

**FINAL ACTION MEMORANDUM  
OPERABLE UNIT III OFF-SITE  
GROUNDWATER REMOVAL ACTION**

**June 12, 1998**

**Prepared by:  
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**and**

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Upton, New York 11973-5000**

**ACTION MEMORANDUM  
OPERABLE UNIT III OFF-SITE GROUNDWATER REMOVAL ACTION**

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## **ACTION MEMORANDUM**

### **I. PURPOSE**

The purpose of this Action Memorandum is to document the decision by the U.S. Department of Energy (DOE) to conduct a removal action to address the area identified as having the highest levels of contamination in off-site groundwater associated with Operable Unit III (OU III) at Brookhaven National Laboratory (BNL). This action is being taken in response to a plume of volatile organic compounds (VOCs) detected in the groundwater both on- and off-site during the remedial investigation of OU III. Additional remedial alternatives for other areas of contamination in OU III groundwater are being evaluated in the OU III Feasibility Study.

This action is being undertaken as an interim removal action in accordance with the Interagency Agreement among DOE, the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC), and will be consistent with the final remedial actions that will be documented in the OU III Record of Decision (ROD). Work will be conducted in accordance with the National Contingency Plan (40 Code of Federal Regulations [CFR] 300).

### **II. SITE CONDITIONS AND BACKGROUND**

#### **A. SITE DESCRIPTION**

##### **1. Physical Location**

BNL is located in the geographical center of Suffolk County on Long Island, New York, in the Town of Brookhaven, as shown in Figure 1. The site contains 5,300 acres, of which 75 percent are wooded. The remainder is developed and contains office buildings, various large research facilities, parking lots, and other areas as shown in Figure 2. Residential neighborhoods located downgradient of BNL are also shown in Figure 2.

The BNL site, formerly occupied by the U.S. Army as Camp Upton during World Wars I and II, was transferred to the Atomic Energy Commission in 1947, to the Energy Research and Development Administration in 1975 and to DOE in 1977. It has been operated as a national laboratory since 1947. The BNL site is owned by DOE and is operated by Brookhaven Science Associates (BSA), L.L.C.

BNL carries out basic and applied research in the fields of high-energy nuclear and solid-state physics, fundamental material and structure properties and the interaction of matter, nuclear medicine, biomedical and environmental sciences, and selected energy technologies. Its major operating facilities include the Brookhaven Medical Research Reactor, the National Synchrotron Light Source, and the Alternating Gradient Synchrotron.

## **2. Integration with the Operable Unit III Feasibility Study**

This removal action has been integrated into the overall remedial approach for OU III, which is being addressed in the OU III Feasibility Study. The objectives and ultimate cleanup goals for this action will be further analyzed in the Feasibility Study and documented in the Record of Decision.

## **3. Removal Site Evaluation**

This removal action concerns elevated concentrations of VOCs that were found in groundwater during the remedial investigation of OU III. The site has been divided into five operable units under the interagency agreement. Operable Unit III is the largest of these and encompasses approximately 50% of the site (figure 3). This area of contaminated groundwater, or plume, was initially discovered between April 1995 and January 1996, during the remedial investigation of OU III, when a series of temporary groundwater vertical profile borings were being drilled. During the remedial investigation, VOC concentrations of up to 4,131 parts per billion (ppb) were found in on-site monitoring wells near the site boundary (MW121-11), and up to 5,140 ppb in off-site monitoring wells (OSC-WC7D). An areal depiction of the total VOC groundwater plume in the deep glacial zone (approximately 120 to 210 feet below land surface) with contour intervals is shown in Figure 4. The primary VOCs detected in this plume are tetrachloroethene (PCE), 1,1,1-trichloroethane (TCA), and carbon tetrachloride. TCA and PCE are the primary contaminants in the on-site portion of the plume, and carbon tetrachloride is more prevalent in the off-site portion of the plume.

The horizontal and vertical extent of the VOCs in the plume is as follows: In the water-table zone (ranging approximately from land surface to 60 feet below land surface), the elevated levels of VOCs (>50 ppb) are centered around the area south of building 96. Other sources identified include the Waste Concentration Facility (WCF), the Paint Shop area, south of Building 464, south of the Brookhaven Graphite Research Reactor (BGRR), and near the southern end of Building 208. Remediation alternatives for these areas are being evaluated in the OU III Feasibility Study.

In the mid-glacial groundwater zone (ranging approximately from 60 to 120 feet below land surface), the VOC plume extends in a north-south direction from Brookhaven Avenue (on-site) to Carleton Drive (off-site). In the east-west direction, the VOC plume extends from Upton Avenue approximately 4,500 feet east to monitoring well MW 105-24. The highest concentrations of on-site VOCs in the mid-glacial zone have been detected in monitoring well MW 113-10, which is located between Princeton Avenue and the south boundary of OU III.

In the deep-glacial zone (ranging approximately from 120 to 210 feet below land surface), the plume with high VOC concentrations (i.e., greater than 50 ppb) is approximately 9,600 feet long and 2,000 feet wide. This is the zone where most of the high concentrations of VOCs are found at the southern boundary and off-site. Figure 4 depicts the extent of this VOC plume. Figure 5

provides a vertical cross-section of this plume depicting its downward migration as it moves south.

#### **4. Release or Threatened Release into the Environment of a Hazardous Substance, Pollutant or Contaminant**

The major threat to the environment from the BNL site is the further migration of contaminants (i.e., VOCs) in the groundwater, which is designated as a "sole-source aquifer" under the federal Safe Drinking Water Act. The basis for this removal action is to treat and prevent further southward migration of the highest VOC contaminant concentrations in off-site groundwater.

The Remedial Investigation/Risk Assessment (RI/RA) Report for OU III, which is expected to be released for public review and comment in summer 1998, will provide detailed information concerning the potential release of contaminants into the environment.

### **B. OTHER ACTIONS TO DATE**

#### **1. Previous Actions**

The *OU III Remedial Investigation/Feasibility Study (RI/FS) Work Plan* (IT Corporation, September 1994) identified monitoring well 130-02 as Area of Concern (AOC) 15B due to the presence of TCA above the maximum contaminant levels (MCLs) permissible by New York State regulations (greater than 5 ppb). Because of the proximity of monitoring well 130-02 to the southwest boundary of the BNL site, there was concern regarding possible off-site migration of TCA. In addition, a significant data gap was identified from Princeton Avenue south to the site boundary in OU III (Figure 2). Therefore, the entire area between Princeton Avenue and the southern boundary of OU III was identified as AOC 15B.

Two objectives were identified for AOC 15B in the OU III RI/FS Work Plan: (1) to evaluate the potential for off-site migration of VOCs at the southern boundary, and (2) to further characterize the hydrology and lithology between Princeton Avenue and the southern boundary.

To meet these objectives, a series of 46 vertical profile borings were drilled in three east-west parallel lines on-site. This work was performed by ERM-Northeast under contract to BNL. Based on the high concentrations of VOCs (greater than 4,000 ppb) detected at the site boundary during this investigation, an additional east-west line of vertical profile borings was added south of the site. This line of test wells, located south of BNL in the industrial park south of the Long Island Expressway, led to the discovery of VOCs at concentrations greater than 5,000 ppb in groundwater off-site.

In 1997, a removal action to address the on-site portion of the plume was implemented. This removal action was documented in a separate action memorandum (BNL, April 1997). The removal action involved the construction of a pump-and-treat system to prevent any further off-site migration of high-level contamination (>50 ppb) in the on-site portion of the VOC plume associated with OU III. This system became operational in June 1997 (See Fig. 4). Free public water hookups have also been offered to property owners in the area immediately to the south of OU I and OU III. This area is bounded by River Road on the west; Colin Drive, Moriches-Middle Island Road and Carleton Drive to the north; Sleepy Hollow Drive and Cranford Boulevard to the east and Sunrise Highway to the south. Initiated in January 1996, the public water hookup offer was made as a precautionary measure to prevent any potential future exposure to groundwater contaminants associated with OU III. Another action memorandum (BNL, December 1996) was prepared to address these public water hookups.

## **2. Current Actions**

Additional work is being conducted on an ongoing basis to obtain more data concerning the VOC plume, both on- and off-site. This work includes soil and groundwater sampling, installation of monitoring wells, and evaluation and selection of future remedial activities. Current data from groundwater monitoring wells installed south of the industrial park indicate that concentrations of this VOC plume are rapidly diminished to the south of the industrial park. Based on these data, the leading edge of this plume of VOCs is located just south of Moriches Middle Island Road and Puritan Drive in North Shirley (see Figures 4 and 5).

## **C. NATIONAL PRIORITIES LIST STATUS**

BNL was added to the National Priorities List in 1989. An Interagency Agreement under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and applicable New York State regulations was negotiated among DOE, EPA, and NYSDEC. The Interagency Agreement became effective in May 1992 and governs the environmental restoration program at BNL.

## **III. THREATS TO PUBLIC HEALTH OR WELFARE AND THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES**

### **A. THREATS TO PUBLIC HEALTH OR WELFARE**

The threats posed by groundwater contamination associated with OU III are of a non-time-critical nature, i.e., based on the existing information and the public water hookups, no imminent or substantial endangerment of public health or welfare and the environment currently exists at these sites that would necessitate cleanup within six months (as defined in the National

Contingency Plan for categorization of specific cleanup efforts as removal actions). The appropriateness of a removal action is based on two of the eight factors that are listed in 40 CFR 300.415(b)(2) of the regulations implementing the National Contingency Plan:

1. Actual or potential exposure to nearby populations, animals or food chain from hazardous substances, pollutants or contaminants; and
2. Actual or potential contamination of drinking water supplies or sensitive ecosystems.

The BNL site is located above a sole-source aquifer as designated by the EPA under the Safe Drinking Water Act, and groundwater is the primary source of drinking water in the area. The groundwater is also classified by New York State as Class GA under 6 New York Code of Rules and Regulations (NYCRR) Part 703. The best usage of Class GA groundwater is a source of potable water supply. Contaminants determined to be from OU III have been found in the groundwater on- and off-site and have been predicted by groundwater modeling to travel beneath off-site domestic wells. Although modeling does not prove that the contaminants will travel beneath residential wells, the depths of contaminants in monitoring wells south of the site boundary correlate well with predictions by the groundwater model. However, these concerns have been addressed through the installation of public water to any potentially impacted areas.

## **B. THREATS TO THE ENVIRONMENT**

The major threat to the environment is further southward migration of the VOC plume and the contamination of additional water resources. As stated earlier, the BNL site is located above an EPA-designated sole-source aquifer.

## **IV. ENDANGERMENT DETERMINATION**

Actual or threatened releases of pollutants and contaminants from the OU III portion of the BNL site, if not addressed by implementing the response action selected in this action memorandum, may present an imminent and substantial endangerment to the environment.

## **V. PROPOSED ACTIONS AND ESTIMATED COSTS**

### **A. PROPOSED ACTIONS**

The proposed action involves the installation of an in-well air stripping system in the industrial park south of the BNL site.



## 1. Proposed Action Description

The proposed action, installation of an in-well air stripping system in the industrial park south of the BNL site, is being performed on an accelerated schedule, prior to completion of the OU III RI/RA Report, the OU III Feasibility Study Report, and the OU III Record of Decision, to prevent the further southward migration of high concentrations of VOCs. The performance of a removal action for this purpose is specifically referenced in the EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.3-02.

This technology utilizes double-screened wells, which pump contaminated water from the lower screen to a small air stripper within the well. The air stripping unit removes the VOCs, and the treated water is then recharged at a shallower depth (upper screen) back into the aquifer. Air stripping is a process by which the water is mixed with air and the chemicals are "stripped out" from the water and collected in the air stream. The air is then returned to a treatment building, treated with granular activated carbon to remove the VOCs, and recycled to the well. The movement of groundwater around the wells establishes a circulation cell within the aquifer, effectively containing the plume.

The rationale for the proposed action is to prevent groundwater containing the highest concentrations of VOCs in off-site groundwater from migrating further south (concentrations as high as 5,140 ppb have been detected in deep monitoring wells in the off-site area). Once this system becomes operational, it will begin to remove the high concentrations of VOCs from the groundwater and prevent any additional southward migration in this area.

This action is part of the overall OU III groundwater remedial strategy and has been incorporated into the OU III Feasibility Study. Further groundwater characterization will be performed, and the applicability of additional treatment alternatives to reduce the contaminant residence time in the groundwater in both on-site and off-site areas will be evaluated in the OU III Feasibility Study and documented in the OU III ROD. These additional treatment options include air stripping, in-well air sparging, soil vapor extraction, air sparging and natural attenuation.

Groundwater modeling was performed to determine the most efficient configuration of well locations, the number of wells, required pumping rates, and an appropriate discharge location. Six double-screened wells pumping at a rate of 60 gallons per minute (gpm) will be used to provide hydraulic control and treatment of the high concentrations of VOCs related to OU III in the industrial park. Figure 6 shows the proposed locations of these wells, and Figure 7 provides a cross-section of the wells and contaminant plume. This action will achieve the goal of hydraulic containment and treatment of the high concentrations of VOCs identified in the industrial park.

### Off-Site Groundwater

Public water hookups were offered to residences in the area as a precautionary measure. Specific remedial actions to address the portions of this off-site VOC plume further downgradient are being addressed in the OU III Feasibility Study and will be documented in the OU III ROD.

### Additional Needed Information

Further information is needed to optimize the components of the selected system. This information and other, more specific data will be generated during the design phases of the groundwater treatment system. Additional groundwater studies of the VOC plume will be conducted and these studies, along with treatment alternatives, will be evaluated in the OU III Feasibility Study.

### Institutional Controls

Institutional controls will be needed off-site to prevent the installation of supply wells or other pumping wells that may mobilize any remaining contaminants or otherwise interfere with the remedial action.

### Compliance with Off-Site Policy

Off-site disposal of spent carbon will be required and will be performed within all relevant and appropriate requirements governing the disposal/regeneration of spent carbon.

## **2. Contribution to Remedial Performance**

Implementation of the removal action is consistent with the overall remedial action for OU III because it initiates the remediation of VOC-impacted groundwater off-site and prevents further southward migration of the highest concentrations.

## **3. Description of Alternative Technologies**

Alternative technologies that may enhance this cleanup effort are being studied and evaluated as part of the OU III Feasibility Study. These technologies include groundwater pump-and-treat, air sparging, soil vapor extraction, in-well air stripping and natural attenuation/decay. The use of in-well air stripping to remove VOCs is a proven and effective method of treatment. An evaluation of technologies for this removal action was discussed in the OU III Off-Site Removal Action Pre-Design Report (Geraghty & Miller, February 1998).

## **4. Applicable or Relevant and Appropriate Requirements**

A detailed discussion of the potential federal and state Applicable or Relevant and Appropriate Requirements (ARARs) will be provided in the OU III RI/RA and Feasibility Study reports. Contaminant-, location-, and action-specific ARARs, as well as To-Be-Considered goals will be identified. The major ARARs governing the BNL site are the classification of the groundwater

at, and downgradient of, the site as a sole-source aquifer under the federal Safe Drinking Water Act, and the classification of the water as Class GA water as defined by New York State law. As such, federal and state MCLs and New York State Class GA groundwater quality standards were compiled to establish cleanup goals. The more stringent of the ARARs were used to establish the cleanup goals.

If monitoring indicates that continued operation of the components of the selected remedy is not producing significant further reductions in the concentrations of contaminants, DOE, NYSDEC, and EPA will evaluate discontinuation of the groundwater treatment system in accordance with the National Contingency Plan. The criteria for discontinuation will include an evaluation of the operating conditions and parameters, as well as a determination that the system has attained the feasible limit of contaminant reduction and that further reductions would be impracticable. The ultimate cleanup goal for this action will be evaluated in the Operable Unit III FS. It is expected that the combination of the groundwater treatment systems and natural attenuation of the remaining contaminants will ultimately meet the cleanup goal of reaching the MCLs for groundwater.

Vapor phase granular activated carbon will be used to treat the air to remove the VOCs and the air will be recycled into the system.

## **5. Project Schedule**

This proposed interim removal action will be performed in accordance with the schedule established under the Interagency Agreement. Major tasks include preparation of the OU III Remedial Design Work Plan, Design Documents, and Bid Specifications; the construction of the in-well air stripping system; and the initiation of the removal action. This project is being performed under an accelerated schedule, with the goal of having the system operational in December 1998. The installation of the treatment system will be started in July 1998 and completed in December 1998. Completion of the system will be followed by a 12-week period of start-up testing followed by the initiation of routine operation and maintenance (O&M). When this action is completed, a close-out report will be prepared.

### **B. ESTIMATED COSTS**

Design and construction costs: \$2,337,000.00

O&M costs for 10 years: \$3,372,000.00

Total estimated costs: \$5,709,000.00.

O&M costs were projected for 10 years, based upon currently available information. The OU III Feasibility Study will determine what other remedial actions will be taken and how this will impact the duration of O&M.

#### **VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN**

A delayed action or no action will increase the potential for contaminant migration in off-site groundwater. Delayed action will potentially increase the scope and cost of the project as larger volumes of the aquifer are impacted.

#### **VII. PUBLIC PARTICIPATION**

Public participation activities for the OU III Off-Site Groundwater Removal Action include door-to-door canvassing of homes and businesses immediately adjacent to the proposed construction area; briefings of elected officials; coordination of public notice publications; conducting three poster sessions; publishing multiple articles in *cleanupdate*, (the ERD newsletter), and mailing of a cover letter and fact/summary sheet explaining the treatment system to the people on the community relations Environmental Restoration Division (ERD) mailing list (approximately 1,800 addressees). In addition, the OU III Off-Site Removal Action Pre-Design Report is in the Administrative Record and is available for public review.

These activities preceded the submission of the Action Memorandum to the Administrative Record. Neighborhood canvassing and briefings of elected officials took place in March/April 1998. Following the canvassing, a mailing, including a fact sheet and cover letter announcing poster session dates and times, was sent to the community relations ERD mailing list. Three poster sessions were conducted during the first week in April 1998.

The public notice of the availability of the Action Memorandum will be published on or before June 17, 1998 in *Newsday* (regional distribution) and in a weekly newspaper (local distribution). A copy of the public notice will be sent simultaneously to the community relations ERD mailing list.

#### **VIII. OUTSTANDING POLICY ISSUES**

There are no major outstanding policy issues at this time.

## **IX. ENFORCEMENT**

The site is owned by DOE and is operated by BSA. Funding for source control and groundwater remediation will be provided entirely by DOE.

The removal action will be conducted in accordance with CERCLA and National Contingency Plan requirements, the Interagency Agreement, Executive Order 12580, and applicable New York State regulations.

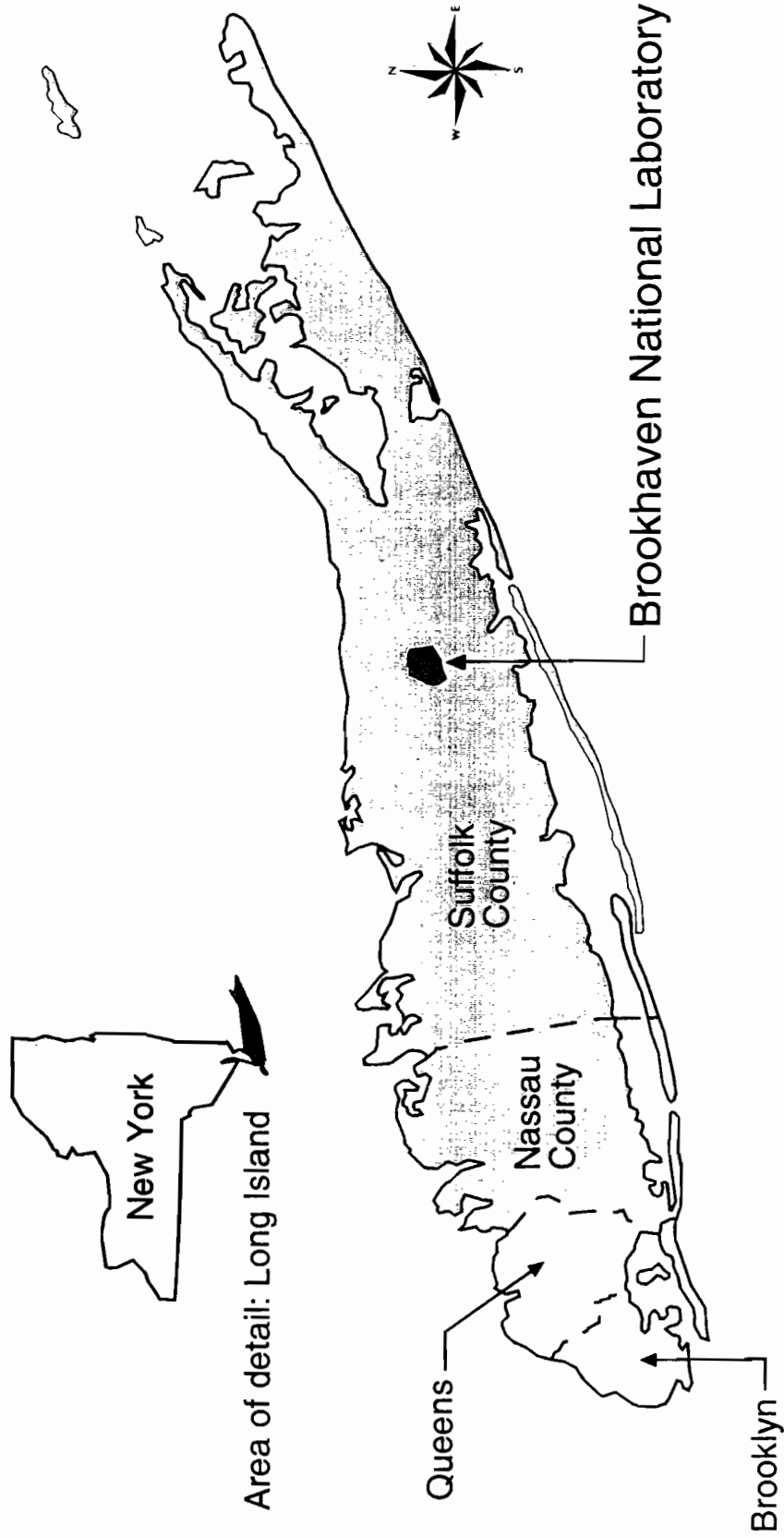
## **X. RECOMMENDATION**

This decision document represents part of the selected remedy for groundwater associated with OU III at BNL in Upton, New York, developed in accordance with CERCLA as amended, and is consistent with the National Contingency Plan.

## LIST OF ACRONYMS AND ABBREVIATIONS

AOC	Area of concern
ARARs	Applicable or relevant and appropriate requirements
BNL	Brookhaven National Laboratory
BGRR	Brookhaven Graphite Research Reactor
BSA	Brookhaven Science Associates
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ERD	Environmental Restoration Division
GA	Groundwater, class A, suitable for potable use
gpm	Gallons per minute
L.L.C.	Limited Liability Corporation
MCLs	Maximum contaminant levels
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
O&M	Operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
OU III	Operable Unit III
PCE	Tetrachloroethene
ppb	Parts per billion
RI/FS	Remedial Investigation/Feasibility Study
RI/RA	Remedial Investigation/Risk Assessment
ROD	Record of Decision
TCA	1,1,1-Trichloroethane
VOCs	Volatile organic compounds
WCF	Waste Concentration Facility

## **FIGURES**



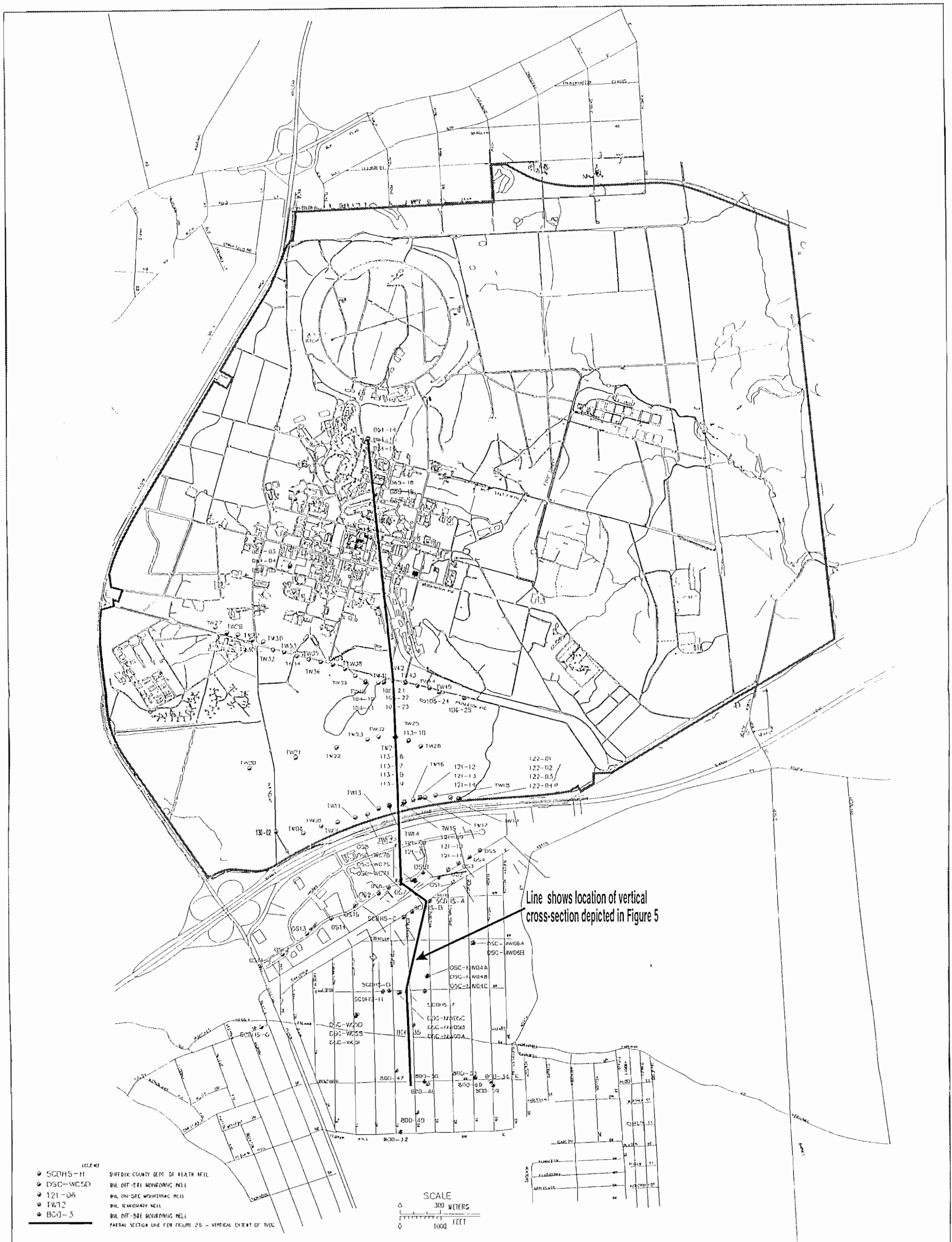
Modified by P. Cooney (BKL)  
 Date: 4/1/88  
 Not to scale  
 Drawing Number: PG-1

**Figure 1**  
**Brookhaven National Laboratory Locator**

Environmental Restoration Division  
 Brookhaven National Laboratory

Prepared By:

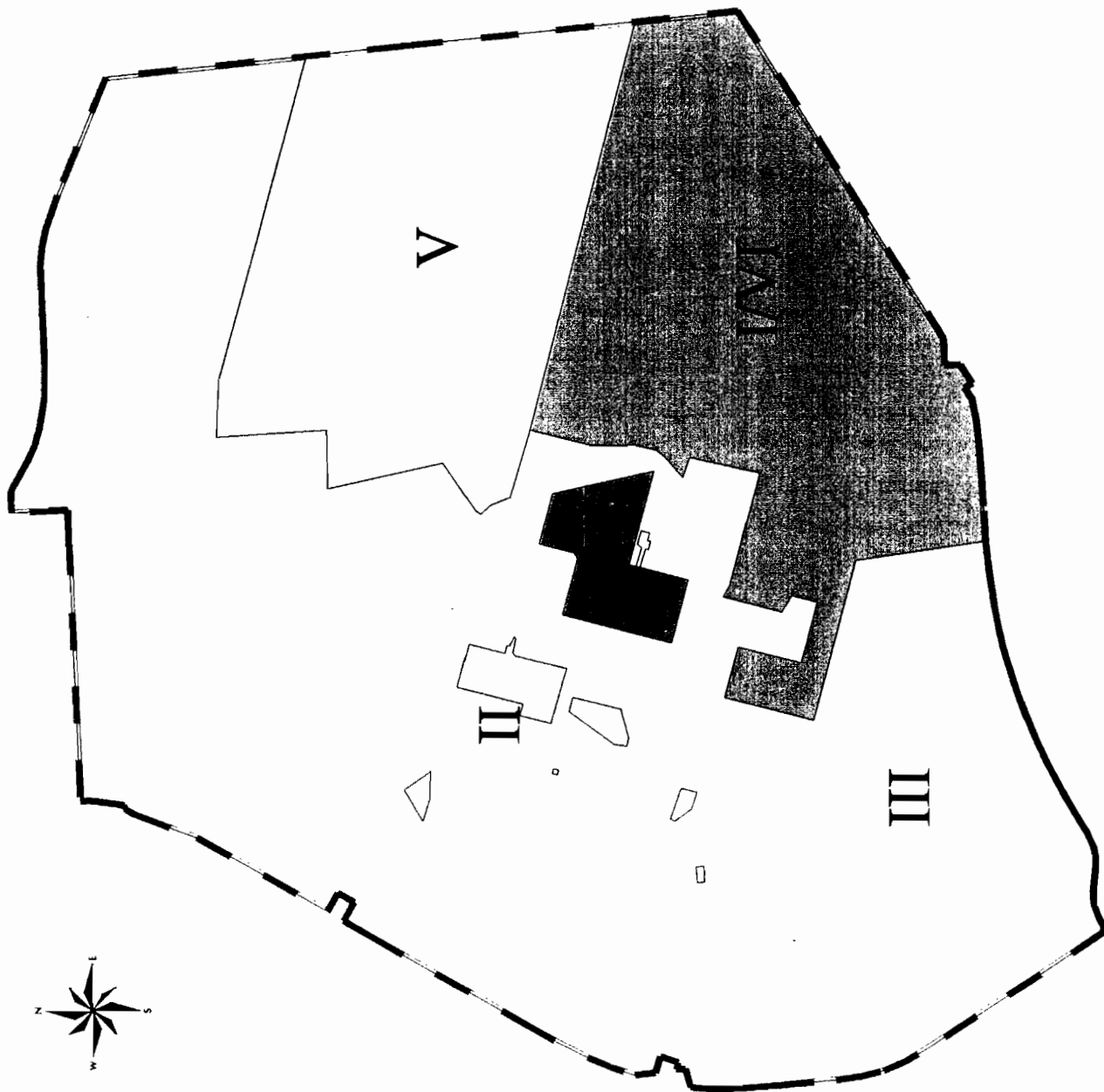




Prepared By:  
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**Brookhaven National Laboratory**

**Figure 2**  
**BNL Site Plan and Monitoring Well Locations**

Modified by: P. Genzer (BNL)  
 Date: 3/5/98  
 Scale: As Shown  
 Drawing Number: PG-08



# OPERABLE UNITS

## LEGEND



Waste Management Areas, Landfills, and Upland Recharge



Alternating Gradient Synchrotron Scrapyard, and Aerial Survey



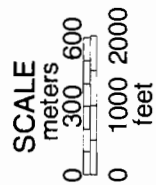
Potable and Supply Wells and Spills

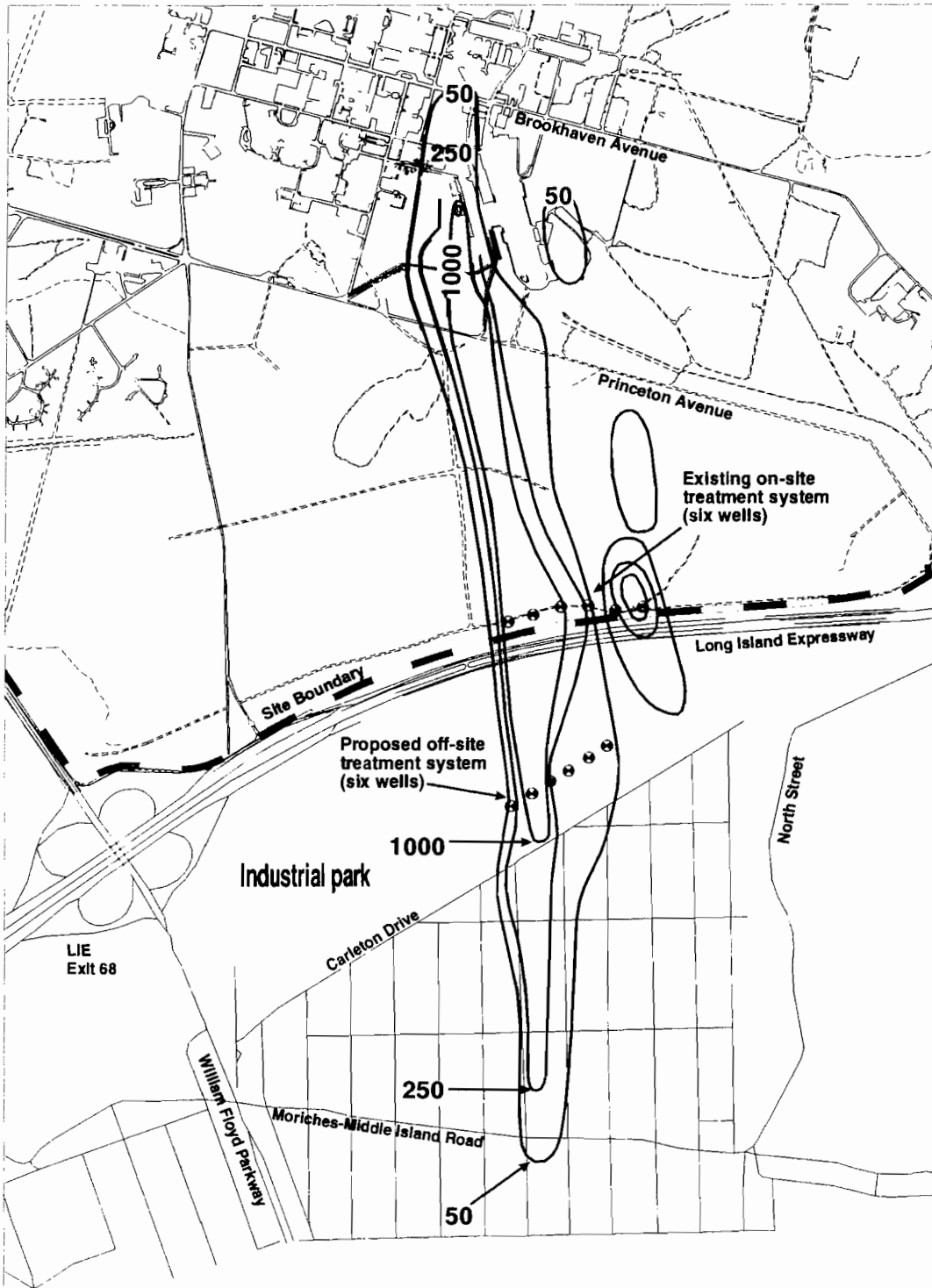


Central Steam Facility



Sewage Treatment Plant



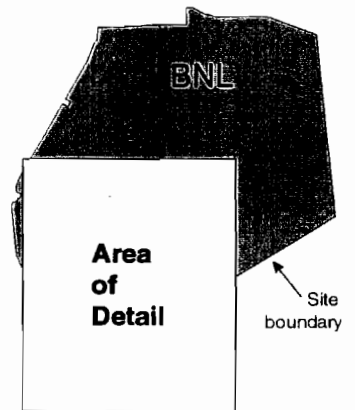
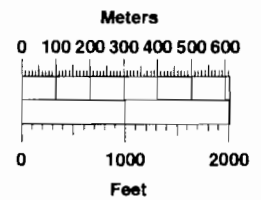


### LEGEND

- Extraction Wells
- Recharge Basins
- ▭ TVOC plume (parts per billion)



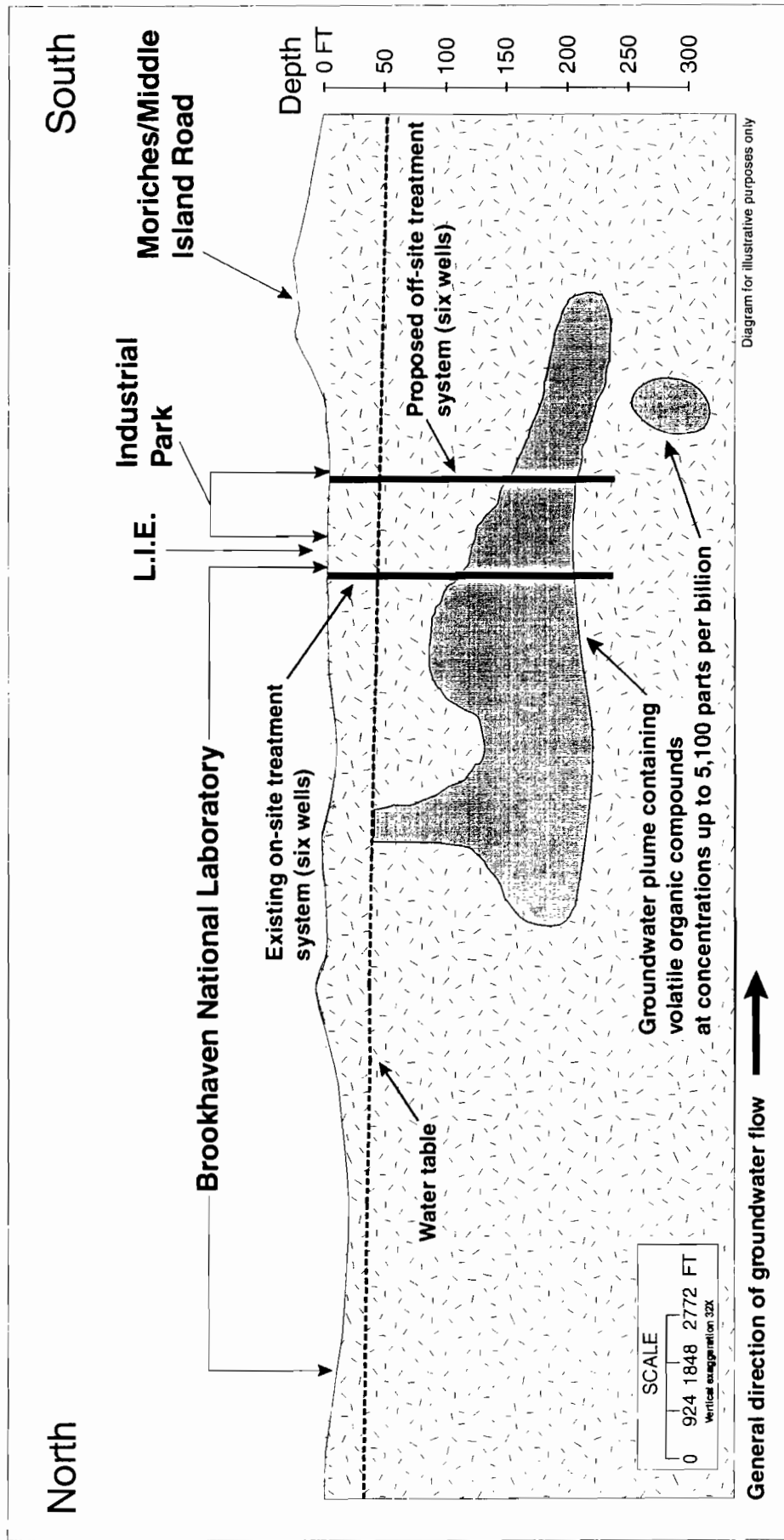
### SCALE



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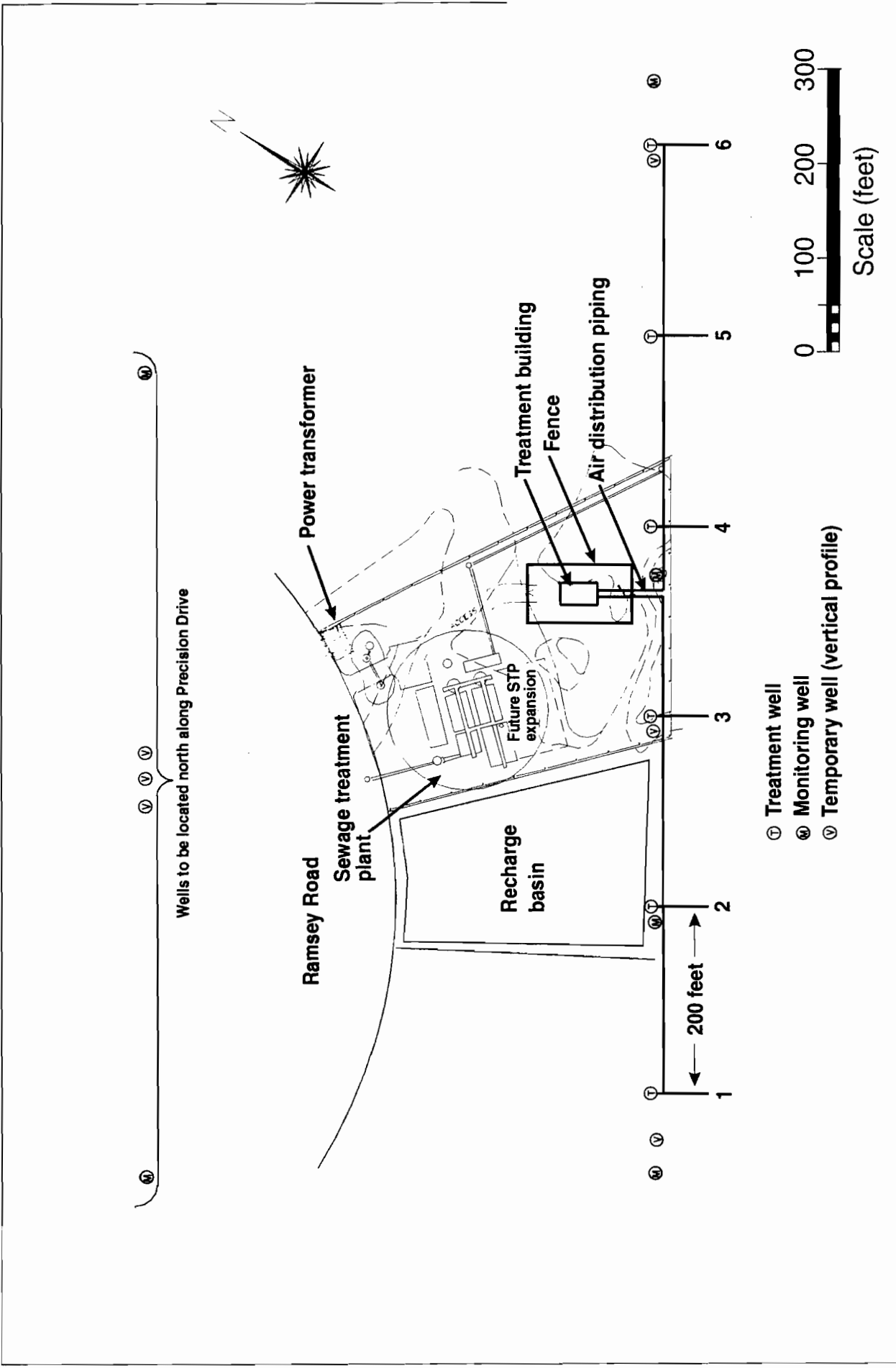
**Figure 4**  
**Areal Extent of VOC Plume**

Modified by: P. Gerner (BNL)  
 Date: 3/5/98  
 Scale: As Shown  
 Drawing Number: PG-4



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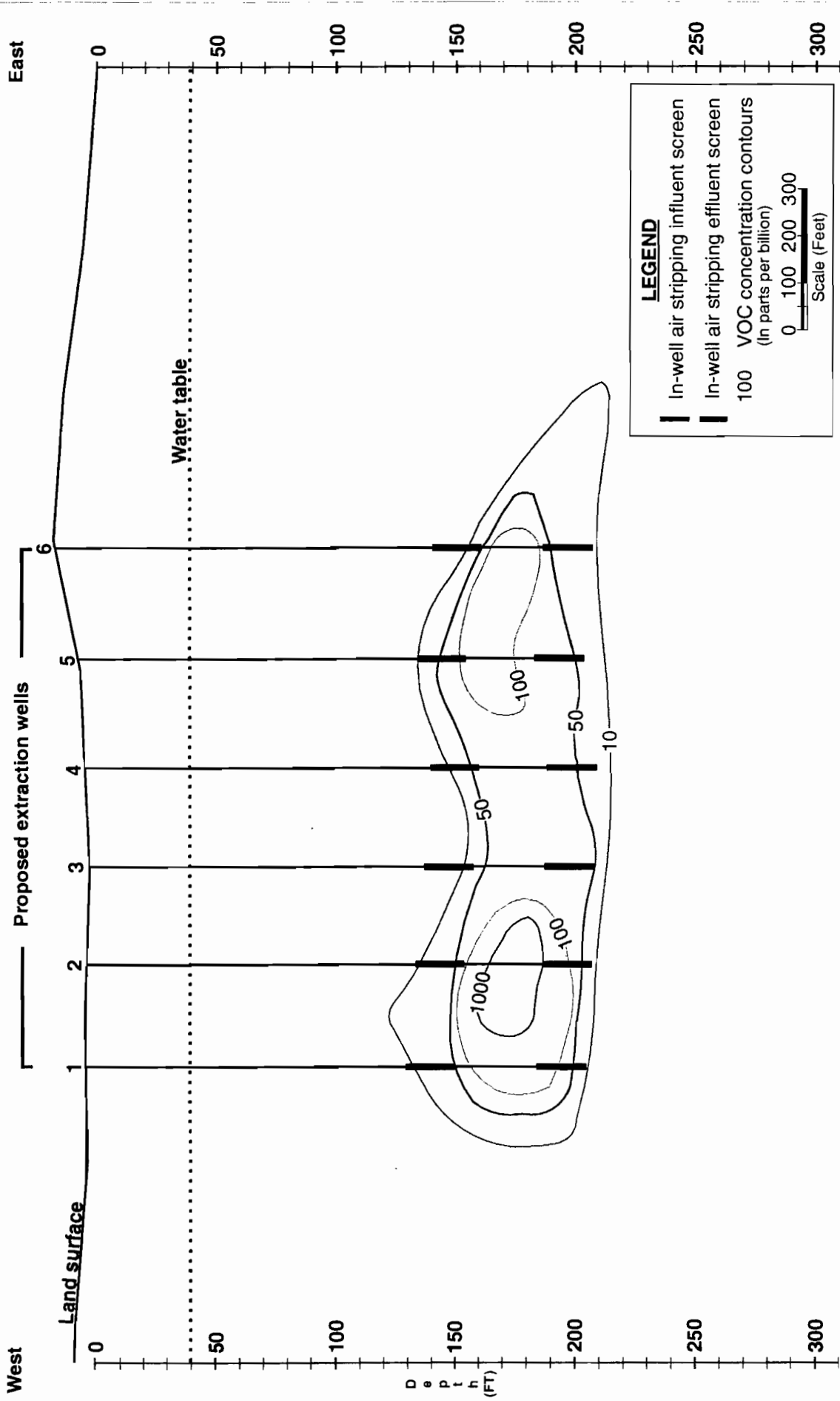
Figure 5  
 Side Cross-Section of VOC Plume



Modified by: F. Guent (BML)  
 Date: 3/9/98  
 Scale: As Shown  
 Drawing Number: PC-2

**Figure 6**  
**Industrial Park Treatment System Conceptual Layout**

Prepared By:  
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 Brookhaven National Laboratory



Prepared By:  
 Environmental Restoration Division  
 Brookhaven National Laboratory

Figure 7  
 Section View of Total VOC Concentrations

Modified by: P. Sumner (BML)  
 Date: 3/98  
 Scale: As Shown  
 Drawing Number: PO-3