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Surplus Facilities Management Program (SFMP)  
Contract No. DE-AC05-81OR20722

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# PRELIMINARY ASSESSMENT FOR NIAGARA FALLS STORAGE SITE

Lewiston, New York

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May 1990



Bechtel National, Inc.

PRELIMINARY ASSESSMENT  
FOR  
NIAGARA FALLS STORAGE SITE  
LEWISTON, NEW YORK

May 1990

Prepared for

UNITED STATES DEPARTMENT OF ENERGY  
OAK RIDGE OPERATIONS OFFICE  
Under Contract No. DE-AC05-81OR20722

by

J. F. Gonzales and L. A. Martin

Bechtel National, Inc.  
Oak Ridge, Tennessee

Bechtel Job No. 14501

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## ABBREVIATIONS

cm	centimeter
cm/s	centimeters per second
g	gram
ft	foot
ft <sup>2</sup>	square foot
ha	hectare
in.	inch
km	kilometer
L	liter
m	meter
m <sup>2</sup>	square meter
m <sup>3</sup>	cubic meter
μCi/ml	microcuries per milliliter
μg/L	micrograms per liter
μmhos/cm	micromhos per centimeter
mi	mile
mg/L	milligrams per liter
pCi/g	picocuries per gram
pCi/L	picocuries per liter
ppb	parts per billion
ppm	parts per million
yd <sup>3</sup>	cubic yard

## ACRONYMS

AEC	Atomic Energy Commission
BNI	Bechtel National, Inc.
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
EPDM	ethylene propylene diene monomer
FUSRAP	Formerly Utilized Sites Remedial Action Program
IWCF	interim waste containment facility
LOOW	Lake Ontario Ordnance Works
MED	Manhattan Engineer District
NFSS	Niagara Falls Storage Site
ORAU	Oak Ridge Associated Universities
PCB	polychlorinated biphenyl
PVC	polyvinyl chloride
ROD	record of decision
SFMP	Surplus Facilities Management Program
TNT	trinitrotoluene
TOC	total organic carbon
TOX	total organic halides

## 1.0 INTRODUCTION

This document presents the findings of the preliminary assessment completed for the Niagara Falls Storage Site (NFSS) in the Township of Lewiston, New York, in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act.

The preliminary assessment is the initial evaluation of a hazardous waste site to determine the severity of the threat the site poses to human health and the environment.

Section 2.0 of this report consists of the preliminary assessment form required by the U.S. Environmental Protection Agency (EPA). Sections 3.0 through 7.0 contain additional information to supplement the form. Bibliographical information appears in Section 8.0.



## 2.0 PRELIMINARY ASSESSMENT FORM

This section consists of the required EPA Preliminary Assessment Form 2070-12, which has been completed for NFSS. Supplemental data describing site ownership and history, vicinity populations, storage pile construction, and summaries of contamination surveys, environmental monitoring, and remedial action are presented in greater detail in Sections 3.0 through 7.0.



POTENTIAL HAZARDOUS WASTE SITE  
PRELIMINARY ASSESSMENT  
PART 1 - SITE INFORMATION AND ASSESSMENT

I. IDENTIFICATION

01 STATE 02 SITE NUMBER  
NY 0890137985

II. SITE NAME AND LOCATION

01 SITE NAME (Legal, common, or descriptive name of site) Niagara Falls Storage Site		02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER 1397 Pletcher Road			
03 CITY Lewiston	04 STATE NY	05 ZIP CODE 14092	06 COUNTY Niagara	07 COUNTY CODE 063	08 CONG DIST
09 COORDINATES LATITUDE 43 12 45 N		LONGITUDE 78 59 10 W			

10 DIRECTIONS TO SITE (Starting from nearest public road)

From I-190 North of Niagara Falls, take the Robert Moses Pkwy. North approx 5 miles, then go East on Pletcher Road approx 2 miles. The site is on the North side of Pletcher Road.

III. RESPONSIBLE PARTIES

01 OWNER (If known) Department of Energy		02 STREET (Business, mailing, residential) P. O. Box 2001			
03 CITY Oak Ridge	04 STATE TN	05 ZIP CODE 37831	06 TELEPHONE NUMBER (615) 576-0948		
07 OPERATOR (If known and different from owner) (Same)		08 STREET (Business, mailing, residential)			
09 CITY	10 STATE	11 ZIP CODE	12 TELEPHONE NUMBER ( )		

13 TYPE OF OWNERSHIP (Check one)

☐ A. PRIVATE ☒ B. FEDERAL: Department of Energy (Agency name)  
☐ C. STATE ☐ D. COUNTY ☐ E. MUNICIPAL  
☐ F. OTHER: (Specify)  
☐ G. UNKNOWN

14 OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)

☒ A. RCRA 3001 DATE RECEIVED: 10/26/89 MONTH DAY YEAR ☒ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: 3/01/86 MONTH DAY YEAR ☐ C. NONE

IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION <input checked="" type="checkbox"/> YES DATE 3/13/90 Local State <input type="checkbox"/> NO		BY (Check all that apply) <input type="checkbox"/> A. EPA <input type="checkbox"/> B. EPA CONTRACTOR <input checked="" type="checkbox"/> C. STATE <input type="checkbox"/> D. OTHER CONTRACTOR <input type="checkbox"/> E. LOCAL HEALTH OFFICIAL <input checked="" type="checkbox"/> F. OTHER: Environmental Enforcement (Specify) Officer for Lewiston, NY	
02 SITE STATUS (Check one) <input type="checkbox"/> A. ACTIVE <input checked="" type="checkbox"/> B. INACTIVE <input type="checkbox"/> C. UNKNOWN		03 YEARS OF OPERATION 1944 1971 BEGINNING YEAR ENDING YEAR <input type="checkbox"/> UNKNOWN	

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED

Various radionuclides, asbestos, polynuclear aromatics, and other non-radiological chemicals and heavy metals. For additional information see Sections 5.0 and 6.0.

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION

Given that extensive remedial action has been conducted at the site and access is controlled, the site poses little threat to the environment and the public. Sections 5.0, 6.0, and 7.0 provide information supporting this conclusion.

V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)

☐ A. HIGH (Inspection required promptly) ☐ B. MEDIUM (Inspection required) ☐ C. LOW (Inspect on time available basis) ☒ D. NONE (No further action needed, complete current disposition form)

VI. INFORMATION AVAILABLE FROM

01 CONTACT Lester K. Price, Director	02 OF (Agency/Organization) Department of Energy		03 TELEPHONE NUMBER (615) 576-0948	
04 PERSON RESPONSIBLE FOR ASSESSMENT Steven K. Oldham	05 AGENCY DOE	06 ORGANIZATION N/A	07 TELEPHONE NUMBER (615) 576-0948	08 DATE 5/14/90 MONTH DAY YEAR



POTENTIAL HAZARDOUS WASTE SITE  
PRELIMINARY ASSESSMENT  
PART 2 - WASTE INFORMATION

I. IDENTIFICATION  
01 STATE 02 SITE NUMBER  
NY 0890137985

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES (Check all that apply) <input checked="" type="checkbox"/> A SOLID <input type="checkbox"/> B POWDER, FINES <input checked="" type="checkbox"/> C SLUDGE <input type="checkbox"/> D OTHER _____ (Specify) <input type="checkbox"/> E SLURRY <input type="checkbox"/> F LIQUID <input type="checkbox"/> G GAS	02 WASTE QUANTITY AT SITE (Measures of waste quantities must be independent) TONS _____ CUBIC YARDS <u>app 250,000</u> NO OF DRUMS <u>32</u>	03 WASTE CHARACTERISTICS (Check all that apply) <input type="checkbox"/> A TOXIC <input type="checkbox"/> B CORROSIVE <input checked="" type="checkbox"/> C RADIOACTIVE <input type="checkbox"/> D PERSISTENT <input type="checkbox"/> E SOLUBLE <input type="checkbox"/> F INFECTIOUS <input type="checkbox"/> G FLAMMABLE <input type="checkbox"/> H IGNITABLE <input type="checkbox"/> I HIGHLY VOLATILE <input type="checkbox"/> J EXPLOSIVE <input type="checkbox"/> K REACTIVE <input type="checkbox"/> L INCOMPATIBLE <input type="checkbox"/> M NOT APPLICABLE
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III. WASTE TYPE

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE	32	55 gal drums	
OLW	OILY WASTE			These drums contain a tar-like
SOL	SOLVENTS			substance containing Polynuclear
PSD	PESTICIDES			aromatics and radionuclides.
OCC	OTHER ORGANIC CHEMICALS			Section 6.0 provides additional
IOC	INORGANIC CHEMICALS			information on these drums.
ACD	ACIDS			
BAS	BASES			
MES	HEAVY METALS			

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently used CAS Numbers)

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/ DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
	Radioactive Residues and Radiologically contaminated Soil	999	These materials are stored in the waste containment facility.		
	Asbestos	999	Building 401 presently contains Asbestos		
	Polynuclear Aromatics	999	Drums in Building 401		
			Additional information on these substances is provided in Sections 5.0 and 6.0.		

V. FEEDSTOCKS (See Appendix for CAS Numbers)

CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS	Not Applicable		FDS		
FDS	See Section 3.0		FDS		
FDS			FDS		
FDS			FDS		

VI. SOURCES OF INFORMATION (See specific references, e.g., state files, sample analysis, reports)

Various publications by Battelle Columbus Laboratories, Bechtel National, Inc. and DOE

list of supporting documents is provided in Section 8.0.



POTENTIAL HAZARDOUS WASTE SITE  
PRELIMINARY ASSESSMENT

PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION

01 STATE 02 SITE NUMBER  
NY 0890137985

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 ☐ A GROUNDWATER CONTAMINATION 02 ☐ OBSERVED (DATE \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED  
03 POPULATION POTENTIALLY AFFECTED \_\_\_\_\_ 04 NARRATIVE DESCRIPTION

Groundwater monitoring indicates that groundwater quality is in compliance with DOE criteria. Section 7.0 provides a summary of groundwater monitoring results.

01 ☐ B SURFACE WATER CONTAMINATION 02 ☐ OBSERVED (DATE \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED  
03 POPULATION POTENTIALLY AFFECTED \_\_\_\_\_ 04 NARRATIVE DESCRIPTION

Surface water monitoring indicates that surface water quality is in compliance with DOE criteria. Section 7.0 provides a summary of surface water monitoring results.

01 ☐ C CONTAMINATION OF AIR 02 ☐ OBSERVED (DATE \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED  
03 POPULATION POTENTIALLY AFFECTED \_\_\_\_\_ 04 NARRATIVE DESCRIPTION

Air monitoring indicates that air quality is in compliance with DOE criteria. Section 7.0 provides a summary of air monitoring results.

01 ☐ D FIRE/EXPLOSIVE CONDITIONS 02 ☐ OBSERVED (DATE \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED  
03 POPULATION POTENTIALLY AFFECTED \_\_\_\_\_ 04 NARRATIVE DESCRIPTION

01 ☐ E DIRECT CONTACT 02 ☐ OBSERVED (DATE \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED  
03 POPULATION POTENTIALLY AFFECTED \_\_\_\_\_ 04 NARRATIVE DESCRIPTION

Site is fenced and secured by on-site personnel during working hours.  
See supporting documentation Sections 3.0 and 7.0.

01 ☐ F. CONTAMINATION OF SOIL 02 ☐ OBSERVED (DATE \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED  
03 AREA POTENTIALLY AFFECTED: \_\_\_\_\_ (Acres) 04 NARRATIVE DESCRIPTION

Very little contaminated soil remains outside the waste containment facility. Required remedial action is nearly completed. See Sections 5.0 and 6.0 for supporting documentation.

01 ☐ G. DRINKING WATER CONTAMINATION 02 ☐ OBSERVED (DATE \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED  
03 POPULATION POTENTIALLY AFFECTED \_\_\_\_\_ 04 NARRATIVE DESCRIPTION

01 ☐ H. WORKER EXPOSURE/INJURY 02 ☐ OBSERVED (DATE \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED  
03 WORKERS POTENTIALLY AFFECTED: \_\_\_\_\_ 04 NARRATIVE DESCRIPTION

01 ☐ I. POPULATION EXPOSURE/INJURY 02 ☐ OBSERVED (DATE \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED  
03 POPULATION POTENTIALLY AFFECTED \_\_\_\_\_ 04 NARRATIVE DESCRIPTION



POTENTIAL HAZARDOUS WASTE SITE  
PRELIMINARY ASSESSMENT  
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION

01 STATE 02 SITE NUMBER  
NY 0890137985

II. HAZARDOUS CONDITIONS AND INCIDENTS (Continued)

01 ☐ J. DAMAGE TO FLORA  
04 NARRATIVE DESCRIPTION

02 ☐ OBSERVED (DATE: \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED

01 ☐ K. DAMAGE TO FAUNA  
04 NARRATIVE DESCRIPTION (include name(s) of species)

02 ☐ OBSERVED (DATE: \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED

01 ☐ L. CONTAMINATION OF FOOD CHAIN  
04 NARRATIVE DESCRIPTION

02 ☐ OBSERVED (DATE: \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED

01 ☐ M. UNSTABLE CONTAINMENT OF WASTES  
(Spills, runoff, standing liquids, leaking drums)

03 POPULATION POTENTIALLY AFFECTED: \_\_\_\_\_ 04 NARRATIVE DESCRIPTION

02 ☐ OBSERVED (DATE: \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED

01 ☒ N. DAMAGE TO OFFSITE PROPERTY  
04 NARRATIVE DESCRIPTION

02 ☐ OBSERVED (DATE: \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED

designated properties were remediated by 1988.

01 ☐ O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs  
04 NARRATIVE DESCRIPTION

02 ☐ OBSERVED (DATE: \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED

01 ☐ P. ILLEGAL/UNAUTHORIZED DUMPING  
04 NARRATIVE DESCRIPTION

02 ☐ OBSERVED (DATE: \_\_\_\_\_) ☐ POTENTIAL ☐ ALLEGED

05 DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR ALLEGED HAZARDS

III. TOTAL POPULATION POTENTIALLY AFFECTED: See Sections 4.0 and 7.0

IV. COMMENTS

V. SOURCES OF INFORMATION (See specific references, e.g., State files, sample analysis reports)

tion 8.0 provides a list of documents used as sources.

### 3.0 BACKGROUND

NFSS is a U.S. Department of Energy (DOE) facility. The site now covers approximately 77 ha (191 acres) and is used for storage of radioactive residues and contaminated soils and rubble. The site is located approximately 16 km (10 mi) north of the City of Niagara Falls and lies within the Township of Lewiston, New York (Figure 3-1).

DOE manages NFSS as part of its Surplus Facilities Management program (SFMP). However, corrective actions at the site have been accomplished through DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP was initiated in 1974 to identify, decontaminate, or control sites that became contaminated as a result of the early days of the nation's atomic energy program.

Bechtel National, Inc. (BNI), DOE's project management contractor for FUSRAP, is responsible for planning and executing remedial action at NFSS with DOE approval. BNI currently maintains site security, performs maintenance as required, and implements the environmental monitoring program. Access to the site is controlled by a fence 2 m (7 ft) high that encloses the DOE property.

#### 3.1 SITE HISTORY

NFSS and adjacent vicinity properties were part of the U.S. Army's original 3,040-ha (7,500-acre) Lake Ontario Ordnance Works (LOOW), constructed to be used for trinitrotoluene (TNT) production early in World War II. TNT production was never initiated and the LOOW was reassigned to the Manhattan Engineer District (MED).

From 1944 to 1947, MED used the LOOW as a storage facility for uranium ore processing residues from a ceramics plant operated by Linde Air Products in Tonawanda, New York. By 1948, 2,430 ha (6,000 acres) of the LOOW had been transferred or sold by the War Assets Administration, with ownership of the remaining 607 ha (1,500 acres) given to the newly formed Atomic Energy Commission

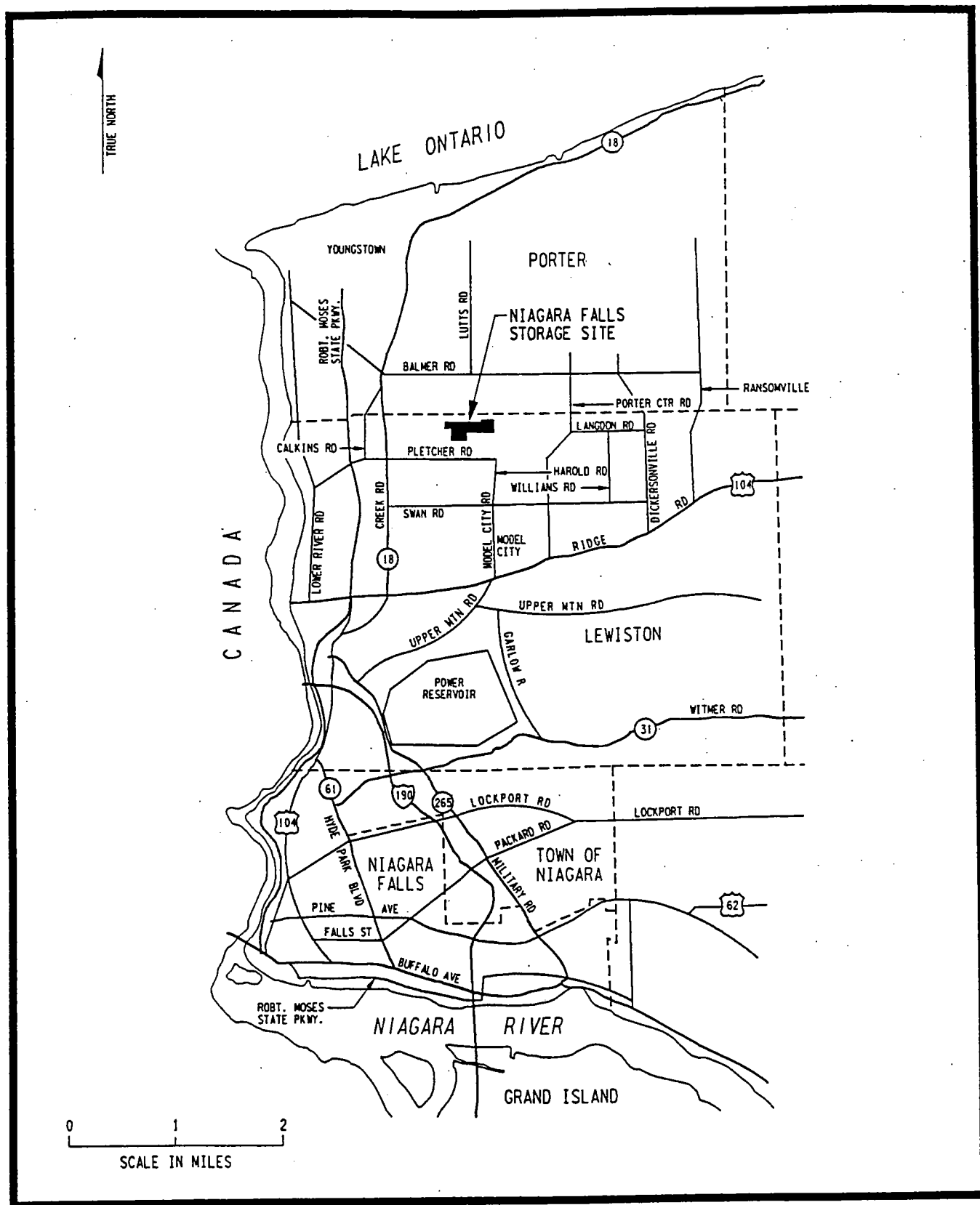


FIGURE 3-1 LOCATION OF NFSS

(AEC). AEC continued to use the site to store additional residues from the Linde plant, as well as residues from Mallinckrodt Chemical Works in St. Louis, Missouri, and other sources.

In addition to storage of uranium ore processing residues, the LOOW was used for interim storage of uranium metal billets (rods) manufactured at the Simonds Saw and Steel Company's plant in Lockport, New York, and as a disposal site for radioactive material wastes from the Knolls Atomic Power Laboratory in Schenectady, New York; the University of Rochester in Rochester, New York; and the MED/AEC Middlesex Sampling Plant in Middlesex, New Jersey. Other probable sources of radioactive materials at the LOOW include the Harshaw Chemical Company in Cleveland, Ohio; Electromet in Niagara Falls, New York; Eldorado Mining and Refining, Ltd. in Port Hope, Ontario; Allegheny Ludlum Steel Company in Watervliet, New York; and Vitro Corporation of America in Grand Junction, Colorado.

On-site storage operations ceased by 1953, and an on-site steam plant was modified to separate nonradioactive isotopes of boron. The plant was in operation between 1953 and 1959 and again between 1965 and 1971. During the first period, a major cleanup of the site included consolidating and removing surface debris and shipping most of these wastes to Oak Ridge, Tennessee. Radioactively contaminated soils and residues were left at the site. Buildings and other features of NFSS existing before remedial actions are illustrated in Figure 3-2.

A significant amount of remedial action has been conducted at the site. Subsection 5.2 presents a chronological summary of the remedial action performed to date.

### 3.2 OWNER HISTORY

In 1944, MED began storage of radioactive low-grade pitchblende residues on a portion of the LOOW. Before this time, the site served as an Army base, on both active and inactive status.



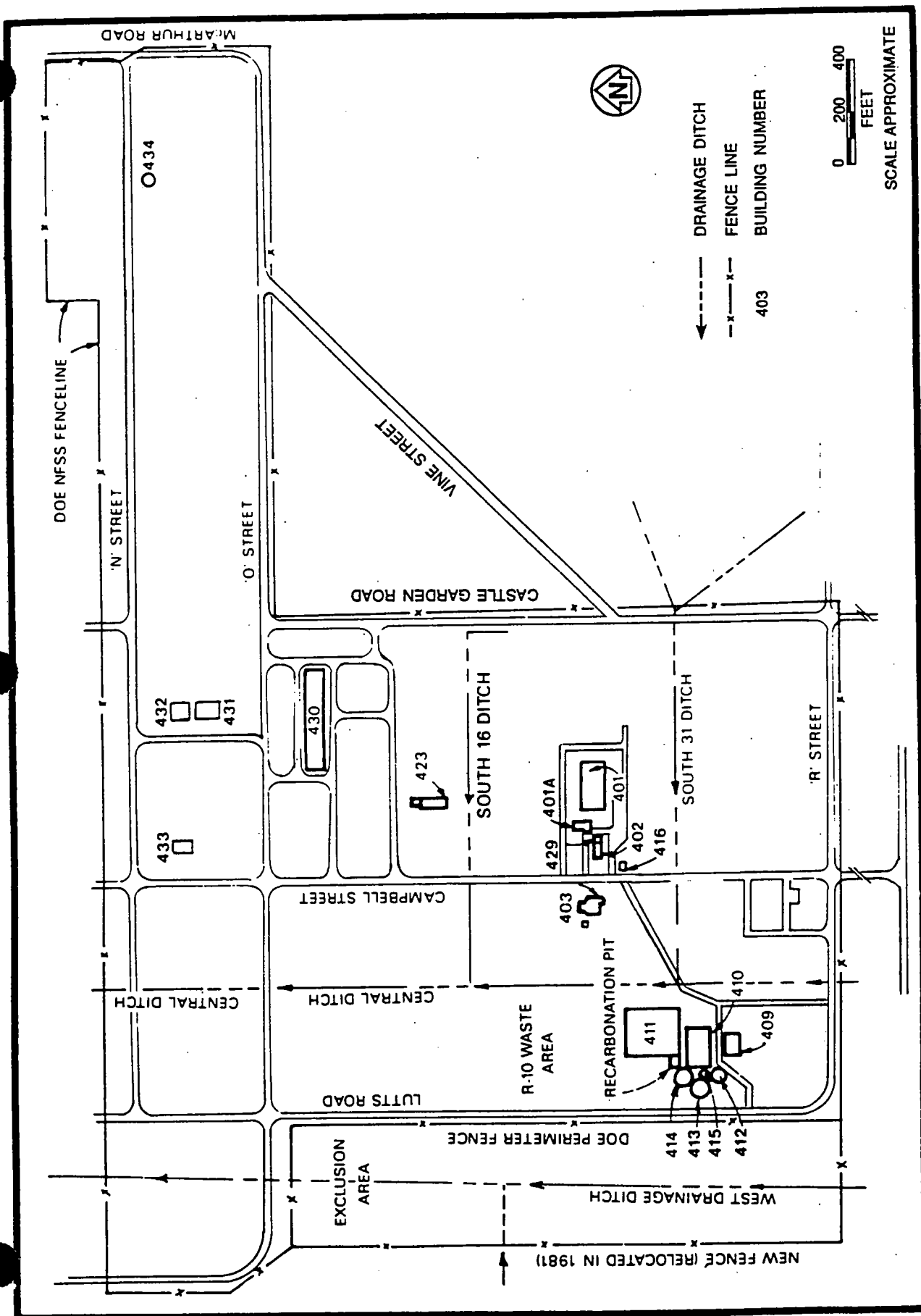


FIGURE 3-2 NFSS PRIOR TO REMEDIAL ACTIONS

In 1948, when the Department of Defense decommissioned the site, AEC acquired 607 ha (1,500 acres) that included residue storage areas. During the late 1940s and early 1950s, additional residues and other contaminated wastes were transported to the site from other eastern and midwestern states.

The site was converted and used by AEC (and later the Energy Research and Development Administration) for boron-10 production. Once production was stopped, the boron facility equipment was removed and the site was maintained as a storage facility.

By 1968, most of the property acquired by AEC had been disposed of through the General Services Administration as surplus, leaving 86 ha (213 acres). In 1975, an additional 9 ha (22 acres) was transferred to the town of Lewiston, New York.

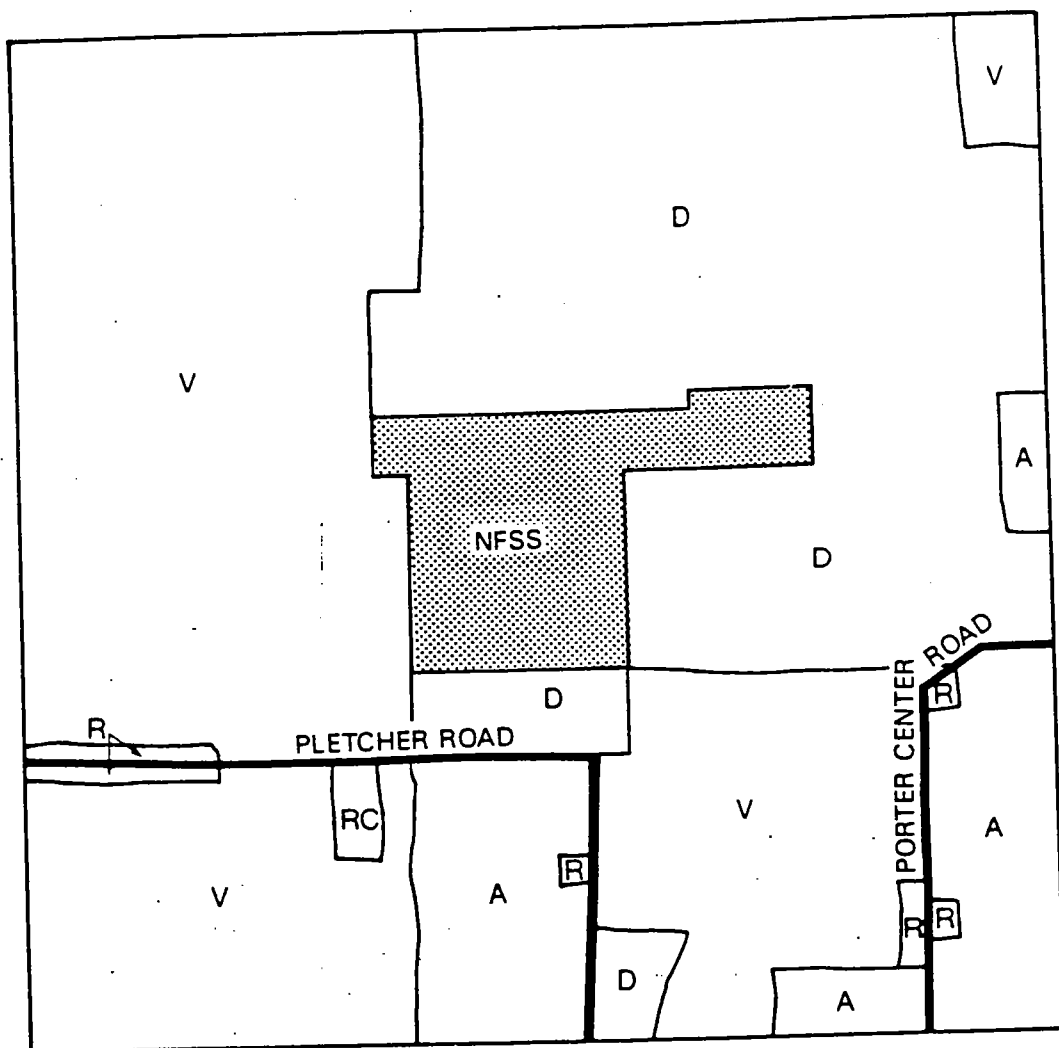
#### 4.0 DESCRIPTION OF VICINITY POPULATIONS AND LAND USE

The primary centers of population near NFSS are the towns of Lewiston, Porter, Niagara, and Niagara Falls City--all in Niagara County. From 1970 to 1980, there was a small decline in population in Niagara County and Porter, a small increase in Lewiston, and somewhat larger population changes in the Town of Niagara (+15 percent) and in Niagara Falls City (-17 percent) (DOE 1986a).

Almost three-quarters of the population of Niagara County live in urban areas. Population density in Niagara County in 1980 was about 170 persons/km<sup>2</sup>. The populations located within a 16-km (10-mi) and an 80-km (50-mi) radius of NFSS are estimated at 140,000 and 3,800,000, respectively, including populations of both the United States and Canada (DOE 1986a).

The permanent residence nearest to the waste containment area is 1.1 km (0.7 mi) southwest, and there is a trailer park 2.6 km (1.6 mi) northwest of the site. Schools are located approximately 2.4 km (1.5 mi) west of the site (DOE 1986a).

Land uses within the townships of Lewiston and Porter are predominantly rural and include row-crop agriculture, orchards, recreational areas, abandoned fields, and forests. Land uses immediately adjacent to the site are varied (see Figure 4-1). A hazardous waste disposal facility is located north of the site, and a sanitary landfill is adjacent to the east side. The property just south of the site is used for storage of clean material to be used as cover in the sanitary landfill.



BASED ON AERIAL PHOTOGRAPHS, SITE VISITS, AND USGS TOPOGRAPHIC MAP, 1:24000 SCALE.  
RANSOMVILLE QUADRANGLE, (PHOTO REVISED 1980)

R RESIDENTIAL  
RC RECREATIONAL  
A AGRICULTURAL

D COMMERCIAL WASTE DISPOSAL  
V VACANT



0 ————— 0.5 MI  
0 ————— 0.8 KM

FIGURE 4-1 GENERALIZED LAND USE IN THE VICINITY OF NFSS

## 5.0 MANAGEMENT OF RADIOACTIVE WASTES

Radioactive contamination on the 607-ha (1,500-acre) site was characterized by Battelle Columbus Laboratories and Oak Ridge Associated Universities (ORAU). Following identification of the radioactively contaminated areas, remedial action was initiated in 1982. While remedial action was being conducted to comply with the National Environmental Policy Act, DOE prepared and published an environmental impact statement for the site (DOE 1986a). A record of decision (ROD) for the site was published in 1986 (DOE 1986b). In 1987, EPA concurred on this ROD with the exception of the long-term disposition of the K-65 residues. To date, virtually all radioactive contamination has been remediated and is stabilized in the interim waste containment facility (IWCF) described in Subsection 5.3. The only exceptions to this are (1) approximately 2,450 m<sup>3</sup> (3,200 yd<sup>3</sup>) of soil stored on a concrete pad where Building 430 once stood and (2) a small area of contamination remaining in situ that will be excavated in 1991. The soil on the concrete pad was excavated following closure of the main cell; it will be incorporated into the main pile when the final cap is placed on the cell.

Following completion of the radiological cleanups, ORAU (the independent verification contractor for FUSRAP) certified that the site complies with current radiological cleanup guidelines.

Subsection 5.1 describes the various types of waste that were remediated. Subsection 5.2 gives a chronological summary of the remedial action activities at NFSS, and Subsection 5.3 presents information on the design of the IWCF.

### 5.1 WASTE IDENTIFICATION

The weight, volume, and storage locations of the residues and sands at NFSS prior to remedial action are given in Table 5-1. This table also gives the specific building (inside the containment cell) in which the residues were placed during remedial action (refer to Figure 3-1 for building locations).

TABLE 5-1  
AMOUNTS AND STORAGE LOCATIONS OF THE MAJOR  
PITCHBLEND RESIDUES AND MIDDLESEX  
SANDS STORED AT NFSS

Residue	Volume (yd <sup>3</sup> )	Storage Location	
		Before Interim Remedial Action	After Interim Remedial Action
K-65	3,200	Building 434	Building 411, Bays A, C, and D
L-30	7,960	Building 411	Building 411, Bays B, C, and D
L-50	2,150	Buildings 413 and and 414	Buildings 413 and 414
F-32	440	Building 411, Bay A	Building 411, Bays B, C, and D
R-10	9,400	North of Building 411	Waste Containment Area North of Building 411
Middlesex Sands	229	Building 410	Building 410 Basement

The K-65 residues resulted from the processing of high-grade pitchblende ore (containing 35-60 percent uranium oxide) by a St. Louis processing plant. Based on the best available data (Battelle 1981), the K-65 residues have a uranium concentration of 1,000 to 2,000 ppm (667 to 1,334 pCi/g) and radium concentration from 180 to 360 ppb (177,840 to 355,680 pCi/g). The K-65 residues have the highest specific activity of the residues at NFSS.

The L-30 residues resulted from the processing of pitchblende ore (containing about 10 percent uranium oxide) by the Linde Ceramics Plant in Tonawanda from December 1943 through October 1944. Available data suggest uranium concentrations ranging from 400 to 5,000 ppm (269 to 3,335 pCi/g) and radium concentrations from 2 to 12 ppb (1,976 to 11,856 pCi/g) in the L-30 residues (Battelle 1981).

The L-50 residues resulted from uranium extraction of pitchblende ores containing approximately 7 percent uranium oxide. Extraction was conducted by the Linde Plant. The uranium and radium concentrations in the L-50 residues range from 100 to 4,000 ppm (67 to 2,668 pCi/g) and 7 to 12 ppb (6,916 to 11,856 pCi/g), respectively (Battelle 1981).

The F-32 residues were the result of a uranium extraction process similar to that which produced the L-30 and L-50 residues. Inventory data indicate that the uranium concentration of the pitchblende ore used by Linde ranged from 4,000 to 6,500 ppm (2,668 to 4,336 pCi/g) (Battelle 1981). The radium concentration is estimated to be 5 ppb (4,940 pCi/g).

The R-10 residues resulted from the processing of ore containing 3.5 percent uranium oxide. The R-10 residues were stored on the ground north of Building 411, and the initial residue inventory suggested a uranium concentration of approximately 2,300 ppm (1,534 pCi/g). The radium concentration in the residues is estimated to be 3 ppb (2,964 pCi/g) (Battelle 1981).

The Middlesex sands are the result of decontamination activities (sandblasting) conducted at the Middlesex Sampling Plant. Measurements made during the Battelle site characterization

indicated levels of less than 100 ppm (67 pCi/g) for uranium and less than 0.01 ppb (10 pCi/g) for radium-226 (Battelle 1981).

## 5.2 REMEDIAL ACTION

Various cleanup activities have been conducted at NFSS. In 1972, approximately 11,469 m<sup>3</sup> (15,000 yd<sup>3</sup>) of contaminated material was excavated from off-site areas and placed on the R-10 pile. During 1981, remedial action activities were performed to clean up contaminated materials located in an area just east of NFSS. Approximately 344 m<sup>3</sup> (450 yd<sup>3</sup>) of material was excavated from the area and returned to NFSS. In 1982, cleanup activities were accelerated and a detailed interim remedial action plan was developed. Most of the steps of this plan have already been accomplished and are described below.

### 5.2.1 1982 Remedial Action Activities

In 1982, BNI and its subcontractors completed work on two major interim remedial actions at NFSS. These included stabilizing the R-10 residues and upgrading and sealing Buildings 413 and 414.

The purposes of the R-10 residue stabilization were to control off-site migration of radioactive materials from the R-10 pile and to reduce radon emanation. Stabilization included clearing and grubbing of the surrounding area, moving approximately 12,004 m<sup>3</sup> (15,700 yd<sup>3</sup>) of contaminated soil near the R-10 pile onto the cleared pile, and constructing a clay dike and cutoff wall around the R-10 pile. The top of the R-10 pile was graded and covered with an ethylene propylene diene monomer (EPDM) liner.

The purpose of the actions at Buildings 413 and 414 was to reduce emissions of radon from L-50 residues stored in these buildings. Roof materials were removed and the troughs that encircle the inside of the buildings near the top of the residues were filled with concrete. Several layers of materials were placed over the residues: sand, synthetic rubber (Hypalon),



and/or sealed to close pathways for possible migration of radionuclides and to prevent future subsidence of compacted wastes.

In addition, work was performed on several buildings in the IWCF. The dilapidated roof of Building 411 was removed and some work was done on the interior of the building to prepare for the residue transfer, dewatering, and stabilization activities. Openings and pipes into Building 410 were also sealed to prepare the building for storing water during residue transfer operations in Building 411. Building 412 was demolished to permit construction of the new dike/cutoff wall.

### 5.2.3 1984 Remedial Action Activities

During 1984, decontamination was completed on 11 of the vicinity properties and some remaining on-site areas of localized contamination. In addition, 2,100 m (6,900 ft) of the Central Drainage Ditch was decontaminated from the Balmer Road intersection to 457 m (1,500 ft) north of Lutts Road. The contaminated soil and rubble from the cleanup of these areas totaled approximately 22,468 m<sup>3</sup> (29,385 yd<sup>3</sup>), and all but 2,753 m<sup>3</sup> (3,600 yd<sup>3</sup>) was placed in the waste containment area. The 2,753 m<sup>3</sup> (3,600 yd<sup>3</sup>) of material from the Central Drainage Ditch north of Lutts Road was placed on the bank for the winter and transported to the waste containment area in 1985.

Meanwhile, the south dike portion of the waste containment area was completed, forming the final segment of the cutoff wall. Also during 1984, Building 410 and the upper portion of Building 415 were demolished, clearing the way for final development and use of the southern portion of the waste containment area. The 0.9-m- (3-ft-) thick clay layer of the interim cap was placed over the northern portion, or about 40 percent, of the waste containment area.

The other major work in 1984 centered on the activities to turn Building 411 into an interim storage area for the L-30, F-32, and K-65 residues. This work included residue transfer and dewatering activities within Building 411 and slurry transfer of the K-65 residues from Building 434 to Building 411.

Figure 3-1 shows Building 411 and the Recarbonation Pit, hereinafter referred to as Bay A of Building 411. The F-32 residues in Bay A were transferred to Bay D, and an underdrain system consisting of slotted polyvinyl chloride (PVC) pipe covered with a layer of sand was placed in the bottom of Bay A. Bay A became a receptacle for the excess water covering residues in other bays of Building 411, and, in connection with Building 410, allowed dewatering and treatment of water to occur.

The F-32 and L-30 residues in Bays B and C also were transferred to Bay D. Bays B and C were then cleaned and underdrain systems were installed. Some vacuum dewatering was performed as a test (actual dewatering began in 1985).

Workers began transferring the K-65 residues from Building 434 to Bay C of Building 411. Working first atop the K-65 tower and later from scaffolding erected along the side, the subcontractor cut openings into the concrete structure to allow hydraulic mining equipment to be inserted. The residues were hydraulically mined and slurry-transferred to Building 411 via a 4-in. steel pipeline. Through the end of 1984 and into early 1985, approximately 75 percent of the residues were transferred in this manner.

#### 5.2.4 1985 Remedial Action Activities

Starting in May 1985, the K-65 residues remaining (25 percent) in Building 434 were transferred to Bay A of Building 411. In total, 516 m<sup>3</sup> (675 yd<sup>3</sup>) of residues and rubble from the inner and outer domes of Building 434 were transferred to the waste containment area. Following removal of these residues the building was completely demolished and the equipment and support facilities used in the transfer operation were decontaminated. Rubble from the above-grade and sub-grade portions of the building was transferred to the waste containment area.

Excavation of contaminated areas on and off site was completed except for 1,453 m<sup>3</sup> (1,900 yd<sup>3</sup>) of material in the area where Building 434 originally stood and three newly discovered hot spots near Lewiston and Niagara Falls. The excavated material was

placed in the waste containment area. The major portion of the interim cap over the waste containment area was also completed, leaving only the section over Building 411 to be completed after transfers of contaminated soil to the waste containment area are complete.

Excavation was performed in the area around Building 434, in on-site road shoulders and ditches, and on the 10 remaining vicinity properties. On-site excavations yielded 8,411 m<sup>3</sup> (11,000 yd<sup>3</sup>) of material; vicinity property cleanup produced 4,817 m<sup>3</sup> (6,300 yd<sup>3</sup>). The latter included 2,753 m<sup>3</sup> (3,600 yd<sup>3</sup>) of soil and sediments removed from the bank of the Central Drainage Ditch, where they had been placed in 1984. Originally, a 914-m (3,000-ft) section of the Central Drainage Ditch was to have been excavated in 1985. However, because the residual contamination generally averaged less than 5 pCi/g over contiguous 100-m<sup>2</sup> (1,076-ft<sup>2</sup>) areas along this section of the ditch and the current DOE easement would be retained (thereby prohibiting construction of residences near the ditch), it was determined that no excavation was necessary.

Water remaining in the K-65 pond beside Building 434 was transferred to Building 411; a 15-cm- (6-in.-) deep residual sediment layer, the pond EPDM liner, and contaminated soil beneath the liner were removed and placed in the containment area. The metal pipeline used in the 1984 slurry transfer operation was cut into sections that were placed in a trench dug along the side of Building 411 and buried in fillcrete. PVC piping used in the slurry transfer operation was crushed and buried in the containment area.

In the early spring, L-30 and F-32 residues in Bay D of Building 411 were transferred to Bays B and C. After the residues were emplaced, vertical drainage wicks were added, and a vacuum seal consisting of approximately 0.9 m (3 ft) of clay was placed atop the residues to keep radon emissions under control and to act as a surcharge to facilitate removal of the remaining water covering the residues. The underdrain dewatering system was then made operative. As the residues in Bays B and C were dewatered and

consolidated, they were covered with contaminated soil from continuing cleanup activities.

Remedial action was also performed on two other on-site buildings (Building 409 and 401). The superstructure, basement walls, and floor slab of Building 409 were decontaminated after treated water held in the building was pumped to the new Pond 3 for treatment; three beams in Building 401 were decontaminated and removed.

Near the end of these activities, several small areas of contamination along Pletcher Road were discovered, characterized, and excavated. Off-site work also included excavation on the Chemical Waste Management, Inc. property north of NFSS. This material was analyzed for hazardous chemicals to determine whether their concentrations were low enough to permit disposal as noncontaminated material in the waste containment area. Since analytical results showed the material to be only radioactively contaminated, it was placed in the IWCF.

In 1985 various other subcontracts were awarded to support the major work described above. These included the construction of water treatment ponds, water treatment and discharge, water sampling and analysis, surveying, and site services. Water treatment proceeded slowly in the early summer and began to inhibit residue placement and dewatering operations at Building 411. To permit these critical activities to proceed, two large ponds (Ponds 3 and 4) were constructed east of the waste containment area to contain a total of 4.8 million gallons of water during treatment and while awaiting release. Approximately 3.1 million gallons were treated and discharged into the Central Drainage Ditch in accordance with the terms of New York Pollutant Discharge Elimination System permit No. 0110469. Ponds 1 and 2 immediately north of the waste containment area were cleaned and restored to original grade.

#### **5.2.5 1986 Remedial Action Activities**

All off-site contaminated areas were cleaned up by the end of 1986, and the contaminated materials were placed in the IWCF, a

containment cell that covers approximately 4 ha (10 acres). Virtually all on-site contaminated areas were also cleaned up by the end of 1986; the contaminated materials were placed in the IWCF. The materials not placed in the IWCF by 1986 are summarized in Sections 5.0 and 6.0. The interim cap was completed in 1986 and the pile has remained closed since.

#### 5.2.6 1987 Remedial Action Activities

No quantifiable remedial action was conducted during 1987.

#### 5.2.7 1988 Remedial Action Activities

The hot spots identified by ORAU during the verification surveys were remediated in 1988, with one exception. This exception is an area north of "O" Street where volatile organics were encountered during remedial action (see Section 6.0). Approximately  $2,450 \text{ m}^3$  ( $3,200 \text{ yd}^3$ ) of radioactively contaminated soil was excavated from these hot spots and placed on the concrete pad where Building 430 once stood. The material is encapsulated with an impermeable membrane.

### 5.3 STORAGE PILE CONSTRUCTION

Most radioactive material stored at NFSS is in the IWCF. A plan view and cross section of the IWCF are shown in Figure 5-1.

The bottom of the waste containment system consists of 1.8 to 7 m (6 to 23 ft) of naturally occurring brown clay in most areas, underlain by 3.3 to 8.8 m (11 to 29 ft) of gray clay. Because of the existence of sand deposits in the brown clay, the gray clay is considered to be the primary migration barrier. It has a permeability that ranges from  $9.7 \times 10^{-9}$  to  $2 \times 10^{-7}$  cm/s (BNI 1986b).

The sidewalls of the containment system consist of a compacted clay dike and cutoff wall. The dike has a minimum width of 2.4 m (8 ft) and extends approximately 1.5 m (5 ft) above the original grade. It rests on the cutoff wall, which has a minimum width of

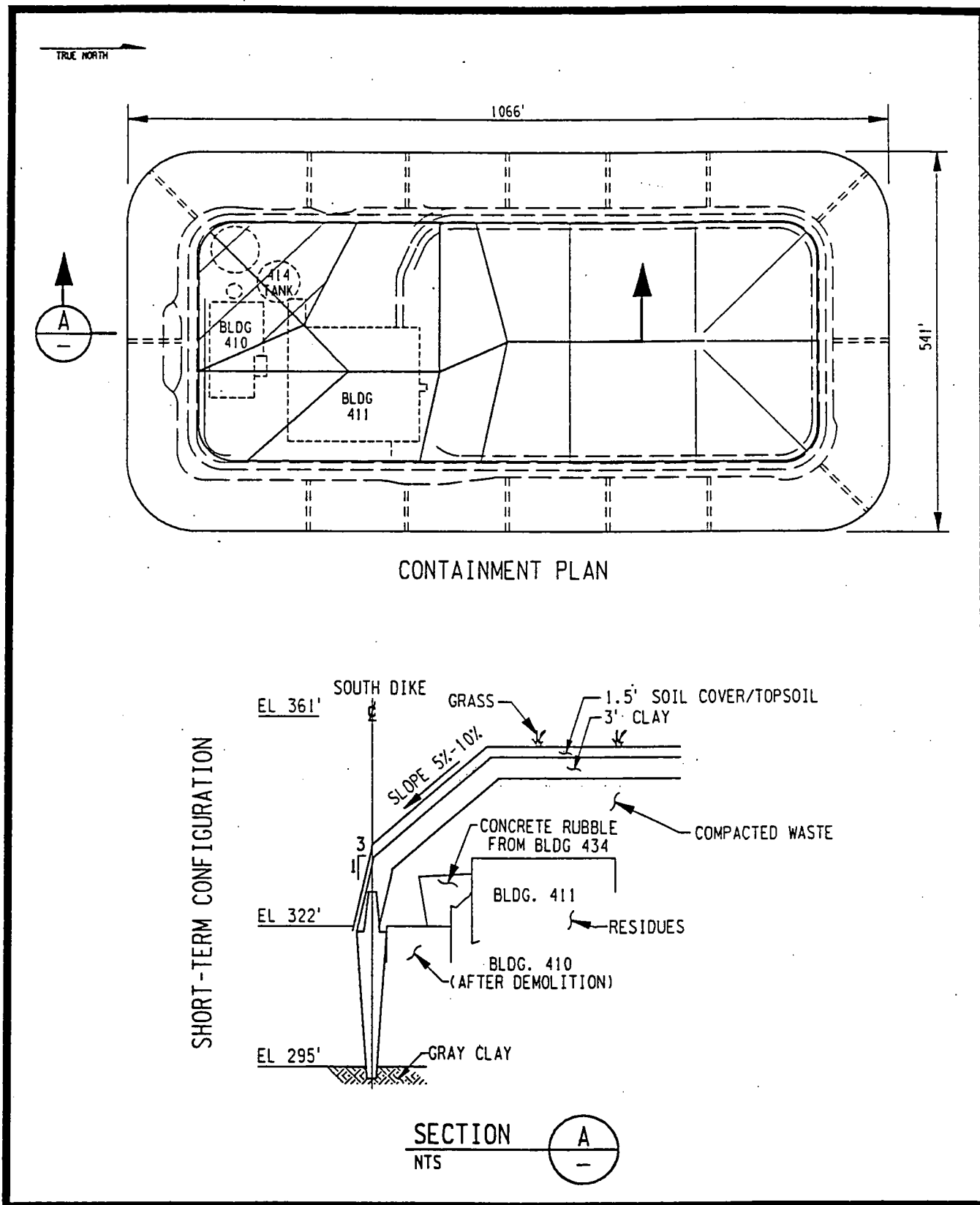


FIGURE 5-1 PLAN VIEW AND SECTION OF INTERIM WASTE CONTAINMENT FACILITY

3.6 m (12 ft) and extends at least 0.5 m (1.5 ft) into the gray clay unit. The height of the cutoff wall beneath the dike ranges between 3 and 7 m (10 and 22 ft), varying with changes in the elevation of the top of the gray clay. In general, the cutoff wall is not centered beneath the dike; rather, its location varies according to subsurface conditions (BNI 1986b).

Waste materials were placed in the containment structure in a manner that will prevent subsidence of the completed structure. Specifically, waste materials were placed in layers and compacted to 90 percent of maximum dry density. Rubble materials were deposited in layers, and the voids were grouted with fillcrete to create a consolidated, dense mass. Voids between machinery and piping were also grouted to prevent subsidence.

The interim cap for the facility is comprised of two layers. The top layer consists of 0.5 m (1.5 ft) of loosely compacted topsoil, which acts as a protective cover for the low-permeability clay layer underlying it. The topsoil layer promotes the growth of a vegetation layer, which protects the clay cap. The 0.9-m- (3-ft-) thick clay layer, which is the primary barrier against moisture and radioactive contaminant migration, was compacted to achieve a permeability of approximately  $10^{-7}$  cm/s (BNI 1986b).

Photographs of the IWCF and other areas of NFSS are provided in Appendix A.

The final storage facility will be completed by upgrading the existing waste containment structure by modifying the existing cap. The existing topsoil layer will be completely removed and 0.3 m (1 ft) of clay will be added and compacted on top of the existing clay layer to provide a total thickness of 1.2 m (4 ft). A 23-cm (9-in.) sand and gravel layer will be placed over the clay as a transition between the clay and an intrusion barrier of rock. The intrusion layer will consist of 0.9 m (3 ft) of well-graded, large rock. The surface of the rock layer will be filled in with smaller rock as a choke course, and another 23-cm (9-in.) sand-and-gravel layer will be placed above the rock layer to function as a transition between the intrusion barrier and the overlying layer. The soil layer will consist of 0.15 m (0.5 ft) of topsoil and 0.3 m

(1.0 ft) of soil material. Shallow-rooted grasses will be planted in this soil layer. The final cap design is illustrated in Figure 5-2.



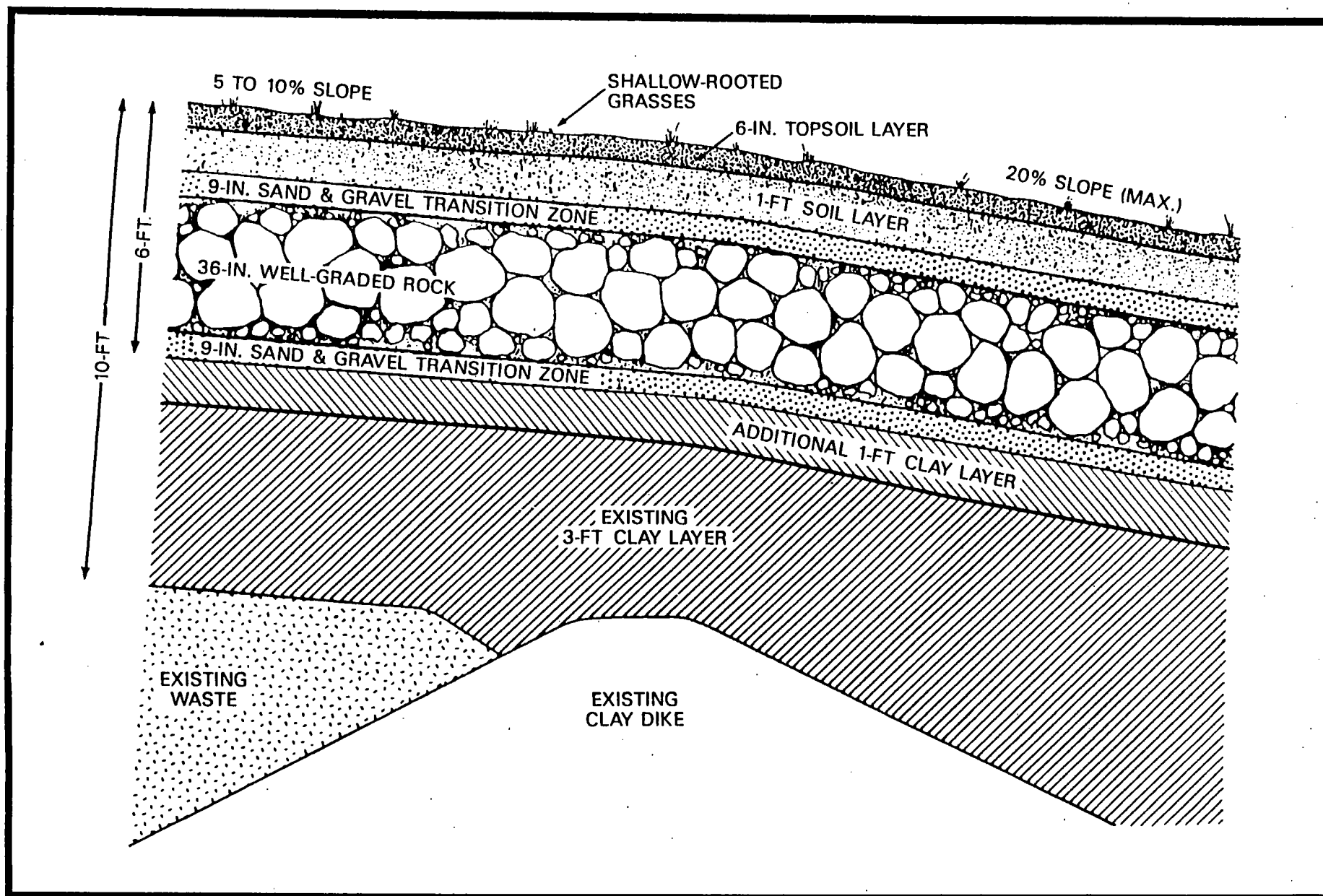


FIGURE 5-2 NFSS LONG-TERM COVER LAYERS

## 6.0 MANAGEMENT OF OTHER WASTES

This section discusses the management of wastes present at NFSS other than the radiologically contaminated soils, residues, and sands discussed in Section 5.0. Other wastes managed at NFSS include roofing material contaminated with asbestos, clean organic material (wood and brush), and drums containing a mixture of polynuclear aromatics (known to be radioactively contaminated).

In 1984, roofing material containing asbestos was removed from Buildings 409 and 410. This material was not radioactive and under the definition of 40 CFR 61 the material can be classified as a nonasbestos material. The New York State Department of Environmental Conservation approved burial of the material on site.

During the remedial actions discussed in the previous sections, organic waste such as lumber, trees, and brush was produced. This material was surveyed, determined to be nonradioactive, and placed in a landfill north of the IWCF. This waste will be left in the landfill to decompose and should not pose any hazards.

Currently, Building 401 is being used to store 32 drums of material removed from vicinity property "G" in 1986. These drums contain a mixture of polynuclear aromatics that are known to be contaminated with radium-226. Additional sampling and analysis is scheduled to be performed in 1990. When the analytical results are available, a decision will be made about where to dispose of these drums. This decision will consider all applicable disposal regulations in effect at the time of disposal.

During the remedial action at NFSS in 1988, a small area containing volatile organics was discovered. Based on the identification of this chemical hot spot, BNI developed a chemical scoping plan to be implemented during the summer of 1990. The plan is attached as Appendix B and is briefly described in the following paragraph.

Soil samples will be collected from areas known to be radioactively contaminated. The soil samples will be analyzed for heavy metals, volatiles, semivolatiles, pesticides, polychlorinated biphenyls (PCBs), and mobile ions. In addition, a soil sample

taken from the known chemical hot spot will be analyzed for characteristics of hazardous waste defined in the Resource Conservation and Recovery Act. Surface water samples will be collected and analyzed for heavy metals, volatiles, and semivolatiles. Sediment samples will be collected and analyzed for heavy metals, volatiles, semivolatiles, pesticides, PCBs, and mobile ions. In addition, a soil gas survey will be conducted as part of the chemical scoping study.

Materials used in the construction of Building 401 contain asbestos. Removal and disposal of the asbestos is scheduled to be conducted in 1991. The building itself is planned to be demolished within two years after the removal of the asbestos.

## 7.0 ENVIRONMENTAL MONITORING

An environmental monitoring program has been under way at NFSS since 1981. The program monitors groundwater, surface water, sediment, and air. The following subsections provide a brief presentation of the results of the environmental monitoring program.

### 7.1 GROUNDWATER

Groundwater at NFSS is analyzed for radiological and chemical contaminants. Groundwater sampling locations are shown in Figure 7-1. Results of radiological analysis of groundwater samples taken since 1985 and presented in Tables 7-1 and 7-2 indicate that there has been no noticeable trend in concentrations of total uranium or radium-226 in groundwater at NFSS.

Chemical analysis of groundwater at NFSS was initiated in 1987. In July 1987, 16 wells were selected for baseline chemical monitoring pursuant to 40 CFR 261, Appendix IX. Baseline quarterly monitoring began the same month and was completed in July 1988. This program included analysis for 54 volatile organic compounds; 65 semivolatile compounds on the Hazardous Substances List; 64 semivolatile compounds that are not on the Hazardous Substances List; 26 pesticides and PCBs from the EPA Contract Laboratory Program List; 12 organophosphate pesticides and 4 herbicides; 24 toxic or potentially toxic metals; and sulfides, fluorides, and cyanides.

Concentrations of most of these compounds were below the limit of detectability of the respective analytical methods. Analytical results for Appendix IX chemical constituents found to be present in detectable quantities are given in Table 7-3.

Indicator parameters, pH, total organic carbon (TOC), total organic halides (TOX), and specific conductance have been analyzed

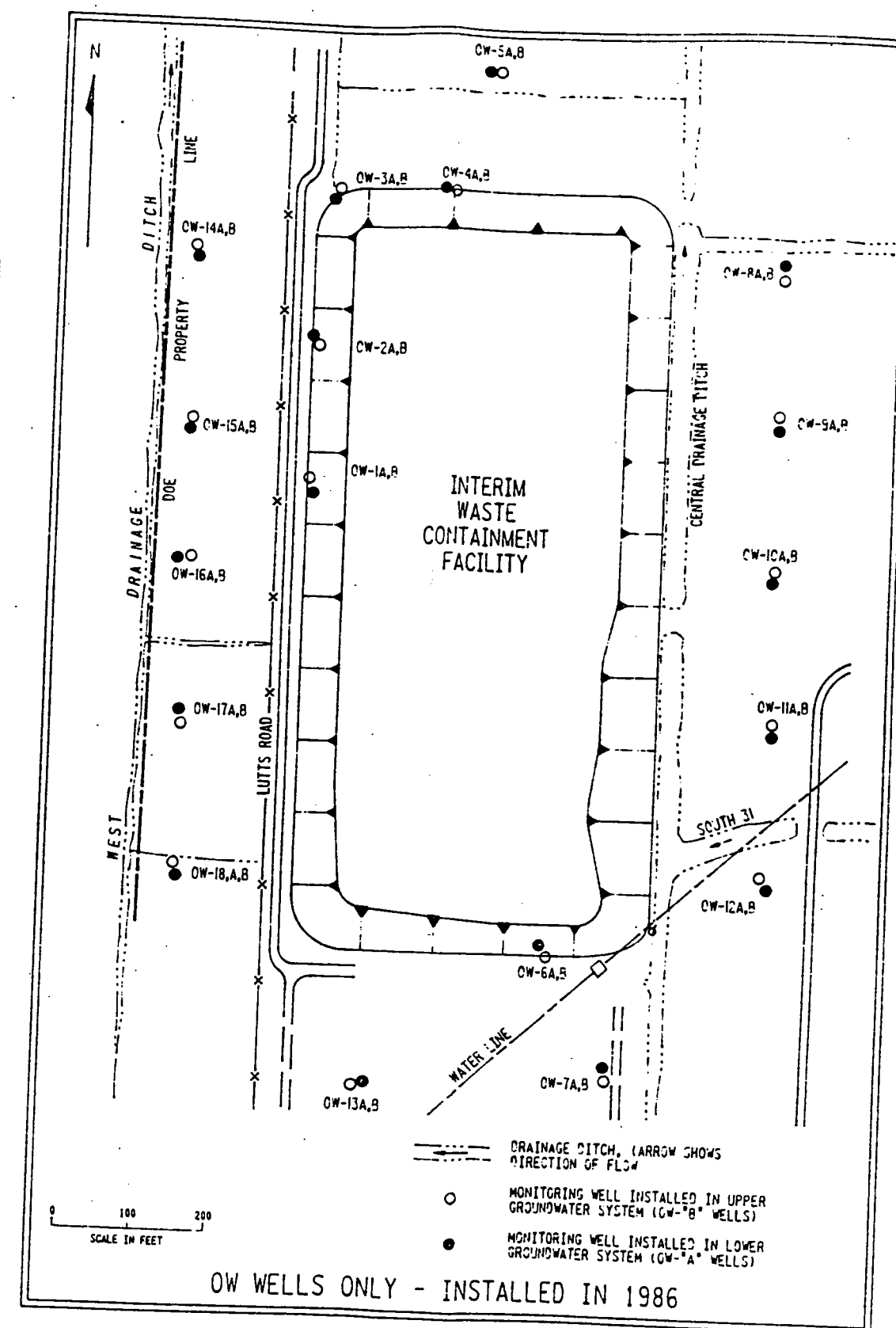
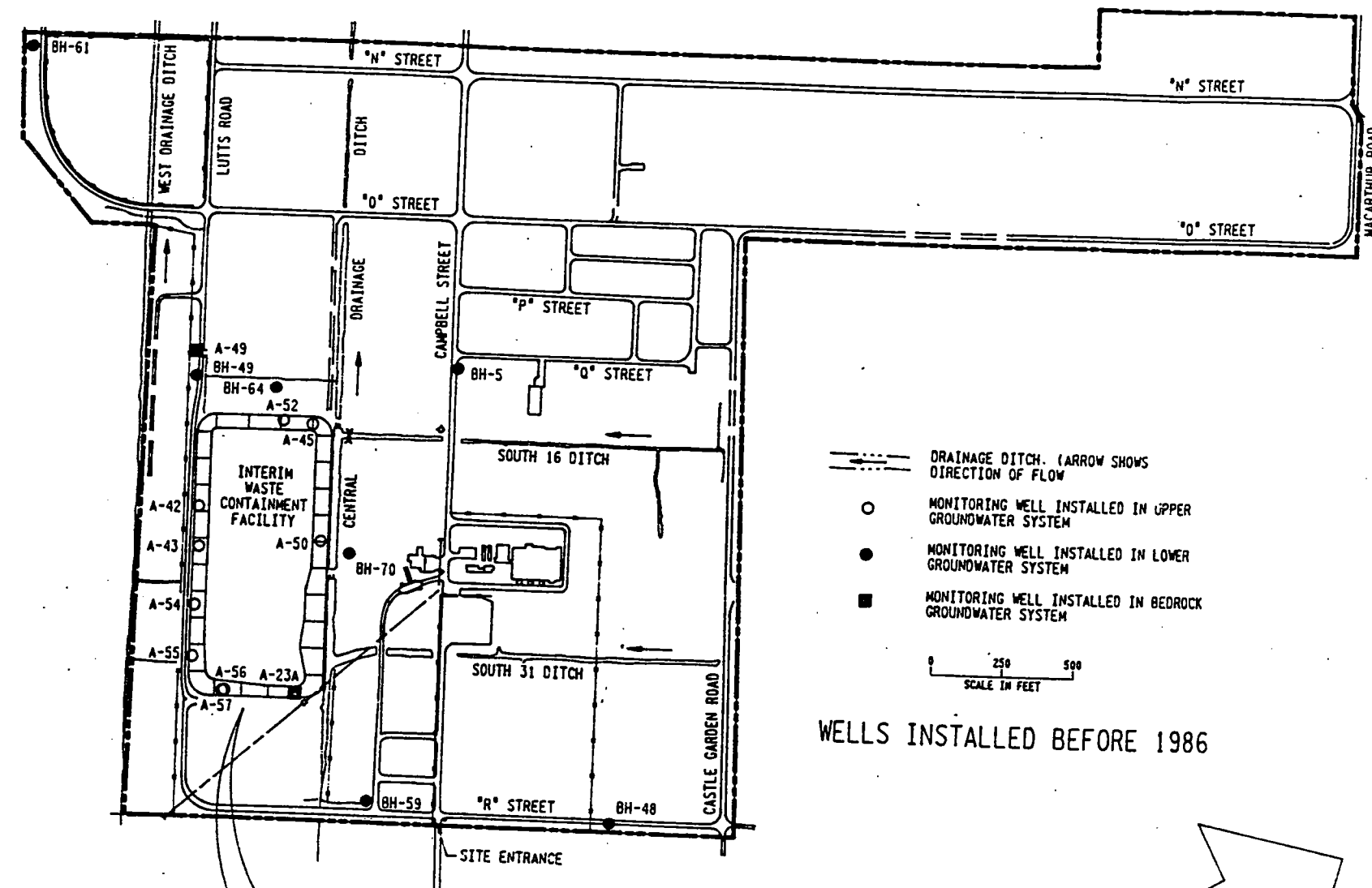


FIGURE 7-1 LOCATIONS OF GROUNDWATER MONITORING WELLS AT NFSS

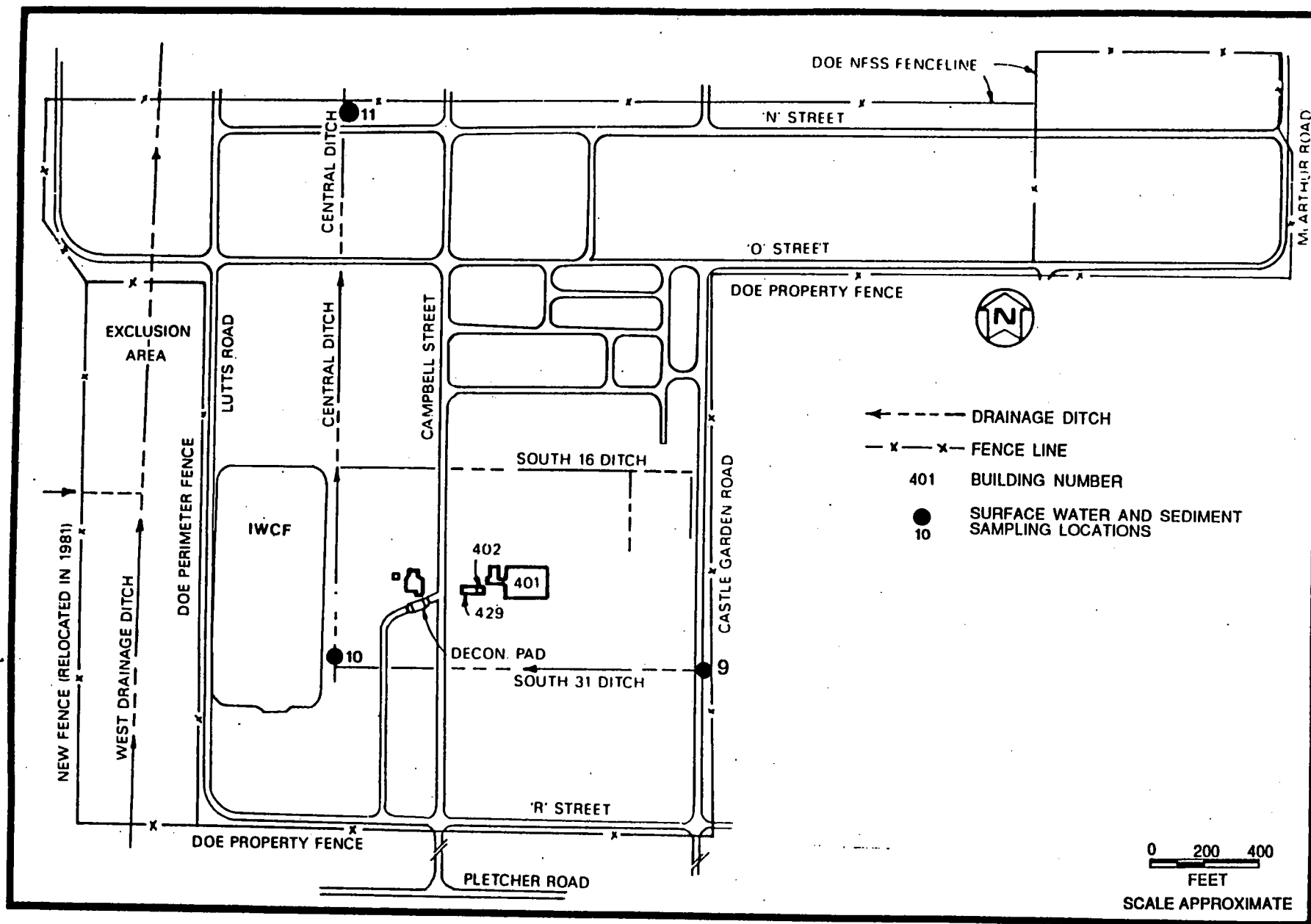


FIGURE 7-2 ON-SITE SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS AT NFSS

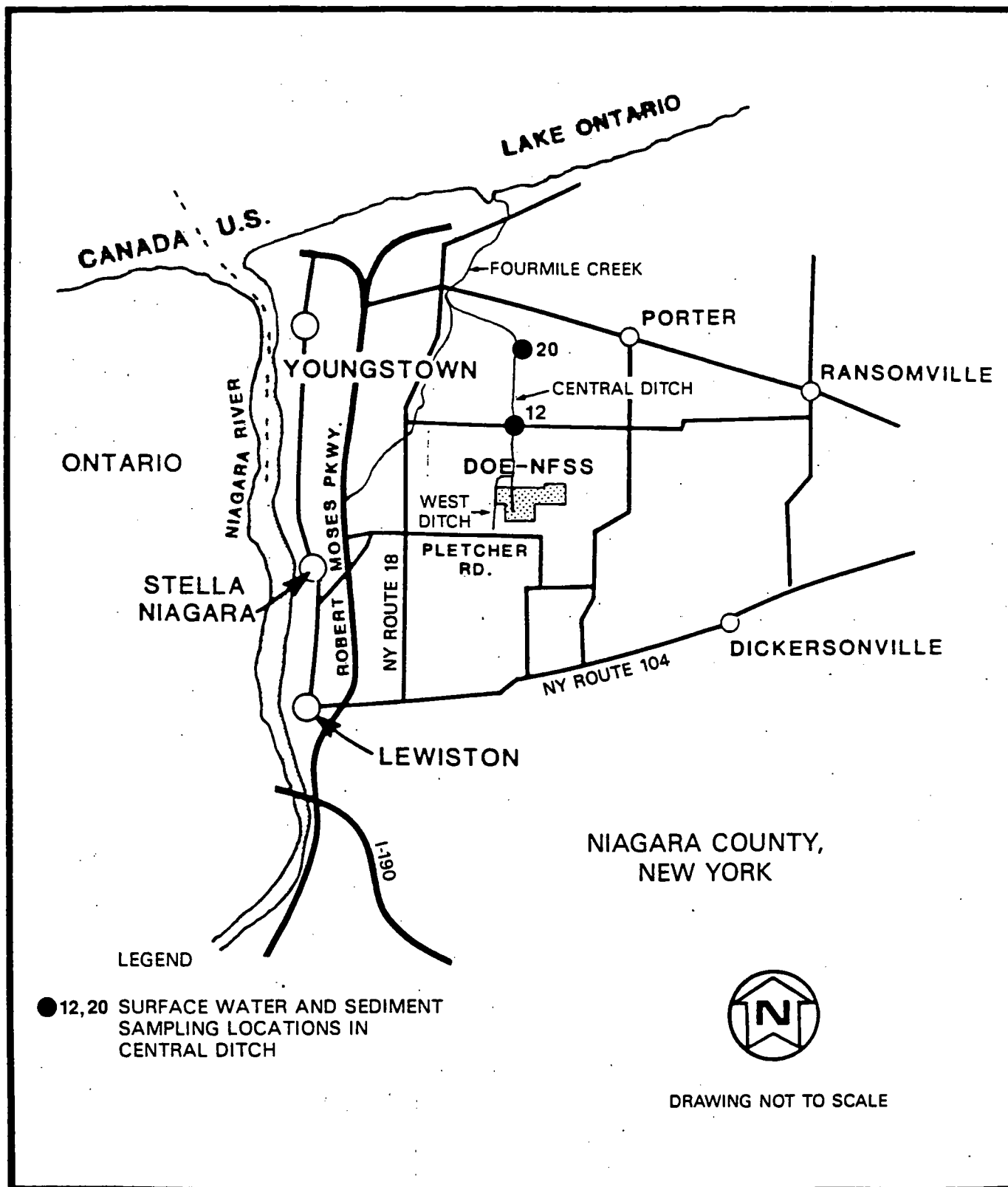


FIGURE 7-3 OFF-SITE SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS IN THE VICINITY OF NFSS

TABLE 7-2  
ANNUAL AVERAGE CONCENTRATIONS OF RADIUM-226  
IN NFSS WATER SAMPLES, 1985-1989

Sampling Location <sup>a</sup>	Concentration ( $10^{-9}$ $\mu\text{Ci/ml}$ ) <sup>b</sup>				
	1985	1986	1987	1988	1989
<u>Surface Water</u>					
<u>On Site</u>					
10	0.4	0.2	0.2	0.2	0.6
11	0.7	0.3	1.8	1.0	2.5
<u>Off Site</u>					
12	0.2	0.3	0.3	0.3	0.6
20	0.4	0.4	0.3	1.0	0.5
<u>Background</u>					
9 <sup>c</sup>	--	--	--	0.2	1.5
<u>Groundwater</u>					
<u>On Site</u>					
BH-5	0.5	0.5	0.4	0.3	0.4
BH-48 <sup>d</sup>	0.6	0.5	0.5	0.7	0.7
BH-61 <sup>e</sup>	0.5	0.3	0.3	0.3	0.4
A-42	0.5	0.6	0.2	0.5	0.6
A-50	0.7	0.5	0.3	0.3	0.5
A-52	0.2	0.3	0.2	0.3	0.6

<sup>a</sup>Sampling locations are shown in Figure 7-1 (groundwater) and Figures 7-2 and 7-3 (surface water).

Sampling locations that have existed in previous years but that no longer exist due to adjustments in the monitoring program or changes caused by remedial action are not reported in trend tables. Data from these locations would not be valid for comparisons or trends.

<sup>b</sup> $1 \times 10^{-9}$   $\mu\text{Ci/ml}$  is equivalent to 1 pCi/L.

<sup>c</sup>Location established in October 1988 at the South 31 Ditch.

<sup>d</sup>Upgradient well.

<sup>e</sup>Downgradient well.



TABLE 7-5

## INDICATOR PARAMETERS AND CONCENTRATIONS OF APPENDIX IX CHEMICAL CONTAMINANTS IN GROUNDWATER AT NFSS, 1987

Page 1 of 4

Parameter (Unit)	Range of Concentrations by Sampling Location (Monitoring Well Number) <sup>a,b,c</sup>					
	1A	1B	5A	5B <sup>d</sup>	7A	7B
Silver (µg/L)	ND	13	11.8	20.7	21.9	21.5
Aluminum (µg/L)	ND	ND	ND	ND	ND	209
Calcium (µg/L x 1000)	72.1-93.8	73.6-111	42.4-43.1	102-108	108-112	106-116
Chromium (µg/L)	37.6	38.4	41.0	73.4	75	82.2
Copper (µg/L)	29.6-139	ND	ND	41.7	ND	53.4-77.6
Iron (µg/L)	ND	ND	ND	ND	ND	163
Potassium (µg/L)	ND	18700	8670	13500	13600	ND
Magnesium (µg/L x 1000)	75.2-81.7	53.2-74.5	77.1	80.3-135	115-127	151-158
Manganese (µg/L)	280-446	29.9-379	97-266	125-259	15-234	54-184
Sodium (µg/L x 1000)	56-57.3	111-127	93	50.9-91.8	125-126	63.0-64.6
Nickel (µg/L)	4.9-155	41.1-154	77.3	49.3-119	106	114-134
Tin (µg/L)	ND	ND	ND	ND	ND	160
Zinc (µg/L)	106	27.7-94	ND	ND	ND	34.5-82
Fluoride (µg/L)	0.26	0.42-0.52	0.41-0.44	0.32	0.37-0.38	0.37-0.41
Acetone (µg/L)	230	14-24	ND	19-50	ND	ND
Bis(2 ethylhexyl) phthalate (µg/L)	10	10	ND	20	52	ND
Diphenylamine (µg/L)	ND	ND	ND	ND	ND	ND
Methylene Chloride (µg/L)	5	ND	ND	ND	ND	ND
Acetonitrile (µg/L)	ND	26	ND	ND	ND	ND
2-Butanone (µg/L)	ND	ND	ND	ND	ND	ND
PCB-1248 (µg/L)	ND	ND	ND	ND	ND	ND

TABLE 7-3  
(Continued)

Page 2 of 4

Parameter (Unit)	Range of Concentrations by Sampling Location (Monitoring Well Number) <sup>a,b,c</sup>					
	12A	12B	13A	13B	14A	14B
Silver (µg/L)	27.2	39-258	ND	15.2	14.5	16.5
Aluminum (µg/L)	203	ND	313	256	ND	ND
Calcium (µg/L x 1000)	133-147	111-137	157-158	126-139	92.0-96.7	116-117
Chromium (µg/L)	91.6	10-66.2	91.0	66.7	ND	43.3
Copper (µg/L)	40-73.3	ND	32.2	ND	54.8	ND
Iron (µg/L)	150	ND	146	ND	ND	ND
Potassium (µg/L)	ND	11500	ND	11100	ND	10900
Magnesium (µg/L x 1000)	133-148	89.7-92.4	182-183	109-119	100-107	72.6-76.7
Manganese (µg/L)	45.6-207	ND	149-746	63.7-84.9	271-669	48-288
37 Sodium (µg/L x 1000)	48.9	.0219-104	.023-58	95-110	5.8-160	152
Nickel (µg/L)	221	107-117	62.2-213	84.7	84.2-148	53.1
Tin (µg/L)	105	ND	ND	ND	104	ND
Zinc (µg/L)	33.6	ND	62.3	28.8	21.5-93	66.7
Fluoride (µg/L)	0.37	0.42-0.44	0.41	0.38	0.33-0.38	0.42-0.44
Acetone (µg/L)	72	47	ND	ND	73	ND
Bis(2 ethylhexyl)phthalate (µg/L)	22	62	ND	ND	ND	0.15
Diphenylamine (µg/L)	ND	ND	ND	ND	10	18
Methylene Chloride (µg/L)	5	5	ND	ND	ND	ND
Acetonitrile (µg/L)	ND	ND	ND	ND	ND	ND
2-Butanone (µg/L)	10	15	ND	ND	ND	ND
PCB-1248 (µg/L)	ND	ND	ND	3	ND	ND

TABLE 7-3

(Continued)

Page 3 of 4

Parameter (Unit)	Range of Concentrations by Sampling Location (Monitoring Well Number) <sup>a,b,c</sup>							FB <sup>e</sup>	TB <sup>f</sup>
	A42	BH5	BH48	BH61	BH63	BH70			
Silver (µg/L)	11.4	ND	31.1	12.4	16.7	28.3		ND	ND
Aluminum (µg/L)	ND	ND	288	ND	ND	256		ND	ND
Calcium (µg/L x 1000)	148-151	102-109	518-544	106-152	189-198	254-315		ND	ND
Chromium (µg/L)	44.5	19.5	102	47.1	58.1	99.7		ND	ND
Copper (µg/L)	ND	ND	30.6	ND	ND	ND		ND	ND
Iron (µg/L)	192	ND	ND	ND	ND	536		ND	ND
Potassium (µg/L)	80	15600	28800	11400	11700	9000		ND	ND
Magnesium (µg/L x 1000)	57.8-58.9	5	103-104	77.7-106	67.2-75.3	156-160		ND	ND
Manganese (µg/L)	330-606	ND	674-783	21.3-76.8	148-183	282-355		ND	ND
ω Sodium (µg/L x 1000)	32.2	107-130	533-568	200-202	242-244	133-151		ND	ND
Nickel (µg/L)	41.2	ND	59.9	47.1	41.7	79.4		ND	ND
Tin (µg/L)	ND	ND	ND	ND	ND	ND		ND	ND
Zinc (µg/L)	80	32.2	58.1	52	33	29.5		ND	ND
Fluoride (µg/L)	0.13-0.14	0.32-0.36	0.47-0.48	0.25-0.28	0.28-0.30	0.27-0.28		0.14	ND
Acetone (µg/L)	240	63	43	ND	ND	ND		11	12
Bis(2 ethylhexyl)phthalate (µg/L)	ND	13	ND	17	15	10-15		11	ND
Diphenylamine (µg/L)	ND	ND	ND	ND	31	ND		ND	ND
Methylene Chloride (µg/L)	5	5	ND	ND	5	5		5	ND
Acetonitrile (µg/L)	ND	ND	ND	ND	ND	ND		ND	ND
2-Butanone (µg/L)	ND	15	ND	ND	ND	ND		ND	ND
PCB-1248 (µg/L)	ND	3.1	ND	0.43	ND	ND		ND	ND

TABLE 7-3

(Continued)

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<sup>a</sup>These wells monitored "Appendix IX" parameters for the third and fourth quarters.

<sup>b</sup>Does not include parameters for which concentrations were below the limit of sensitivity of the analytical method used.

<sup>c</sup>ND - No detectable concentration. Where only one value is listed, concentration ranged from ND to the value in the table.

<sup>d</sup>Well 5B is an extremely poor producer.

<sup>e</sup>FB - Field blank used to determine contamination resulting from sample collection.

<sup>f</sup>TB - Trip blank used to determine contamination during shipment.

for in groundwater at NFSS since 1987. There has been no appreciable trend in these parameters during the monitoring period. Analytical results for calendar year 1989 are presented in Table 7-4.

Twenty-two metals were analyzed for in 43 wells during calendar year 1988. Heavy metal concentrations found in these wells are reported in Table 7-5.

## **7.2 SURFACE WATER**

Surface water samples were taken both on and off site at sampling locations shown in Figures 7-2 and 7-3. Surface water at the site is monitored for total uranium and radium-226. Concentrations of these radionuclides in surface water at NFSS have remained relatively stable since 1985 at very low levels (Tables 7-1 and 7-2).

## **7.3 SEDIMENTS**

Sediment samples have been collected and analyzed for total uranium and radium-226 at NFSS since 1985. Sediment samples are taken at the same locations as surface water samples both on and off site. Concentrations of total uranium and radium-226 in sediment samples show no significant trend and are at levels nearly equivalent to background.

## **7.4 RADON**

Radon concentrations have been monitored at the site boundary since 1985. The radon levels approximate background levels for the area and have not fluctuated noticeably. Prior to the remedial action activities conducted in the mid-1980s, radon emission was a concern at NFSS; however, the data collected since 1985 indicate that the IWCF has been effective in controlling radon emission.

TABLE 7-4  
RANGES OF WATER QUALITY PARAMETERS IN GROUNDWATER  
AT NFSS, 1989

Page 1 of 2

Sampling Location (Well No.) <sup>a</sup>	Parameter			
	pH (Standard Units)	Total Organic Carbon (mg/L)	Total Organic Halides (µg/L)	Specific Conductance (µmhos/cm)
OW-1A	6.9 - 9.8	2.0 - 23.4	ND - 71 <sup>b</sup>	1640 - 1940
OW-1B	7.4 - 7.7	2.2 - 8.5	ND - 80	1180 - 1310
OW-2A	7.6 - 8.0	4.2 - 14.9	ND	1610 - 1890
OW-2B	7.2 - 8.0	2.6 - 40.3	ND - 41	1590 - 1780
OW-3A	7.4 - 7.8	3.9 - 22.9	ND	2240 - 2470
OW-3B	7.3 - 7.5	4.2 - 9.3	ND	2120 - 2460
OW-4A	7.4 - 8.0	3.2 - 14.6	ND	1320 - 1400
OW-4B	7.5 - 8.1	3.2 - 32.7	ND - 96	1380 - 1520
OW-5A	7.7 - 8.0	2.3 - 21.5	ND - 110	1260 - 1670
OW-5B	7.4 - 7.6	3.0 - 35.3	ND - 40	1620 - 1850
OW-6A	7.4 - 7.9	2.3 - 9.4	ND - 125	1770 - 1940
OW-6B	7.2 - 7.3	2.8 - 22.5	ND - 46	1770 - 2800
OW-7A	7.2 - 7.6	1.8 - 2.7	ND - 29	1800 - 2310
OW-7B	7.6 - 7.7	2.1 - 2.4	ND - 23	2080 - 2580
OW-8A	7.6 - 7.9	3.1 - 101	ND - 34	2260 - 2880
OW-8B	7.3	4.6 - 19.6	ND - 28	1770 - 2280
OW-9A	7.5 - 7.8	5.3 - 24.1	ND - 24	1920 - 2480
OW-9B	7.3 - 7.5	4.4 - 5.0	ND - 44	2140 - 3050
OW-10A	7.5 - 8.4	4.0 - 28.5	ND - 70	1260 - 1570
OW-10B	7.4 - 7.8	3.4 - 13.4	ND - 17	1300 - 1580
OW-11A	7.4 - 7.6	3.6 - 12.4	ND	1610 - 1980
OW-11B	7.5 - 7.7	2.4 - 32.7	ND - 23	1580 - 1930
OW-12A	7.4 - 7.5	5.5 - 23.2	ND - 39	1680 - 2240
OW-12B	7.4 - 7.7	3.2 - 13.1	ND - 20	1610 - 2050
OW-13A	11.1 - 11.4	3.3 - 7.5	ND - 38	1830 - 2620
OW-13B	7.3 - 7.4	3.5 - 38.8	ND - 22	1830 - 2940
OW-14A	7.4 - 8.1	2.2 - 7.0	ND - 33	1670 - 1960
OW-14B	7.3 - 7.4	2.2 - 129	ND	1320 - 1550
OW-15A	7.6 - 7.7	2.0 - 2.5	ND - 10	2200 - 2420
OW-15B	7.4 - 7.6	3.0 - 19	ND - 37	1610 - 1900
OW-16A	7.7 - 8.1	2.1 - 25.4	ND - 12	2440 - 2380
OW-16B	7.4	2.4 - 52	ND - 24	1110 - 1320
OW-17A	7.7 - 8.0	2.2 - 37.4	ND	2460 - 2630
OW-17B	7.4 - 7.5	2.6 - 25.1	ND	1500 - 1720
OW-18A	7.6 - 8.3	2.9 - 36.2	ND - 54	1580 - 2410
OW-18B	7.3 - 7.8	5.3 - 37.5	ND	2110 - 3590
A-42	7.1 - 7.3	2.5 - 7.0	ND - 40	1280 - 1680
A-50	7.4 - 7.5	10.4 - 12.4	ND - 25	1720 - 2150
A-52	7.0 - 7.6	6.6 - 7.0	ND - 26	1260 - 1540

TABLE 7-4  
(continued)

Page 2 of 2

Sampling Location (Well No.) <sup>a</sup>	Parameter			
	pH (Standard Units)	Total Organic Carbon (mg/L)	Total Organic Halides (µg/l)	Specific Conductance (µmhos/cm)
BH-5	11.5 - 11.6	6.2 - 7.6	ND	1200 - 1430
BH-48 <sup>c</sup>	7.4 - 7.9	1.3 - 2.7	ND	3500 - 4720
BH-61	7.4 - 9.4	2.9 - 7.0	ND - 85	957 - 1400

<sup>a</sup> Monitoring well locations are shown in Figure 7-1.

<sup>b</sup> ND - No detectable concentration.

<sup>c</sup> Upgradient well.

TABLE 7-5

RANGES OF CONCENTRATIONS OF METAL IONS IN GROUNDWATER AT NFSS, 1988<sup>a</sup>

Page 1 of 5

Parameter (µg/L)	Ranges of Concentrations by Sampling Location (Monitoring Well Number) <sup>b,c</sup>										
	OW-1A	OW-1B	OW-2A	OW-2B	OW-3A	OW-3B	OW-4A	OW-4B	OW-5A	OW-5B	OW-6A
Aluminum	269	ND	ND	ND	ND	221-227	ND	ND	ND	ND	311
Arsenic	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boron	154-655	140-491	178-950	158-848	537-558	160-239	434-515	114-207	491-538	129-261	384-603
Barium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium (x 1000)	86.9-137	83.4-113	120-1346	101-167	76.9-98.4	101-120	64.5-77.9	94.1-97.5	41-48.5	97.9-104	93.8-117
Cadmium	ND	5	ND	ND	8	11	6	ND	ND	6	4
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	10.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	ND	ND	28.3	ND	ND	ND	ND	47.5	ND	32.9-77	58
Iron	138	ND	ND	ND	145	107	118	107	ND	ND	ND
Potassium (x 1000)	8.36-20.6	2.5-16.3	ND	5.47	5.76	6.77-10.1	57.8-57.9	5	5.93-84.7	55.8-79.9	11-13.3
Magnesium (x 1000)	86.3-109	78.4-84.6	72.8-107	68.6-108	126-167	194-212	48.9-60.0	94-100	86.3-93	131-133	66.9-99.4
Manganese	24-133	116-202	33.2-150	52-134	128-176	21-145	40.4-54.8	42.1-80.8	36.5-56	44.5-52	99.5-264
Molybdenum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium (x 1000)	67.1-156	48.5-150	60.5-183	65-144	124-158	91.4-111	101-110	39.9-45.6	93.2-97.8	43.9-47.6	84.6-107
Nickel	4.9-9	43.8-50	ND	ND	53.0	ND	ND	ND	48	ND	47.6-77
Antimony	ND	ND	88	77	ND	ND	72	ND	84	53	ND
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Thallium	187	ND	ND	ND	ND	134-190	100	ND	100	109	ND
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	29.6-43	23.6-310	27.6-85	23-63.2	62.1-405	34.5-393	43-80.6	22-44.2	21-69.5	20.3-139	20-69.0



TABLE 7-5

(continued)

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Parameter (µg/L)	Ranges of Concentrations by Sampling Location (Monitoring Well Number) <sup>b,c</sup>										
	OW-6B	OW-7A	OW-7B	OW-8A	OW-8B	OW-9A	OW-9B	OW-10A	OW-10B	OW-11A	OW-11B
Aluminum	244-411	363	327	251-266	244-322	208-551	265-503	251-360	244-428	228-680	252-691
Arsenic	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	244
Boron	167-237	197-384	779-976	1020-1170	87-204	880-1070	215-343	428-584	128-428	86-232	763-894
Barium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	285
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.7
Calcium (x 1000)	123-144	92.8-115	102-119	134-171	127-145	137-177	16.5-18.2	76.2-90.4	45.5-74	113-141	78.3-96.8
Cadmium	8	5	5	ND	6	5	7	ND	ND	7	6
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	53.6
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	20.9
4A Copper	28.3-61	38-59	46	45	26.1-49	50-60	30.1-51.5	41.2-42	55-62.9	28.6-80.4	38-82.1
Iron	106	151	144	221	ND	159-223	137-146	107	ND	102	146
Potassium (x 1000)	53.8-63.6	2.14-5	6.55-10.2	10.2-14.1	2.2	8.88-17.7	2.99	7.11-13.8	3.72-8.78	1.97-7.87	8.39-14.2
Magnesium (x 1000)	201-234	151-1876	133-152	103-114	155-177	74.8-89.8	21.8-23.4	55.9-87.7	79.3-127	13.2-15.3	92.8-124
Manganese	128-182	26.2-190	93.2-135	118-204	30.8-73.4	41.8-170	33-192	20.4-58	23-98.5	38-198	75-199
Molybdenum	ND	ND	ND	ND	ND	106	ND	ND	ND	102	110
Sodium (x 1000)	62.3-81.8	54.7-78.9	121-147	176-235	53.8-63.5	138-164	61.4-72.1	73.1-90.9	34.5-65.6	37.5-51.2	76.5-101
Nickel	45-99	ND	41	ND	ND	ND	ND	ND	24-57.5	ND	63.9-88
Antimony	43.5-75.4	ND	ND	40.3-60.5	50	68.2-80.6	80.7	ND	ND	74.3-85.9	82.5-82.7
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	253
Thallium	189	186	ND	ND	ND	ND	128-164	ND	ND	155	211
Vanadium	56.3	50.3	ND	ND	ND	61.5	ND	ND	ND	92.5	114
Zinc	93.7	20-61.9	22-80	29-124	27.3-98.7	51-125	126-167	23.7-133	28.2-137	141-191	44.6-194

TABLE 7-5

(continued)

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Parameter (µg/L)	Ranges of Concentrations by Sampling Location (Monitoring Well Number) <sup>b,c</sup>										
	OW-12A	OW-12B	OW-13A	OW-13B	OW-14A	OW-14B	OW-15A	OW-15B	OW-16A	OW-16B	OW-17A
Aluminum	214-271	210-1290	208	252-332	316	108-224	278-542	326	247-545	236-263	283-453
Arsenic	ND	ND	16	ND	ND	ND	ND	ND	ND	ND	ND
Boron	891-1090	165-285	604-825	85-251	593-875	ND	1040-1170	127-208	756-923	140-809	634-885
Barium	ND	ND	ND	ND	ND	ND	ND	ND	201	ND	ND
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium (x 1000)	126-139	11.9-13.2	39.7-119	150-172	100-131	84.9-96.1	160-181	91.6-10.2	12.8-14.6	10.1-82.8	14.9-208
Cadmium	5	5	ND	8	ND	ND	ND	ND	ND	8	7
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	42	45-159	46	30.3-47	42	37.1-45	43-58.5	70.3-73.5	59.6	25.1-45	30.1-49.2
Iron	144	174	ND	ND	122-220	112	114-171	107	100	145-208	115
Potassium (x 1000)	10.1-12	2.1-23	14.1-66.5	1.92-5	6.94-15.2	1.81	7.16-18	1.36	1.37	6-7.14	1.71-21.4
Magnesium (x 1000)	93.2-108	133-158	66.5-119	199-229	72.9-83.6	98.9-118	86.5-97	136-148	19.5-22.3	9.3-193	138-193
Manganese	159-340	29-84.8	26.4-45.4	20.6-160	91-195	61.6-173	95.9-202	43.6-244	18.5-78.8	80-696	116-225
Molybdenum	ND	186	ND	ND	ND	ND	107	ND	132	ND	109
Sodium (x 1000)	90.3-109	43.5-56.5	104-169	61.4-78.3	141-185	48.8-64.5	166-217	67.9-84.9	145-180	4.88-180	136-197
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	70.5
Antimony	ND	84.8	ND	63.2	41.2	72.2	46.3	51.6	ND	49.7	43.5
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Thallium	ND	124	ND	161	ND	ND	ND	116	188	133	ND
Vanadium	ND	163	ND	ND	ND	ND	56.8	ND	ND	ND	50.6
Zinc	26-163	29-258	33-48.2	26.8-60.5	43.7-148	23-50.5	37-110	28.9-137	82.9	28-463	26.5

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TABLE 7-5

(continued)

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Parameter (µg/L)	Ranges of Concentrations by Sampling Location (Monitoring Well Number) <sup>b,c</sup>								
	OW-17B	OW-18A	OW-18B	A-42	BH-5	BH-48 <sup>d</sup>	BH-61	BH-63	BH-70
Aluminum	347-395	351-1100	263-991	235-1540	136-329	336-466	274	335	363-418
Arsenic	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boron	94-265	650-813	121-247	120-267	165-195	2770-2870	788-948	1000-1050	1360-1428
Barium	ND	ND	ND	68	211	ND	ND	ND	ND
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium (x 1000)	94.3-107	124-139	162-178	148-170	65.2-110	532-544	98.6-119	133-153	350-396
Cadmium	5	5	16	ND	ND	ND	ND	ND	ND
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	15.3-65.9	ND	ND	ND	ND
46 Copper	27.6-57.3	22-130	27-126	192	ND	36.7	ND	25.3	ND
Iron	116	105	137-164	ND	ND	121-203	ND	ND	200-406
Potassium (x 1000)	1.85	7.86-26.7	3.25-13.8	3.33-30.1	12.5-14.2	24.8-29.2	6.96-9.61	7.74	9.49-12.2
Magnesium (x 1000)	128-159	151-194	319-377	55.9-69.1	ND	94.4-107	70.2-96.6	72.4-76.6	137-154
Manganese	60.8-183	148-333	36-208	214-577	ND	743-787	47.9-86.7	18.5-23	327-490
Molybdenum	ND	201	201	204	ND	ND	ND	ND	ND
Sodium (x 1000)	61.6-89.3	134-188	137-186	23-47.5	50.2-71.9	402-612	157-215	180-202	135-164
Nickel	44.2-82.5	40-81.5	44.8	ND	ND	ND	ND	ND	ND
Antimony	65.4	58.7	118	ND	ND	ND	60.5	ND	ND
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND
Thallium	ND	ND	104-109	ND	ND	ND	ND	ND	ND
Vanadium	24-28.7	50.1-125	69.1-128	167	ND	62.2	ND	ND	58.3
Zinc	31.7-114	24.4-162	22-616	29.2-143	136	44.9-147	37.3-136	70-244	34.2-209

TABLE 7-5  
(continued)

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<sup>a</sup> Does not include parameters for which the concentrations were below the limit of sensitivity of the analytical method used.

<sup>b</sup> ND - No detectable concentration. Where only one value is listed, the concentration ranged from ND to the value in the table.

<sup>c</sup> Sampling locations are shown in Figure 7-1.

<sup>d</sup> Upgradient well.

## 7.5 EXTERNAL GAMMA RADIATION

External gamma radiation has been monitored at the site since 1985. Monitoring locations are shown in Figure 7-4. Although there has been some fluctuation, radiation levels in 1989 are lower than those measured in previous years (Table 7-6). The measured levels are essentially equal to background values in the area.

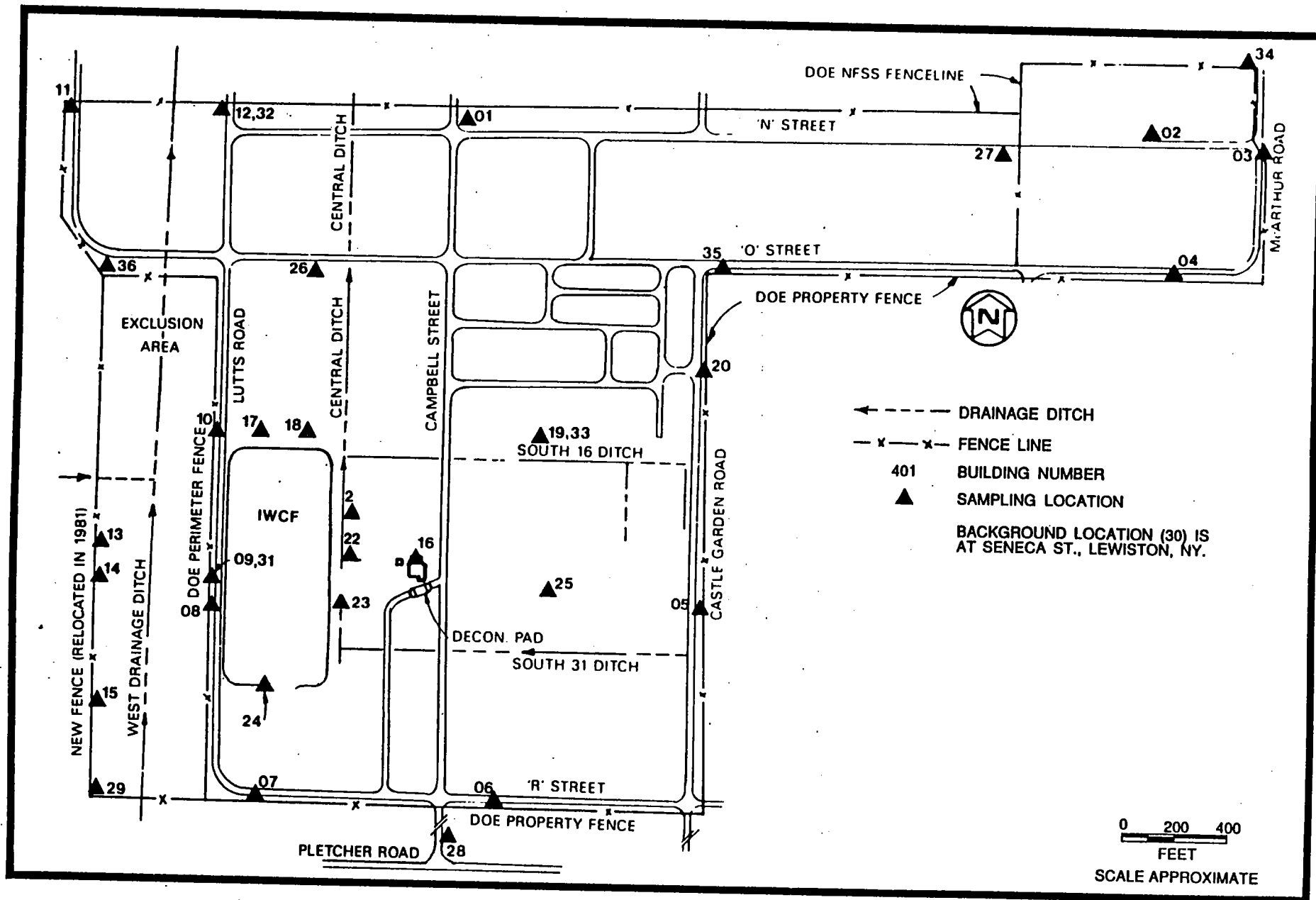


FIGURE 7-4 EXTERNAL GAMMA RADIATION MONITORING LOCATIONS AT NFSS

TABLE 7-6  
ANNUAL AVERAGE EXTERNAL GAMMA RADIATION LEVELS  
AT NFSS, 1985-1989

Page 1 of 2

Sampling Location <sup>a</sup>	Radiation Level (mrem/yr) <sup>b</sup>				
	1985	1986	1987	1988	1989
<u>Site Boundary</u>					
1	18	16	11	11	-C
3	24	4	11	9	-C
4	48	14	13	7	-C
5	24	14	16	22	2
6	21	8	3	16	-C
7	20	8	11	7	2
11	12	4	2	5	-C
12	11	2	6	8	-C
13	14	-C	-C	6	1
14	6	3	7	14	-C
15	3	6	6	14	3
20	65	26	24	23	8
28	14	14	14	10	2
29	14	-C	-C	10	-C
32 <sup>d</sup>	10	6	5	8	-C
34	16	6	8	3	-C
35	16	15	14	14	1
36	6	5	16	10	-C
<u>Background</u>					
30 <sup>e</sup>	91	69	64	71	61
120 <sup>f</sup>	--	--	--	--	83
121 <sup>g</sup>	--	--	--	--	87

<sup>a</sup>Site boundary stations only. Sampling locations are shown in Figure 3-1.

<sup>b</sup>Measured background has been subtracted from readings taken at site boundary stations.

<sup>c</sup>Measurement was equal to or less than measured background value.

<sup>d</sup>Station 32 is a quality control for station 12.

TABLE 3-11  
(continued)

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<sup>e</sup>Station 30 was established in 1985, approximately 6.4 km (4 mi) southwest of NFSS at Seneca St., Lewiston, NY.

<sup>f</sup>Station 120 was established in April 1988 at Pletcher Rd., Lewiston, NY, approximately 1.6 km (1 mi) southwest of NFSS.

<sup>g</sup>Station 121 was established in April 1989 at the intersection of Route 104 and Swain Rd., Lewiston, NY, approximately 1.6 km (1 mi) south of NFSS.



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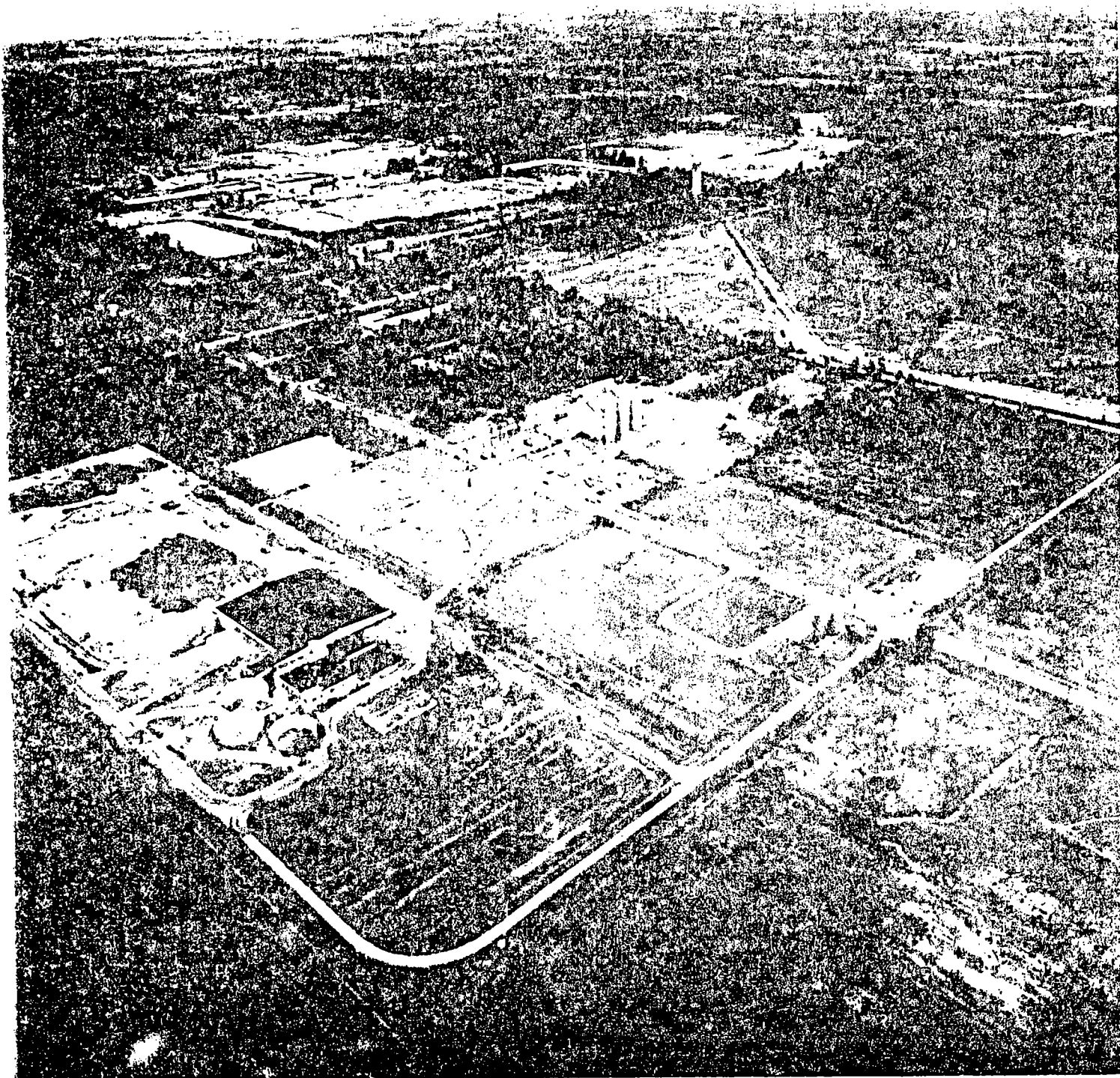
APPENDIX A  
PHOTOGRAPHS OF NFSS

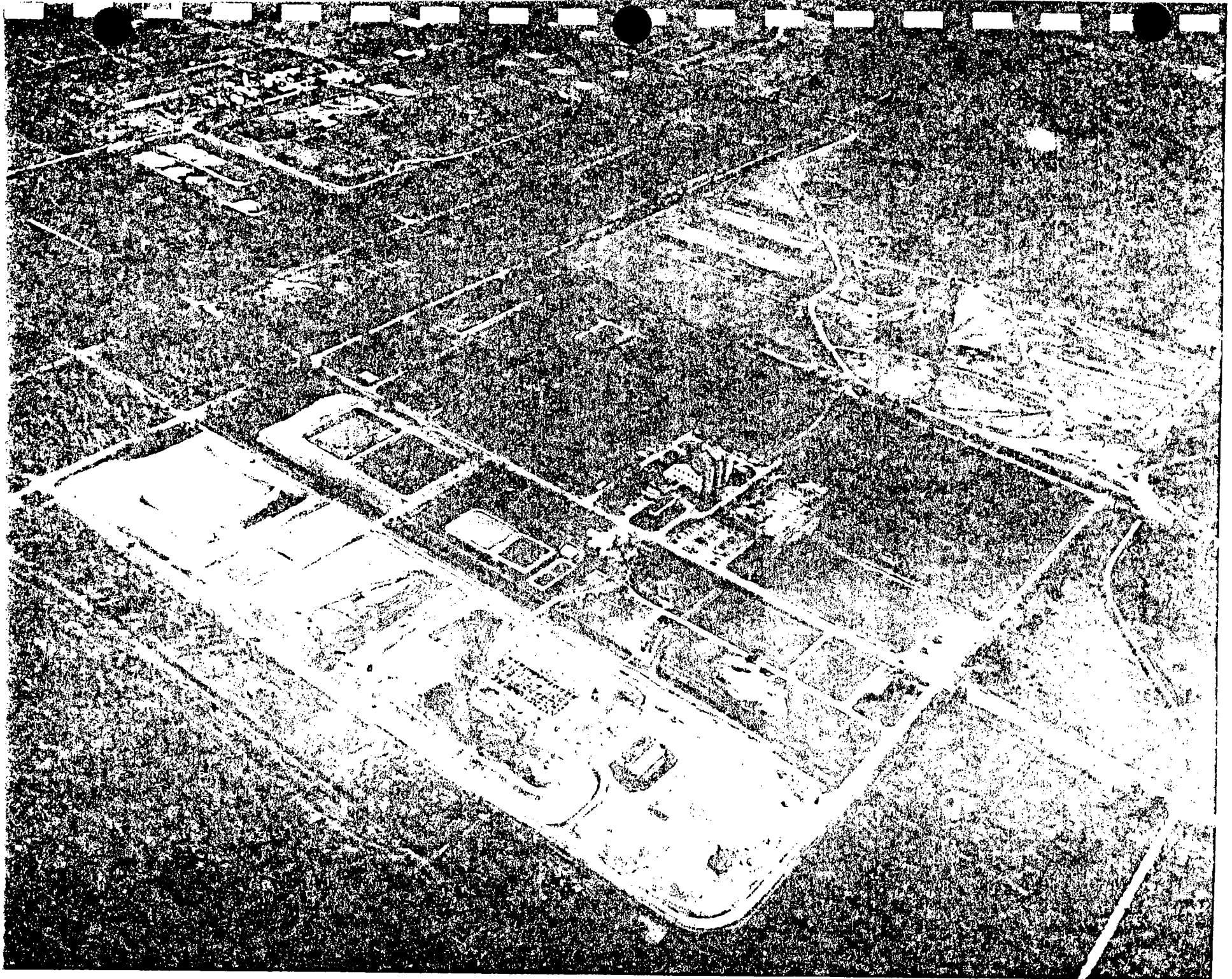
Photograph 1 shows NFSS in early 1983. The R-10 residues had been stabilized and demolition of Building 412 had been initiated.

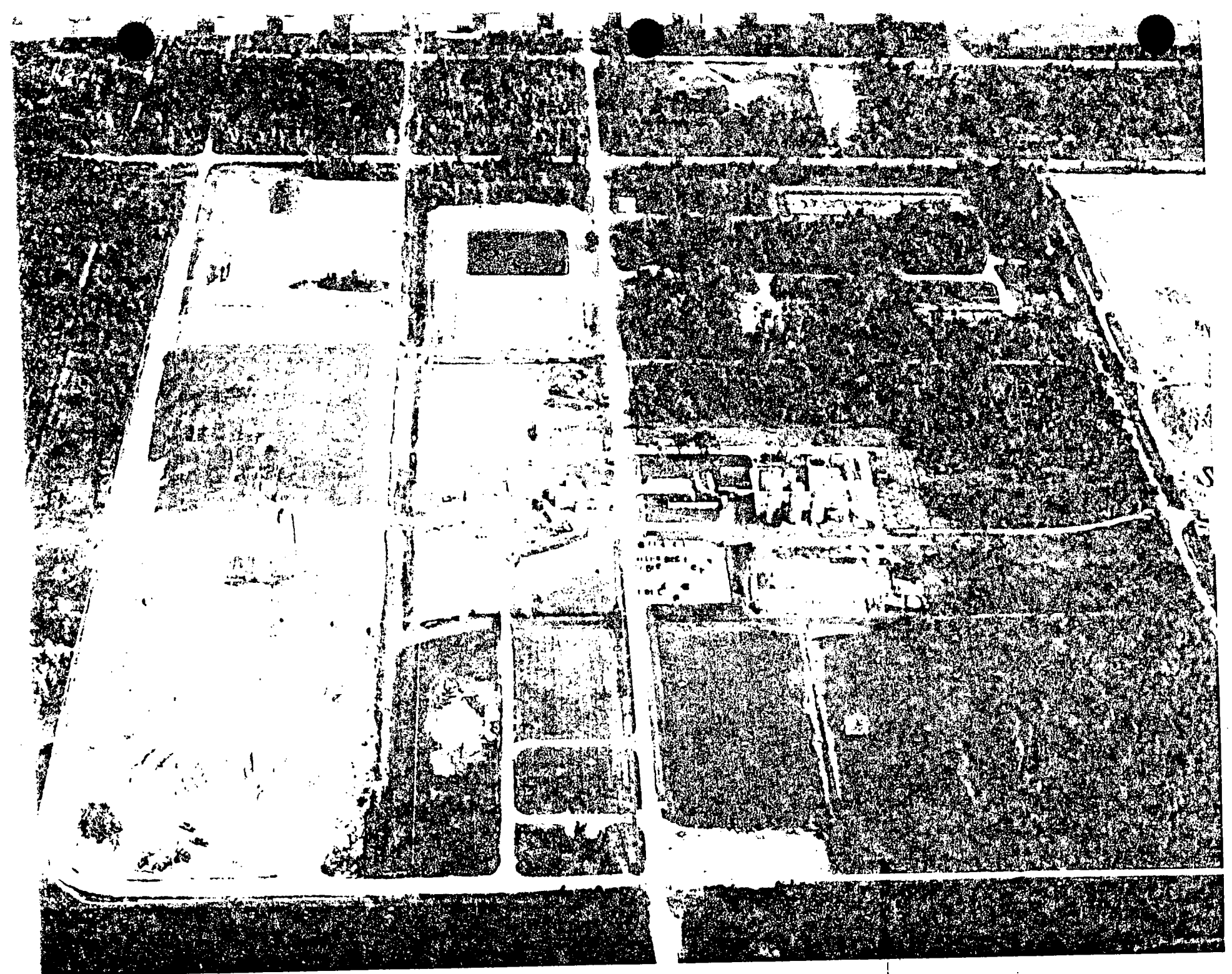
Photograph 2 was taken in mid-summer 1985. The K-65 tower had been demolished and the surrounding area cleaned.

Photograph 3 was taken in late fall 1985. This photograph shows part of the interim cap in place.

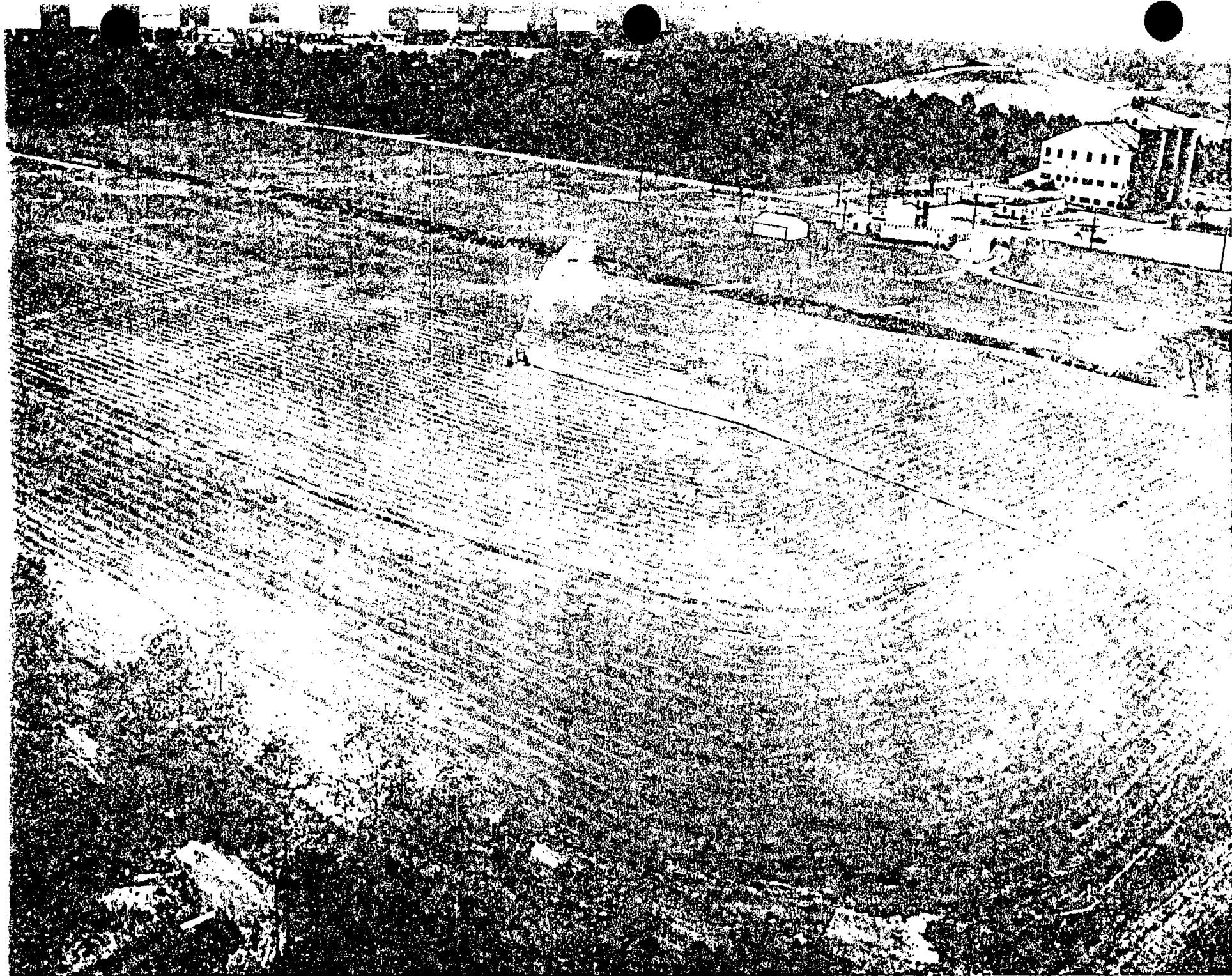
Photograph 4 was taken in 1988. It shows the completed interim cap.













APPENDIX B  
PRELIMINARY SCOPING  
STUDY FOR THE  
NIAGARA FALLS STORAGE SITE

PRELIMINARY SCOPING STUDY FOR THE  
NIAGARA FALLS STORAGE SITE

MAY 1990

Prepared for  
United States Department of Energy  
Oak Ridge Operations Office  
Under Contract No. DE-AC05-81OR20722

By

Bechtel National, Inc.  
Oak Ridge, Tennessee

Bechtel Job No. 14501

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## 1. INTRODUCTION

The Niagara Falls Storage Site (NFSS) was used in the past as a storage, transshipment, and disposal site for chemical and radioactive wastes. Under the Surplus Facilities Management Program (SFMP), the Department of Energy (DOE) has consolidated radioactive waste and radioactively contaminated soils into an on-site containment facility. However, a comprehensive investigation to determine if nonradiological contaminants are present at the site has not been conducted. To facilitate the investigation of potential nonradiological contamination on the site or migrating from the site, the following tasks were completed.

- (1) Existing nonradiological contaminant analytical results for NFSS were reviewed to identify potential areas of contamination.
- (2) The migration potential of suspected nonradiological contaminants was assessed based on a review of historical data and the mobility of the suspected contaminants.
- (3) A chemical characterization plan was developed to investigate the potential pathways for off-site migration.

This report summarizes the results of these activities.

## 2. BACKGROUND

In 1983, under the direction of DOE, Bechtel National, Inc. (BNI) initiated activities to consolidate radioactive waste and radioactively contaminated soils at the site and on vicinity properties. The remedial action was completed in 1988 and resulted in a 191,000-m<sup>3</sup> (250,000-yd<sup>3</sup>) interim waste containment facility (IWCF) and a small temporary storage pile that will be incorporated into the IWCF. During final excavation of radioactively contaminated soils in 1988, a small area with detectable levels of organic vapors was encountered. Samples analyzed to identify the contaminant causing the vapors revealed the presence of several chemical constituents above background concentrations: trichloroethene, toluene, bis(2-ethylhexyl)phthalate, 1,2-dichloroethene, and tetrachloroethene.

The results of these samples demonstrated the need to evaluate past use of the site to determine the potential for other nonradiological contaminants at the site. This determination, documented in this report, includes review of the history of the site, previous contaminant survey reports, and current data from environmental monitoring. These sources are described below.

NFSS has been used for several purposes over the past 50 years. The 77.4-ha (191-acre) site was originally part of the Lake Ontario Ordnance Works (LOOW). In the early 1940s, the site was developed as a trinitrotoluene (TNT) production facility. The materials for production of explosives were present at the site, but production was never initiated. The primary use of the facility from 1940 to the mid-1950s was for the storage, transshipment, and disposal of mostly radioactive wastes from several sources. In addition, the steam plant (Building 401) was modified for the production of boron-10 from 1953 to 1959 and 1965 to 1971.

Historical records indicate that the majority of the materials managed at the LOOW came from the following companies and organizations: Linde Air Products, Inc.; Mallinckrodt Chemical Plant; University of Rochester; Knolls Atomic Power Laboratory; Union Carbide's Electrometallurgical Operations; Middlesex Sampling Plant; Oak Ridge National Laboratory; Eldorado Mining and Refining Co.; and Brookhaven National Laboratory. These organizations primarily shipped radioactive materials to the site. Historical records indicate that nonradiological materials, chemicals, and waste were also received at the site. However, records do not specify the materials that were received, stored, or disposed of and whether or not TNT production materials were removed from or disposed of on site. In addition, radioactive ores and residues naturally contained high levels of several heavy metals and, therefore, are a potential source of nonradiological contamination.

An environmental monitoring program, which began in 1981, monitors air, surface water, groundwater, sediments, and gamma radiation levels to verify compliance with the DOE radiation protection standard of 100 mrem/yr. Results of the program have indicated that NFSS is in compliance with the DOE radiation protection standards and that radiological contamination is not migrating off site. The groundwater has been analyzed for radiological and nonradiological contaminants and has shown certain heavy metal contaminants to be present above background levels.

### 3. PREVIOUS SURVEYS AND INFORMATIONAL REPORTS

The primary sources of information on the nonradiological conditions of the site consist of the following:

Battelle Columbus Laboratories, A Comprehensive Characterization and Hazard Assessment of the DOE-Niagara Falls Storage Site, BMI-2074 (Revised), Columbus, Ohio, 1981.

Bechtel National, Inc., Niagara Falls Storage Site Annual Site Environmental Report - Calendar Year 1988, DOE/ORO/20722-219, Oak Ridge, Tenn., 1989.

Aerospace Corporation, Background and Resurvey Recommendations for the Atomic Energy Commission Portion of the Lake Ontario Ordnance Works, ATR-82 (7963-04)-1, Washington, D.C., November 1982.

National Lead Company of Ohio, Draft Informational Report on the U.S. Department of Energy - Niagara Falls Site, NLCO-003EV, Cincinnati, Ohio, July 1979.

Other sources available for review included environmental monitoring reports from 1983 through 1987, data collected during the characterization of the Linde Air Products and Mallinckrodt sites, interviews with personnel associated with work on the site in the past, and LOOW operating records.



#### 4. POTENTIAL CONTAMINANTS

The extensive use of the site as a storage, transshipment, and production facility may have resulted in numerous nonradiological materials and wastes being stored on site. Historical records of the exact nature of all materials that may have been stored and disposed of at the site are incomplete but may include some of the following:

- o Nitric acid, potassium chlorate, diazodinitrophenol, barium nitrate, and other chemicals used in explosives production that may have remained in storage after the Army chose not to initiate TNT production
- o Research wastes (such as animal carcasses) and laboratory wastes
- o Solvents and waste oils from the maintenance shop (Building 407, former location shown in Figure 4-1)
- o Fluorine from a hydrogen fluoride release in the early 1950s and other substances that may have been stored in cylinders and disposed of on site
- o Various chemicals shipped to the site for storage but not documented in detail [i.e., "two (railroad) cars of chemicals received from Eldorado Mining and Refining Co."]
- o Heavy metals present in the radioactive residues received from Linde Air Products and Mallinckrodt Chemical Plant
- o Lead sulfide

Records indicate that storage of materials often resulted in severely corroded containers and releases to the environment. Therefore, it would be expected that contaminants could migrate from the source and associated contaminated soil to surface water and groundwater and, subsequently, off the site. This section discusses the chemical contaminants that may be present in soil, groundwater, and surface water.

Because historical records are limited in detail, all buildings as well as indicated disposal areas should be considered to have the potential for nonradiological contamination. Figure 4-1 shows the

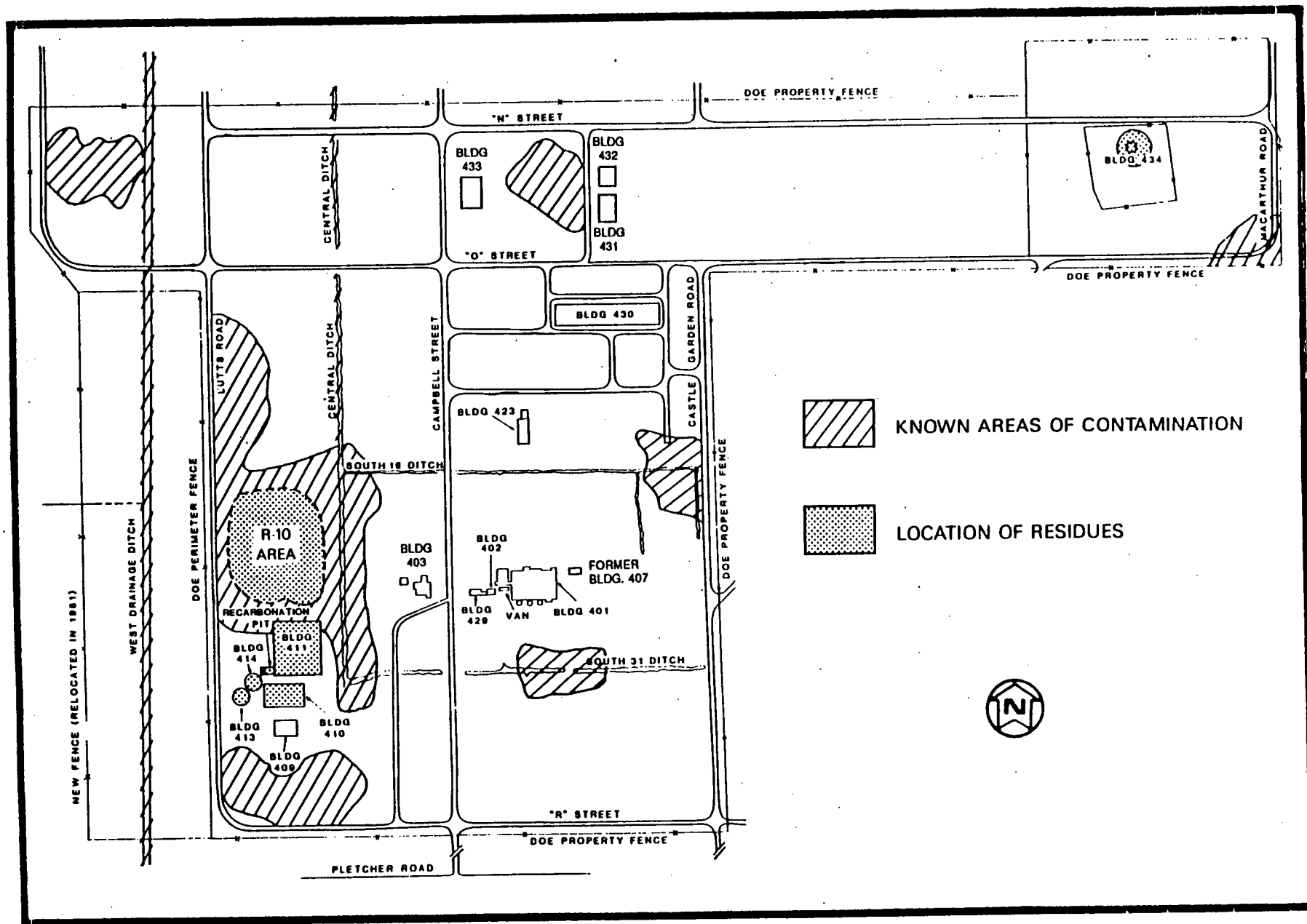


FIGURE 4-1 SITE CONFIGURATION AND LOCATION OF RADIOACTIVE CONTAMINATION AT NFSS IN 1981

locations of some of the buildings on the NFSS portion of the original LOOW and areas of radiological contamination located on site in 1981. The present configuration of NFSS is shown in Figure 4-2. Figure 4-3, based on some historical records, shows areas used for disposal or storage on NFSS. There are three sources of nonradioactive contamination at the site: heavy metals from the radioactive wastes, chemical substances that may have been stored or disposed of on site, and contaminants resulting from the production of boron-10.

The primary nonradioactive contaminants expected to be found are heavy metals. Based on information provided by the Battelle report, the following heavy metals have been detected at high levels in site soils: vanadium, cobalt, nickel, copper, lithium, and lead. The following contaminants have been detected at high levels in the on-site ditches: cobalt, nickel, copper, barium, lithium, fluorine, cerium, and sodium. Based on chemical characterization of the sites that produced the wastes, arsenic, beryllium, cadmium, and thallium may also be found. If the source of these contaminants was solely associated with the radioactive wastes, it would be expected that these contaminants have been removed to the IWCF with the radioactive wastes and soils. However, if these nonradioactive contaminants migrated deeper into the soil than the radionuclides, or if an additional source of contamination was present, these areas of contamination have not been identified.

Nonradioactive contaminants other than heavy metals that may have been stored or disposed of at the site are not easily determined. Chemicals were known to have been received at the site, nonradioactive chemicals and equipment were stored in Building 430, and the University of Rochester sent laboratory waste to NFSS for disposal. Because historical records refer to trenches, it is possible that isolated areas of heavy metals, organic volatile and semivolatile compounds, fluorides, sulfides, cyanides, etc., may be

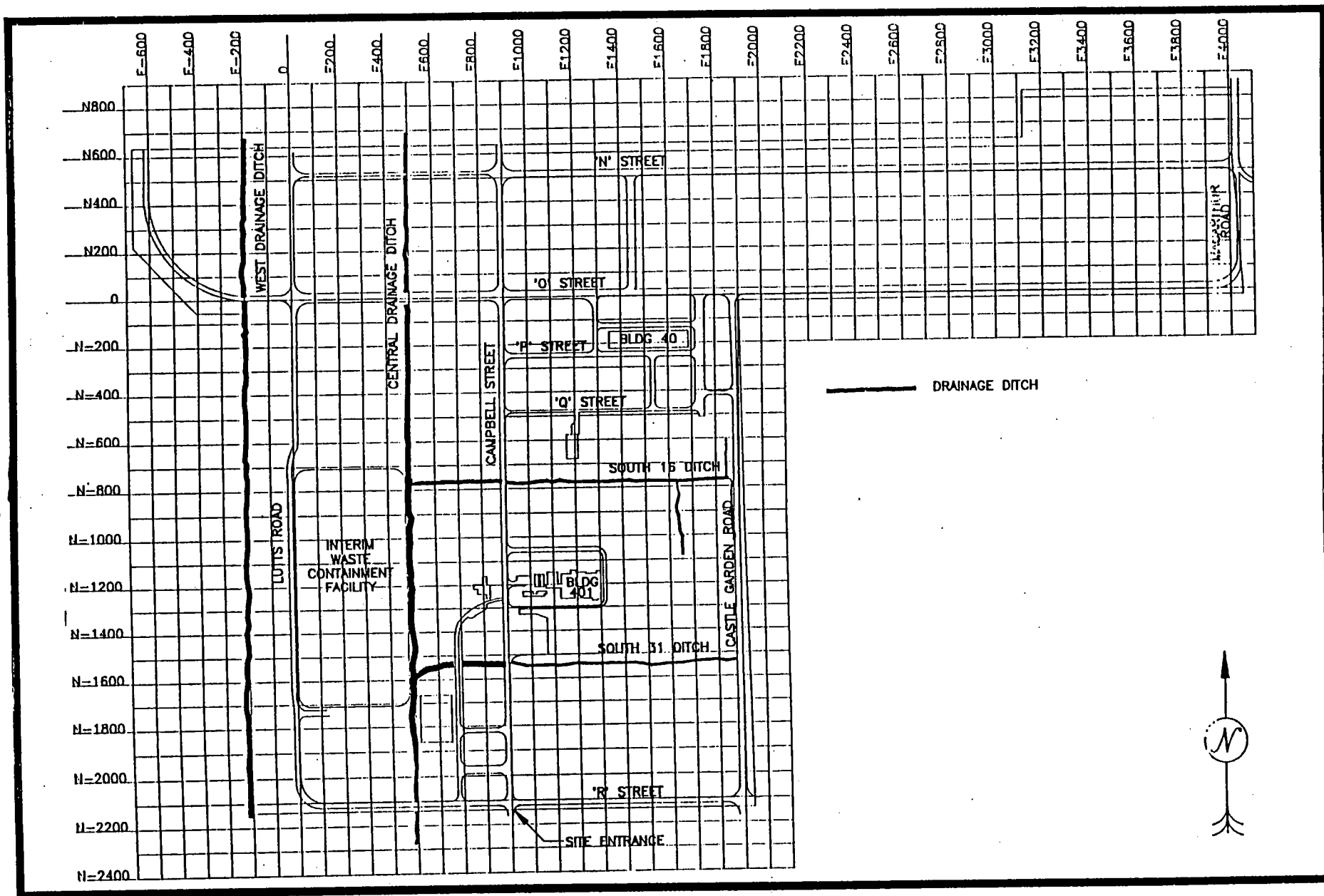


FIGURE 4-2 PRESENT CONFIGURATION OF NFSS

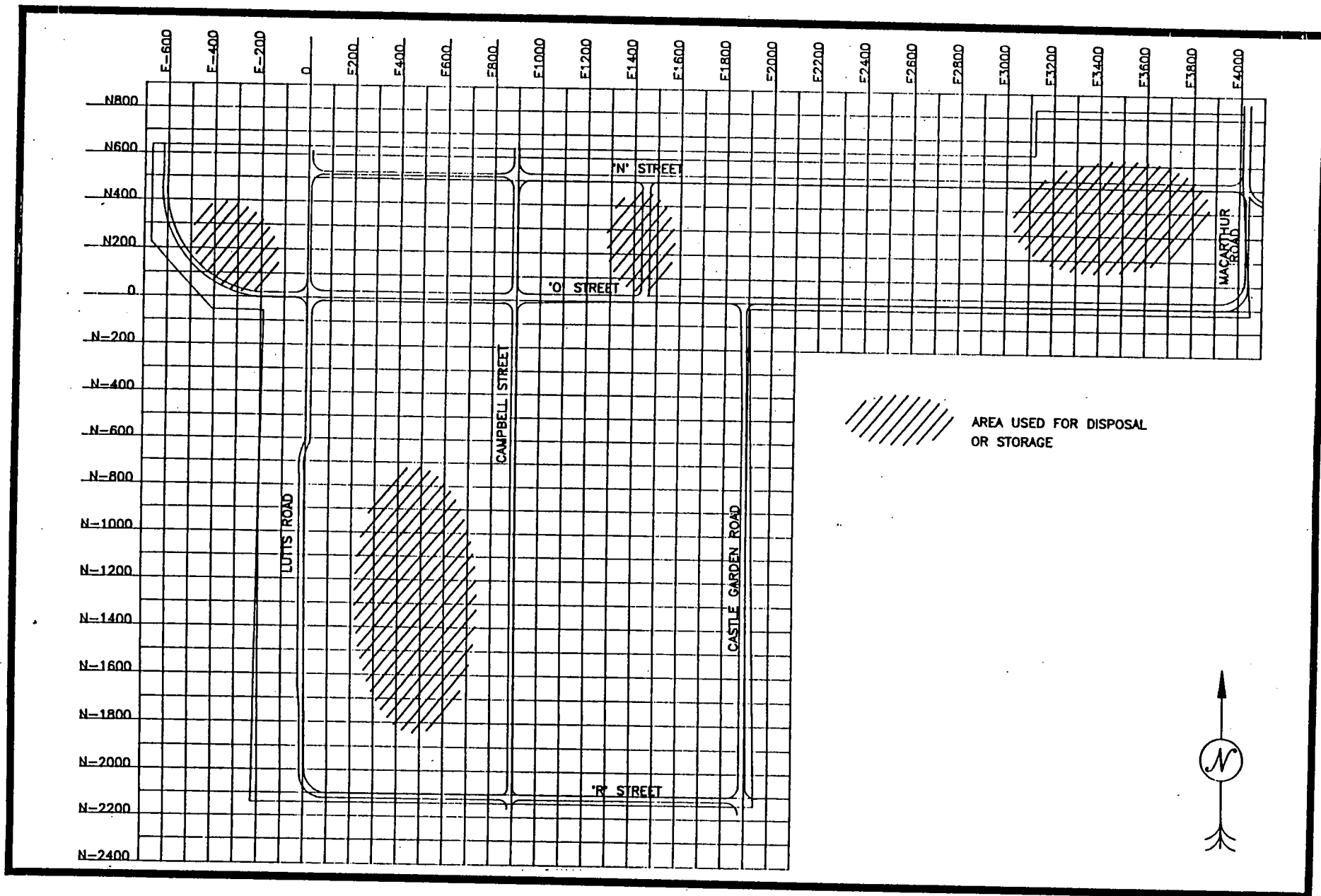


FIGURE 4-3 PREVIOUS STORAGE LOCATIONS AT NFSS

present. However, LOOW records are lacking in sufficient detail to verify their existence or to determine the location and the contents of the trenches.

The primary nonradioactive contaminant that may have resulted from the boron-10 production is boron, and contamination would be expected to be associated with the production facility in Building 401 and the product storage area located across O Street, north of Building 430.

## 5. MIGRATION POTENTIAL

The migration of contaminants could occur as a result of two mechanisms: surface water runoff and surface water infiltration and percolation to groundwater. This section discusses the migration potential to groundwater and surface water considering the types of contaminants that may be involved.

### 5.1 SURFACE WATER

The contaminants that would be expected to appear in surface water are those from contaminated surface areas that are amenable to runoff through suspension or solution. Contaminants present in soil in high concentrations, as discussed in Section 4, may be present in on-site surface waters. The contaminants may exist in one of two forms: suspended solids or dissolved solids. Suspended contaminants (i.e., heavy metals) may or may not be removed by physical processes prior to surface water leaving the site. Dissolved contaminants may be removed depending on the type of contaminant and any biological or physical processes that may occur in the ditches (i.e., aeration, which results in the removal of volatile organics). Dissolved contaminants are much more difficult to remove than suspended contaminants that may settle out due to gravity during quiescent conditions. However, on-site contaminants may not be the only source of nonradiological contamination. Surface waters in the South 31 and South 16 ditches may also receive contaminants from an upgradient off-site land disposal facility.

Surface water samples are collected quarterly as part of the environmental monitoring program. Samples are analyzed for total uranium and radium-226 and approximate background. Surface waters have not been tested for nonradiological contaminants.

### 5.2 GROUNDWATER

The primary source of groundwater contamination would result from infiltration of rainfall and surface water through the soil.

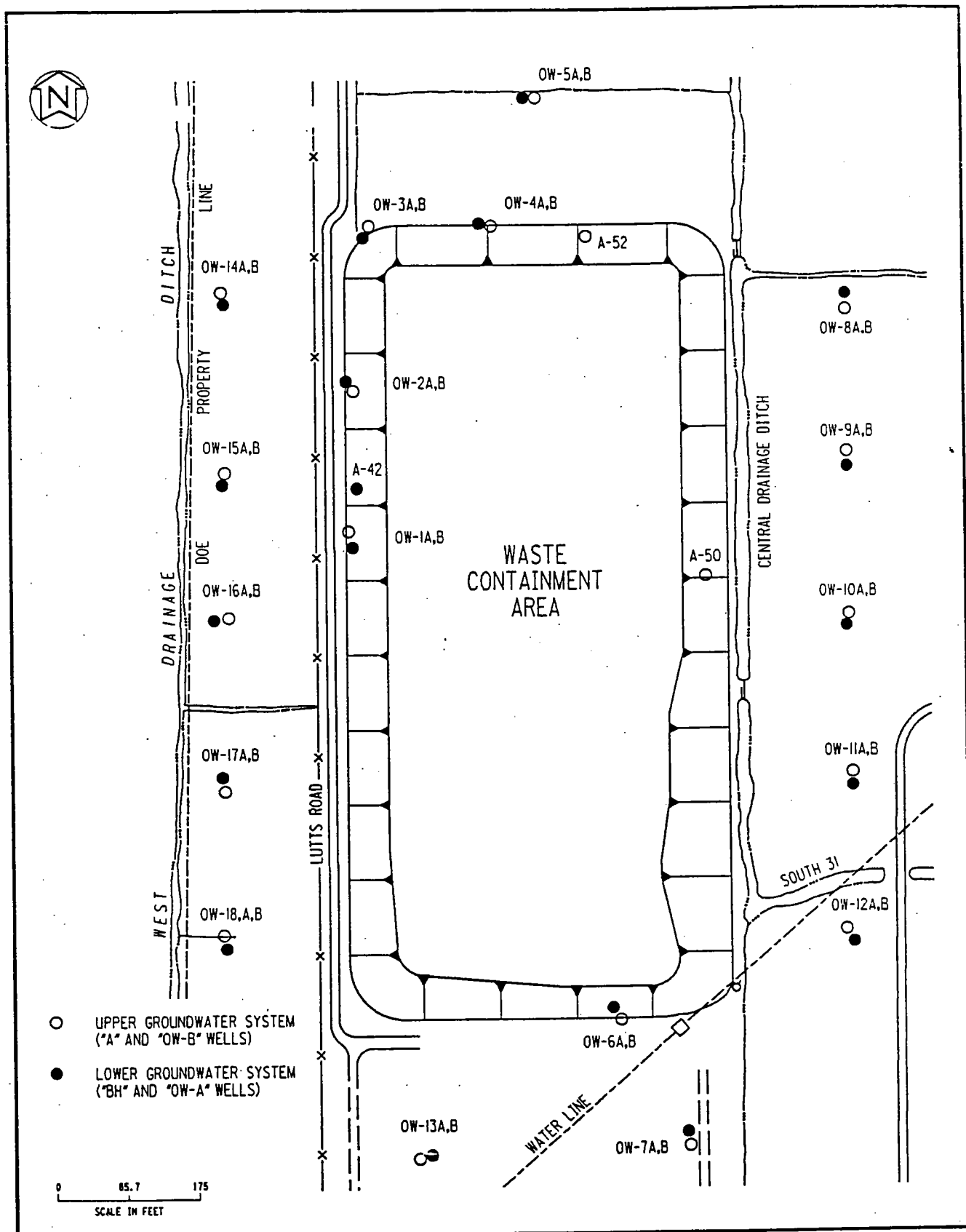
Contaminants that are soluble in water would be most likely to migrate through this pathway. Heavy metal migration through the soil profile could be significant considering the number of years the facility operated. However, the migration of heavy metals to groundwater may have been slowed by the uppermost soils, which have a significant clay fraction.

As part of the environmental monitoring program, groundwater monitoring has been conducted around the IWCF to detect any contaminants that could be leaching from the waste pile. Thirty-six wells immediately surrounding the IWCF and six other on-site wells, as shown in Figures 5-1 and 5-2, are monitored quarterly. In 1987, nonradiological constituent analysis on groundwater samples was initiated and the samples were analyzed for heavy metals, total organic halides (TOX), total organic carbon (TOC), pH, specific conductivity, volatile and semivolatile organic compounds, pesticides, polychlorinated biphenyls (PCBs), fluorides, sulfides, and cyanides. The analytical results indicate the following are present above background concentrations: arsenic, barium, boron, cadmium, cobalt, nickel, vanadium, and beryllium. Environmental monitoring in 1987 and 1988 indicated that other metals are above detection limits, as are contaminants such as acetone, fluoride, and Arochlor-1248. The possibility of off-site contamination migrating onto the site has not been investigated.

### 5.3 SEDIMENT

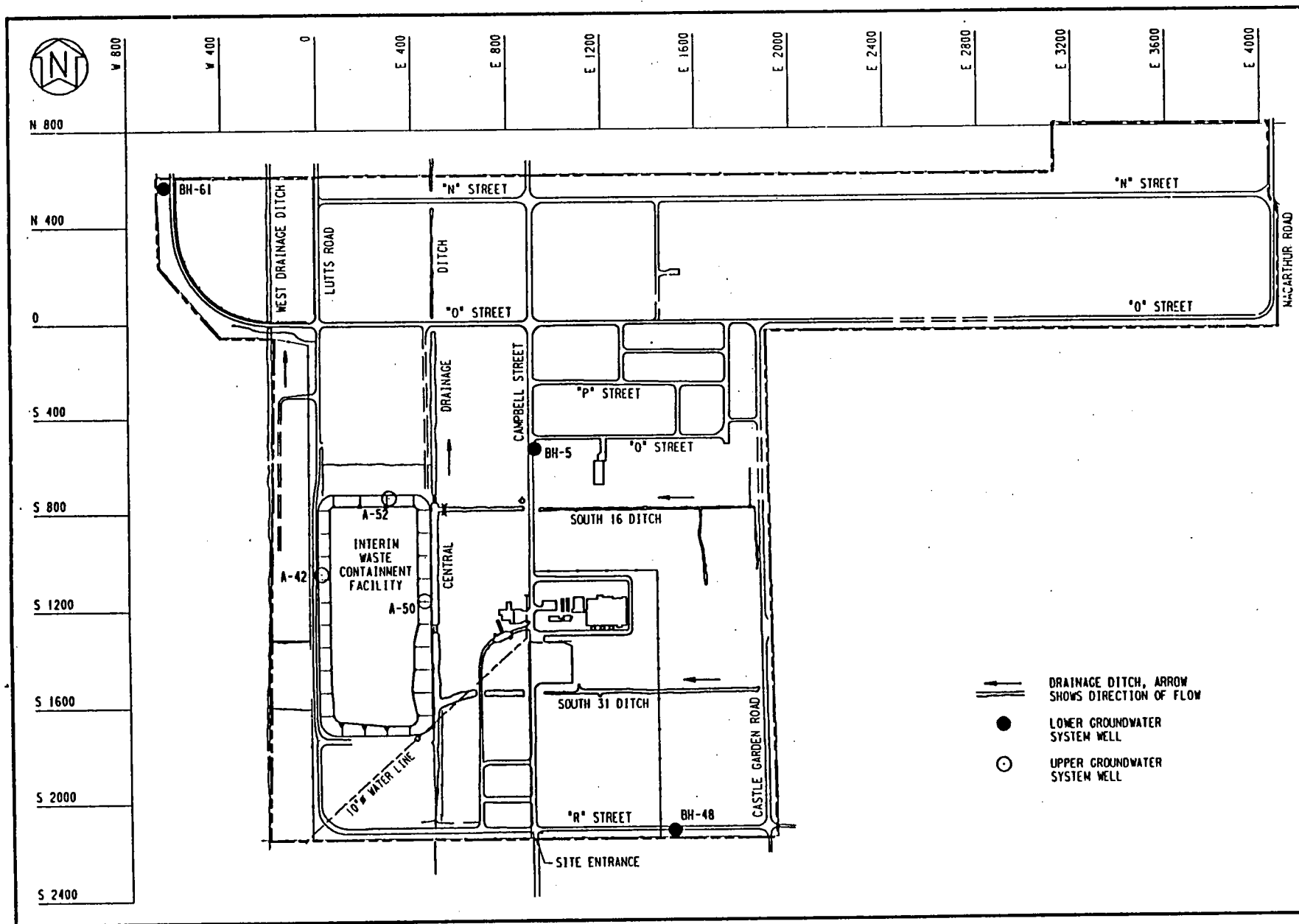
Sediment in the four ditches on site may provide a source of contaminants for surface water and groundwater. Suspended contaminants may settle out of surface water during quiescent periods, only to be resuspended during turbulent flow. Resuspension provides an additional source of surface water contaminants. Water present in the ditches may infiltrate sediments, dissolve contaminants, and percolate downward toward groundwater. Areas where sediments accumulate provide an indication of potential contaminant migration by this pathway.





202W9802.DGN

FIGURE 5-1 LOCATIONS OF GROUNDWATER MONITORING WELLS SURROUNDING INTERIM WASTE CONTAINMENT FACILITY



202WMS10.DGN

FIGURE 5-2 LOCATIONS OF GROUNDWATER MONITORING WELLS OUTSIDE IWCF

## 6. PROPOSED SHORT-TERM SAMPLING STRATEGY

The proposed short-term sampling strategy has been designed to investigate areas where migration of contaminants may be occurring or sources of contaminants may be located. Based on the results of the scoping study, the strategy will investigate groundwater and surface water migration pathways and potential locations of non-radiological contaminants in soil. The costs associated with this sampling strategy are provided in Appendix A.

### 6.1 SURFACE WATER AND SEDIMENT

To investigate the potential for contaminant migration through the surface water pathway, the following characterization activities (which include the current environmental monitoring sample locations) should be conducted:

- (1) Twelve surface water samples will be collected at the locations shown in Figure 6-1. The samples should be analyzed for heavy metals and volatile and semivolatile organic compounds.
- (2) Nine sediment samples will be collected at the locations shown in Figure 6-2. The samples should be analyzed for heavy metals, pesticides and PCBs, volatile and semivolatile organic compounds, and additional mobile ions.

Upon evaluation of this surface water and sediment data, a determination will be made as to whether to incorporate this sampling scheme into the environmental monitoring program.

### 6.2 GROUNDWATER

To investigate the potential for contaminants to migrate off site through the groundwater pathway, the following characterization activities should be conducted:

- (1) The groundwater portion of the environmental monitoring program should be continued for the parameters that are currently being monitored.

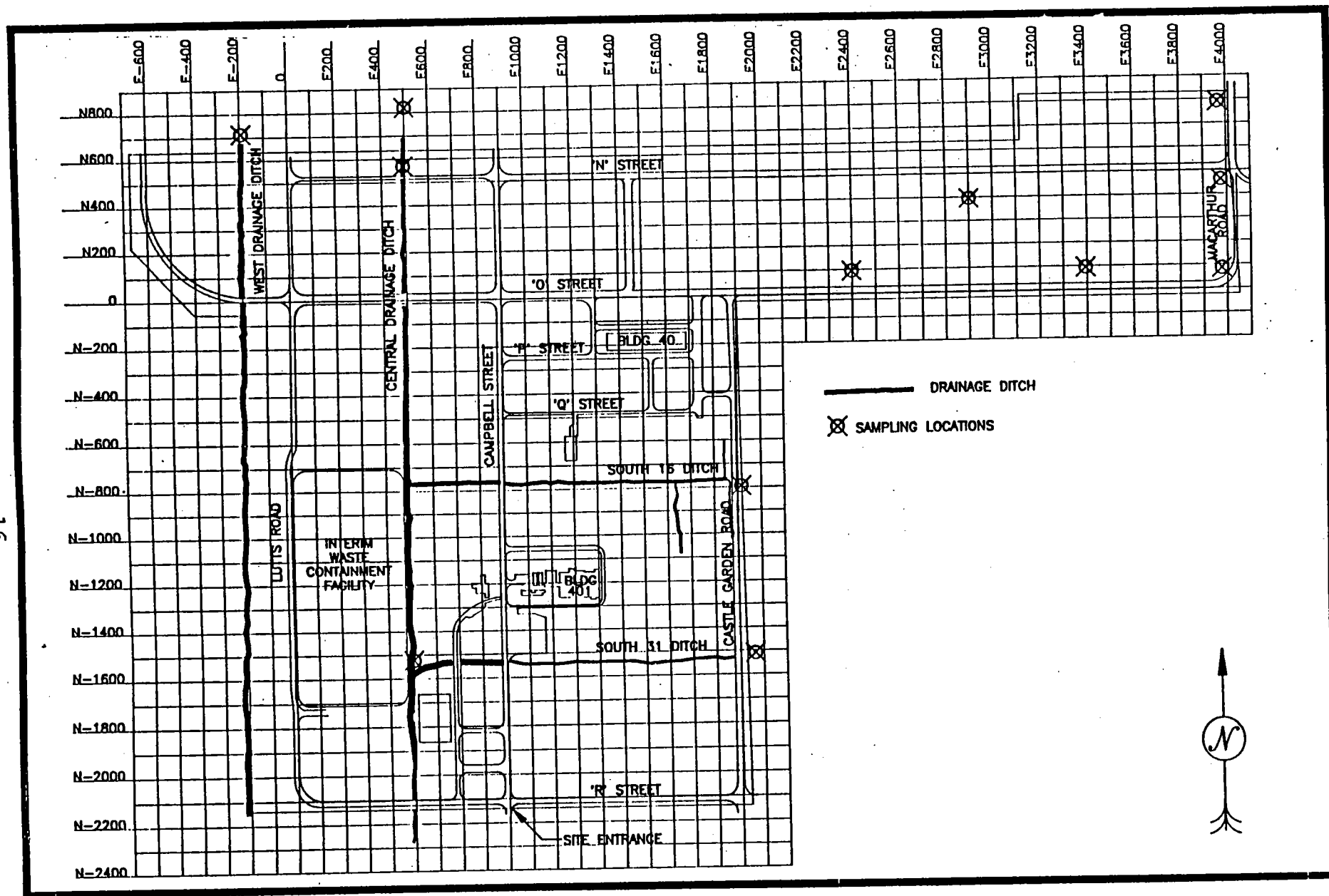


FIGURE 6-1 SURFACE WATER SAMPLING LOCATIONS

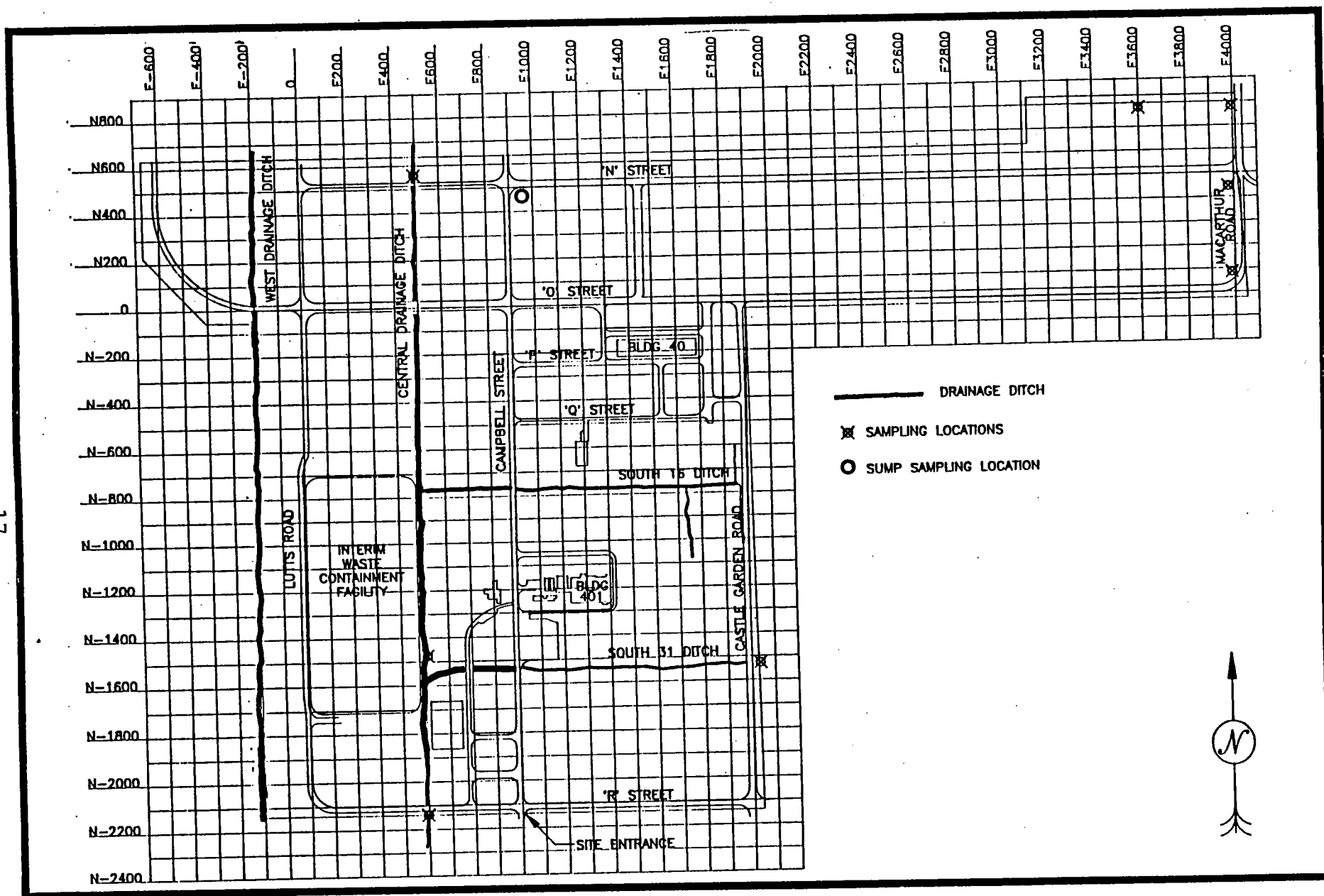


FIGURE 6-2 SEDIMENT SAMPLING LOCATIONS

- (2) Wells numbered BH-46 and BH-50, shown in Figure 6-3, should be added to the groundwater monitoring program. The wells should be sampled quarterly for at least one year and samples analyzed for heavy metals, volatile and semivolatile organic compounds, specific conductance, and pH.
- (3) Analysis for volatiles and semivolatiles should be added to the existing groundwater monitoring program for the following wells, shown in Figures 6-3 and 6-4.

OW - 14A  
OW - 14B  
OW - 16A  
OW - 16B  
OW - 13A  
OW - 13B  
OW - 9A  
OW - 9B  
OW - 5A  
OW - 5B  
BH - 60  
BH - 51  
BH - 48

- (4) Analysis for metals should be added to the sampling scheme for BH-51 and BH-60, shown in Figure 6-3.

### 6.3 SOILS

To investigate the potential for non-radiological contaminants that may be present in soils, the following characterization activity should be conducted:

Thirteen soil samples will be collected at varying depths [up to 3 m (10 ft)] at locations shown in Figure 6-5. The samples will be analyzed for heavy metals (including Boron), pesticides and PCBs, volatile and semivolatile organic compounds, and mobile ions. Samples from the known chemical hotspot will be analyzed for RCRA characteristics.

As described in the earlier sections, NFSS has the potential for volatile organics contamination. However, the currently available information is not sufficient to determine the presence or absence of this contamination. To further investigate the potential for volatile organics, a soil gas screening survey will be employed. Soil gas surveying is a widely accepted preliminary screening tool for investigation of vadose zone properties and subsurface

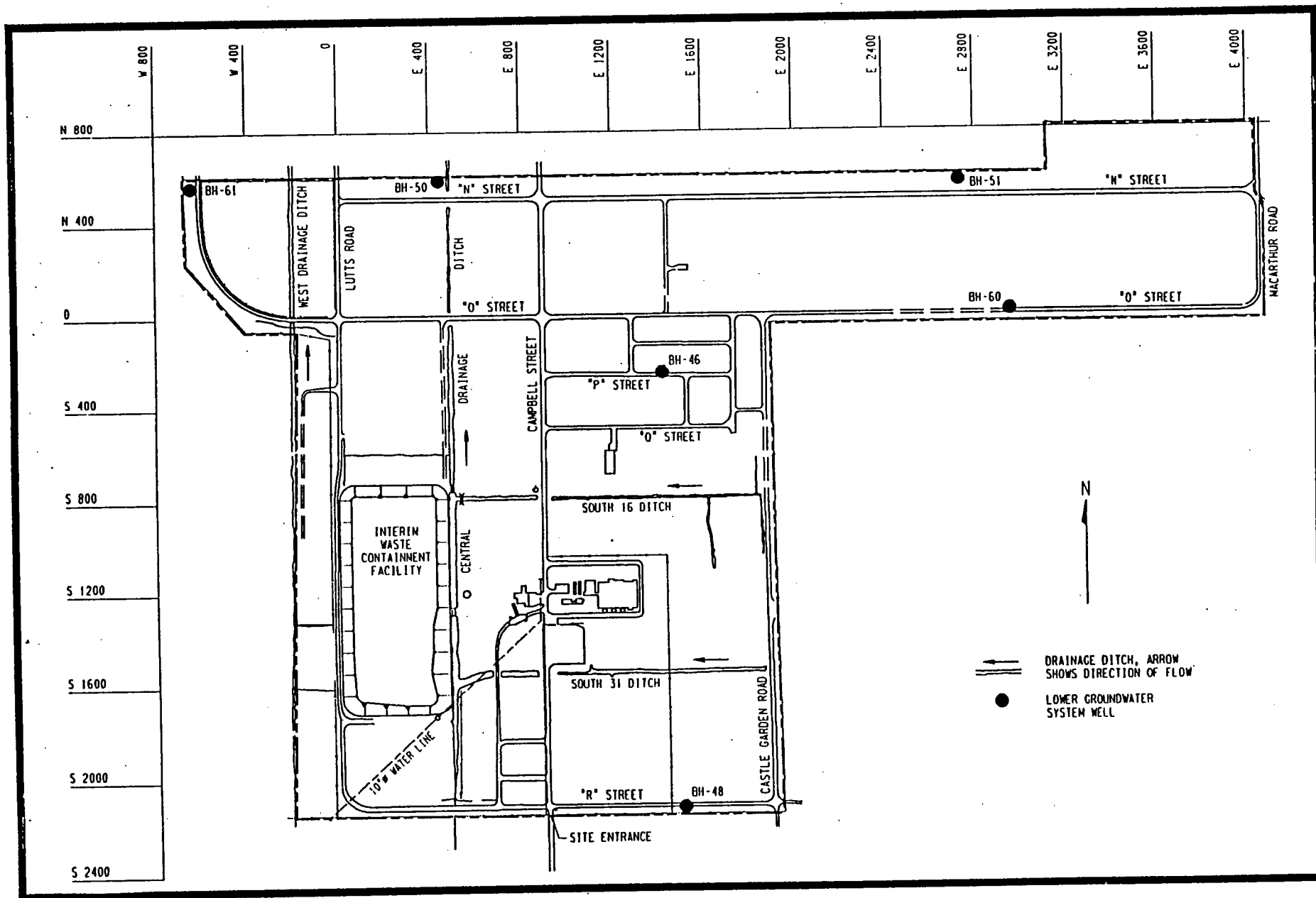
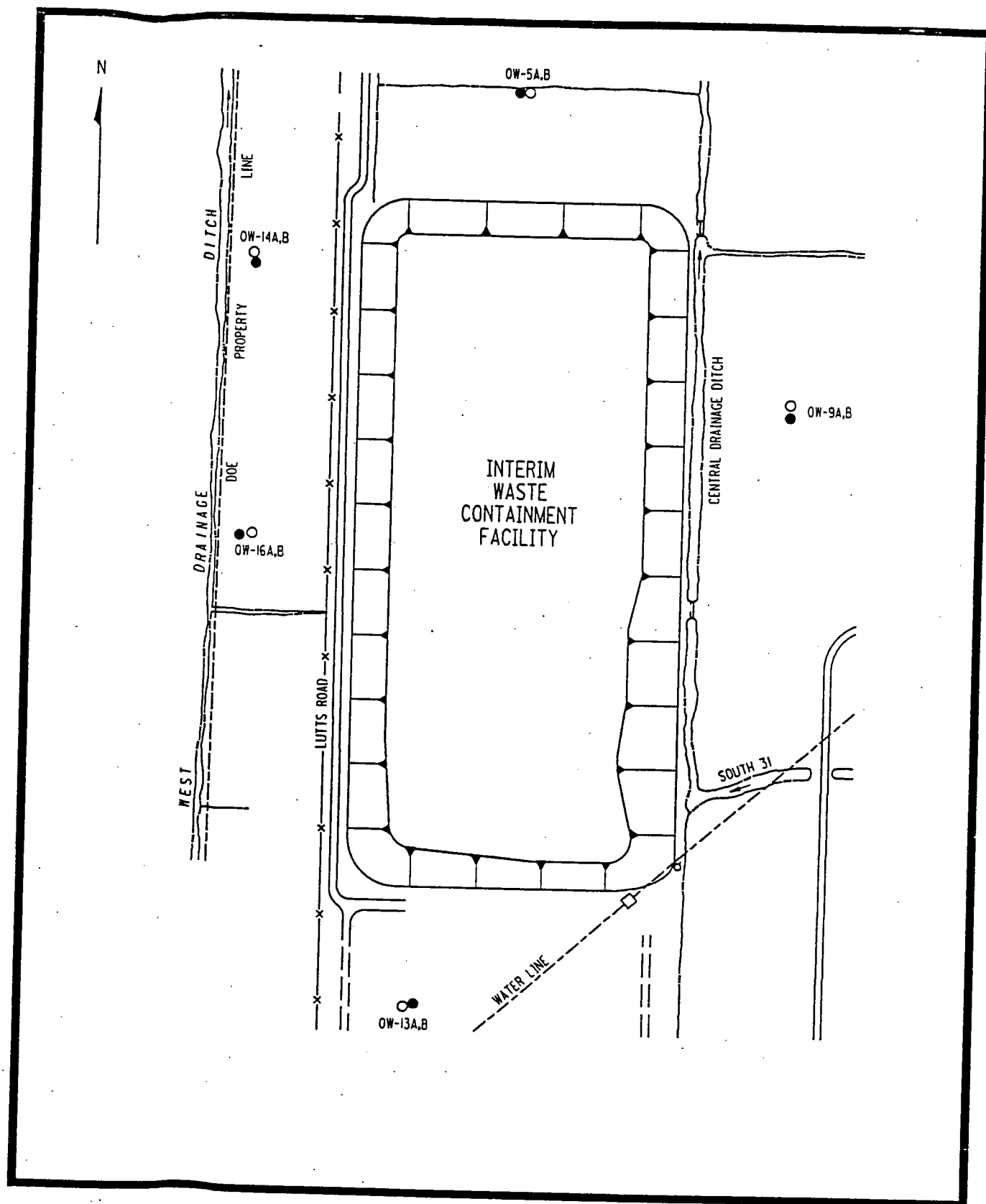


FIGURE 6-3 LOCATIONS OF GROUNDWATER MONITORING WELLS OUTSIDE THE IWCF WITH NON-RADIOLOGICAL ANALYSES TO BE ADDED OR MODIFIED



**FIGURE 6-4** LOCATIONS OF GROUNDWATER MONITORING WELLS SURROUNDING IWCF WITH NON-RADIOLOGICAL ANALYSES TO BE ADDED OR MODIFIED



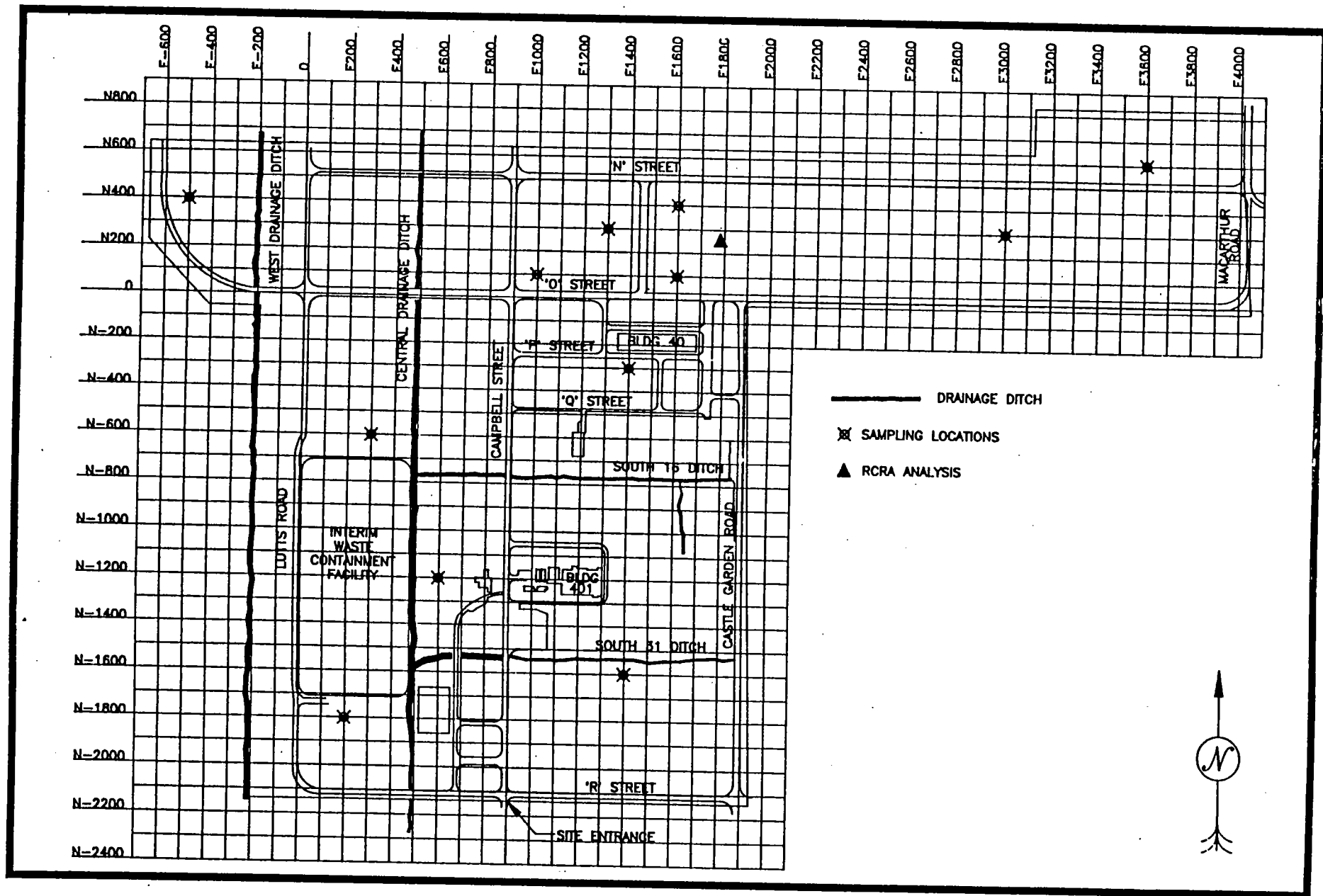


FIGURE 6-5 SOIL SAMPLING LOCATIONS

contamination by volatile organics. Soil gas survey contour maps will be developed, as necessary, to qualitatively define any contamination found. The soil gas surveying will be performed around existing structures, foundations, and those areas DOE plans to excise from the site through the General Services Administration. A company specializing in soil gas surveys will be subcontracted to perform the sampling and analysis.

## 7. PROPOSED LONG-TERM SAMPLING STRATEGY

Based on the results of the short-term strategy presented above, a long-term strategy for further investigation of the site may need to be developed. For example, if results indicate contaminant migration, further investigation may be required into previous storage and disposal areas to determine the source of migrating contaminants, areas where nonradiological contaminants have been encountered, and further documentation of the potential for off-site contaminants migrating onto the site.

Additional sampling may also be needed in the future even if migration of contaminants is not occurring. Should DOE ever desire to release portions of NFSS that are not needed to support the waste containment cell, DOE would be obligated to demonstrate that the property is not contaminated with hazardous substances. Such a determination would most likely require soil sampling over a large area of the site to verify the presence or absence of the hazardous substances identified in this study.

It is recommended that additional monitoring wells be installed within the next twelve months along Castle Garden Road in order to monitor groundwater in that portion of the site.

## 8. SUMMARY

In summary, available information and data concerning the NFSS have been evaluated and it can be concluded that the potential exists for nonradiological contaminants to be present on site. To investigate the potential for off-site migration of contaminants, a short-term sampling strategy has been developed which examines the groundwater and surface water migration pathways. Based on the results of the short-term investigation, a long-term investigation that would further characterize any contaminants present may need to be considered.

APPENDIX A  
SHORT-TERM SAMPLING STRATEGY COSTS

## SHORT-TERM SAMPLING STRATEGY COSTS

The following costs are associated with collecting and analyzing the samples identified in Section 6.0. The labor costs are based on the assumption that a drill rig will not be required, and that Eberline technicians will collect all of the samples.

### Analytical Costs:

<u>Media</u>	<u>Analysis</u>	<u>Cost per Sample</u>	<u>Number of Samples</u>	<u>Total Cost</u>
Surface Water	Heavy Metals	\$275	12	\$ 3,300
	Volatiles	\$350	12	\$ 4,200
	Semi-volatiles	\$700	12	\$ 8,400
Sediment Samples	Heavy Metals	\$325	9	\$ 2,925
	Pesticides/PCBs	\$300	9	\$ 2,700
	Volatiles	\$450	9	\$ 4,050
	Semi-volatiles	\$750	9	\$ 6,750
	Mobile Ions	\$170	9	\$ 1,530
Groundwater	Heavy Metals	\$275	4	\$ 1,100
	Volatiles	\$350	15	\$ 5,250
	Semi-volatiles	\$700	15	\$10,500
	Specific Conductance	\$ 10	2	\$ 20
	pH	\$ 0	15	\$ 0
Soil	Heavy Metals	\$325	13	\$ 4,225
	Pesticides/PCBs	\$300	13	\$ 3,900
	Volatiles	\$450	13	\$ 5,850
	Semi-volatiles	\$750	13	\$ 9,750
	Mobile Ions	\$170	13	\$ 2,210
	RCRA Char.	\$605	1	\$ 605
Total Analytical Cost				\$ 77,265

### Labor Cost:

The following assumptions were made in calculating the labor costs for the sampling activities:

- (1) The total duration of the sampling effort (except for monitoring the groundwater) will be two weeks.

(2) Four Eberline technicians will be required.

(3) The groundwater sampling activities can be added to the existing environmental monitoring activities with minimal cost impact.

Labor costs: [4 technicians][2 weeks][\$2,000/week/technician]  
= \$16,000

Total cost:

The total cost for the sampling activities will be \$93,265.



068232

80-202

**Department of Energy**

Oak Ridge Operations

P.O. Box 2001

Oak Ridge, Tennessee 37831-8723

May 11, 1990

Ms. Helen Shannon  
Regional Docket Coordinator  
ERRD - Federal Facilities Section  
U. S. EPA, Region II  
26 Federal Plaza, Room 2930  
New York, New York 10278

Dear Ms. Shannon:

**PRELIMINARY ASSESSMENT FOR NIAGARA FALLS STORAGE SITE**

As requested in Mr. Wing's March 7, 1990, letter, the Department of Energy (DOE) has compiled a preliminary assessment (PA) for our Niagara Falls Storage Site (NFSS). This document is enclosed for your review. As you will note, we have supplied a considerable amount of backup information in addition to the required PA forms. This information consists of a summary document we have developed to support the PA as well as a historic report prepared by Battelle on site conditions prior to remedial action. We felt this extra information was needed to help the Environmental Protection Agency (EPA) understand the full scope of the actions which have already been accomplished at the site by DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP) and Surplus Facilities Management Program (SFMP).

After your review of the PA, I hope you will concur with DOE's assessment of the status of activities at NFSS. Principally, we believe that:

- 1) contamination at NFSS has and is being properly addressed by FUSRAP/SFMP which are mature, ongoing remedial action programs,
- 2) the vast majority of the hazards at the site have already been mitigated via extensive remedial actions conducted from 1981 through 1988,
- 3) DOE is moving responsibly and in a timely manner to delineate and control any potential remaining contamination, and
- 4) site inspection, hazard ranking scoring, and placement on the National Priorities List (NPL) are not necessary to protect human health and the environment surrounding NFSS. In fact, the administrative burden which would arise from placing the site on the NPL may well impede progress currently planned for the site.



068232

Ms. Helen Shannon

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If there are any questions on these submittals, please contact me at  
(615) 576-1830.

Sincerely,



William M. Seay, Site Manager  
Technical Services Division

Enclosures

cc: Rick Robertson, BNI  
Jim Wagoner, EM-423, DOE-HQ  
Bill Murphie, EM-423, DOE-HQ  
Andy Wallo, EH-25, DOE-HQ

068232

Ms. Helen Shannon

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**ENCLOSURES (for our use only)**

**Battelle Characterization Report**

**Preliminary Assessment**