been no decision to eliminate any option at this time.

Issue. The DOE has said many times that if DOE could find a place to move the Maywood wastes, they would. Now that the Envirocare site in Utah is available, DOE won't move the wastes.

Response. As noted above, DOE has not foreclosed any option for disposal. However, because the Maywood materials are designated as 11e(2) by-product materials under the amended Atomic Energy Act, they may be excluded from disposal at the Envirocare site under the terms of its license with the Utah Bureau of Radiation Control and the terms of the agreement between the Utah Bureau of Radiation Control and the NRC that gave Utah Agreement State Status. This issue must be resolved. For the present, all potential sites have equal status. No site has been excluded from consideration.

Issue. Will DOE consider buying homes on West Central Avenue that are contaminated?

Response. The DOE has no plans to purchase homes in the vicinity of the Maywood site. Characterization studies show that it is feasible for all known sites to conduct remedial or removal actions that will reduce contaminant levels to DOE guidelines or below.

Issue. What is under the MISS pile?

Response. A description of the MISS waste pile is given in Section 3.1.1 of this work plan-implementation plan. Most of the lowest surface is the original MISS soil. Some soil was excavated to prepare for the pile. This went either into the pile itself or was pushed to the side. The ground surface was packed down and a 6-inch layer of sand was placed on top with a berm at the perimeter. A liner was placed on the sand and an additional 6 inches of sand was placed over the liner to serve as a collection system for any liquids that might collect within the pile. Twelve inches of fine material was spread over the sand and then the contaminated soil and rubble were piled above. Finally, the pile was covered with another liner and the two liners were sealed together at the edges.

Issue. Are the people on West Central Avenue exposed to more radiation when more soil is brought onto the MISS pile?

Response. See Response A-9.

Issue. Has room been cleared to add another pile on the MISS?

Response. An area was prepared on the MISS in 1985 to handle additional soils from Lodi. Those wastes were never excavated due to restrictions imposed by the Borough of Maywood. Thus, the prepared area was not used and, in the intervening time, has deteriorated to the extent it could no longer be used for additional wastes. No new pile could be created on the MISS without additional site preparation.

Issue. When the MISS pile is opened does it increase the emissions to the residential area nearby?

Response. In testimony given by Mr. Richard Robertson, Bechtel National, Inc., at the December 6, 1990, public meeting in Hackensack, New Jersey, he stated that, when it was necessary to open the pile, dust control measures were employed and monitoring stations were placed around the opening to record the level of any emissions. These measures would control dust emissions and keep them within DOE requirements.

There might also be radon-222 and radon-220 gas emissions at these times. With radon, it is not the gas but the decay products formed when the gas decays that are the health hazard. For a puff of radon, by the time many of these decay products have formed they and the radon gas would be substantially diluted in the atmosphere and, therefore, would be indistinguishable from the normal background levels off the site.

Comments of Gregory Allen

Issue. Has overseas treatment and disposal of the Maywood wastes been researched? Will that be a consideration in the selection of the final solution?

Response. The Feasibility Study will consider all options for disposal of the Maywood wastes. Overseas treatment and disposal, although a unique proposal, will not be ruled out *a priori* and will be screened on a par with all other options.

Issue. Is funding currently allocated for the treatment and/or disposal of the Maywood wastes?

Response. The DOE plans for remedial and removal actions, including budgetary projections, extend several years into the future but the ability to initiate and complete these plans depends upon annual appropriations from Congress. Currently, DOE has only received Congressional funds to continue work until the end of the 1991 Fiscal Year (the end of September 1991).

Issue. Have removal actions been considered utilizing state hazardous waste disposal facilities?

Response. As Senator Contillo testified at this public meeting, New Jersey has not been able to site any hazardous waste site, neither chemical nor radiological, within the state boundaries. Sites to be created by compacts of states under the Low-Level Radioactive Waste Policy Amendments of 1985 (Public Law 99-240) are not intended to handle large volume, low concentration nuclear waste as exists at the Maywood site. Thus, the suggestion offered, while appreciated, does not appear to be a feasible option.

Comments of Senator Paul Contillo

Issue. The schedule for dealing with this site is unacceptable.

Response. See Response B-1.

Issue. The State of New Jersey has been unable to site any hazardous waste site within the state boundaries. A bipartisan bill supporting the movement of the Maywood wastes to the Utah site has been sponsored by Senator Contillo.

Response. The DOE appreciates the information supplied by Senator Contillo. At the point in the RI/FS-EIS where alternatives are enumerated and evaluated, this experience upon the part of New Jersey will be taken into consideration.

Comments of Mayor John Steuert

Issue. The schedule proposed for remedial action will foreclose the use of the Utah site.

Response. The DOE is constrained to follow the steps laid out in the Superfund process and to follow the process agreed to in the Federal Facility Agreement signed jointly by EPA Region II and DOE. It is hoped that these actions will not foreclose any options for the eventual resolution of the Maywood site problems.

Issue. Is it possible that taxes can be retrieved from the federal government for those lost on the MISS site due to federal ownership?

Response. In responding to Mayor Steuert at the public meeting, Mr. Fiore stated that DOE would be willing to meet with representatives of the borough and explore this issue. A convenient time and place can be arranged by contacting Mr. Fiore.

Comments of Ruth Bahto

Issue. Ms. Bahto expressed anxiety over the safety of her children due to the Maywood Site wastes.

Response. The DOE empathizes with Ms. Bahto's concerns. However, the survey of Ms. Bahto's property did not show it to be contaminated. In the short term, DOE will strive to control excess doses to the citizens in the vicinity of the Maywood site to as low as reasonably achievable. In the long term, DOE desires to resolve this problem and reduce excess doses as much as feasible.

Issue. Ms. Bahto urged the movement of the Maywood site wastes to Utah.

Response. This option is one of several that will be considered in the evaluation of disposal alternatives in the RI/FS-EIS.

Comments of Robert Breslin

Issue. Mr. Breslin expressed frustration at the slow pace of action and urged DOE to move the waste out of Maywood.

Response. See Response B-1.

Comments of Charles Judd

Issue. The Envirocare of Utah site, as of November 30, 1990, can accept mixed waste.

Response. The DOE appreciates this information. The DOE's reading of the terms of the license issued by the Utah Bureau of Radiation Control and the permit issued by the Utah Bureau of Solid and Hazardous Waste to Envirocare is that only naturally occurring radioactive material (NORM) mixed with hazardous constituents defined by the Resource Conservation and Recovery Act may be disposed of at the site. The DOE believes that the Maywood site radioactive materials classify as by-product material, not NORM, and therefore they may be restricted from the site. The DOE is aware of the NRC's expressed intent to review Envirocare's request for a license to accept and dispose of uranium and thorium by-product material, as defined in Section 11e(2) of the amended Atomic Energy Act, at its Clive, Utah, site. The DOE will monitor the NRC's action. Until this issue is resolved, DOE cannot state whether the Envirocare site is an acceptable option for Maywood site waste disposal. In the meantime, disposal at this site remains one of many options that will be considered in the feasibility study.

Issue. Envirocare is uncertain as to what will happen after 2 years when the U.S. Environmental Protection Agency's mixed waste national capacity variance expires.

Response. The DOE is also uncertain about this.

Issue. Envirocare would like to meet with DOE to resolve DOE's concerns with regard to disposal at Envirocare's Utah site.

Response. The DOE would be willing to explore the Envirocare option. Arrangements for a meeting can be made through Mr. Lester Price at the DOE Field Office (see Response D-1 for address).

Comments of Dr. George Brush

Issue. The solution to the Maywood waste problem can be expedited.

Response. As stated in the responses to others with this similar concern, the process laid out in the Superfund regulations and in the Federal Facility Agreement unfortunately lead to an extended schedule. The DOE believes that to be fair to all parties concerned and to avoid legal challenges that might extend the process even longer, the process should be adhered to strictly.

REFERENCES (Appendix D)

Bechtel National, Inc., 1990, *Maywood Interim Storage Site Annual Site Environmental Report, Maywood, New Jersey, Calendar Year 1989,* DOE/OR/20722-267, prepared for U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tenn., May.

Eckerman, K.F., A.B. Wolbarst, and A.C.B. Richardson, 1988, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversions Factors for Inhalation, Submersion, and Ingestion,* Federal Guidance Report No. 11, EPA-520/1-88-020, prepared by Oak Ridge National Laboratory, Oak Ridge, Tenn., for U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, D.C., Sept.

Oak Ridge National Laboratory, 1989, *Results of the Radiological Survey at 142 West Central Avenue, Maywood, New Jersey (MJ041),* ORNL/RASA-88/84, Oak Ridge, Tenn., June.

U.S. Department of Energy, 1988, *Radioactive Waste Management,* DOE Order 5820.2A, Washington, D.C., Sept. 26.

U.S. Department of Energy, 1990, *Federal Facility Agreement, Maywood Interim Storage Site, Docket No. 11,* CERCLA-FFA-00101, Oak Ridge Operations Office, Oak Ridge, Tenn., Sept. 17.

APPENDIX E

RELATED FEDERAL PROJECTS

APPENDIX E

RELATED FEDERAL PROJECTS

DOE has prepared EIS documents for other programs and other sites under its remedial action program that are similar to the documents that will be used as references in implementing the CERCLA/NEPA process at the Maywood Site. Examples include:

- U.S. Department of Energy, 1983, *Final Environmental Impact Statement, Remedial Actions at the Former Vitro Rare Metals Plant Site, Canonsburg, Washington County, Pennsylvania*, DOE/EIS-0096-F, 2 vol., July.
- U.S. Department of Energy, 1984, *Final Environmental Impact Statement, Remedial Actions at the Former Vitro Chemical Company Site, South Salt Lake, Salt Lake County, Utah*, DOE/EIS-0099-F, 2 vol., July.
- U.S. Department of Energy, 1985, *Final Environmental Impact Statement, Remedial Actions at the Former Vanadium Corporation of America Uranium Mill Site, Durango, La Plata County, Colorado*, DOE/EIS-0111-F, 2 vol., Oct.
- U.S. Department of Energy, 1986, *Final Environmental Impact Statement, Remedial Actions at the Former Climax Uranium Company Uranium Mill Site, Grand Junction, Mesa County, Colorado*, DOE/EIS-0126-F, 2 vol., Dec.
- U.S. Department of Energy, 1986, *Final Environmental Impact Statement, Long-Term Management of the Existing Radioactive Wastes and Residues at the Niagara Falls Storage Site*, DOE/EIS-0109-F, April.

In addition, the U.S. Nuclear Regulatory Commission and the U.S. Environmental Protection Agency have prepared EISs on various related programs, proposed standards, and specific sites, including:

- U.S. Environmental Protection Agency, 1982, *Final Environmental Impact Statement for Remedial Action Standards for Inactive Uranium Processing Sites (40 CFR 192)*, Vols. 1 and 2; EPA 520/4/82-013-1, -2, Oct.
- U.S. Nuclear Regulatory Commission, 1983, *Final Environmental Statement Related to the Decommissioning of the Rare Earths Facility, West Chicago, Illinois, Docket No. 40-2061, Kerr-McGee Chemical Corporation*, NUREG-0904, May.
- U.S. Environmental Protection Agency, 1986, *Final Environmental Impact Statement, Proposed Wastewater Treatment Facilities for Eastern St. Charles County, Missouri, Including: Duckett Creek Sewer District, St. Peters Sewer District, St. Charles Sewer District, Portage de Sioux District*, EPA 907/9-86-003, May.

- U.S. Nuclear Regulatory Commission, 1989, *Final Supplement to the Final Environmental Statement Related to the Decommissioning of the Rare Earths Facility, West Chicago, Illinois, Docket No. 40-2061, Kerr-McGee Chemical Corporation*, NUREG-0904, Supplement No. 1, April.

APPENDIX F

ENGLISH/METRIC - METRIC/ENGLISH EQUIVALENTS

TABLE F.1 English/Metric Equivalents

Multiply	By	To obtain
acres	0.4047	hectares (ha)
cubic feet (ft^3)	0.02832	cubic meters (m^3)
cubic yards (yd^3)	0.7646	cubic meters (m^3)
degrees Fahrenheit (°F) − 32	0.5555	degrees Celsius (°C)
feet (ft)	0.3048	meters (m)
gallons (gal)	3.785	liters (L)
gallons (gal)	0.003785	cubic meters (m^3)
inches (in.)	2.540	centimeters (cm)
miles (mi)	1.609	kilometers (km)
pounds (lb)	0.4536	kilograms (kg)
short tons (tons)	907.2	kilograms (kg)
short tons (tons)	0.90718	metric tons (t)
square feet (ft^2)	0.9290	square meters (m^2)
square yards (yd^2)	0.8361	square meters (m^2)
square miles (mi^2)	2.590	square kilometers (km^2)

TABLE F.2 Metric/English Equivalents

Multiply	By	To obtain
centimeters (cm)	0.3937	inches (in.)
cubic meters (m^3)	35.31	cubic feet (ft^3)
cubic meters (m^3)	1.308	cubic yards (yd^3)
cubic meters (m^3)	264.2	gallons (gal)
degrees Celsius (°C) + 17.78	1.8	degrees Fahrenheit (°F)
Hectares (ha)	2.471	acres
kilograms (kg)	2.205	pounds (lb)
kilograms (kg)	0.001102	tons, short (t)
kilometers (km)	0.6214	miles (mi)
liters (L)	0.2642	gallons (gal)
meters (m)	3.281	feet (ft)
metric tons (t)	1.1023	short tons (tons)
square kilometers (km^2)	0.3861	square miles (mi^2)
square meters (m^2)	10.76	square feet (ft^2)
square meters (m^2)	1.196	square yards (yd^2)