U. S. DEPARTMENT OF ENERGY

BROOKHAVEN NATIONAL LABORATORY

OPERABLE UNIT III

RECORD OF DECISION

April 14, 2000

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I. DECLARATION OF THE RECORD OF DECISION

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SITE NAME AND LOCATION

OPERABLE UNIT III
BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK

STATEMENT OF BASIS AND PURPOSE

This record of decision (ROD) presents the selected remedial actions for Operable Unit (OU) III of the Brookhaven National Laboratory (BNL) site in Upton, New York. OU III was developed to address groundwater plumes emanating from the central and southern portion of the BNL site. The selected remedy addresses on and off-site groundwater contaminated with volatile organic compounds (VOCs), and tritium and strontium-90 in groundwater on-site. Thirteen areas of concern (AOCs) located in OU III, four AOCs from other OUs and two Additional Areas of Investigation (AAIs) were investigated and characterized in the Remedial Investigation Report for OU III.

These remedial actions were selected in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (hereinafter jointly referred to as CERCLA), and is consistent, to the extent practicable, with the National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan). This decision is based on the Administrative Record for the BNL site.

The State of New York concurs with the selected remedial actions.

ASSESSMENT OF THE SITE

Actual or potential releases of hazardous substances, including chemical and radioactive materials from these areas, may present a threat to public health, welfare or the environment if they are not addressed by implementing the response actions selected in this ROD.

DESCRIPTION OF THE SELECTED REMEDY

Operable Unit III is one of the six operable units at the BNL site for which remedies have been or will be selected. This ROD documents the selected remedial actions for groundwater contamination in OU III. Removal actions, which are either complete or on going are integrated into the final actions. Completed removal actions and source areas are addressed in Table 2. This ROD documents remedies that are consistent with the overall site cleanup strategy. The ROD includes a description of principal contaminants and their representative risks. Cleanup goals have been established to meet regulatory standards. The clean up objectives are: to meet the drinking water standards in groundwater for VOCs, strontium-90 and tritium; complete the cleanup of the groundwater in a timely manner, which for the Upper Glacial Aquifer goal is 30 years or less; and, prevent or minimize further migration of VOCs, Strontium-90 and tritium in groundwater. Current and future land uses were evaluated in this ROD. The costs of each remedy were estimated and are discussed in the ROD. The best balance of the Environmental Protection Agency's (EPA) remedy selection criteria was used to identify the following selected actions:

Volatile Organic Compounds (VOCs) Remedy: There is a large plume of groundwater contaminated with VOCs in the central and southern portion of the BNL Site and off-site. Several Interim Removal Actions (IRAs) have begun to address VOC contamination, including treatment systems at the southern site boundary and in an off-site, downgradient industrial park. Additionally, public water was provided in a large area south of the BNL Site, to protect public health while the groundwater cleanup is underway.

The selected remedy, Alternative V10c, involves active remediation of both on-site and off-site VOC contamination. It includes the following systems: operation of the on-site and off-site IRAs, including the On-Site Southern Boundary IRA and the Off-Site Industrial Complex IRA; installation of new remedial systems at the Long Island Power Authority (LIPA) right-of-way, North Street, the Brookhaven Airport, downgradient of North Street East, and the eastern portion of the industrial park; and an additional treatment system on-site at Middle Road. The remedy also includes either a new remedial system and/or expansion of the existing on-site pump and treat system to address lower levels of VOCs in the western part of the plume, and a source removal system using re-circulation wells with air stripping treatment near Building 96. Details of the specific number of treatment systems and locations needed to meet the cleanup objectives will be determined during the design process. The period of pumping needed to achieve cleanup objectives will be determined based on monitoring and operating data. Each treatment system will have a monitoring well network which will include downgradient sentry wells. These monitoring well networks will be used to help assess the effectiveness of achieving the clean up objectives. The exact number of monitoring wells will be determined during the design process. The assessment and evaluation of all treatment systems in achieving the clean up objectives will be performed annually. The details of the annual assessment and evaluation will be determined during the design process. If the annual assessments show that the treatment systems are not achieving the clean up objectives then the treatment systems will be modified and/or augmented to ensure that the clean up objectives are being met.

This selected remedy (V10c) is not the one that was proposed in the Proposed Remedial Action Plan (PRAP). The proposed remedy (V10b) did not include the treatment system located on-site for the western low-level VOC plume. The additional system was added in response to community and regulatory concerns about potential impacts to the Carmans River.

If, after source control is complete and effective, the annual assessment indicates that continued operation of the components of the selected remedy is not producing further reductions in the concentrations of contaminants in groundwater, DOE, NYSDEC, and EPA will evaluate whether discontinuance of the remedy is warranted or if modification and/or augmentation of the treatment systems is needed to ensure that the cleanup objectives are met.

Tritium Remedy: A pump and recharge system, which includes three pumping wells located on-site along Princeton Avenue, was installed in May 1997 to extract the tritium contaminated groundwater and discharge it further north to a recharge basin on-site. Pumping at the leading edge of the plume was taken as a precautionary measure to inhibit contaminated groundwater from advancing towards the site's boundary and allow more time for the tritium to decay. A carbon filtration unit also was included in the pump and recharge system to remove VOC's that are also present.

The selected remedy is a modification of alternative T4, as originally proposed in the PRAP. The remedy will combine extraction of groundwater in response to specific contingencies and extensive monitoring and reporting to assure that the cleanup objectives are met. Three specific contingencies were identified in the PRAP, and a fourth has been added in this ROD to address regulatory concerns. Other actions will be evaluated and implemented, as necessary, to ensure that the cleanup objectives are met. Additional monitoring wells will supplement the existing groundwater monitoring network downgradient of the High Flux Beam Reactor's (HFBR) spent fuel pool.

The first and second contingencies were developed to ensure that the tritium plume would migrate no further downgradient above drinking water standards. After an evaluation period established during design of the selected remedy, the tritium pump and recharge system on Princeton Avenue will be put on stand-by and later operated as needed as an integral component of these contingencies. The evaluation period will extend up to a maximum of one year after ROD finalization and will include an analysis of the data against the following two contingency criteria. These two specific contingencies identified are 1) to evaluate the need to reactivate the Princeton Avenue IRA if tritium concentrations exceed 25,000 pCi/l at the Chilled Water Plant Road, and/or 2) reactivate the Princeton Avenue IRA if tritium concentrations exceed 20,000 pCi/l at Weaver Drive.

A third contingency was developed to ensure that if the most concentrated part of the plume were to act as a source of continuing contamination, active remediation would remove this problem. This contingency proposed a low flow extraction system to be installed in the most concentrated area of tritium contamination near the HFBR and activated if concentrations exceed 2,000,000 pCi/l at the front of the reactor. This system then would be used to remove groundwater containing the highest concentrations of tritium from the aquifer. The extracted tritium contaminated water will be disposed of offsite. Technologies to reduce the volume of water that requires off-site disposal may be identified during design. Since the PRAP was issued to the public, groundwater near the HFBR has exceeded 2,000,000 pCi/l. DOE is currently in the process of constructing some of the wells for this low flow extraction system on Cornell Avenue and developing plans to extract the most concentrated part of the plume in front of the HFBR. These extraction wells are scheduled to begin operation no later than three months after execution of this ROD.* The detailed operational parameters for this system will be developed during design.

* Revised on 5-1-00

In addition to the ones originally identified in Alternative T4 and proposed in the PRAP, a fourth contingency, an additional low flow extraction system will be installed and operated near Temple Place. This additional system was added in response to regulatory concerns about potential plume migration. The exact location, operational parameters and treatment and disposal options for the extracted water will be developed during design. Operation of the Temple Place extraction system will continue for up to one year. As these extraction wells operate, extensive monitoring will occur to evaluate the effect of extraction locally, as well as on the entire plume. Because of the inherent uncertainties of predicating plume behavior based on groundwater modeling, the actual monitoring data will be evaluated and used to help determine whether continued operation of this extraction system is needed to achieve the cleanup objectives. The criteria to continue system operation beyond one year will be developed during design and based on the attainment of the cleanup objectives.

Strontium-90 Remedy: There are concentrated areas of strontium-90 contamination in the groundwater at three on-site locations: the Chemical Holes Area, the Brookhaven Graphite Research Reactor (BGRR), and the Waste Concentration Facility.

The selected remedy, Alternative S5a, involves installing extraction wells and using ion exchange to remove strontium-90 from the extracted water. Details of the specific number of treatment systems and locations needed to meet the cleanup objectives will be determined during the design process. The period of pumping needed to achieve the cleanup objectives will be determined based on monitoring and operating data. Before implementation of the remedy, a pilot treatability study will be performed to evaluate the effectiveness of extraction and treatment. The final remedy may potentially be modified based on the results of this study. Clean water will be discharged on-site. Residual waste that contains strontium-90 will be disposed of at a licensed facility off-site.

If an assessment and evaluation indicates that continued operation of the components of the selected remedy is not producing further reductions in the concentrations of contaminants in groundwater, DOE, NYSDEC, and EPA will evaluate whether discontinuance of the remedy is warranted or if modification and/or augmentation of the treatment systems is needed to ensure that cleanup objectives are met

Source Areas: Some source areas and soil contaminants are, have been, or will be addressed in other RODS. Thirteen AOCs assigned to OU III were investigated as suspected source areas of groundwater contamination. Also, as the work for OU III was proceeding, groundwater contamination from other OUs and Additional Areas of Investigation (AAIs) was included in the investigation and assessment. Table 1 describes these AOCs and AAIs. Table 2 outlines the actions required for these suspected source areas. Many of the suspected source areas had completed and/or ongoing removal actions and no further action is required. The selected remedy requires a source removal system using re-circulation wells with air stripping treatment near Building 96; excavation and off site disposal of the PCB contaminated soils at Building 96 that are above the New York State cleanup levels; remediation of the groundwater near the Carbon Tetrachloride Tank Spill Area; completion of the Building 830 Underground Storage Tank Removal Action; and management of other suspected source areas as shown in Table 2. The final remedy for potential source areas in AOC-26B (Building 96), such as the anomalies discovered during the geophysical survey, will be documented in a subsequent Record of Decision.

Other Remedy Components: All of the groundwater plumes will require monitoring of new and existing wells and institutional control of the groundwater until completion of remediation. These wells will be located adjacent to the treatment systems and along the downgradient plumes. They will help determine the effectiveness of each treatment system in reducing the concentrations of contaminants over time. Long-term monitoring will also determine the ultimate duration for operation of the treatment systems and will support future decisions to make any changes to the final remedy. At the request of the homeowner, DOE can arrange for monitoring of private wells used for drinking water on properties that previously have declined DOE's offer of public water hookups. In addition, any sale or transfer of BNL property will meet the requirements of CERCLA 120(h) to ensure that future users will not be exposed to unacceptable levels of contamination in the groundwater.

Deferred Decisions: The final remedy for potential source areas in AOC-26B (Building 96), such as the anomalies discovered during the geophysical survey, will be documented in a subsequent Record of Decision. Also, the final remedy for AOC-9D, the Pile Fan Sump, will be documented in the Brookhaven Graphite Research Reactor (BGRR) Record of Decision.

DECLARATION

The selected remedies are protective of human health and the environment, comply with federal and state requirements that are legally applicable or relevant and appropriate to the remedial actions, and are cost effective. These remedies utilize permanent solutions and alternative treatment technologies to the maximum extent practicable, and satisfy the statutory preference for remedies that employ treatment that reduces contaminant toxicity, mobility or volume as a principal element.

Should new information become available regarding disposal costs or the cost effectiveness of new technologies during the remedial design or remedial actions that could affect how the remedy selected in this ROD is implemented, the remedy may be modified and documented if such a change does not constitute a fundamental change in the remedy.

A five-year review of the remedial action pursuant to CERCLA §121(c), 42 U.S.C. §9621(c), will be necessary, since some of the selected remedies could result in hazardous substances remaining on site above health-based levels.

George J. Malosh — Date: 4/18/00
Manager, Brookhaven Group
U.S. Department of Energy

Robert P. Gordon — Date: 4-18-00
Contracting Officer, Brookhaven Group
U.S. Department of Energy

Jeanne M. Fox — Date: 6/20/00
Jeanne Fox
Regional Administrator, Region 2
U.S. Environmental Protection Agency

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LIST OF ACRONYMS

LIST OF ACRONYMS

AAI	Additional Areas of Investigation
AGS	Alternating Gradient Synchotron
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
AS	Air Stripping
ATSDR	Agency for Toxic Substances and Disease Registry
BER	Brookhaven Executive Roundtable
BGRR	Brookhaven Graphite Research Reactor
BHG	Brookhaven Group
BLIP	Brookhaven Linear Isotope Producer
BLS	Below Land Surface
BMRR	Brookhaven Medical Research Reactor
BMSL	Below Mean Sea Level
BNL	Brookhaven National Laboratory
CEDE	Committed Effective Dose Equivalent
CERCLA	Comprehensive Environmental Response Compensation & Liability Act
COPC	Chemicals of Potential Concern
CWF	Chilled Water Facility
DCE	1,1 dichloroethene
DOE	United States Department of Energy
DOT	Department of Transportation
EE/CA	Engineering Evaluation/Cost Analysis
EDB	Ethylene dibromide
EP	Extraction Procedure
EPA	United States Environmental Protection Agency
ERD	Environmental Restoration Division
ERM	Effects Range Median
ES&HS	Environmental Safety and Health Services
FS	Feasibility Study
GRA	General Response Action
HFBR	High Flux Beam Reactor
HI	Hazard Index
HWMF	Hazardous Waste Management Facility
IAG	Interagency Agreement
ILCR	Individual Lifetime Cancer Risk
IRA	Interim Removal Action
LDL	Low Detection Limit

LINAC	Linear Accelerator
LIPA	Long Island Power Authority
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
NYCRR	New York State Codes, Rules and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
OU	Operable Unit
PA/SI	Preliminary Assessment/Site Inspection
PCB	Polychlorinated biphenols
PCE	tetrachloroethene
PFS	Pile Fan Sump
PRAP	Proposed Remedial Actin Plan
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RAV	Remedial Action V
RCG	Remedial Capture Goal
RCRA	Resource Conservation and Recovery Act
RESRAD	Residual Radioactive Material Guideline Computer Code
RI	Remedial Investigation
ROD	Record of Decision
RS	Responsiveness Summary
SCDHS	Suffolk County Department of Health Services
SCWA	Suffolk County Water Authority
S&EP	Safety and Environmental Protection Division
SPDES	State Pollutant Discharge Elimination System
STP	Sewage Treatment Plant
SVE	Soil Vapor Extraction
TAL	Target Analyte List
TAGM	NYSDEC Technical Assistance Guidance Memorandum
TBC	To Be Considered
TCA	1,1,1 trichloroethane
TCE	trichloroethylene

TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TVOC	Total Volatile Organic Compound
µg/l	micrograms per liter
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WCF	Waste Concentration Facility

II. DECISION SUMMARY

II. DECISION SUMMARY

1. SITE NAME, LOCATION, AND DESCRIPTION

Brookhaven National Laboratory (BNL) is a federal facility owned by the U.S. Department of Energy (DOE). BNL conducts research in physical, biomedical and environmental sciences and energy technologies.

BNL is located in Upton, Suffolk County, New York, about 60 miles east of New York City, near the geographic center of Long Island (Figure 1). The following are the distances to neighboring communities from BNL: Patchogue 10 miles west-southwest, Bellport 8 miles southwest, Center Moriches 7 miles southeast, Riverhead, 13 miles east; Wading River, 7 miles north-northeast; and Port Jefferson, 11 miles northwest.

The BNL property, consisting of 5,321 acres, forms an irregular polygon, and each side is approximately 2.5 miles long. Figure 2 is a current land use map of the BNL site. The developed portion of the site includes the principal facilities located near the center of the site, on relatively high ground. They are contained in an area of approximately 900 acres, 500 acres of which were originally developed by the Army. The remaining 400 acres are occupied mostly by various large research machine facilities. Outlying facilities occupy approximately 550 acres and include an apartment area, Biology Field, former Hazardous Waste Management Facility, Sewage Treatment Plant, firebreaks, and the Landfill Areas. The site's terrain is gently rolling, with elevations varying between 40 to 120 feet above sea level. The land lies on the western rim of the shallow Peconic River watershed, with a tributary of the river rising in marshy areas in the northern section of the tract.

The sole source aquifer beneath BNL has three water-bearing units: the moraine and outwash deposits, the Magothy Formation, and the Lloyd Sand Member of the Raritan Formation. These units are hydraulically connected and make up a single zone of saturation with varying physical properties extending from a depth of 45 to 1,500 feet below the land surface. These three water-bearing units are designated as a "sole-source aquifer" by the U.S. Environmental Protection Agency (EPA) and serve as the primary source of drinking-water for Nassau and Suffolk Counties.

To effectively manage remediation of the BNL site, 29 Areas of Concern (AOCs) were identified and divided into discrete groups called Operable Units (OUs), and Removal Actions. The BNL site is divided into six Operable Units (Figure 3).

Figure 4 shows the extent of OU III. It encompasses approximately 50 percent of the total area of the Laboratory. OU III was developed to address groundwater contamination in the central and southern portion of the site and in the off-site areas where groundwater contamination has migrated. Thirteen AOCs assigned to OU III were investigated as suspected source areas of groundwater contamination. Also, as the work for OU III was proceeding, groundwater contamination from other OUs and Additional Areas of Investigation (AAIs) was included in the investigation and assessment. Table 1 describes these AOCs and AAIs.

2. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The BNL site, formerly Camp Upton, was occupied by the U.S. Army during World Wars I and II. Between the wars, the site was operated by the Civilian Conservation Corps. It was transferred to the Atomic Energy Commission in 1947, to the Energy Research and Development Administration in 1975, and to DOE in 1977.

In 1980, the BNL site was placed on New York State's Department of Environmental Conservation (NYSDEC) list of Inactive Hazardous Waste Sites. On December 21, 1989, the BNL site was included on EPA's National Priorities List because of soil and groundwater contamination that resulted from past operations of BNL. Subsequently, the EPA, NYSDEC, and DOE entered into a Federal Facilities Agreement (herein referred to as the IAG) that became effective in May, 1992 (Administrative Docket Number: II-CERCLA-FFA-00201) to coordinate cleanup activities. The IAG identified areas of concern that were grouped into operable units to be evaluated for response actions. The IAG requires a remedial investigation/feasibility study for OU III, pursuant to 42 U.S.C. 9601-9675, to meet the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) requirements. The IAG also requires cleanup actions to address the identified concerns. Cleanup actions at the BNL site will be conducted pursuant to CERCLA, 40 CFR Part 300.

BNL's Final Response Strategy Document (SAIC, 1992) grouped the identified areas of concern into seven operable units. Several operable units were subsequently combined. Remedial investigations and risk assessments were conducted to evaluate the nature and extent of contamination, and potential risks associated with the areas of concern addressed in this Record of Decision. The Operable Unit III Feasibility Study Report (IT, 1999b) was prepared to evaluate the alternatives for remediating the contaminated groundwater addressed in this ROD.

2.1 Site History

2.1.1 Previous Actions and Remedial Investigation/Feasibility Study

Removal actions, and a CERCA compliant Remedial Investigation/Feasibility Study (RI/FS) were identified and implemented for OU III. Removal Actions are accelerated actions to prevent, minimize, and mitigate damages to public health or the environment from a release or threatened release and/or be consistent with this final action. Table 2 summarizes these removal actions.

DOE took additional actions in OU III to remove sources of groundwater contamination. These actions include removal of contaminated soils and underground piping and cesspools and septic tanks. These actions are listed in Table 1 where each AOC in OU III is described and are also summarized in Table 3.

The Operable Unit III Remedial Investigation Report (IT, 1999a) includes an evaluation of the nature and extent of contamination, and the human-health and ecological risks associated with the contamination from thirteen AOCs in OU III, and groundwater contamination from four AOCs in OU II/VII. Two additional areas of investigation were characterized.

The Operable Unit III Feasibility Study Report (IT, 1999b) addresses the procedures used in identifying, developing, screening, and evaluating a range of remedial alternatives for the contamination in OU III.

Remedial action alternatives evaluated in the Operable Unit III Feasibility Study Report dealt with on- and off-site groundwater contaminated with VOCs (AOC 15, AOC 24A, AAI 1, and AAI 2), on-site groundwater contaminated with tritium (AOC 29), and on-site groundwater contaminated with strontium (AOC 9, AOC 10, AAI I, and AAI 2). The selected alternatives for groundwater contamination in OU III are described below and summarized in Table 2.

Volatile Organic Compounds (VOCs) Remedy

Several interim removal actions already have begun to address VOC contamination as part of the proposed remedy:

- A groundwater treatment system began operation in June 1997 through which VOC contaminated groundwater is extracted at the south boundary and treated by air-stripping. The goal is to prevent additional migration of the contaminated groundwater off the BNL site.

- Another groundwater treatment system began operation in September 1999 along the southern side of the Industrial Complex south of the Laboratory. This system will prevent further migration of the highest concentrations of the deep VOC plume using in-well air stripping.

- Public water was provided to an area south of BNL, and will protect public health while the groundwater cleanup is underway.

- Two underground storage tanks and contaminated soils, which are potential sources of groundwater contamination, have been removed from Building 830.

In addition to these activities, the selected remedy, Alternative V10c, includes a groundwater treatment system at BNL's Middle Road to prevent migration and further contamination of the deeper Magothy Aquifer, and to reduce the duration of remediation in the Upper Glacial Aquifer. The selected remedy will also include a source removal system using re-circulation wells with air stripping treatment near Building 96. The final remedy for potential source areas in AOC-26B (Building 96), such as the anomalies discovered during the geophysical survey, will be documented in a subsequent Record of Decision. Finally, additional off-site groundwater treatment systems are planned to capture and treat VOCs; they will be located at the Long Island Power Authority (LIPA) right-of-way, North Street, the Brookhaven Airport, downgradient of North Street East, the eastern portion of the Industrial Park and in the western OU III low-level

VOC plume. The Feasibility Study estimated approximate numbers and locations of treatment wells. However, details of the specific number of treatment systems and locations needed to meet the performance objective will be determined during the design process.

The exact number of years of active groundwater treatment needed to achieve Remedial Action Objectives will be determined based on monitoring and operating data. If, after source control is complete and effective, monitoring indicates that continued operation of the components of the selected remedy is not producing further reductions in the concentrations of contaminants in ground water, in accordance with the National Contingency Plan, DOE, NYSDEC, and EPA will evaluate whether discontinuance of the remedy is warranted. The criteria for discontinuation will include but not be limited to complete and effective source control, an evaluation of the operating conditions and parameters and a determination that the remedy has attained the feasible limit of contaminant reduction and that further reductions would be impractical.

In addition to the active groundwater treatment systems to remediate the VOCs in groundwater, this alternative requires: monitoring of new and existing wells; completion of the Building 830 Underground Storage Tank Removal Action; management of other potential source areas as shown in Table 2; and institutional control of the on-site groundwater until completion of remediation. At the request of the homeowner, DOE can arrange for monitoring of private wells used for drinking water on properties that previously have declined DOE's offer of public water hookups.

At present, limited characterization has been performed in the Magothy, so additional characterization and installation of groundwater monitoring wells are planned. This work will be done during the design of the remedy, and will be included in the site records. When this characterization and monitoring is completed, the need for a remedy for the Magothy Aquifer, will be evaluated by DOE, EPA and NYS DEC. If a remedy for the Magothy Aquifer is necessary, either this record of Decision will be modified or another decision document will establish the selected action. In either case, the public will have an opportunity to review and comment in accordance with CERCLA.

This selected remedy (V10c) is not the one proposed in the PRAP. The proposed remedy (V10b) did not include the treatment system located on-site for the western low-level VOC plume. The additional system was added in response to community and regulator concerns about potential impacts to the Carmans River.

Tritium Remedy

A pump and recharge system, which includes three pumping wells located on-site along Princeton Avenue, was installed in May 1997 to extract the tritium contaminated groundwater and discharge it further north to a recharge basin on-site. Pumping at the leading edge of the plume was taken as a precautionary measure to inhibit contaminated groundwater from advancing towards the site's boundary and allow more time for the tritium to decay. A carbon filtration unit is included in the pump and recharge system to remove VOCs that are also present in the groundwater.

The selected remedy is a modification of alternative T4, as originally proposed in the PRAP. The remedy will combine extraction of groundwater in response to specific contingencies and extensive monitoring and reporting to assure that the cleanup objectives are met. Three specific contingencies were identified in the PRAP, and a fourth has been added in this ROD to address regulatory concerns. Other actions will be evaluated and implemented, as necessary, to ensure that the cleanup objectives are met. Additional monitoring wells will supplement the existing groundwater monitoring network downgradient of the High Flux Beam Reactor's (HFBR) spent fuel pool.

The first and second contingencies were developed to ensure that the tritium plume would migrate no further downgradient above drinking water standards. After an evaluation period established during design of the selected remedy, the tritium pump and recharge system on Princeton Avenue will be put on stand-by and later operated as needed as an integral component of these contingencies. The evaluation period will extend up to a maximum of one year after ROD finalization and will include an analysis of the data against the following two contingency criteria. These two specific contingencies identified are 1) to evaluate the need to reactivate the Princeton Avenue IRA if tritium concentrations exceed 25,000pCi/l at the Chilled Water Plant Road, and/or 2) reactivate the Princeton Avenue IRA if tritium concentrations exceed 20,000 pCi/l at Weaver Drive.

A third contingency was developed to ensure that if the most concentrated part of the plume were to act as a source of continuing contamination, active remediation would remove this problem. This contingency proposed a low flow extraction system to be installed in the most concentrated area of tritium contamination near the HFBR and activated if concentrations exceed 2,000,000 pCi/l at the front of the reactor. This system then would be used to remove groundwater containing the highest concentrations of tritium from the aquifer. The extracted tritium contaminated water will be disposed of offsite. Technologies to reduce the volume of water that requires off-site disposal may be identified during design. Since the PRAP was issued to the public, groundwater near the HFBR has exceeded 2,000,000 pCi/l. DOE is currently in the process of constructing some of the wells for this low flow extraction system on Cornell Avenue and developing plans to extract the most concentrated part of the plume in front of the HFBR. The detailed operational parameters for this system will be developed during design.

In addition to the ones originally identified in Alternative T4 and proposed in the PRAP, a fourth contingency, an additional low flow extraction system will be installed and operated near Temple Place. This additional system was added in response to regulatory concerns about potential plume migration. The exact location, operational parameters and treatment and disposal options for the extracted water will be developed during design. Operation of the Temple Place extraction system will continue for up to one year. As these extraction wells operate, extensive monitoring will occur to evaluate the effect of extraction locally, as well as on the entire plume. Because of the inherent uncertainties of predicating plume behavior based on groundwater modeling, the actual monitoring data will be evaluated and used to help determine whether continued operation of this extraction system is needed to achieve the cleanup objectives. The criteria to continue system operation beyond one year will be developed during design and based on the attainment of the cleanup objectives.

Strontium-90 Remedy

There are concentrated areas of strontium-90 contamination in the groundwater at three on-site locations: the Glass Holes area, the Brookhaven Graphite Research Reactor (BGRR), and the Waste Concentration Facility. Strontium-90 is a radioactive element with a half-life of 29.1 years.

The selected remedy, Alternative S5a, involves installing extraction wells and using ion exchange to remove the strontium-90 from the extracted water and on-site discharge of the clean water. Details of the specific number of treatment systems and locations needed to meet the cleanup objectives will be determined during the design process. Before implementation of the remedy, a pilot treatability study will be performed to evaluate the effectiveness of extraction and treatment. The final remedy may potentially be modified based on the results of this study. Residuals that contains strontium-90 will be disposed of off-site.

If, after source control is complete and effective, monitoring indicates that continued operation of the components of the selected remedy is not producing further reductions in the concentrations of contaminants in groundwater, in accordance with the NCP, DOE, NYSDEC, and EPA will evaluate whether discontinuance of the remedy is warranted. The criteria for discontinuation will include but not be limited to complete and effective source control, an evaluation of the operating conditions and parameters and a determination that the remedy has attained the feasible limit of contaminant reduction and that further reductions would be impractical.

2.1.2 History of OU III

Table 1 summarizes the AOCs and AAIs in OU III. A summary of inorganic, organic, and radiological contamination of groundwater, soil, and surface water before the Remedial Investigation is given in the Operable Unit III Remedial Investigation/Feasibility Study Work Plan (IT, 1994). More detailed descriptions and references are given in the Operable Unit III Remedial Investigation Report for OU III (IT 1999a).

2.2 Enforcement Activities

In 1980, the BNL site was placed on NYSDEC's list of Inactive Hazardous Waste Sites. On December 21, 1989, the BNL site was included on EPA's National Priorities List (NPL). Inclusion on the NPL reflects the relative importance placed by the federal government on ensuring the expedient completion of environmental investigations and the resulting cleanup. Subsequently, the EPA, NYSDEC, and DOE entered into a Federal Facilities Agreement (herein referred to as the InterAgency Agreement; IAG) that became effective in May 1992 (Administrative Docket Number: II-CERCLA-FFA-00201). It identified AOCs to be evaluated for response actions at the BNL site. The IAG requires a Remedial Investigation/Feasibility Study to be conducted for OU III, pursuant to 42 U.S.C. 9601 et. seq., to meet CERCLA requirements. The IAG also requires the conduct of cleanup actions to address identified concerns.

BNL's Final Response Strategy Document (SAIC, 1992) grouped the identified AOCs into seven OUs; several of these were subsequently combined The OUs are in various stages of completion. Remediation at the BNL site will be conducted under CERCLA, 40 CFR Part 300.

After issuing the RODs for the remaining OUs, the necessity of a final assessment from a site-wide perspective will be determined to ensure that the ongoing or planned remedial actions will provide a comprehensive remedy for the BNL site, which is protective of human health and the environment.

3. HIGHLIGHTS OF COMMUNITY PARTICIPATION

A Community Relations Plan was finalized for the BNL site in September, 1991. In accordance with CERCLA Section 113 (k) (2)(B)(I-v) and 117, and the community relations plan, the community relations program focused on public information and involvement. A variety of activities provide information and seek public participation, including a stakeholders mailing list, community meetings, availability sessions, site tours, workshops, and fact sheets. An Administrative Record, documenting the basis for the selection of removal and remedial actions at the BNL site, was established and is maintained at the local libraries listed below. The Administrative Record also includes current site reports, press releases and fact sheets. The following libraries maintain the Administrative Record:

Longwood Public Library
800 Middle Country Road
Middle Island, NY 11953

Mastics-Moriches-Shirley Community Library
301 William Floyd Parkway
Shirley, NY 11967

Brookhaven National Laboratory
Research Library
Bldg. 477A
Upton, NY 11973

The Administrative Record also is kept at EPA's Region II Administrative Records Room, 290 Broadway, New York, NY, 10007-1866.

A public comment period to review the proposed remedy (Proposed Remedial Action Plan, PRAP) and the Final Operable Unit III Remedial Investigation Report and Feasibility Study

Report began on March 1, 1999 and was extended through April 30, 1999. A public meeting was held on March 24, 1999 in Berkner Hall at Brookhaven National Laboratory. The Responsiveness Summary section of this document summarizes written and oral comments and DOE responses on the preferred remedial alternatives.

Level of Community Support for the Preferred Alternative

From the comments received during the public-comment period, DOE and BNL believe that the public and local elected officials are in general agreement with the selected remedial alternatives.

During the sixty-day comment period, 28 written comments were received on the OU III documents. The majority of them focused on general concerns, such as the length of time required for cleanup, the length of the comment period, the volume and complexity of material, and the issue of property value. Concern was also voiced about the limited characterization of groundwater in the Magothy Aquifer and the potential for human exposures to VOCs transferred to air in the VOC air stripping treatment processes. Several commentors wanted more specific information on the location of treatment wells and on the location and frequency of monitoring. There was some concern about using natural attenuation as part of the remedy, and some people felt that more active treatment in a shorter time should be undertaken. Several commentors also requested more detailed information on performance standards for the proposed treatment systems.

The Responsiveness Summary summarizes community comments on the preferred remedial alternatives.

Changes in the Remedy Presented in the FS and PRAP

In response to requests by stakeholders, the comment period was extended an additional 30 days. The following modifications were made to the preferred remedial alternative based on regulators' and the public's concerns and input:

- The selected remedy for VOC contamination in groundwater for OU III (V10c) is not the one proposed by DOE in the Proposed Remedial Action Plan (PRAP). The proposed remedy (V10b) did not include the treatment system to be located in the western low-level VOC plume. The additional systems were added in response to community and regulator concerns about potential impacts to the Carmans River.

- The selected remedy is a modification of alternative T4, as originally proposed in the PRAP. The remedy will combine extraction of groundwater in response to specific contingencies and extensive monitoring and reporting to assure that the cleanup objectives are met. Three specific contingencies were identified in the PRAP, and a fourth has been added in this ROD to address regulatory concerns. In addition to the ones originally identified in Alternative T4 and proposed in the PRAP, a fourth contingency, an additional low flow extraction system will be installed and operated near Temple Place. This additional system was added in response to regulatory concerns about potential plume migration. In addition to the ones originally identified in Alternative T4 and proposed in the PRAP, a fourth contingency, an additional low flow extraction system will be installed and operated near Temple Place. This additional system was added in response to regulatory concerns about potential plume migration. The exact location, operational parameters and treatment and disposal options for the extracted water will be developed during design. Operation of the Temple Place extraction system will continue for up to one year. As these extraction wells operate, extensive monitoring will occur to evaluate the effect of extraction locally, as well as on the entire plume. Because of the inherent uncertainties of predicating plume behavior based on groundwater modeling, the actual monitoring data will be evaluated and used to help determine whether continued operation of this extraction system is needed to achieve the cleanup objectives. The criteria to continue system operation beyond one year will be developed during design and based on the attainment of the cleanup objectives. Other actions will be evaluated and implemented, as necessary, to ensure that the cleanup objectives are met. Additional monitoring wells will supplement the existing groundwater monitoring network downgradient of the High Flux Beam Reactor's (HFBR) spent fuel pool.

- Community and regulator concerns were raised on the adequacy of the proposed remedy for the Magothy aquifer. As a result of continued input, the proposed remedy for the Magothy aquifer that was contained in the FS/PRAP has been removed from the ROD. Additional characterization and installation of groundwater monitoring wells are planned. After the additional characterization of the Magothy aquifer has been completed the need for a remedy for the Magothy aquifer will be evaluated by DOE, EPA, and the NYS DEC. If a remedy for the Magothy aquifer is necessary, either this Record of Decision will be modified or another decision document will establish the selected action.

- The proposed remedy in the FS/PRAP for Building 96 was air sparging/soil vapor extraction (AS/SVE). Based upon additional technical evaluation, a source removal system using re-circulation wells with air stripping treatment near Building 96 was selected as the preferred remedy for the VOC groundwater contamination for Building 96.

Summary of Community Participation Activities for OU III

DOE encourages public input to ensure that the preferred remedy for Operable Unit III effectively meets community needs and protects human health and the environment. To ensure early and effective community input into this process, DOE and BNL began reaching out to the community before the Proposed Plan was released. In August and September of 1998, stakeholders were invited to participate in Community Roundtables, and canvassing of residents was conducted. In October 1998, a Community Workshop on OU III cleanup options was held. These activities are summarized in the Final Report on OU III Early Community Input (BNL, 1998c).

Community members had the opportunity to discuss their concerns directly with the BNL and DOE staff. Some of their input was incorporated into the Feasibility Study. For example, stakeholders requested consideration of an option that would complete VOC cleanup faster (in approximately ten years). This alternative was added to the list of those evaluated in the Feasibility Study. Concern was also expressed about the impact of VOCs on the Carmans River, and additional groundwater modeling was done and a new cleanup alternative developed which included possible treatment systems for the western low-level VOC plume. Stakeholder support for leaving the tritium and strontium in the ground rather than extracting it was strong, and this also affected the alternatives recommended for cleanup. This input was used to help develop and evaluate cleanup alternatives in the Feasibility Study.

During the comment period on the Proposed Plan and Feasibility Study, information sessions were held. A public meeting was held on March 24, 1999 in Berkner Hall at Brookhaven National Laboratory. Additional community relations activities included briefings to elected officials and community groups, and articles in the BNL's Environmental Restoration Division's newsletter *cleanupdate*.

Over 2,300 people are on the BNL mailing list. They receive the newsletter ***cleanupdate*** along with frequent mailings about specific remediation activities. Invitations to roundtables, information sessions or public meetings are often included in the mailings. BNL employees and retirees (a combined total of nearly 5,000) also receive ***cleanupdate*** and articles in the Brookhaven Bulletin which update them on specific remediation topics. The recently formed Community Advisory Council is another avenue for stakeholder groups to have access to BNL and DOE management and to learn about BNL. While the public continues to be concerned about the contamination that BNL caused and is interested in tracking the progress of cleanup, trust appears to be growing that the contamination is being addressed appropriately.

The Responsiveness Summary gives an overview of all the community relations activities for OU III.

4. SCOPE AND ROLE OF OPERABLE UNIT AND RESPONSE ACTION

To adequately evaluate BNL's existing and potential environmental problems, and to group these problems into workable units that could be properly scheduled and managed, the 29 AOCs were grouped into six OUs and a number of Removal Actions.

The OU III Remedial Investigation/Feasibility Study, Proposed Plan, and ROD were completed and are in the Administrative Record. Pursuant to the findings documented in the Remedial Investigation/Risk Assessment Report, Feasibility Study, and the Proposed Plan, this ROD addresses remediation of contaminated groundwater in OU III, and documents earlier actions to remediate groundwater, remove cesspools and septic tanks, connect nearby residents to public water supplies and remove sources of groundwater contamination in OU III. Conducting these remedial actions under OU III is part of BNL's overall response strategy, and is expected to be consistent with any planned future actions.

The other OUs are currently in different phases of Remedial Investigation/Feasibility Study, or remedy implementation, and have been or will be addressed in separate RODs.

5. SUMMARY OF SITE CHARACTERISTICS

The main purposes of the Remedial Investigation were to determine the nature, magnitude and extent of contamination from the AOCs included in OU III, those AOCs in OU II/VII that may be associated with groundwater contamination in OU III, and additional areas of investigation, and also to characterize the potential health risks and environmental impacts of any contaminants present. Sampling and analyses conducted during the investigation consisted of geophysical logging, radiological surveys, Geoprobe™ soil sampling, monitoring well borings, Geoprobe™ groundwater sampling, monitoring well groundwater sampling, supply well sampling, surface water sampling, and sediment sampling.

5.1 Identification of Contamination

Classification of the nature and extent of soil and groundwater contamination was based on screening criteria for chemicals and radiological constituents in the various sample media. Whenever possible, established regulatory criteria, known as chemical specific Applicable or Relevant and Appropriate Requirements (ARARs) were used to screen the analytical data. This was the case for groundwater, where state and/or federal Maximum Contaminant Levels (MCLs) exist for many chemicals. In the absence of ARARs, non-enforceable regulatory guidance values, known as "to be considered" criteria, or "TBCs" were used to screen the data. This was the case for soils, which have no established state or federal ARARs. Radionuclides in soils, for which there are no individual ARAR or TBC concentrations, were screened against site-specific levels calculated using a risk model (Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD (ANL, 1993)) that allowed a dose limit of 15 mrem/year above background. For chemical contamination, State (NYSDEC, 1994a) and EPA (EPA, 1994) soil cleanup guidance was used.

The screening concentrations were used to identify potential contaminant source areas, evaluate contaminant distribution patterns, and assess potential contaminant migration pathways. Table 4 summarizes media-specific screening criteria for contaminants that exceeded any screening criteria in OU III.

5.2 Soil, Sediment, Groundwater and Surface Water Investigations

5.2.1 Summary of Study Area Investigation

The OU III Remedial Investigation (RI) characterized the nature and extent of contamination in OU III's sixteen AOCs and four other identified areas that pose an unacceptable risk to human health and the environment. The field investigation for the OU III RI was conducted from October 1995 through July 1997; sampling and analysis activities consisted of the following:

- Collection and analysis of 76 Geoprobe™ soil samples for one or more of the following analyses: target compound list (TCL) volatile organic compounds (VOCs), TCL semivolatile organics, TCL pesticides and polychlorinated biphenyls (PCBs), target analyte list (TAL) inorganics, gamma spectroscopy, strontium-89, strontium-90, tritium, isotopic americium and thorium, gross alpha/beta activity, geotechnical parameters, and total organic carbon (TOC).

- Collection and analysis of 406 Geoprobe™ groundwater samples for one or more of the following analytes: TCL low detection limit (LDL) VOCs, TCL semivolatile organics, TCL pesticides and PCBs, TAL inorganics, filtered TAL inorganics, gamma spectroscopy, LDL gamma spectroscopy, strontium-89, strontium-90, isotopic americium and thorium, tritium, gross alpha/beta activity, europium-154, europium-155, radium 226/228, vanadium-238, plutonium-238, plutonium-239/240, technetium-99, cyanide, filtered cyanide, and TOC.

- Collection and analysis of 123 groundwater samples from monitoring-wells for one or more of the following analytes: TCL VOCs, TCL semivolatile organics, TCL pesticides and PCBs, TAL inorganics, gamma spectroscopy, strontium-89, strontium-90, tritium, gross alpha/beta activity, and cyanide.

- Collection and analysis of four supply-well samples for one or more of the following analytes: TCLVOCs, TCL semivolatile organics, TCL pesticides and PCBs, TAL inorganics, gamma spectroscopy, strontium-89, strontium-90, tritium, gross alpha/beta activity, and cyanide.

- Collection and analysis of three surface-water samples for TCL VOCs, TCL semivolatile organics, TCL pesticides and PCBs, TAL inorganics, gamma spectroscopy, strontium-89, strontium-90, tritium, wet chemistry parameters, and cyanide.

- Collection and analysis of nine surface-sediment samples for TCL VOCs, TCL semivolatile organics, TCL pesticides and PCBs, TAL inorganics, gamma spectroscopy, strontium-89, strontium-90, tritium, gross alpha/beta activity, geotechnical parameters, and TOC.

- Collection and analysis of two sump-water samples for TCL VOCs, gamma spectroscopy, strontium-89, strontium-90, tritium, and gross alpha/beta activity.

- Installation and sampling of 182 temporary wells on-site and off-site.

5.2.2 Summary of Nature and Extent of Contamination

The data collected during the OU III Remedial Investigation in conjunction with additional screening surveys at BNL, and the HFBR Tritium Plume Investigation were used to assess the nature and extent of contamination in the soils, groundwater, surface water, and sediments in the OU III study area. Significant findings on the types of contaminants identified, potential sources of contamination, and the horizontal and vertical extent of contamination is summarized for each medium in the following sections. Table 4 shows the contaminants identified as being of potential concern (i.e. elevated) based on a comparison to screening levels in each media and area of concern.

Surface Soil

To evaluate the nature and extent of contamination in surface soils, samples were taken at the Building 830 Pipe Leak and Underground Storage Tanks, the TCE Spill Area, and the Process Supply Wells and Recharge Basins AOCs. Most inorganic analytes were detected at concentrations either slightly above or below screening concentrations. Thallium and mercury were elevated in samples collected from the Building 830 area. Elevated levels of copper and manganese were detected in the recharge basins in the Process Supply Wells and Recharge Basins AOC. Volatile organic compounds and pesticides were not detected above screening levels in surface soil. PCBs were detected in surface soils above screening levels in the Building 96 area (AOC-26B). Benzo(a)pyrene was the only semi-volatile organic compound detected at a concentration more than twice the screening level, in surface soils from the TCE Spill area. Polycyclic aromatic hydrocarbons, such as benzo(a)pyrene, are commonly encountered in commercial/industrial areas, and can enter the environment in releases from truck and automobile exhausts. Cesium-137 was the only radionuclide with an activity above the screening concentration, in two samples from the Building 830 area. These contaminated soils were removed as part of an OU III Removal Action, using the soil cleanup levels developed under OU I.

Subsurface Soil

Subsurface soil was sampled to determine the horizontal and vertical extent of contamination in OU III. Subsurface soil samples were collected from the Paint Shop, the Building 830 area, the Bubble Chamber Spill Area, the TCE Spill Area, Leaking Sewer Pipes, the Old Firehouse, and the Process Supply Wells and Recharge Basins AOC. The average concentrations of most analytes in the subsurface soils were below the screening concentration. Analytes detected at concentrations above screening levels were manganese, nickel, thallium, benzo(a)pyrene, and cesium-137. Manganese was elevated in subsurface samples from the recharge basins in the Process Supply Wells and Recharge Basins AOC. Nickel was elevated in samples from the Building 830 area and the Bubble Chamber Spill Area. Thallium concentrations were elevated in subsurface soil from the Paint Shop, the Building 830 area, the Bubble Chamber Spill Area, TCE Spill Area, Leaking Sewer Pipes, and the Old Firehouse. Elevated concentrations of benzo(a)pyrene were found in subsurface samples collected from the Old Firehouse. Cesium-137 and Thorium-230 were detected above screening levels in a subsurface sample collected from the area of the Building 830 USTs. These contaminated soils were removed as part of an OU III Removal Action, using soil cleanup levels developed under OU I.

Surface water

Three recharge basins were sampled as part of OU III: the two basins in AOC 24C, and the recharge basin in the Bubble Chamber Spill Area. There was no evidence of contamination of the Recharge Basins from radioactive wastewater discharges. The basin in the Bubble Chamber Spill Area had elevated levels of copper and benzo(a)pyrene. Iron and copper were elevated in the two basins in AOC 24C. Volatile organics, pesticides and PCBs were not elevated in OU III surface water.

Sediment

Sediment samples were taken from the recharge basins in AOC 24, an inactive cesspool associated with the Paint Shop, a recharge basin in the Bubble Chamber Spill Area, and recharge basin HT at the North End of the LINAC. Contamination was found only in Recharge Basin HT at the North End of LINAC, with elevated levels of mercury, copper, lead, silver, and zinc. A separate sample contained elevated levels of PAHs and one pesticide, delta-BHC. Radionuclides were not detected in sediments in excess of screening levels. The contamination with petroleum hydrocarbon and pesticides may be related to storm water run-off containing oils and greases from nearby asphalt paved roads and parking lots, and run-off from the LINAC area.

Groundwater

Groundwater sampling was conducted to define the vertical and horizontal extent of contamination in groundwater. The groundwater investigation identified the following plumes of contamination: VOCs (carbon tetrachloride, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene), strontium-90, and tritium.

Volatile Organic Compounds: Carbon tetrachloride was detected at elevated levels in the deep glacial zone (60-150 feet below sea level), in a north-south direction from an area south of Princeton Avenue to an area south of Moriches-Middle Island Road. The carbon tetrachloride plume is approximately 9,500 feet long and up to 900 feet wide. The highest concentrations of carbon tetrachloride, greater than 1,000 ppb, are located between the BNL South Boundary and Carlton Drive. The highest concentration detected to date was approximately 5,100 ppb. The 1,000 ppb plume is approximately 1,500 feet long by 200 feet wide. The exact source of the contamination has not been identified, but it is suspected that it no longer exists. Potential sources for carbon tetrachloride and other contaminants are being evaluated under BNL's Facility Review and PA/SI programs.

Tetrachloroethene (PCE) was found in the vicinity of Building 96 in the water-table zone and in the deep glacial zone near the site boundary. PCE in groundwater samples ranged from 10 to 15,000 ppb. The main source of the PCE is the area immediately south of Building 96, which had been used as a truck-wash station and drum-storage area. In the water-table zone, the PCE plume is approximately 1,600 feet long by 500 feet wide. In the mid-glacial it is about 4,400 feet long by 600 feet wide. There are high concentrations of PCE (greater than 1,000 ppb) in the deep glacial zone from an area north of Princeton Avenue to the southern portion of the Industrial Park.

1,1,1-trichloroethane (TCA) was found in groundwater samples above the MCL of 5 ppb at concentrations ranging from 6 to 1,600 ppb. The two areas with most of the elevated TCA concentrations are the area just south of Building 96 in the middle of the site and the area around the Waste Concentration Facility (WCF) and Alternating Gradient Synchrotron (AGS) in the northern portion of the site. The sources of the elevated levels near the WCF and AGS probably were the cesspools associated with the Bubble Chamber Area. These cesspools contained TCA and were remediated. The TCA in the mid-glacial zone can be described as two types of contamination: high (greater than 50 ppb) and low (less than 50 ppb). The high concentrations occur at three locations between Brookhaven Avenue and South Boundary Road.

Trichloroethene (TCE) was detected in wells above the MCL of 5 ppb at levels ranging from 7 to 27 ppb, primarily in the area between Princeton Avenue and the South Boundary Road.

Because of the similarities of the VOCs found in groundwater in OU III, the horizontal and vertical extent of total volatile organic compounds (TVOC) in groundwater also were assessed. In addition to the data collected as part of the OU III RI, groundwater data were collected for the OU I/IV and for Removal Action V (RA V) located in OU I.

Figure 5 shows the areal extent of Total Volatile Organic Compounds (TVOC) in groundwater. The TVOC contamination extends from the water table to 150 feet below mean sea level. However, the TVOC plume encompasses a larger area, due to the presence of other compounds, such as carbon tetrachloride and TCA. Elevated concentrations of TVOCs are located south of Building 96, in the AGS area, in the Supply and Material Area, and south of the former landfill. TVOCs in groundwater near the AGS and Supply and Material area are being monitored. Further migration of contamination will be prevented by the existing south boundary treatment system and planned systems at Middle Road. Contamination near the former landfill is addressed under Removal Action V. Contamination near Building 96 is addressed under this ROD.

The highest concentrations of TVOC in the mid-glacial zone (greater than 50 ppb) appear as slugs, or discrete areas of contamination, at three locations between Brookhaven Avenue and the South Boundary Road. The high concentration TVOC plume in the deep-glacial zone extends from north of Rowland Street to the downgradient extent of the carbon tetrachloride plume located between Moriches-Middle Island Road and Crestwood Avenue. The deep-glacial plume is approximately 14,000 feet long and up to 2,000 feet wide.

There are two locations of OU I/IV VOC plumes in the mid-glacial zone. The first is on-site, south of Brookhaven Avenue and North of Princeton Avenue; the second is off BNL with elevated concentrations within a localized area along Sleepy Hollow Drive. The Removal Action V (RAV) VOC plume within the mid-glacial zone is located off site just south of the RAV extraction wells. The plume is approximately 3,000 feet long and extends from the Long Island Expressway to the south. The highest concentration of VOCs detected was 258 ppb of TCA.

Strontium-90: Strontium-90 was detected above the MCL of 8 picoCuries per liter (pCi/l) at concentrations ranging from 8.45 to 566 pCi/l. The highest activities (i.e. 566 pCi/l) were observed during the Pile Fan Sump (PFS) groundwater sampling. Most strontium-90 in groundwater is associated with two areas on-site: the Brookhaven Graphite Research Reactor (BGRR), and the Waste Concentration Facility (WCF). There are two distinct strontium-90-contaminated plumes (Figure 6), one around the BGRR, WCF, and PFS, and the other around the Glass Holes.

The plume south of the BGRR is approximately 1,000 feet long and 500 feet wide. The larger of the two Strontium-90 plumes actually is composed of two plumes, the northern half composed of Strontium-90 originating from the WCF and associated tanks and pipelines, and the southern originating from the BGRR Pile Fan Sump area. The larger WCF/Pile Fan Sump Plume is approximately 2,000 feet long and 500 feet wide.

Tritium: Elevated concentrations of tritium were detected downgradient of the High Flux Beam Reactor (HFBR). The source of this tritium was the HFBR Spent Fuel Pool, which was emptied in December 1997. The highest activity was 2,290,000 pCi/l in a monitoring well directly in front of the HFBR (IT, 1999c) ; tritium activity at the downgradient edge of the plume is between 1,000 and 5,000 pCi/l. The tritium plume is located entirely within the boundaries of the Laboratory. The portion of the plume that exceeds the MCL for tritium (20,000 pCi/l) extends approximately 4,500 feet north of BNL's southern boundary at depths from 40 to 150 feet below land surface. The dimensions of the 1,000 pCi/l plume are approximately 3,200 feet long and 625 feet wide. The 20,000 pCi/l plume is approximately 2,600 feet long and 250 feet wide. A second area immediately north of the HFBR stack has tritium concentrations greater than the drinking water. Figure 7 shows the extent of the tritium plume on-site.

Summary of Fate and Transport

Two separate groups of contaminants were identified as potentially of concern in OU III: the groundwater contaminants, and the sediment, soil, and surface-water contaminants. In general, the contaminants in groundwater at OU III are relatively mobile, having moderate to high water-solubility and/or low K_{OC} values. The majority of the contaminants identified as potentially of concern in soils, sediments, and surface waters at OU III exhibit relatively low- water-solubilities and/or high K_{OC} values and, therefore, have low leachabilities and low mobilities in groundwater. Also, most of the contaminants detected in near surface areas (i.e., surface soils, surface water) are not highly volatile. Almost all of the contaminants exhibit a strong tendency to adsorb to soil particles and remain relatively immobile in the soils as demonstrated by their high K_{OC} and K_d values.

The fate of a constituent in the environment is a function of its chemical properties and the physical nature of the site. The potential for environmental transport was examined based on a review of the topographic and hydrogeologic characteristics of the site and a review of the available physical constants and chemical characteristics of each constituent. The most significant fate and transport processes for the study area are summarized below:

- The greatest potential for transport of contaminants at the OU III site is via groundwater transport. Volatile organic compounds, including PCE, TCA, and carbon tetrachloride, have been detected in groundwater plumes indicating their ongoing transport. Also, the radionuclides strontium-90 (which has limited mobility) and tritium (which is mobile and moves with water) were detected in groundwater.
- Volatilization, dust generation, and air transport are considered insignificant based on the extremely limited surface-soil and surface-water contamination.
- Most constituents present in vadose soils and sediments on site are relatively insoluble and have a greater tendency to remain adsorbed. Thus, leaching to groundwater is not expected to be important. Those contaminants considered leachable have already been detected in groundwater.
- From the limited biota expected to occur in the recharge basins or in association with the recharge basins, bioaccumulation of constituents in the food chain is expected to be an insignificant transport pathway.

5.3 Action Summary for OU III

5.3.1 Source Removal

Several actions have been taken to remove sources of groundwater contamination (Table 3).

Additional actions were taken to remove potential sources of groundwater contamination at other locations on-site; these include the landfills removal action, removal of cesspools and cesspool contents, removal of underground storage-tanks, and replacement of leaking sewer-pipes.

5.3.2 Facility Site Review

BNL has embarked on an extensive Facility Site Review to identify potential release- points of contaminants from BNL's facilities to the environment. The review began in April 1997 and is an important element of BNL's comprehensive plan to delineate and characterize environmental issues at the site and to develop strategies for cleanup and remediation. The purpose of the project was to review all BNL facilities to identify equipment, operations and activities that have the potential to degrade groundwater. The Facility Site Review categorized facilities as either Priority I or Priority II, based upon previous uses and the age of the facility.

Priority I facilities are those that used or generated significant quantities of radioactive material during the 1950s and 1960s. In addition, facilities that have a history of major programmatic changes during operational periods are considered Priority I facilities. Facilities that do not meet the criteria for Priority I status were designated Priority II.

Twelve Priority I and eight Priority II action items were identified for the Environmental Restoration Division (ERD) during the Facility Site Review. All action items identified in the

Facility Site Review will be tracked by representatives of BNL's Environmental Safety and Health Services (ES&HS) until closeout reports have been prepared.

Preliminary Assessment /Site Inspection (PA/SI) investigation were developed to evaluate areas of interest identified in the April 1997 Facility Review. The PA/SI consisted of a field investigation that included collecting and analyzing soil and groundwater samples. The results of this investigation will be used to determine if an identified area should be considered an AOC. Follow-up activities from the Facility Review are continuing.

5.3.3 Removal Actions and Interim Removal Actions

The following interim removal actions (IRAs) and Removal Actions have been or are being undertaken to immediately reduce concentrations, migration, or exposure to groundwater contaminants:

- On-site OU III Southern Boundary Groundwater Interim Removal Action (IRA): This IRA was implemented in June 1997 in response to the detection of a plume of VOCs in groundwater both on- and off-site. The goal is to prevent additional off-site migration of VOCs in the most concentrated part of the plume at the southern boundary. The IRA consists of a groundwater recovery system at the southern boundary (Figure 8), extraction of groundwater through six wells, and treatment through air-stripping. The clean water then is discharged to a recharge basin. The locations of wells for this pump-and-treat system are shown in Figure 9.

- Off-site OU III Industrial Complex Groundwater Interim Removal Action: This IRA is being implemented to address the off-site migration of the highest concentrations of the deep VOC plume beyond the industrial complex located south of OU III. Its objective is to hydraulically control, extract, and treat groundwater through in-well air-stripping, using an array of seven wells along the southern side of the industrial complex. This interim removal action began in September 1999.

- Off-site Public Water Hookup Interim Action: To ensure protection of the health of the residents located downgradient of OU III and OU I, a residential public-water hookup was established (Figure 10). Public water was provided to homes potentially in the path of contaminated groundwater associated with BNL. Long-term monitoring of groundwater off-site will be conducted.

- Tritium Groundwater Interim Removal Action: This IRA was implemented in response to elevated levels of tritium detected downgradient of the HFBR. It consists of (1) removing of spent fuel from the pool and installation of a stainless steel liner, (2) elimination of potential sources of leakage, and (3) pumping groundwater at the leading edge of the plume. At the time, tritium concentrations were expected to decrease over time and not cross the BNL boundary, three wells were installed along Princeton Avenue as a precautionary measure to extract tritium-contaminated groundwater. The groundwater is treated for chemical contamination by carbon adsorption and discharged to a recharge basin to allow additional time for the tritium to decay. This system began operation in May 1997. A schematic of the re-circulation system is shown in Figure 11.

- Building 830 Underground Storage Tanks Removal Action: This action has removed two out-of-service underground storage tanks, a concrete valve pit, associated piping and contaminated soils and vegetation. The tanks have been removed and the soils have been excavated. Contaminated wastes are in the process of being shipped off site for disposal.

- Interim Removal Action V: This Removal Action addresses on-site groundwater associated with the Current Landfill and former Hazardous Waste Management Facility, both located in OU I. A pump-and-treat system was installed at the south boundary in December 1996 to intercept groundwater containing VOCs migrating from the two source areas and prevent them from moving off-site. The system includes two extraction wells and an air-stripping tower. The clean water is recharged via the RA V recharge basin in the center of the BNL site.

- Carbon Tetrachloride Tank Removal Action. The tank was removed and a removal action is underway to pump-and-treat carbon tetrachloride in groundwater in the immediate vicinity of the former tank.

5.3.4 Current Remedial Action Summary

Based on the results of the OU III RI, the primary concerns associated with the OU III study area are groundwater contamination by VOCs, tritium, and strontium-90. A detailed analysis of alternatives was conducted in the OU III Feasibility Study for onsite groundwater contamination by strontium, on- and off-site groundwater contamination by TVOCs, and on-site groundwater contamination by tritium. Soil contamination with Cesium-137 found in AOC 11/12 (Building 830 Pipe Leak and Tanks) was addressed under an Interim Removal Action.

6. SUMMARY OF SITE RISKS

A baseline risk assessment was done to estimate the human health and ecological risks that could result from exposure to contaminants in OU III if no remediation is performed beyond that accomplished to date. Present and future potential exposures to chemical and radiological contaminants in groundwater, surface water, sediment, soil and subsurface soil were evaluated. The risk assessment is documented in the OU III Remedial Investigation Report (IT, 1999a).

Data collected from the four AAIs were not included in the risk assessment because cleanup actions are underway (Table 2).

6.1 Humau Health Risks

A four-step process was used to assess site-related human health risks assuming a reasonable maximum exposure scenario:

- Hazard Identification: identifies the contaminants of concern based upon factors such as toxicity, frequency of occurrence, and concentration.

- Exposure Assessment: estimates the magnitude of actual and/or potential human exposures, their frequency and duration, and exposure pathways (e.g., external exposure from gamma radiation, ingestion of contaminated well water) by which humans could be exposed.

- Toxicity Assessment: determines the types of adverse health effects associated with exposures and the relationship between the magnitude of exposure (dose) and severity of adverse effects (response).

- Risk Characterization: summarizes and combines outputs of the exposure and toxicity assessments to quantitatively assess site-related risks.

Two kinds of human health hazards were addressed in the risk assessment for Operable Unit III: cancer induction and non-carcinogenic toxicity.

Cancer Risk is expressed in terms of the probability that a given human receptor will develop cancer due to estimated exposures over a 70-year lifetime. The current federal acceptable risk range for individual lifetime excess carcinogenic risk is one-in-ten-thousand to one-in-one-million.

Non-carcinogenic effect risks due to Operable Unit III contaminants were estimated by dividing the intake of a chemical by the acceptable intake over the period of exposure. These non-carcinogenic effects are expressed as Hazard Indices (HI). A Hazard Index greater than 1.0 indicates a potential for non-carcinogenic health effects. The maximum acceptable HI is 1.0.

The baseline risk assessment evaluated the health effects that could result from exposure to chemical and radiological contamination in groundwater, surface water, soil and sediment as a result of dermal contact, inhalation, and ingestion associated with current and potential future land uses.

6.1.1 Identification of Coutaminants of Potential Concern

The risk assessment focused on contaminants that are likely to pose significant risks to human health; they are summarized in Table 5. Six inorganic constituents, 16 radionuclides, and 8 organics were identified as chemicals of potential concern.

6.1.2 Exposure Assessment

The baseline risk assessment addressed potential risks to human health by identifying potential pathways by which people may be exposed to contaminants at the site under current and future land-use conditions. Tables 6 and 7 summarize the exposure scenarios evaluated in this baseline risk assessment. The reasonable maximum exposure scenario was evaluated.

Current Use

The populations exposed under the current land-use scenario were assumed to be on-site industrial workers and an on-site trespasser. The current on-site worker was assumed to perform routine daily activities in OU III, and soil-related exposure pathways were analyzed (inhalation of resuspended soil, incidental ingestion of soil, and dermal contact with soil). Potential exposure of onsite workers or trespassers to subsurface soil was not considered because there is no construction work involving excavation currently in progress in OU III. Occupational exposures to surface water and sediment were not considered since BNL personnel are not routinely exposed to surface water and sediment in the recharge basins during their daily work assignments.

For an older child on-site trespasser, five exposure pathways were evaluated in the current land use exposure assessment: inhalation of resuspended soil; incidental ingestion of soil; direct dermal contact with soil; direct dermal contact with surface water; and, direct dermal contact with sediment. Trespassers were assumed not to ingest surface water or sediment since the recharge basins are too shallow for swimming or wading. The risk assessment for radionuclides did not include the pathways for dermal contact with sediment and surface water because the exposures were orders of magnitude smaller than those for ingestion and inhalation.

Ingestion of on-site groundwater also was not included in the exposure assessment for current use. Wells on-site are constantly monitored for contamination and, if necessary, the groundwater is treated to remove it.

Off-site residences were offered connections to the public-water supply, but a few have elected not to make this connection. The baseline risk assessment evaluated risk to off-site populations from exposure to contaminants in groundwater.

Future Use

Three hypothetically exposed populations were identified for potential future exposures: a short-term construction worker, an industrial worker, and a resident. The future land use scenario was conservatively assumed to occur after 30 years. The radionuclide risk assessment also estimated risks at 50, 100 and 1000 years.

The short-term construction worker was assumed to be exposed through inhalation of soil particulates and dust, incidental ingestion of soil, and dermal contact with soil. Three soil-related exposure pathways were assumed for the future industrial worker: inhalation of particulates and dust; incidental ingestion of soil; and dermal contact with soil.

Residential exposures were evaluated for both an adult and a young child (age 0-6 years). This conservative scenario assumed that a resident would live on-site for 30 years and use on-site groundwater for all domestic water needs. The exposure pathways were: inhalation of soil; incidental ingestion of soil; dermal contact with soil; ingestion, dermal contact (bathing; chemicals only) and inhalation (showering; chemicals only) of groundwater. Because radionuclides may bioaccumulate in plants and animals, the radiological risk assessment included ingestion of home-grown vegetables and of game and livestock as a potential exposure pathway.

6.1.3 Toxicity Assessment

Two human health hazards were addressed in the risk assessment for Operable Unit III: cancer induction and non-carcinogenic toxicity. Tables 8, 9 and 10 summarize the non-carcinogenic and carcinogenic toxicity values for the contaminants of concern.

EPA developed reference doses for indicating the potential for adverse health effects. Reference Doses (RfDs), expressed in units of milligrams/kilogram-day (mg/kg-day), are estimates of daily exposure levels for humans that are thought to be safe over a lifetime.

Cancer slope-factors were developed by EPA for estimating excess lifetime cancer risk associated with exposure to potentially carcinogenic chemicals. Slope factors are expressed in units of $(mg/kg\text{-}day)^{-1}$.

In the toxicity assessment the toxicological properties of the selected chemicals of potential concern were summarized. Many carcinogenic slope-factors and reference doses were obtained from EPA's Integrated Risk Information System database. Slope-factors and reference doses/concentrations not available in that database were obtained from EPA's second most current source of toxicity information, the Health Effects Assessment Summary Tables. When toxicity values were not available for a specific chemical, the chemical was evaluated qualitatively. Uncertainties related to the chemical toxicity data were also addressed. Some toxicity values in the risk assessment are extremely conservative estimates and include uncertainty factors that may reduce the estimated safe exposure concentrations by up to 1000 times.

6.1.4 Human Risk Characterization

Non-carcinogenic risks were assessed using a hazard index (HI) approach, based on a comparison of expected intakes of the contaminant and safe levels of intake (RfD, Reference Doses, Table 8). Estimated intakes of chemicals from environmental media (e.g. the amount of a chemical ingested from contaminated drinking water) are compared to the RfD to derive the hazard quotient for the contaminant in the particular medium. The HI is obtained by adding the hazard quotients for all compounds across all media that impact a particular population. An HI greater than 1.0 indicates that the potential exists for noncarcinogenic health effects to occur from site-related exposures. The HI is a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Potential carcinogenic risks were evaluated using the cancer slope-factors (Tables 9 and 10) developed by EPA. Slope-factors are multiplied by the estimated intake of a potential carcinogen to generate an upper-bound estimate of the excess lifetime cancer risk associated with exposure to the compound at that level of intake.

For known or suspected carcinogens, EPA considers excess upper-bound individual lifetime cancer risks of between 10^{-4} to 10^{-6} to be acceptable. This level indicates that an individual has not greater than a one-in-ten-thousand to one-in-one-million chance of developing cancer as a result of site-related exposures to a carcinogen over a 70-year period under specific exposure conditions.

Chemical Risk Assessment

The non-carcinogenic and carcinogenic risks associated with the chemical contaminants of concern at the site that exceed EPA's acceptable levels are summarized in Table 11.

Under current land use, the cumulative carcinogenic risk is 2×10^{-6} for both an on-site worker and an older child as an on-site trespasser. These risks are within the EPA's acceptable cancer risk range (1×10^{-4} to 1×10^{-6}). The total cumulative non-carcinogenic hazards to the on-site worker and on-site trespasser were negligible (0.08 and <0.01, respectively) compared to the acceptable HI value of 1.

The carcinogenic risk from carbon tetrachloride to the current adult and young child off-site resident exposed to the maximum concentrations measured in groundwater were 8×10^{-3} and 4×10^{-3}, respectively. These values exceed the acceptable cancer risk range. The non-carcinogenic health hazard from carbon tetrachloride for the adult and young child off-site resident exposed to the maximum concentrations measured in groundwater were 200 and 470, respectively, both of which exceed EPA guidance levels. TCA is not a human carcinogen and there is no EPA published value for non-carcinogenic risk; thus, the risks associated with current land use exposure cannot be quantitatively estimated for off-site residents. However, the maximum concentration of TCA measured off-site (100 μg/l) is 20 times the maximum contaminant level (5 μg/l). Thus, the presence of TCA and carbon tetrachloride plumes in off-site groundwater could present a public health concern to the few off-site residents who declined access to publicly supplied water.

Under the future land-use conditions, the total chemical carcinogenic risks for a future on-site industrial or construction fell within or below the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6}, and the acceptable HI of one. The risks to the future residential child and adult were slightly above the EPA's target risk range. This risk is driven by arsenic, for which the risks are over-estimated. The slope factor for arsenic $(1.5 \text{ mg/kg-day})^{-1}$ is an overestimate. Uncertainties in the study used to derive this value include the likelihood of a non-linear dose-response relationship, problems with exposure estimates, and differences in protein intake levels which may result in a differential susceptibility to arsenic. Several epidemiological studies in the United States have found no association between skin cancer and arsenic in drinking water.

The non-carcinogenic hazard index for the hypothetical future on-site resident adult and young child were estimated to be 3.4 and 8.5, respectively. Ingestion of manganese in groundwater contributed the most hazard to the HI.

Manganese (Mn) is a ubiquitous element that is essential for normal physiologic functioning in all animal species, including humans. The National Research Council recommends a provisional daily dietary Mn intake for adults of 2.0 to 5.0 mg. The EPA established reference dose for Mn is 10 mg/day (0.14 mg/kg-day for a 70-kg adult) for chronic human consumption of Mn in the diet with an uncertainty factor of 3.

If conservative assumptions were made for OU III that a hypothetical future resident uses the groundwater at OU III as the sole water supply and drinks 2 L/day of water from wells, then, based on the 95% UCL of 1,173 μg/L, the Mn intake can be calculated to be 0.034 mg/kg-day. This Mn intake of 0.034 mg/kg-day is much less than the EPA established RfD of 0.14 mg/kg-day for Mn. Even if based on the maximum detected Mn concentration, the calculated Mn intake is 0.195 mg/kg-day, which is only slightly higher than the EPA established reference dose of 0.14 mg/kg-day; this should not be a concern. The reference dose is estimated to be an intake for the general population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. In addition, the reported Mn concentrations were obtained from the unfiltered groundwater samples that contain more Mn than the filtered groundwater samples. The filtered groundwater would be more representative of drinking water conditions. Mn in groundwater is, therefore, not considered a concern for human health.

An additional risk assessment was done for the future receptors, assuming exposure to the VOC groundwater plumes identified in OU III (TCA, PCE and carbon tetrachloride). The conservative assumption was made that in the future (30 years) houses would be built near the highest detected concentrations of these on-site plumes, and the residents would use the residential wells as the sole water supply for domestic uses. The risk to a future resident using groundwater at the highest concentration of carbon tetrachloride and PCE exceeds the acceptable risk range. Estimated risks to an adult from exposure to carbon tetrachloride and PCE in groundwater were 6×10^{-4} and 5×10^{-3} respectively. Estimated risks to a child from exposure to carbon tetrachloride and PCE in groundwater were 3×10^{-4} and 2×10^{-3}. Under this highly unlikely scenario, the presence of TCA, PCE and carbon tetrachloride plumes in groundwater on-site could pose a potential health concern for a future resident.

The non-carcinogenic HI for a future on-site residential adult who would be exposed to carbon tetrachloride and PCE at the maximum detected concentrations was estimated to be 14 and 20, respectively. The HI's for the future on-site residential child are 33 and 48. These calculated non-carcinogenic HIs exceed EPA's acceptable HI of 1. TCA risks to a future resident using water from the on-site plumes were not calculated quantitatively because there are no EPA established toxicity values for TCA. However, the maximum concentration of TCA in the on-site plume was 920 µg/l, which is almost 200 times the MCL (5 µg/l). Under this highly unlikely scenario, the presence of TCA, PCE and carbon tetrachloride plumes in groundwater on-site could pose a potential health concern for a future on-site resident.

The carcinogenic risk from carbon tetrachloride for the adult and young child off-site resident exposed to the maximum concentrations measured in groundwater in the future were assumed to be the same as for the current off-site risk assessment (8×10^{-3} adult, 4×10^{-3} child). The non-carcinogenic HI's for the future off-site adult and child were 200 and 470, respectively. Thus, the presence of TCA and carbon tetrachloride plumes in off-site groundwater in the future could present a public health concern to the few off-site residents who declined access to publicly supplied water.

Radiological Risk Assessment

Table 12 summarizes the results of the radiological baseline risk assessment for contaminants that exceeded the acceptable risk range.

The radiological risk analyses conducted found that under current land-use conditions, cancer risks for industrial workers at 1, 30 and 50 years from now were 4×10^{-4}, 3×10^{-4}, and 1×10^{-4}, respectively. These risks are slightly above the acceptable risk range of 1×10^{-4} to 1×10^{-6}. For the on-site trespasser, risks at 1, 30, and 50 years from now were 4×10^{-5}, 1×10^{-5}, and 6×10^{-6}, which fall below the acceptable risk range. External gamma exposure was the dominant pathway, and the major contributing radionuclides were Cs-137 and Co-60.

The conservative future land-use scenario assumed an on-site resident who was nearly self-sufficient in terms of raising or harvesting a significant portion of their diet from the OU III site. The calculated risk for this unlikely scenario suggests that OU III would pose potential cancer risks slightly above the acceptable risk range to a future on-site population (3×10^{-4} at year 30 and 1×10^{-4} at year 50). The major contributing pathway is exposure to external gamma from radionuclides in soil. For the future industrial worker, risk at year 30, is 1×10^{-4}. Risks to industrial workers at years 50 and 100 were below the acceptable risk range. The risk to a short-term construction worker involved in excavation activities in year 30 and beyond was very small (2×10^{-7} in year 30, 8×10^{-8} in year 50).

An additional risk assessment was done for the future on-site risk assessment, assuming exposure to the highest concentrations of tritium and strontium-90 measured in groundwater in OU III. The conservative assumption was made that future (30 years) residential houses would be built near the highest detected concentrations of these on-site plumes, and the residents would use the residential wells as the sole water supply for domestic uses. Cancer risks to an on-site resident via the groundwater ingestion pathway for strontium-90 was 1×10^{-4}, and for tritium 2×10^{-3}, which are at or above the acceptable risk range.

Because a few residents off-site elected not to be connected to the public-water supply, the risks to an off-site resident were evaluated. The calculated risk for an off-site resident exceeded EPA's recommended level.

6.2 Ecological Risk

The Ecological Risk Assessment determined whether historical activities at Operable Unit III resulted in levels of chemical and radiological contamination that could adversely affect the ecosystems there.

A standard ecological risk assessment (as prescribed by the EPA) consists of a four-step process used for assessing related ecological risks for a reasonable maximum exposure scenario:

- **Problem Formulation**: a qualitative evaluation of a contaminant's release, migration, and fate; identification of contaminants of concern, receptors, exposure pathways, and known ecological effects of the contaminants; and, selection of endpoints for further study.

- **Exposure Assessment**: a quantitative evaluation of the release, migration, and fate of the contaminant; characterization of exposure pathways, and receptors; and measurement or estimation of concentrations at exposure points.

- **Ecological Effects Assessment**: literature reviews, field studies and toxicity tests linking contaminant concentrations to effects on ecological receptors.

- **Risk Characterization**: measurement or estimation of current and future adverse effects.

Table 13 shows the potential chemicals of concern for the ecological risk assessment.

Unlike assessments of human-health risk which are concerned with effects on individuals, assessments of ecological risk focus on wildlife population and ecosystem-level effects. Because there is little toxicity data relevant to wildlife, it is difficult to draw inferences at the population- and ecosystems-level. Thus, the ecological assessment for OU III was largely qualitative.

The soil contamination to which terrestrial organisms could be exposed was limited to two small areas: one area at the TCE Soil Area is in a building courtyard that is virtually inaccessible to wildlife, and the other area occupies very limited surface area within the developed portions of OU III at the Building 830 Underground Storage Tank area. Therefore, the exposure of terrestrial wildlife to soil contaminants is insignificant.

From comparing surface-water concentrations in the Recharge Basins to available New York State surface water standards, the screening risk assessment indicated that the most significant potential risks to aquatic communities are due to copper in all three recharge basins investigated (HT at the North End of LINAC, HN01, and HN02). In addition, cadmium concentrations in

Recharge basin HN01 were elevated. This analysis is very conservative. The risk was estimated by comparing criteria for dissolved metals to a total measured metal concentration, which will necessarily overestimate risk. In addition, New York State Class D surface water-body standards were used as a screening benchmark. The habitat potential of the recharge basins is very limited due to low water levels, the intermittent presence of water, high temperatures and low dissolved oxygen. Recharge basins are not expected to function as Class D water bodies, and therefore, the risk to aquatic biota is not significant.

The potential risk to the benthic community was most significant in Recharge Basin HT, located at the north end of the LINAC. Mercury, copper, silver and several PAHs were more than an order of magnitude greater than the sediment quality criteria applied. Mercury posed a marginal risk in all other recharge basins. However, the benthic community expected in recharge basins is limited by the habitat. Applying sediment criteria to recharge basins overestimates the risk to the community that could occur there, and risk is expected to be minimal.

Consumption of surface water from the recharge basins by terrestrial animals was also evaluated. Surface water concentrations of contaminants were orders-of-magnitude less than the target species' (cottontail rabbit) drinking water no-observed effect level.

6.3 Basis for Response/Remedial Action Objectives

Remedial action objectives (RAOs), or "cleanup objectives," are specific goals to protect human health and the environment. These objectives are based on available information standards, such as applicable or relevant and appropriate requirements (ARARs), and risk-based levels established in the risk assessment. After evaluating the nature and extent of contamination in soils, groundwater, surface water, and sediment, and assessing the chemical and radiological risks associated with exposure to contaminants of potential concern, the following RAOs were developed:

- Meet the drinking water standards in groundwater for VOCs, strontium-90 and tritium.
- Complete cleanup of the groundwater in a timely manner. For the Upper Glacial Aquifer, this goal is 30 years or less.
- Prevent or minimize further migration of VOC, Sr-90 and tritium in groundwater.

The selected remedies will prevent further migration of high concentrations of contaminants in groundwater.

If, after source control is complete and effective, monitoring indicates that continued operation of the components of the selected remedy is not producing further reductions in the concentrations of contaminants in ground water, in accordance with the National Contingency Plan, DOE, NYSDEC, and EPA will evaluate whether discontinuance of the remedy is warranted. The criteria for discontinuation will include complete and effective source control, an evaluation of the operating conditions and parameters as well as a determination that the remedy has attained the feasible limit of contaminant reduction and that further reductions would be impractical.

From the results of the Remedial Investigation and Baseline Risk Assessment, it was determined that contaminants in all environmental media, except groundwater, posed minimal risk to human health and the environment. Soil contamination that exceeded screening levels in the Remedial Investigation study did not present important risks to human or ecological health with one exception; the soils contaminated with Cesium-137 at Building 830's underground storage tanks. This soil has been excavated under a Removal Action. It should be noted that many sources of contaminated soil and sediment not included under OU III already have been remediated.

Residents immediately south of the Laboratory were offered a hookup to public water supplies, eliminating the potential source of exposure to, and risk from groundwater contaminants. However, some residents elected not to be connected to public water, or still use well-water for various purposes, like watering a garden and filling a swimming pool. The human-health risk assessment found that VOCs in groundwater could present a public health concern for the few off-site residents who declined publicly supplied water. These homes will be monitored at the request of the homeowner.

The following contaminated groundwater plumes were identified to be of concern:

- On-site groundwater contaminated with strontium;
- On-site groundwater contaminated with tritium; and
- On-site and off-site groundwater contaminated with VOCs.

The remedial action alternatives presented in the Feasibility Study and this Proposal Plan address these plumes. In addition, seven interim removal actions (IRAs) were undertaken to immediately reduce concentrations, impact, migration, or exposure to groundwater contaminants.

The primary contaminants identified in groundwater were carbon tetrachloride, tetrachloroethene, trichloroethane, strontium-90, and tritium. Groundwater contamination in OU III was separated into four areas according to the type and location of contaminants.

These four areas are 1) the on-site TVOC area which includes the TVOC present in the water table and Upper Glacial aquifer on BNL; 2) the off-site TVOC area which includes contamination in the water table, Upper Glacial aquifer, and Magothy aquifer off-site and south of BNL; 3) the strontium-90 contamination in the water-table zone present at the BGRR/WCF and the Glass Holes area; and, 4) the tritium plume in the vicinity of the HFBR.

7. DESCRIPTION OF ALTERNATIVES

CERCLA requires that each site remedy be protective of human health and the environment, be cost effective, comply with other statutory laws, and utilize permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. In addition, the statute includes a preference for using treatment as a principal element for reducing the toxicity, mobility and volume of hazardous substances.

Remedial action alternatives evaluated in the Operable Unit III Feasibility Study Report addressed on-site groundwater contaminated with strontium, on-site groundwater contaminated with tritium, and on- and off-site groundwater contaminated with VOCs. The following alternatives were retained for detailed analysis in the Feasibility Study Report.

7.1 Cleanup of VOC Contaminated Groundwater

Most alternatives to remediate VOCs in groundwater use in-well air-stripping systems or other appropriate technologies in combinations of different locations. Figure 12 is a schematic of a typical in-well air-stripping system. Possible locations for off-site treatment systems include the Long Island Power Authority (LIPA) right of way, North Street, the Eastern Portion of the Industrial Park, and two locations at the northern end of the Brookhaven Airport.

All alternatives (except the No Action Alternative) also assume a groundwater treatment system on the BNL site at Middle Road, and at Building 96, continued operation of the south boundary pump-and-treat system, and completion and operation of the Industrial Park in-well air-stripping system, all of which will help prevent further migration of contaminants into the deeper Magothy Aquifer. All the alternatives rely on natural attenuation to reduce concentrations and include extensive monitoring and modeling of the plume over time.

The number of wells selected for each alternative was based on available characterization and hydrogeological data. The actual number of wells used in the selected alternative will be identified during the design phase. Alternatives investigated in detail to remediate VOCs in groundwater are described below. Table 14 summarizes the costs and time to meet Remedial Action Objectives. Because not all of the alternatives originally identified in the Feasibility Study were evaluated in detail, the alternatives listed below are not all numbered sequentially.

V1 - No Action

The no action alternative includes no remedial activities for site-wide VOC contamination. In accordance with the National Contingency Plan, the No Action Alternative must be assessed and compared to the other alternatives.

V2 – Natural Attenuation

Under this alternative, VOC contamination in groundwater will be remediated through the continued operation of three IRAs: the Southern Boundary IRA treatment system; the Off-site Industrial Complex IRA; and, the Off-site Public Water Hookup Interim Action. This alternative also includes a source removal system using re-circulation wells with air stripping treatment near

Building 96. Additional reductions in on- and off-site concentrations of VOCs in groundwater will be achieved through natural attenuation. Natural attenuation occurs when physical, chemical and biological processes reduce the mass, toxicity and mobility of subsurface contamination in a way that reduces risk to human health and the environment to acceptable levels. Installing new monitoring wells, and groundwater monitoring and modeling will be required to evaluate the possibility of impacting potential receptors, such as surface-water bodies, supply wells, and potable wells.

V7 On-Site In-Well Air-stripping/Off-Site In-Well Air-stripping With Hot Spot Containment (4 wells in RA V) and 4 Wells in Western OU III Low Level VOC Plume
This alternative involves actively remediating on-site and off-site VOC contamination. It includes the on-site systems in alternative V3: the operation of the on-site and off-site IRAs, installation of an in-well air-stripping system at Middle Road and a source removal system in the vicinity of Building 96. This alternative also involves installing in-well air-stripping systems at five locations off-site: the Long Island Power Authority (LIPA) Right-of-Way, Brookhaven Airport, North Street/Sleepy Hollow Drive, near North Street in the OU I RAV plume, and within the western OU III low-level VOC plume. Based on the installation, system operation, modeling, and pre-design data, the specific number of treatment systems and locations needed to meet the performance objective may be modified during the design process. The exact number of years of pumping needed to achieve Remedial Action Objectives will be determined based on monitoring and operating data. Additional monitoring wells are planned and sampling and analysis will be conducted. The goal of this alternative is to reduce further migration of the VOC plume south of the off-site sub-systems.

V10b On-Site In-Well Air-stripping/Off-Site In-Well Air-stripping at Hot Spots (1 well in RA V)
This alternative includes all the components of Alternative V7, with an additional well in the OUs I/IV Industrial Complex (East) and without the in-well air-stripping wells in the western OU III low-level VOC plume. This alternative involves actively remediating both on-site and off-site VOC contamination. It includes the following on-site systems: operation of the on-site and off-site IRAs, installation of an in-well air-stripping system at Middle Road, and installation of a source-removal system near Building 96. This alternative also involves installing in-well air-stripping systems at five locations off-site: 1 well in the industrial park east, 3 in-well air-stripping well at the LIPA Right-of-Way, 7 wells at Brookhaven Airport, 4 at North Street/Sleepy Hollow Drive, and 1 near North Street in the OU I RAV plume. The goal is to reduce further VOC plume migration south of the off-site sub-systems.

V10c On-Site In-Well air-stripping/Off-Site In-Well Air-stripping With Hot Spot and Western OU III Low Level VOC Plume Containment
This alternative involves active remediation of both on-site and off-site VOC contamination. It includes the following systems: operation of the on-site and off-site IRAs, including the On-Site Southern Boundary IRA and the Off-Site Industrial Complex IRA; installation of new in-well air stripping systems at the LIPA right-of-way, North Street, the Brookhaven Airport, downgradient of North Street East, the eastern portion of the industrial park; additional treatment systems on-site at Middle Road and in the western OU III low-level VOC plume; and a source removal

system using re-circulation wells with air stripping treatment near Building 96. The Brookhaven Airport containment systems, and the OU III and OUI/IV hot spot containment systems will be identical to the Alternatives V10b. The objective of this alternative is to capture and contain the OU III, OUI/IV, and RAV plume in a similar well configuration as alternative V10b in addition to capturing and containing of the western low level VOC plume. The purpose is prevent or reduce the levels at which this low level VOC plume migrates and discharges to the Carmans River. Details of the specific number of treatment systems and locations needed to meet the performance objective will be determined during the design process. The exact number of years of pumping needed to achieve Remedial Action Objectives will be determined based on monitoring and operating data.

V11 On-Site In-Well Air-stripping/Off-Site In-Well Air-stripping at Hot Spots
This alternative involves active remediation of both on-site and off-site VOC contamination. It includes the following on-site systems: operation of the on-site and off-site IRAs, installation of an in-well air-stripping system at Middle Road, and the installation of a source-removal system near Building 96. This alternative also involves the installation of in-well air-stripping systems off-site: 1 well in the industrial park east, 10 wells at Brookhaven Airport, and 4 at North Street/Sleepy Hollow Drive. The goal is to reduce further migration of the VOC plume south of the off-site sub-systems. This alternative has no treatment at the LIPA right-of-way and, therefore, has more treatment wells located down-gradient at the Airport.

V13 - On-Site/Off-site Extraction and Treatment/On-Site Discharge
The configuration for this alternative is identical to that of Alternative V10b. Groundwater collected by all the extraction wells will be pumped via piping to a treatment system located on-site, treated by an air-stripper to remove volatiles, and discharged to the OU III basin. This alternative includes the following on-site systems: operation of the on-site and off-site IRAs, installation of extraction wells at Middle Road, and installation of a source-removal system near Building 96. This alternative also involves installing extraction wells at locations off-site: 1 well in the industrial park east, 1 well at the LIPA Right-of-Way, 7 wells at Brookhaven Airport, and 4 at North Street/Sleepy Hollow Drive. The goal is to reduce further VOC-plume migration south of the off-site sub-systems.

7.2 Cleanup of Strontium-90 Contaminated Groundwater

Alternatives investigated in detail to remediate strontium-90 in groundwater are described below. Table 15 summarizes the costs and time to meet Remedial Action Objectives. Because not all of the alternatives originally identified in the Feasibility Study were evaluated in detail, the alternatives listed below are not all numbered sequentially.

S1 - No Action
The no action alternative has no remedial activities. In accordance with the National Contingency Plan, the No Action Alternative must be assessed for comparison to the other alternatives.

S2 - Natural Attenuation
Under this alternative, the Sr-90 contamination in the water-table zone near the Brookhaven Graphite Research Reactor, Waste Concentration Facility, and Pile Fan Sump (BGRR/WCF/PFS) is slowly reduced through natural attenuation without any control, removal, treatment, or other mitigating actions. Modeling and monitoring of groundwater is required to evaluate the possibility of impacting potential receptors, such as surface-water bodies, supply- and potable-wells. The monitoring program involves installing new wells to monitor the extent and boundaries of the plumes.

S4 - In Situ Precipitation/Natural Attenuation
In this innovative alternative, a two step in-situ chemical precipitation process is used to contain the strontium-90 plume. In the first step, solutions containing dissolved phosphate are forced through the groundwater and soil, via injection wells, to react with the strontium contaminants, and convert them to more insoluble compounds. Phosphate salts of strontium are very insoluble. In the second step, solutions of lime are injected into the aquifer. This forms calcium hydroxyapatite (a calcium phosphate), which can co-precipitate or adsorb the strontium. Continued groundwater monitoring would be a part of this alternative.

S5a - Groundwater Extraction/Ion Exchange/On-Site Discharge
This alternative includes extracting groundwater from two wells within the BGRR/WCF/PFS plume, and one well downgradient of well 106-16 located south of the Glass Holes area. At each location (BGRR area and Glass Holes area), a system will be installed to treat the using ion-exchange before recharge to an on-site recharge basin. Figure 13 shows a schematic of the proposed Sr-90 ion-exchange system. Ion-exchange resin will be disposed of off-site. The BGRR and WCF pumps would operate for 25 to 30 years and the Glass Holes pumps for 8 years. Continued groundwater monitoring also would be a part of this alternative.

S7 - Extraction and Treatment at BGRR/Permeable Reactive Wall at Glass Holes
Under this alternative, the WCF/BGRR/PFS strontium plume will be remediated utilizing two extraction wells with groundwater treatment via ion exchange, similar to Alternative S5a. However, the Glass Holes strontium plume remediation will be accomplished using a permeable reactive barrier. The permeable reactive walls will consist of a 3-foot-thick bed of granular clinoptilolite. As the groundwater flows through this zeolite mineral, strontium will be absorbed on the bed. Continued groundwater monitoring would also be a part of this alternative.

7.3 Cleanup of Tritium Contaminated Groundwater

Remedial alternatives are being developed for different sections of the tritium plume. Of special interest is the "hot-spot" area of the plume, located along the downgradient edge of the HFBR Building footprint. Several alternatives address containment or removal of this highly contaminated groundwater, including ones that address the leading edge of the 20,000 pCi/l tritium plume.

A tritium Interim Removal Action (IRA) system is operating that recovers approximately 120 gallons per minute from three wells located along Princeton Avenue. The groundwater is treated by carbon adsorption to remove VOCs and discharged to the RA V recharge basin. Because the HFBR spent-fuel pool was emptied, no additional source of tritium exists.

Alternatives investigated in detail to remediate tritium in groundwater are described below, and the costs and time to meet Remedial Action Objectives are summarized in Table 16.

T1 - No Action
The No Action alternative provides a comparative baseline against which to evaluate other alternatives. Under this alternative, no remedial action will occur and the contamination will be left "as is," without any control, removal, treatment, or other mitigating actions. Long term monitoring and modeling will not be performed for the No Action alternative.

T2 - Natural Attenuation/No IRA
This alternative will consist of natural attenuation with the deactivation of the tritium IRA at Princeton Avenue. Natural attenuation is the process by which concentrations of tritium decrease in the groundwater by diffusion, dilution, and radioactive decay. The natural attenuation process can effectively reduce the contaminant's toxicity, mobility, or volume to levels that are protective of human health and the environment. This option requires groundwater modeling, and evaluating the contaminant's degradation rates and pathways. The primary objective of modeling is to demonstrate that natural processes of decay can reduce concentrations to levels below regulatory standards. Sampling and analyses must be conducted throughout the natural attenuation process to confirm that degradation is proceeding at rates consistent with those predicted through groundwater modeling. The monitoring program will involve at a minimum, 88 existing monitoring wells. Additional monitoring wells are being planned. The wells will be sampled and analyzed for tritium quarterly for five years and annually for the following 20 years. The 20-year time frame is a conservative estimate.

T3 - Natural Attenuation/IRA
This alternative is the same as Alternative T2, except it includes the continued operation of the tritium IRA. This option requires modeling, and evaluating the contaminant degradation rates. Sampling and analyses must be conducted throughout the natural attenuation process to confirm that degradation is proceeding at rates consistent with those predicted through groundwater modeling. The monitoring program will involve, at a minimum, 88 existing monitoring wells. Additional monitoring wells are currently being planned. The wells will be sampled and analyzed for tritium quarterly for five years and annually for the following 15 years.

T4 - Natural Attenuation with Contingency-Based Remediation
This alternative includes monitored natural attenuation with a contingency remedy to address tritium contamination in groundwater. Additional monitoring wells will supplement the existing groundwater monitoring network downgradient of the High Flux Beam Reactor's spent-fuel pool. After an evaluation period established during design of the selected remedy and consultation with EPA and NYSDEC, the tritium pump and recharge system on Princeton Avenue will be put on stand-by and operated as needed as an integral component of the

contingency remedy for the tritium plume. The evaluation period will extend up to a maximum of one year after ROD finalization. The tritium plume will be monitored to ensure that natural attenuation is achieving the remedial action objectives. If the tritium plume is not attenuating as expected, one or more contingencies will be implemented to assure the remedial action objectives. Specific contingencies identified are 1) to evaluate the need to reactivate the Princeton Avenue IRA if tritium concentrations exceed 25,000 pCi/l at the Chilled Water Plant Road, and/or 2) reactivate the Princeton Avenue IRA if tritium concentrations exceed 20,000 pCi/l at Weaver Drive. The exact method of determining when these levels have been exceeded, including the number of confirmation samples, will be determined during the design phase. A low-flow extraction system will be installed in the most concentrated area of tritium contamination near the HFBR and activated if concentrations exceed 2,000,000 pCi/l at the front of the reactor. The 2,000,000 pCi/l value incorporates a 25 percent safety factor over the maximum value of 1,600,000 pCi/l that was detected during the remedial investigation to account for uncertainties in sampling and analysis. This system then would be used to remove groundwater containing the highest concentrations of tritium from the aquifer. The exact method of determining when these levels have been exceeded, including the number of confirmation samples, will be determined during the design phase. The extracted tritiated water will be disposed of off-site. Additional monitoring wells will be installed at the HFBR and included in the existing network.

T5 – Extraction/Recirculation/No IRA

This alternative will actively contain the tritium plume with concentrations above 20,000 pCi/l. It includes extracting groundwater at the furthest downgradient portion of the 20,000 pCi/l plume and recirculating the extracted groundwater to the RA V recharge basin. This alternative is similar to the current tritium IRA, except for the location of the extraction wells. It assumes that the tritium IRA will be placed in standby mode.

T6 – Low-Flow Pumping, Hot-Spot Removal/On-Site Storage/Natural Attenuation/No IRA

This alternative uses two extraction wells, pumping at very low rates, to contain and capture the highest concentrations of tritium at the downgradient edge of the plume. The goal is to decrease the extent of the entire tritium plume, its migration, and the duration of time to achieve 20,000 pCi/l concentration, given a one-year focused tritium hot-spot removal action. Two extraction wells will be installed directly downgradient of the HFBR pumping 1 gpm each. The extraction wells will operate for one year and will remove a total of 1.05 million gallons of groundwater. The recovered groundwater will be pumped and stored in a 1.2 million-gallon above-ground tank for approximately 50 years, until the concentration of tritium naturally decays to activities below drinking water standards (20,000 pCi/l). The groundwater then will be pumped to recharge basin RA V where it will percolate through the soil column into the water table. The monitoring program will involve, at a minimum, 88 existing monitoring wells. Additional monitoring wells are being planned. This alternative assumes that the tritium IRA will be placed in standby mode.

T7 – Low-Flow Pumping, Hot-Spot Removal/Off-Site Evaporation/Natural Attenuation/No IRA

This alternative includes installing the same groundwater extraction system discussed in Alternative T6. However, instead of on-site storage, the tritiated groundwater will be evaporated off-site. The extracted groundwater will be transferred directly to a 20,000 gallon feed-tank, and then into tanker trucks that will be transported to a treatment facility for evaporation. No residuals will result from this treatment. This alternative assumes that the tritium IRA will be placed in standby mode.

T8 – Low-Flow Pumping, Hot-Spot Removal/On-Site Evaporation/Natural Attenuation/No IRA

This alternative includes the installation of the same groundwater extraction system as discussed in Alternative T6. However, instead of on-site storage, tritium will be evaporated into the atmosphere using an existing evaporator. It will evaporate the tritiated water to the atmosphere from a stack 70 feet from the base of its skid. No residuals will be produced from this process. This alternative assumes that the tritium IRA will be placed in standby mode.

8. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

8.1 CERCLA Criteria

CERCLA guidance requires that each remedial alternative identified in the Feasibility Study be compared according to nine criteria. Those criteria are subdivided into three categories:

(a) threshold criteria that relate directly to statutory findings and must be satisfied by each chosen alternative;
(b) primary balancing criteria that include long- and short-term effectiveness, implementability, reduction of toxicity, mobility, volume, and cost; and
(c) modifying criteria that measure the acceptability of the alternatives to state agencies and the community.

DOE identified its preferred remedy by evaluating all of the alternatives against EPA's nine evaluation criteria.

Each alternative was evaluated against the following seven criteria (1) overall protection of human health and the environment, (2) compliance with ARARs, (3) long-term effectiveness and permanence, (4) reduction of toxicity, mobility, and volume, (5) short-term effectiveness, (6) implementability, (7) cost, (8) state acceptance and (9) community acceptance. To the maximum extent practical, CERCLA requires that remedial action alternatives must 1) be protective of human health and the environment, (2) attain ARARs, (3) be cost effective, (4) utilize permanent solutions and alternative treatment technologies, and (5) reduce toxicity, mobility, or volume.

Threshold Criteria

<u>*Overall Protection of Human Health and the Environment*</u> addresses whether an alternative provides adequate protection, and describes how risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) considers if a remedy meets all federal and state ARARs, including provisions for invoking a waiver.

Balancing Criteria

Once an alternative satisfies the threshold criteria, five balancing criteria are used to evaluate other aspects of the remedial alternatives. The balancing criteria are 1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility, or volume through treatment; (3) short-term effectiveness; (4) implementability; and (5) cost.

Long-Term Effectiveness addresses the amount of remaining risk, and the ability of an alternative to protect human health and the environment over time, once cleanup goals have been met.

Reduction of Toxicity, Mobility, or Volume addresses the anticipated performance of treatment that permanently and significantly reduces the toxicity, mobility, or volume of waste.

Short-Term Effectiveness and Environmental Impacts addresses the impact to the community and site-workers during construction or implementation, and includes the time needed to finish work.

Implementability addresses the technical and administrative feasibility of an alternative, including the availability of materials and services required for cleanup.

Cost compares the differences in cost, including capital, operation, and maintenance costs. Estimates are based on present-day costs and are highly uncertain.

Modifying Criteria

The modifying criteria are used in the final evaluation of remedial alternatives: state and community acceptance. For both, the factors that are considered include the elements of the alternatives that are supported, the elements those that are not supported, and elements of the alternatives that have strong opposition.

State Acceptance addresses whether the State agrees with, opposes, or has no comment on the preferred alternative.

Community Acceptance addresses the issues and concerns the public may have regarding each of the alternatives.

8.2 Comparative Analysis

A detailed comparative analysis of all alternatives is provided in the Feasibility Study. A summary of comparative analysis of alternatives, based upon the evaluation criteria noted above, is given below. This detailed evaluation of alternatives was done only for strontium contamination in groundwater; tritium contamination in groundwater, and TVOCs in groundwater.

Once each of the alternatives was individually evaluated against the seven criteria, a comparative analysis of alternatives was conducted. A brief summary of the comparative analysis of alternatives is provided below. Tables 17, 18, and 19 summarize the comparative analyses of alternatives. Cost estimates are given in Table 20.

8.2.1 Comparative Analysis of TVOC Alternatives

For groundwater contaminated with VOCs, seven alternatives were evaluated in detail. The alternatives include natural attenuation to address all or portions of plume which might not be directly influenced by an active remedial system. This remedial approach is cost-effective and efficient for restoring VOC-contaminated groundwater.

All alternatives except V1 (No Action) include operating the Southern Boundary System, Industrial Complex IRA system, and a source removal near Building 96. Capital- and operating-costs for these three items also were included for each alternative to represent the total cost of remediation of the VOCs. The majority of alternatives that include additional treatment use in-well air-stripping to further treat VOC contaminated groundwater. Alternative V13 uses traditional pump-and-treat technology to capture, contain, and treat groundwater on- and off-site.

Due to the depth to contaminants in the groundwater, the type of contaminants, and type of geology, only two types of groundwater extraction technologies were used to develop alternatives; groundwater extraction wells and in-situ in-well air-stripping. Treatment technologies evaluated included air-stripping, carbon-adsorption, and UV-oxidation.

If, after source control is complete and effective, monitoring indicates that continued operation of the components of the selected remedy is not producing further reductions in the concentrations of contaminants in ground water, in accordance with the NCP, DOE, NYSDEC, and EPA will evaluate whether discontinuance of the remedy is warranted. The criteria for discontinuation will include complete and effective source control, an evaluation of the operating conditions and parameters as well as a determination that the remedy has attained the feasible limit of contaminant reduction and that further reductions would be impractical.

The alternatives (except V1, No Action) focus on restoring the Upper Glacial aquifer due to the higher velocity of groundwater, more potential receptors, and increased potential for plume growth and migration. The remediation of the Upper Glacial aquifer will also reduce VOCs migration into the Magothy resulting in faster cleanup of the deeper aquifer. Additional characterization and monitoring of the Magothy aquifer will be conducted to allow evaluation of the need for a remedy for the Magothy aquifer.

Several alternatives (V7, V10b, V10c, V11, V13) include installing treatment wells at the downgradient edge of the VOC plume at Brookhaven Airport. These wells reduce the plume's migration south of Flower Hill Drive.

Two alternatives (V7 and V10c) also have remedial subsystems, which address the low-level VOC plume, present to the west of the main plume. They attempt to reduce the migration and plume growth of the low levels of VOC which eventually discharge to the Carmans River.

Overall Protection of Human Health and the Environment

All alternatives with the exception of V1 include the operation of the southern boundary treatment system, off-site Industrial Complex IRA, the hookup of residential homes to public water downgradient of the BNL site, installation and monitoring of additional on-site and off-site wells and VOC source removal at Building 96. Therefore, all of the alternatives with the exception of V1 will provide a degree of protection of human health and the environment by minimizing exposure pathways.

Alternatives with off-site treatment (V7, V10b, V10c, V11, V13) provide for the protection of human health and the environment because they offer a high reduction in contaminant concentrations and mobility. These alternatives improve overall protection of human health and the environment by removing the contaminants from off-site groundwater to RAOs and by allowing contaminant levels in the aquifer to reach MCLs over time by natural attenuation. Alternatives V10b and V10c provide the greatest amount of protection through the reduction of contaminants both on and off-site of BNL and result in compliance with ARARs in 30 years.

All treatment alternatives require long periods of time to remediate (25 years to greater than 30 years). In the case of Alternative V1 and V2, contaminated groundwater will continue to migrate, and protection of human health and the environment will not be achieved. However, through the implementation of a risk management program including groundwater monitoring, residential well monitoring, public water hookups, and a natural attenuation remedial plan, risks posed by the VOCs to human health and the environment may be minimized.

For those alternatives that implement off-site remediation, groundwater modeling indicates that the VOC contaminants will discharge to the Carmans River at low concentrations (i.e., less than 5 µg/l). Carmans River discharges as a result of the OU III and OU I/IV plumes are less than 1 µg/l. Carmans River discharges as a result of the low-level VOC plume is less than 5 µg/l. The VOC discharge levels to the Carmans River should likely be reduced or prevented as part of Alternatives V7 and V10c which incorporate a treatment system for the OU III low level VOC plume.

Alternatives with air emissions will be evaluated for compliance with appropriate air regulations (Air Guide-1). On-site treatment systems not passing air discharge screening will include off-gas treatment prior to discharge. All off-site treatment systems will include off-gas treatment using carbon filters.

Compliance with ARARs

Alternatives V1 and V2 do not achieve chemical-specific ARARs for the on-site and off-site VOC contamination since Federal MCLs and state groundwater standards will be exceeded for the next 30 years. Alternatives V10b, V10c, and V13 remediate the groundwater in the Upper Glacial aquifer within 30 years, and are therefore in compliance with ARARs and RAOs. Alternative V7 does not comply with chemical-specific ARARs because VOC concentrations exceeding the MCL still persist within the Upper Glacial aquifer after 30 years.

Alternatives requiring discharge of water or air will comply with chemical-specific and action-specific ARARs at the discharge point through engineering controls and monitoring.

Long-term Effectiveness

Alternative V1 will not significantly reduce concentrations of contaminants nor limit the mobility of the contaminated groundwater migration. All other alternatives actively treat the groundwater. Contaminant migration, plume growth, and VOC discharge levels to the Carmans River are the highest in this alternative compared to all other alternatives.

Alternative V2 includes operating the on-site and off-site IRAs along with an air-stripping/soil vapor extraction system for the VOC source-area. This baseline alternative results in no further impacts to the aquifer from VOCs at the source area, as well controlling the migration of the VOC plume at the boundary and at the Industrial Complex. Groundwater modeling shows that the MCL is not reached on-site and off-site of BNL within 30 years. However, significant reductions in the plume's extent are observed.

Model simulations indicate that Alternatives V7, V10b, V10c, V11 and V13 will prove very effective in long-term reduction of the contaminant's concentrations and mobility due to the intensive remedial effort applied. These alternatives are the most effective in removing and reducing VOC concentrations in the aquifers.

Alternative V11, which involves treatment through in-well stripping wells placed in non-residential areas, requires longer to achieve the MCL than other alternatives (except for V7) that include off-site wells within residential areas. Alternatives that include remediation wells sited within plume's hot spots, regardless of residential areas, have accelerated schedules and an effective remediation of the Upper Glacial aquifer in 30 years.

Alternative V7 is the least aggressive. This alternative includes the reduction and capture of VOCs within the OU III low-level VOC plume and RA V plume. It also includes installing Brookhaven Airport wells for prevention of migration beyond Flower Hill Drive. It still results in the greatest migration of VOC contaminants for the OU III and OU I/IV off-site plumes, with levels above the MCL persisting within the Upper Glacial aquifer after 30 years. Although not simulated, Alternatives V7 and V10c would likely result in the lowest levels of VOC discharge to the Carmans River due to the OU III low-level plume systems.

Reduction of Toxicity, Mobility, and Volume

All alternatives except V1 include operating the southern boundary treatment system, off-site Industrial Complex IRA, installing and monitoring additional on-site and off-site monitoring wells for natural attenuation and source removal at Building 96. Groundwater modeling showed that these remedial components alone reduce contaminant volume and mobility and will prevent further migration of high concentrations of VOCs past the property line. Natural attenuation will significantly reduce contaminant concentrations in the aquifer for the on-site VOC plume during the 30-years of operation of the southern boundary treatment system. However, by placing additional recovery wells on-site and off-site in addition to the IRAs, the remedial strategy is accelerated.

Off-site treatment in Alternatives V7, V10b, V10c, V11 and V13 effectively reduces the toxicity, mobility, and volume of off-site VOCs, and prevents significant migration. Potential discharges to the Carmans River are also reduced. However, even with the aggressive off-site treatment in Alternatives V10b, V11 and V13, small discharges (less than 5 μg/l) are simulated to occur within 30 years. These discharges may be further reduced or prevented by installing of an OU III low-level VOC plume treatment system, as in Alternatives V7 and V10c. If the alternatives provided no off-site treatment, groundwater modeling has shown that VOCs at concentrations between 5 μg/l and 15 μg/l may enter the Carmans River.

Natural attenuation, a component of all the alternatives, reduces contaminants by natural means over a period of time.

Alternatives V10b, V10c, and V13 restore the Upper Glacial aquifer to the MCL in approximately 30 years, and result in the greatest extent of reduction in the contaminant's toxicity, mobility, and volume. Alternative V10c may result in lower levels of VOC discharge to the Carmans River than Alternatives V10b and V13 because of the OU III low level VOC plume treatment system. Therefore, these alternatives comply with the RAOs discussed in this ROD. The amount of time required for Alternative V7 to restore the Upper Glacial aquifer exceeds 30 years.

Short-term Effectiveness

Alternative V1 does not include any major active remediation and, therefore, presents the least risk to the community or workers.

Alternative V2, natural attenuation, represents the baseline for the VOC alternatives. It contains the installation of an air-stripping/soil vapor extraction system at building 96, a suspected source-area for VOCs, and installing and monitoring of additional on-site and off-site wells to assess natural attenuation. Alternative V2 also includes the installation and operation of an off-site IRA along with operation and maintenance of the Southern Boundary IRA treatment system. The operation of the IRAs, air-stripping/soil vapor extraction system, and a natural attenuation program are remedial components in all the alternatives except for Alternative V1. These components pose some risks of exposing on-site workers to VOCs through dermal contact, ingestion, and inhalation during construction activities and system operation. However, exposure can be prevented by using proper personal protection equipment. All alternatives except V1 produce process residuals, such as spent carbon requiring proper handling.

The alternatives involving in-well stripping (V7, V10b, and V10c, and V11) provide the least short-term risk to workers and to the community during installation because in-well air-stripping systems require less extensive construction, minimal contact with groundwater, and generate fewer process residuals. However, potential emissions and noise from off-site air-stripping systems located in residential areas may be a concern for the community. These impacts will be minimized by engineering controls such as off-gas treatment and enclosures.

Alternative V13 includes extracting groundwater for treatment, and its discharge. This alternative has some risk to on-site workers through dermal contact, ingestion, and inhalation of contaminants during construction and system operation. These risks can be reduced by using proper personal protection equipment and trained personnel.

Implementability

From a technical standpoint, all of the alternatives can be implemented. Pump-and-treat and in-well stripping technologies have been demonstrated either on-site or at other contaminated sites. Equipment, contractors, and venders required to implement the alternatives are available. In-well air-stripping was demonstrated by field pilot tests at BNL to be effective in reducing contaminants to discharge standards.

Administratively, implementation of off-site alternatives will be difficult due to regulatory approval, public acceptance, and the requirements for property access for installing the off-site treatment systems. Alternative V13 will be the most difficult to implement administratively because it will involve installing underground piping through major roadways (e.g., Long Island Expressway), residential areas and industrial areas. The in-well air-stripping systems will require LIPA approval for implementation.

All remedial alternatives will require compliance with Air-Guide-1 air-discharge limits for the air-strippers, the in-well stripping systems, and the air-stripping/soil vapor extraction system. Compliance can be easily demonstrated by the use of off-gas treatment where appropriate. Off-gas treatment system (carbon adsorption) has been proposed at systems with high VOC contamination for wells located in residential areas.

Alternative V1, No Action, is the easiest to implement because it requires no construction, remedial or monitoring actions.

Cost

All VOC alternatives (except for V1) include costs for installing and operating the southern boundary and Industrial Complex IRA systems, and source removal at Building 96, as well as for natural attenuation/groundwater monitoring.

Southern boundary costs were included because on-site recovery at Middle Road affected the net present-worth cost of the southern boundary treatment system by influencing operating time frames. Implementation of on-site recovery at Middle Road reduced the cost of operating the southern boundary treatment system by its system's operating duration from 30 years to 15 years. However, the total remedial cost, including additional on-site treatment at Middle Road, was higher than the total cost for operating the southern boundary system alone for 30 years (alternative V2). Table 20 summarizes the capital, operation, and maintenance, and total net present worth cost for each of the alternatives.

The costs of alternatives V10b and V10c, are comparable. Alternatives V10b and V13, are similar in well configuration to one another. The VOC alternative with the lowest cost is alternative V2 (natural attenuation), and the alternative with the highest cost is V7.

State Acceptance

New York State, based on its review of the Feasibility Study and the Proposed Plan, has concurred with the selected alternative (V10c).

Community Acceptance

Written and verbal comments received from the community during the public comment period and at the public meeting held on March 24, 1999 have been evaluated. From the comments received during the public-comment period, DOE and BNL believe that the public and local elected officials are in general agreement with the selected remedial alternatives. The Responsiveness Summary Section of this Record of Decision contains the comments from the community and DOE's responses. In response to community concerns, the selected remedy (V10c) includes treatment systems to be located in the western low-level VOC plume that were not part of the originally proposed remedy (V10b). These additional systems were added in response to the concerns of the community and regulators about potential impacts to the Carmans River.

8.2.2 Strontium Comparative Analysis

Groundwater strontium contamination was detected around the BGRR, WCF, PFS, and the Glass Holes area. Five remedial alternatives were evaluated in detail to address the groundwater strontium contamination. In-situ technologies included in situ chemical precipitation

(Alternative S4), and reactive permeable barrier (Alternative S7). Other remedial technologies evaluated included ion exchange (Alternative S5a).

The natural attenuation alternative S2 is protective of human health and environment because of the slow migration rate of the strontium in groundwater. No receptors are impacted for the duration of the remedial alternative, 60 years. However, this alternative does not result in compliance with RAOs within 30 years. Pump and treat alternative S5a is effective in removing strontium from the aquifer, and results in compliance with RAOs within 30 years.

In-situ technologies use containment as means of addressing the strontium contamination in the groundwater. These technologies prevent any further migration and rely on radioactive decay to comply with RAOs. However, because strontium is not very mobile in the aquifer and because of the flat groundwater gradient around the BGRR, these technologies are not cost effective and do not result in compliance with RAOs in a timely manner.

Overall Protection of Human Health and the Environment

The Natural Attenuation alternative is protective of human health or the environment, over the long-term since groundwater modeling simulations show no impact to any potential receptors. However, the Natural Attenuation alternative requires 60 years to naturally decay to ARARs. The No Action alternative cannot address the future protection of human health and the environment due to the lack of long-term monitoring and modeling data.

The In situ Precipitation Alternative S4 provides added protection to the environment since the mobility of the Sr-90 is reduced.

Alternatives S5a and S7 are also protective of human health and the environment by remediating the Sr-90 contaminated groundwater to the MCL within 30 years.

Protection of human health can be measured by both the impact of the remediation scheme to the aquifer and the environment and the impact of the consequences of the remedial alternative. Although Alternatives S5a and S7 result in restoration of the aquifer, the potential exposure to contaminants has been increased. These alternatives also result in the generation of radiological waste that must be managed, transported, and disposed off-site which also increases potential exposure. Because of the low mobility of Sr-90 at both the Glass Holes and WCF/PFS areas, no potential impacts to receptors is anticipated, and all Sr-90 contamination remains within the boundaries of BNL.

Compliance with ARARs

Alternatives S5a and S7, as well as the In situ Precipitation Alternative S4 will comply with chemical specific ARARs within 30 years at all locations impacted by Sr-90; therefore, these alternatives comply with RAOs for the restoration of the aquifer within 30 years. In the Natural Attenuation Alternative S2 and the No Action Alternative S1, ARARs are not achieved within 30 years. However, the Glass Holes area reaches the MCL in approximately 40 to 50 years, and the

WCF/PFS area reaches the MCL in approximately 60 to 70 years. However, plume mobility and growth are negligible at all locations during this time period.

Through proper design and permitting of Alternatives S5a and S7, the discharge of the treated Sr-90 will comply with all applicable chemical-specific and action-specific ARARs through the use of proven technology and proper design.

Long-term Effectiveness

Alternatives S1 and S2 will reduce contaminant concentrations through natural processes of decay, dilution and adsorption. Alternative S4 enhances adsorption to prevent migration. The groundwater transport modeling shows no impact on potable water wells or BNL supply wells over a 60-year period. The concentration of Sr-90 within the plumes are, over the long-term, reduced.

For Alternatives S5a and S7, concentrations of Sr-90 are reduced to the MCL within 30 years at WCF/PFS area. In addition for Alternative S5a cleanup of the Glass Holes area will occur within 8 years. The treatment systems will generate residual waste as a result of the ion exchange technology. The residuals will be managed and disposed as low level radioactive waste. Exposure to waste can be minimized through proper training of personal and the use of personal protection equipment to reduce long-term risk of exposure. For Alternative S7, the PRB will adsorb Sr-90 from the plume for at least 25 years. It will remove Sr-90 from the groundwater and immobilize the adsorbed Sr-90 within the wall until it radioactively decays.

Reduction of Toxicity, Mobility, and Volume

Alternative S1 does not use treatment or containment to reduce toxicity, mobility or volume of the Sr-90 in the groundwater. In Alternative S2, the Sr-90 concentrations will be reduced by natural processes of decay, dilution and adsorption. Minimal contaminant migration is supported by groundwater modeling and long-term monitoring in Alternative S2. Transport through the aquifer is minimal and the bulk of the contamination remains within the same area in the water table zone of the Upper Glacial aquifer.

Alternative S4 and the permeable reactive wall component Alternative S7 reduce the mobility of the Sr-90 by treatment. Reduction in toxicity and volume are achieved by natural decay.

Alternative S5a and the WCF/PFS component of the Alternative S7 use extraction and treatment systems to reduce the toxicity, mobility and volume of contaminated groundwater to below the 8 pCi/l MCL. The Sr-90 removed from the groundwater will be adsorbed on the zeolite unit within the groundwater treatment system and will be transported off-site for disposal. Since this material is disposed of off-site rather than into an on-site landfill, the Sr-90 is permanently removed from the site.

No significant advantages are observed in plume migration for Alternative S5a over Alternative. S2 or S4 because of the low mobility of the Sr-90.

Short Term Effectiveness

The No Action Alternative (S1) does not include any disturbance, site access or use of the site and therefore does not present the community or on-site workers with any additional risks resulting from potential release of contaminants.

Alternative S2, Natural Attenuation, consists of allowing the natural processes of radioactive decay, diffusion, dilution and adsorption to reduce the concentration of Sr-90 in the groundwater to the acceptable level. Short-term risks are limited to possible worker exposure to contaminated soil and groundwater during installation of monitoring wells and groundwater sampling. In the short term, this alternative contains minimal exposure to Sr-90 contamination to the construction worker or the community.

Alternative S4, the In situ Precipitation alternative, will require drilling of 55 injection wells and mixing and injection of immobilization chemicals into the aquifer to trap the Sr-90. Some risk exists from the construction activities and from the drill cuttings. Accidents and exposure can be prevented with proper training, and appropriate protective equipment.

Alternative S5a, Groundwater Extraction/Ion Exchange/On-site Discharge, the "pump and treat" remedy, involves extraction of groundwater from two areas of high Sr-90 concentration (WCF/PFS and Glass Holes), and treatment and discharge to on-site recharge basins. This alternative results in immediate control of the migration of the highest Sr-90 concentration areas and reduces Sr-90 concentrations in the aquifer. Installation of this system presents some risk to on-site workers through dermal contact, ingestion or inhalation of groundwater and/or soils during construction and O&M activities. However, exposure can be prevented by using proper personal protection equipment.

Alternative S7, Groundwater Extraction/Ion Exchange/On-site Discharge/Permeable Reactive Wall, the "Hybrid" alternative, includes the "pump and treat" system at the WCF/PFS area and the installation of a PRB at the Glass Holes area. This alternative requires the management of over 2,000 cubic yards of excavated soil, including up to 1,000 yards of soil from the aquifer that may contain some radioactivity. This soil must be managed to prevent exposure to construction workers and to prevent migration of dust.

Implementability

The No Action Alternative S1 will be easily implemented since no action is required. The Natural Attenuation Alternative S2 will require a public awareness and monitoring program, both of which can be easily implemented. The In situ Precipitation Alternative S4 requires drilling of injection wells and mixing and injection of chemicals to immobilize the Sr-90. All activities associated with this alternative are readily available and proven, although avoiding underground utilities and pipelines in the WCF/PFS area will require extensive planning and some survey activities. A treatability study will be conducted to confirm the parameters necessary for stabilization of the Sr-90.

Alternative S5a will require the construction of treatment systems, extraction systems and discharge lines. The treatment equipment required are readily proven and commercially available. A treatability study will be conducted during the remedial design activities to confirm that Sr-90 loading and removal kinetics are as expected and that the 8 pCi/l MCL can be met. Sampling for treatment effectiveness and groundwater monitoring will also be required and can be easily implemented.

Installing the permeable reactive wall for Alternative S7 will be difficult. This alternative requires not only the excavation of an 80 foot deep trench under slurry and the placement of 1,039 cubic yards of clinoptilolite in the trench, but also management of over 2,000 cubic yards of excavated soil, including up to 1,000 yards of soil from the aquifer that may contain some radioactivity. This soil must be managed to prevent exposure to construction workers and to prevent release of dust to the atmosphere.

Cost

Costs for these alternatives are summarized in Table 20. There are no costs associated with Alternative S1. Installation of monitoring wells, groundwater sampling and analysis, and groundwater modeling are included in all other alternatives.

Although Alternatives S4 and S5a cost an additional $1,000,000 to $5,000,000 over Alternative S2, and restore the groundwater resource faster by reducing the mass of contaminants, no significant advantages are observed in implementing these alternatives over natural attenuation due to the low mobility of Sr-90 and lack of receptor impact.

State Acceptance

New York State, based on its review of the Feasibility Study and the Proposed Plan, has concurred with the selected alternative (S5a).

Community Acceptance

Written and verbal comments received from the community during the public comment period and at the public meeting held on March 24, 1999 have been evaluated. From the comments received during the public-comment period, DOE and BNL believe that the public and local elected officials are in general agreement with the selected remedial alternatives. The Responsiveness Summary Section of this Record of Decision contains the comments from the community and DOE's responses.

8.2.3 Tritium Comparative Analysis

The HFBR spent fuel pool tritium plume extends from the HFBR to Princeton Avenue and is currently being remediated with the Princeton Avenue IRA system. A total of eight remedial alternatives for the tritium plume were evaluated in detail. They include variations of natural attenuation (T2, T3, T4), and hot spot removal at the reactor (T6, T7, T8).

Hot spot extraction alternatives presents three methods of managing the tritium contaminated water: 1) on-site evaporation 2) off-site evaporation 3) on-site storage. No cost effective treatment technologies are available for the removal of tritium from groundwater. Therefore, no treatment alternatives were carried forward for a detailed analysis.

Groundwater modeling results for natural attenuation without the current IRA system indicated that the current IRA has little to no effect on the tritium plume and does not result in a shorter remediation timeframe for the plume. Therefore, most of the alternatives assumed that the Princeton IRA system would not be in operation.

Alternative T4 is based on natural attenuation of the tritium plume with contingency pumping based remediation at the HFBR and at Princeton Avenue. The contingencies were developed to address concerns regarding potential migration of tritium in excess of the simulated results and potential high levels of tritium which have not been detected at the HFBR. In the event that 1) the tritium plume in excess of 25,000 pCi/l reaches the Chilled Water Plant, an evaluation of the need to reactivate the Princeton Avenue IRA will be conducted, and/or 2) In the event the tritium plume in excess of 20,000 pCi/l migrates to Weaver Drive, the Princeton Avenue IRA system will be reactivated. Alternative T4 statesthat if tritium levels at the HFBR exceed 2,000,000 pCi/l, selective hot spot pumping will take place at the reactor.

Alternatives T7 and T8 involve on- and off-site evaporation of the extracted tritium, which introduces an additional risk to the public.

Overall Protection of Human Health and the Environment

Based on the results of groundwater modeling presented, the no action alternative (T1) will not ensure the protection of human health and environment because even though the contaminant plume is predicted to attenuate to below chemical-specific ARARs before migrating off the BNL property, however, confirmation of this is not available, due to the lack of groundwater modeling or monitoring in this alternative. Therefore, overall protection of human health and the environment is not achieved.

Alternatives T2 through T8 are protective of human health and the environment. Tritium concentrations are rapidly reduced by dispersion, dilution, and decay. For the natural attenuation alternative, 20 to 25 years is required for the aquifer concentrations to meet the 20,000 pCi/l MCL. No impact to potential receptors is predicted, and groundwater with tritium levels higher than the MCL will not pass Princeton Avenue for any of the alternatives.

Alternatives T4, T5, T6, T7 and T8 require the extraction and handling of tritiated groundwater which can potentially increase the exposure rate to tritium. Transportation alternatives T4 and T7 also increase the chance for exposure due to the large distance of travel required for final disposition of the tritium. Alternatives T4, T7, T8 involve on- and off-site evaporation of the extracted tritium, which introduces an additional risk to the public.

Compliance with ARARs

The No Action Alternative T1 cannot prove compliance with the chemical-specific ARARs. Groundwater tritium quality is projected to be in compliance with ARARs after the 20 to 25 year period. However, confirmation of this is not available, due to the lack of groundwater monitoring in this alternative. Therefore, compliance with ARARs are not achieved for this alternative. The Natural Attenuation alternatives as well as Alternatives T4 through T8 eventually, within 20 years, comply with ARARs. Dilution and decay reduce tritium concentrations to below the MCL of 20,000 pCi/l.

Groundwater discharge standards (chemical specific and action specific ARARs) for tritium and VOCs will be attained by all alternatives utilizing extraction.

The on-site evaporation alternative will require approval from regulators due to the discharge of tritium to the atmosphere. However, the discharge concentrations will be substantially below the existing limit for the HFBR Stack.

Long-term Effectiveness

Alternative T1, Natural Attenuation Alternative T2 and Natural Attenuation Alternative T3 which includes the continuation of the tritium IRA will reduce contaminant concentrations in groundwater via decay, dilution and diffusion. For natural attenuation, groundwater transport modeling predicts no impact on potable water wells or BNL supply wells. The concentrations of tritium within the plumes are, over 20 to 25 years, attenuated by decay and dispersive processes to below the drinking water standard. Continuation of the IRA re-circulation system does not enhance the natural attenuation process and results in a second, low concentration (less than 2,000 pCi/l) plume south of the RA V basin.

Since the No Action Alternative T1 does not include modeling or monitoring, the long-term effectiveness of Alternative T1 cannot be verified.

Alternatives T6, T7 and T8, hot spot extraction of tritium groundwater and long-term storage for radioactive decay, off-site evaporation, or on-site evaporation will remove significant amounts of tritium. However, a significant reduction in cleanup duration was not observed from these alternatives when compared to Alternative T2. The cleanup time is reduced by only 3 to 5 years with no significant reduction in the overall plume migration distance. The same observation is true of the Contingency Based Remediation Alternative T4.

For Alternatives T4, T7 and T8, the long-term risks due to possible exposure tritium in the atmosphere are increased as a result of discharge of tritium to the atmosphere. This risk is not significant.

Reduction of Toxicity, Mobility, and Volume

Neither the No Action Alternative (T1), continuation of the IRA (T3) nor Natural Attenuation (T2) uses treatment or containment to reduce toxicity, mobility or volume of the tritium in the groundwater. The tritium concentrations will be gradually reduced or attenuated by natural processes of decay, dilution and dispersion. Slight contaminant migration will continue because groundwater is not contained or treated. Alternatives T4, T6, T7 and T8 use extraction of the hot spot to reduce the toxicity, mobility and volume of contaminated groundwater. The tritium in the extracted groundwater is permanently removed from the aquifer.

None of the extraction alternatives (T3 through T8) have noticeable impacts on the migration of tritium as compared to the Natural Attenuation Alternative, T2. In all alternatives, tritium greater than the MCL will not migrate past Princeton Avenue.

Short Term Effectiveness

Alternative T1 does not include any disturbance, site access or use of the site and therefore does not present the community or on-site workers with any additional risks resulting from potential release of contaminants.

Alternative T2, Natural Attenuation, allows the natural processes of radioactive decay, diffusion, dilution and adsorption to reduce the concentrations of tritium in the groundwater to acceptable levels. Short-term risks are limited to possible worker exposure to contaminated soil and groundwater during groundwater sampling. In the short term, this alternative allows further migration of the tritium plumes, although it is rapidly attenuated by decay and dispersive processes.

Alternative T3, Natural Attenuation with the operation of the tritium IRA is similar to T2; however, the operation of the IRA may increase potential exposure to workers since the groundwater is extracted and then discharged to an on-site recharge basin.

In Alternative T5, containment by recirculation, groundwater from the southern edge of the 20,000 pCi/l contour is extracted and pumped upgradient to the RA V recharge basins. This limits the migration of this part of the plume and minimizes the volume of the aquifer that exceeds the MCL for tritium.

Alternatives T4, T6, T7 and T8, the "hot spot" remedies, involve extraction of groundwater from the areas of high tritium concentration within the plume, treatment (by on-site storage, off-site evaporation, or on-site evaporation). All of these alternatives present some risk to on-site workers through dermal contact, ingestion and inhalation from construction activities and regular operation and maintenance activities. However, exposure can be minimized by using proper work practices and procedures.

In all alternatives, the time to remediate to MCLs within the aquifer is equal to or less than 20 to 25 years. No significant reductions are observed in the time remediate to reach MCLs when active remediation is implemented (T5, T6, T7 and T8).

Implementability

Alternatives T1 and T2 will require a public awareness program and natural attenuation will require monitoring, both of which can be easily implemented. Alternatives T4 through T8 will require the construction of storage tanks, carbon units, extraction systems and discharge lines. The treatment equipment required is readily proven and commercially available. Sampling for treatment effectiveness and groundwater monitoring can be easily implemented.

The alternatives associated with off-site disposal, T4 and T7 may encounter some difficulty in obtaining approvals for transportation and off-site evaporation activities, which could lead to delays in the implementation of this alternative. Additionally, the on-site storage and on-site evaporation alternatives may also have community acceptance problems that could complicate or delay implementation.

Cost

There are no costs associated with the no action alternative. Costs associated with the installation of monitoring wells, groundwater sampling and analysis, and groundwater modeling are required for all alternatives.

Table 20 summarizes the costs for the evaluated alternatives. The alternative with the lowest capital cost is Alternative T2 since all monitoring wells required for natural attenuation monitoring have already been installed. The alternative with the highest capital cost is Alternative T6, groundwater recovery with on-site storage. This cost is mostly associated with construction of the large storage tank for this alternative. The cost for Alternative T4 that was originally proposed in the PRAP will be increased since the selected remedy is a modification of Alternative T4 which contains an additional low flow extraction system that will be installed and operated near Temple Place.

The alternative with the lowest operation and maintenance costs is alternative T2. Alternative T7 has the highest costs because of the expense of the transportation and off-site disposal of the approximately one million gallons of tritiated groundwater at $20 per gallon.

State Acceptance

New York State, based on its review of the Feasibility Study and the Proposed Plan, has concurred with a modification of alternative (T4) which includes a fourth contingency. An additional system was added in response to regulatory concerns about potential plume growth.

Community Acceptance

Written and verbal comments received from the community during the public comment period and at the public meeting held on March 24, 1999 have been evaluated. From the comments received during the public-comment period, DOE and BNL believe that the public and local elected officials are in general agreement with the selected remedial alternatives. The Responsiveness Summary Section of this Record of Decision contains the comments from the community and DOE's responses. In response to community concerns, the proposed remedy for tritium contamination in groundwater (T4) was modified to be more specific about when the existing pump-and-recharge system would be put on stand-by. The selected remedy keeps the pump-and-treat system running for up to a maximum of one year after the ROD is signed.

9. SELECTED REMEDIES

This ROD documents the selected remedial actions for OU III. Figure 14 shows the areal extent of the TVOC, strontium-90 and tritium contamination in groundwater along with planned and existing pumping locations. The best balance of EPA's remedy selection criteria was used to identify the following selected actions:

Volatile Organic Compounds (VOCs) Remedy

Several Interim Removal Actions (IRAs) have begun to address VOC contamination, including treatment systems at the southern site boundary and in an off-site, downgradient industrial park. Additionally, public water was provided in a large area south of the Site, to protect public health while the groundwater cleanup is underway.

The selected remedy, Alternative V10c, involves active remediation of both on-site and off-site VOC contamination. It includes the following systems: operation of the on-site and off-site IRAs, including the On-Site Southern Boundary IRA and the Off-Site Industrial Complex IRA; installation of new in-well air stripping systems at the LIPA right-of-way, North Street, the Brookhaven Airport, downgradient of North Street East, and the eastern portion of the industrial park; and an additional treatment system on-site at Middle Road. The remedy also includes either in-well air stripping and/or expansion of the existing on-site pump and treat system to address lower levels of VOCs in the western part of the plume. The remedy will also include a source removal system using re-circulation wells with air stripping treatment near Building 96. The PCB contaminated soils at Building 96 that are above the New York State cleanup levels (1 ppm) will be excavated and sent to an off site disposal facility. The final remedy for potential source areas in AOC-26B (Building 96), such as the anomalies discovered during the geophysical survey, will be documented in a subsequent Record of Decision. Details of the specific number of treatment systems and locations needed to meet the cleanup objectives will be determined during the design process. The exact number of years of pumping needed to achieve cleanup objectives will be determined based on monitoring and operating data.

Additional surface soil sampling was conducted for the Building 96 area in accordance with the addendum to the Building 96 Scrapyard Predesign Characterization Work Plan to define the extent of PCB contaminated soils in the Building 96 Scrapyard. Surface soil samples were collected from twelve locations from zero to two inches and analyzed for PCBs. The results from the PCB sampling effort indicated concentrations of PCBs ranging from 5.6 ppm to 710 ppm. Additional sampling will be conducted to further define the area of contaminated soil. Results from these sampling events will be included in the Building 96 Final Design Report or Design Addendum. Based on the currently available data the remediation of the PCB soils will consist of excavation and off site disposal in a licensed facility.

If, after source control is complete and effective, monitoring indicates that continued operation of the components of the selected remedy is not producing further reductions in the concentrations of contaminants in ground water, in accordance with the National Contingency Plan, DOE, NYSDEC, and EPA will evaluate whether discontinuance of the remedy is warranted. The criteria for discontinuation will include complete and effective source control, an evaluation of the operating conditions and parameters as well as a determination that the remedy has attained the feasible limit of contaminant reduction and that further reductions would be impractical.

At present, limited characterization has been performed in the Magothy, so additional characterization and installation of groundwater monitoring wells are planned. This work will be done during the design of the remedy, and will be included in the site records. When this characterization and monitoring is completed, the need for a remedy for the Magothy Aquifer, will be evaluated by DOE, EPA, and NYS DEC. If a remedy for the Magothy Aquifer is necessary, either this record of Decision will be modified or another decision document will establish the selected action. In either case, the public will have an opportunity to review and comment in accordance with CERCLA.

Strontium-90 Remedy

There are concentrated areas of strontium-90 contamination in the groundwater at three on-site locations: the Glass Holes Area, the Brookhaven Graphite Research Reactor (BGRR), and the Waste Concentration Facility.

The selected remedy, Alternative S5a, involves installing extraction wells and using ion-exchange to remove strontium-90 from the extracted water. Details of the specific number of treatment systems and locations needed to meet the performance objective will be determined during the design process. The exact number of years of pumping needed to achieve Remedial Action Objectives will be determined based on monitoring and operating data. Before implementation of the remedy, a pilot treatability study will be performed to evaluate the effectiveness of extraction and treatment. The final remedy may potentially be modified based on the results of this study. Treated water will be discharged on-site. Residual waste that contains strontium-90 will be disposed off-site.

If, after source control is complete and effective, monitoring indicates that continued operation of the components of the selected remedy is not producing further reductions in the concentrations of contaminants in ground water, in accordance with the National Contingency Plan, DOE, NYSDEC, and EPA will evaluate whether discontinuance of the remedy is warranted. The criteria for discontinuation will include complete and effective source control, an evaluation of the operating conditions and parameters as well as a determination that the remedy has attained the feasible limit of contaminant reduction and that further reductions would be impractical.

Tritium Remedy

A pump and recharge system, which includes three pumping wells located on-site along Princeton Avenue, was installed in May 1997 to extract the tritium contaminated groundwater and discharge it further north to a recharge basin on-site. Pumping at the leading edge of the plume was taken as a precautionary measure to inhibit contaminated groundwater from advancing towards the site's boundary and allow more time for the tritium to decay. A carbon filtration unit is included in the pump and recharge system to remove VOCs that are also present in the groundwater.

The selected remedy is a modification of alternative T4, as originally proposed in the PRAP. The remedy will combine extraction of groundwater in response to specific contingencies and extensive monitoring and reporting to assure that the cleanup objectives are met. Three specific contingencies were identified in the PRAP, and a fourth has been added in this ROD to address regulatory concerns. Other actions will be evaluated and implemented, as necessary, to ensure that the cleanup objectives are met. Additional monitoring wells will supplement the existing groundwater monitoring network downgradient of the High Flux Beam Reactor's (HFBR) spent fuel pool.

The first and second contingencies were developed to ensure that the tritium plume would migrate no further downgradient above drinking water standards. After an evaluation period established during design of the selected remedy, the tritium pump and recharge system on Princeton Avenue will be put on stand-by and later operated as needed as an integral component of these contingencies. The evaluation period will extend up to a maximum of one year after ROD finalization and will include an analysis of the data against the following two contingency criteria. These two specific contingencies identified are 1) to evaluate the need to reactivate the Princeton Avenue IRA if tritium concentrations exceed 25,000pCi/l at the Chilled Water Plant Road, and/or 2) reactivate the Princeton Avenue IRA if tritium concentrations exceed 20,000 pCi/l at Weaver Drive.

A third contingency was developed to ensure that if the most concentrated part of the plume were to act as a source of continuing contamination, active remediation would remove this problem. This contingency proposed a low flow extraction system to be installed in the most concentrated area of tritium contamination near the HFBR and activated if concentrations exceed 2,000,000 pCi/l at the front of the reactor. This system then would be used to remove groundwater containing the highest concentrations of tritium from the aquifer. The extracted tritium contaminated water will be disposed of offsite. Technologies to reduce the volume of water that requires off-site disposal may be identified during design. Since the PRAP was issued to the public, groundwater near the HFBR has exceeded 2,000,000 pCi/l. DOE is currently in the process of constructing some of the wells for this low flow extraction system on Cornell Avenue and developing plans to extract the most concentrated part of the plume in front of the HFBR. The detailed operational parameters for this system will be developed during design.

In addition to the ones originally identified in Alternative T4 and proposed in the PRAP, a fourth contingency, an additional low flow extraction system will be installed and operated near Temple Place. This additional system was added in response to regulatory concerns about potential plume migration. The exact location, operational parameters and treatment and disposal options for the extracted water will be developed during design. Operation of the Temple Place extraction system will continue for up to one year. As these extraction wells operate, extensive monitoring will occur to evaluate the effect of extraction locally, as well as on the entire plume. Because of the inherent uncertainties of predicating plume behavior based on groundwater modeling, the actual monitoring data will be evaluated and used to help determine whether continued operation of this extraction system is needed to achieve the cleanup objectives. The criteria to continue system operation beyond one year will be developed during design and based on the attainment of the cleanup objectives.

Source Areas

Thirteen AOCs assigned to OU III were investigated as suspected source areas of groundwater contamination. Also, as the work for OU III was proceeding, groundwater contamination from other OUs and Additional Areas of Investigation (AAIs) was included in the investigation and assessment. Table 1 describes these AOCs and AAIs. Table 2 outlines the actions required for these suspected source areas. Many of the suspected source areas had completed and/or ongoing removal actions, and no further action is required. Table 3 outlines source removal actions to date. This remedy requires a source removal system using in-well air stripping near Building 96; completion of the Building 830 Underground Storage Tank Removal Action; remediation of the groundwater near the Carbon Tetrachloride Tank Spill Area; and management of other suspected source areas as shown in Table 2.

Other Remedy Components

All of the groundwater plumes will require monitoring of new and existing wells and institutional control of the groundwater until completion of remediation. These wells will be located adjacent to the treatment systems and along the downgradient plumes. They will help determine the effectiveness of each treatment system in reducing the concentrations of contaminants over time. Long-term monitoring will also determine the ultimate duration for operation of the treatment systems and will support future decisions to make any changes to the final remedy. At the request of the homeowner, DOE can arrange for monitoring of private wells used for drinking water on properties that previously have declined DOE's offer of public water hookups.

10. STATUTORY DETERMINATIONS

Remedy selection is based on CERCLA, and its amendments, and the regulations contained in the National Contingency Plan. All remedies must meet the threshold criteria; protection of human health and the environment, and compliance with ARARs. CERCLA also requires that the remedy use permanent solutions and alternative treatment technologies to the maximum extent practicable and that the implemented action must be cost effective. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

10.1 Protection of Human Health and the Environment

TVOCs in groundwater: Alternative V10c protects human health and the environment because it minimizes potential exposure pathways, offers a large reduction in contaminant toxicity, mobility, and volume, and meets ARARs in the Upper Glacial Aquifer in 30 years.

Strontium in Groundwater: Alternative S5a will remove Sr-90 from the aquifer and will prevent migration of the contaminated groundwater and restore the aquifer within 30 years. This alternative is protective of human health and the environment as the aquifer is restored to the Sr-90 MCL within 30 years. No receptors will be impacted during treatment.

Tritium in Groundwater: Alternative T4, which has been modified from what was originally proposed in the PRAP, will protect human health and the environment because the contaminant plume naturally attenuates to below chemical-specific ARARs within a reasonable period of time (20-25 years). No potential receptors are identified within the path of the plume for the duration of the time required for the plume to naturally attenuate to MCLs. Discharge of tritium at the off-site disposal facility will result in a short-term temporary increase in exposure to tritium at and near the facility. This increase will not present a significant human health risk.

10.2 Compliance with ARARs

The National Contingency Plan Section 300.430 (P) (5) (ii) (B) requires that the selected remedy attain the federal and state ARARs or obtains a waiver of an ARAR.

Chemical-Specific ARARs

TVOCs in groundwater: Alternative V10c will meet ARARs for the Glacial Aquifer within 30 years. Discharges to water or air will comply with chemical-specific ARARs through engineering controls and monitoring.

Strontium in Groundwater: Alternative S5a will comply with chemical-specific ARARs within 30 years at all locations impacted by Sr-90. Discharges to water or air will comply with chemical-specific ARARs through engineering controls and monitoring.

Tritium in Groundwater: Alternative T4, which has been modified from what was originally proposed in the PRAP, will comply with the chemical-specific ARARs since Federal MCL and the New York State groundwater standard will not be exceeded after 20-25 years. The tritium will, through natural decay, dispersion and dilution reach the MCL within 20-25 years. If necessary, groundwater extraction and re-circulation or hot spot removal will be use to augument the natural attenuation process. Discharge of tritium at the off-site facility will be in accordance with the air permit for that facility.

Location-Specific ARARs

No location-specific ARARs were identified for the proposed alternatives.

Action-Specific ARARs

Remedies requiring discharge of water or air will comply with chemical-specific and action-specific ARARs at the discharge point through engineering controls, monitoring and acquisition of appropriate permits.

To Be Considered Guidance

No to be considered guidance was identified for the selected remedies.

10.3 Cost Effectiveness

Based on the expected performance standards, the selected remedies have been determined to be cost effective because they provide overall protection of human health and the environment, long- and short-term effectiveness, and compliance with ARARs, at an acceptable cost. Table 20 provides a comparison of costs for all alternatives evaluated for strontium contaminated groundwater, tritium contaminated groundwater, and TVOC contaminated groundwater.

10.4 Use of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The National Contingency Plan prefers a permanent solution whenever possible. The recommended selected remedy is a final action that utilize permanent solutions to the maximum extent practicable.

10.5 Five-Year Review

Five-years review will be conducted until cleanup goals are met throughout the aquifer and to determine the effectiveness of the groundwater surveillance programs.

III. RESPONSIVENESS SUMMARY

INTRODUCTION

The Responsiveness Summary Section of the Record of Decision (ROD) summarizes public comments and concerns on the Feasibility Study Report (FS) and the Proposed Remedial Action Plan (PRAP) for Operable Unit III, and the Department of Energy 's (DOE) responses to them.

The Responsiveness summary serves two functions:

1. It provides decision-makers with information about the views of the community on the proposed remedial actions and any alternatives; and

2. It documents how public comments were considered during the decision-making process, and provides answers to the major comments.

The public comment period for the review of the OU III FS report and the Proposed Remedial Action Plan began on March 1, 1999 and was extended through April 30, 1999. A public meeting was held on March 24, 1999 in Berkner Hall at Brookhaven National Laboratory. This document summarizes the written and oral comments on the preferred remedial alternatives and the OU III RI/FS, the DOE's responses, and the changes made to the proposed remedial action.

Approximately 75 people attended the public meeting. At the public meeting DOE and BNL distributed copies of the PRAP and other related information. Copies of the FS and PRAP were available at the following Administrative Record Repositories for public review during the comment period:

1. U.S. Environmental Protection Agency – Region II Library, Administrative Records Room, New York, NY
2. Longwood Public Library, Middle Island, NY
3. Research Library, Brookhaven National Laboratory, Upton, NY.
4. Mastics-Moriches-Shirley Community Library, Shirley, NY.

The preferred remedial alternative was modified as follows based on the concerns and input of regulators and the public:

- The selected remedy for volatile organic carbon (VOC) contamination in groundwater in OU III (V10c) is not the one proposed in the PRAP. The proposed remedy (V10b) did not include the treatment systems to be located in the western low-level VOC plume. The additional system was added in response to the concerns of the community and regulators about potential impacts to the Carmans River.

- The selected remedy for tritium contamination in groundwater (T4) is a modification of alternative T4, as originally proposed in the PRAP. The selected remedy is more specific about when the existing pump-and-recharge system would be put on stand-by.

The selected remedy keeps the pump-and-treat system running for up to a maximum of one year after the ROD is signed. Also, three specific contingencies were identified in the PRAP, and a fourth has been added in this ROD to address regulatory concerns. This fourth Contingency, and additional low flow extraction system, will be installed and operated near Temple Place.

- Community and regulator concerns were raised on the adequacy of the proposed remedy for the Magothy aquifer. As a result of continued input, the proposed remedy for the Magothy aquifer that was contained in the FS/PRAP has been removed from the ROD. Additional characterization and installation of groundwater monitoring wells are planned. After the additional characterization of the Magothy aquifer has been completed the need for a remedy for the Magothy will be evaluated by DOE, EPA, and the NYS DEC. If a remedy for the Magothy aquifer is necessary, either this Record of Decision will be modified or another decision document will establish the selected action.

- The proposed remedy in the FS/PRAP for Building 96 was air sparging/soil vapor extraction (AS/SVE). Based upon additional technical evaluation, re-circulation wells with air stripping treatment was selected as the preferred remedy for the VOC groundwater contamination for Building 96.

The Responsiveness Summary is divided into the following sections:

1. RESPONSIVENESS SUMMARY OVERVIEW: This section briefly describes the site background and DOE's selected alternatives.

2. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS: This section gives the history of community concerns and describes the community's involvement in selecting a remedy for the OU III groundwater.

3. COMPREHENSIVE SUMMARY OF MAJOR QUESTIONS, COMMENTS, AND CONCERNS AND DOE RESPONSES: This section summarizes the written comments DOE received during the public comment and the oral comments received during the public-meeting period and DOE's responses. A transcript of the public meeting is in the Administrative Record. General questions and issues and specific written technical questions are treated separately.

4. COMMUNITY RELATIONS ACTIVITIES: This section summarizes community relations activities for Operable Unit III.

1. RESPONSIVENESS SUMMARY OVERVIEW

Site History

Brookhaven National Laboratory (BNL) is a multidisciplinary scientific research center owned by the DOE and operated by Brookhaven Science Associates (BSA). BNL conducts basic and applied research in the fields of high-energy nuclear and solid-state physics, fundamental material and structural properties and the interactions of matter, nuclear medicine, biomedical- and environmental-sciences, and selected energy technologies.

BNL is located about 60 miles east of New York City, in Upton, Suffolk County, New York, near the geographic center of Long Island. The BNL site, formerly Camp Upton, was occupied by the U.S. Army during World Wars I and II. The site was transferred to the Atomic Energy Commission in 1947, to the Energy Research and Development Administration in 1975, and to the DOE in 1977.

The BNL property is an irregular polygon of 5,321 acres that is roughly square, each side of which is approximately 2.5 miles long. The terrain is gently rolling, with elevations varying between 40- to 120-feet above sea level. The land lies on the western rim of the shallow Peconic River watershed, with a tributary of the river rising in marshy areas in the northern section of the tract.

The aquifer beneath BNL is comprised of three water bearing units: the moraine and outwash deposits (known as the Upper Glacial Aquifer), the Magothy Aquifer, and the Lloyd Sand Member of the Raritan Formation. These units are hydraulically connected and make up a single zone of saturation with varying physical properties from a depth of approximately 45 feet to 1,500 feet below the land surface. These three water-bearing units are designated as a "sole-source" aquifer by the U.S. Environmental Protection Agency (EPA) and serve as the primary drinking water source for Nassau and Suffolk Counties.

As a result of historical operations at the site, BNL was placed on the EPA National Priorities List in December, 1989. In May, 1992, DOE entered into an Interagency Agreement (IAG) for the BNL site with the EPA and New York State Department of Environmental Conservation (NYSDEC) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The IAG established the framework and schedule for characterizing, assessing, and remediating the site in accordance with CERCLA.

BNL has 29 Areas of Concern (AOCs). To ensure their effective management, these areas were grouped into six distinct Operable Units (OU). The OUs are areas for which independent removal or remedial actions may be performed as part of the overall site remediation.

Operable Unit III

OU III is bounded by the northern, southern, and western property boundaries of BNL and encompasses approximately 50 percent of the Laboratory's total area. OU III was developed to address groundwater contamination in the central and southern portion of the site and in the off-site areas where groundwater contamination has migrated. Thirteen AOCs assigned to OU III were investigated as suspected source areas of groundwater contamination. Also, as the work for OU III was proceeding, groundwater contamination from other OUs and Additional Areas of Investigation (AAIs) was included in the investigation and assessment.

These AOCs and AAIs were investigated in the Remedial Investigation/Risk Assessment (RI/RA) for OU III. Based on the findings of this RI/RA, DOE, BNL, EPA, and NYSDEC determined that the groundwater is the only environmental medium in OU III that requires an action to protect human health. The contamination in the groundwater that requires remedial action includes volatile organic compounds (VOCs) in on-and off-site groundwater, and strontium-90 and tritium in on-site groundwater.

Selected Remedial Alternatives for OU III

Groundwater contamination issues at BNL include volatile organic compounds (VOCs) in on- and off-site groundwater, and strontium-90 and tritium in on-site groundwater. Several alternatives were evaluated for each of the contaminated groundwater plumes.

The remedy ultimately selected by DOE and approved by EPA and NYSDEC will be implemented in a timely manner. The approved remediation facilities are expected to be installed within two to five years after the final remedy is selected.

The design, off-site land access, and construction are the primary tasks that will need to be completed for installing the groundwater treatment systems. Their installation will be prioritized to address the highest VOC concentrations and those portions of the plume with the greatest potential to impact receptors.

The following selected remedy for tritium, strontium-90 and VOCs in groundwater is a combination of groundwater treatment and monitoring and that restores to maximum contaminant levels (MCLs) the portion of Long Island's sole source aquifer contaminated by BNL in a timely manner.

<u>Volatile Organic Compounds (VOCs)</u>

Several accelerated actions already have begun to address VOC contamination and are part of the selected remedy:

- A groundwater treatment system began operating in June 1997 through which VOC-contaminated groundwater is extracted at the south boundary of BNL and treated by air-stripping. The goal of the system is to prevent additional off-site migration of the most contaminated part of the plume.

- Another groundwater treatment system began operating in September 1999 along the southern side of the Industrial Complex south of the Laboratory. This system will prevent further migration of the highest concentrations of the deep VOC plume using in-well air-stripping.

- Public water was provided to people in an area south of BNL, and will protect public health while the groundwater cleanup is under way.

- Carbon Tetrachloride Tank Removal Action. Tank was removed and a removal action is underway to pump-and-treat carbon tetrachloride in groundwater in the immediate vicinity of the former tank. Additional treatment using carbon is scheduled to start in the summer of 1999.

- Two underground storage tanks and contaminated soils, potential sources of groundwater contamination, have been removed from the Building 830 yard.

In addition to these activities, the selected remedy, Alternative V10c, includes a groundwater-treatment system on-site at Middle Road to prevent migration and further contamination of the deeper Magothy Aquifer, and to reduce the duration of remediation in the Upper Glacial Aquifer. Also included is a source removal system using re-circulation wells with air stripping treatment near Building 96. Finally, additional off-site groundwater treatment systems are planned to capture and treat VOCs; they will be located at the LIPA right-of-way, North Street, the Brookhaven Airport, downgradient of North Street East, the eastern portion of the Industrial Park and in the western OU III low-level VOC plume. The specific number of treatment systems and the locations needed to meet the performance objective will be determined during the design process.

At present, limited characterization has been performed in the Magothy, so additional characterization and installation of groundwater monitoring wells are planned. This work will be done during the design of the remedy, and will be included in the site records. When this characterization and monitoring is completed, the need for a remedy for the Magothy Aquifer, will be evaluated by DOE, EPA and NYS DEC. If a remedy for the Magothy Aquifer is necessary, either this record of Decision will be modified or another decision document will establish the selected action. In either case, the public wil have and opportunity to review and comment in accordance with CERCLA.

This selected remedy (V10c) is not the one proposed in the PRAP. The proposed remedy (V10b) did not include the treatment system located on-site for the western low-level VOC plume. The additional system was added in response to community and regulator concerns about potential impacts to the Carmans River.

Tritium

A pump and recharge system, which includes three pumping wells located on-site along Princeton Avenue, was installed in May 1997 to extract the tritium contaminated groundwater and discharge it further north to a recharge basin on-site. Pumping at the leading edge of the plume was taken as a precautionary measure to inhibit contaminated groundwater from advancing towards the site's boundary and allow more time for the tritium to decay. A carbon filtration unit also was included in the pump and recharge system to remove VOC's that are also present.

The selected remedy is a modification of alternative T4, as originally proposed in the PRAP. The remedy will combine extraction of groundwater in response to specific contingencies and extensive monitoring and reporting to assure that the cleanup objectives are met. Three specific contingencies were identified in the PRAP, and a fourth has been added in this ROD to address regulatory concerns. Other actions will be evaluated and implemented, as necessary, to ensure that the cleanup objectives are met. Additional monitoring wells will supplement the existing groundwater monitoring network downgradient of the High Flux Beam Reactor's (HFBR) spent fuel pool.

The first and second contingencies were developed to ensure that the tritium plume would migrate no further downgradient above drinking water standards. After an evaluation period established during design of the selected remedy, the tritium pump and recharge system on Princeton Avenue will be put on stand-by and later operated as needed as an integral component of these contingencies. The evaluation period will extend up to a maximum of one year after ROD finalization and will include an analysis of the data against the following two contingency criteria. These two specific contingencies identified are 1) to evaluate the need to reactivate the Princeton Avenue IRA if tritium concentrations exceed 25,000pCi/l at the Chilled Water Plant Road, and/or 2) reactivate the Princeton Avenue IRA if tritium concentrations exceed 20,000 pCi/l at Weaver Drive.

A third contingency was developed to ensure that if the most concentrated part of the plume were to act as a source of continuing contamination, active remediation would remove this problem. This contingency proposed a low flow extraction system to be installed in the most concentrated area of tritium contamination near the HFBR and activated if concentrations exceed 2,000,000 pCi/l at the front of the reactor. This system then would be used to remove groundwater containing the highest concentrations of tritium from the aquifer. The extracted tritium contaminated water will be disposed of offsite. Technologies to reduce the volume of water that requires off-site disposal may be identified during design. Since the PRAP was issued to the public, groundwater near the HFBR has exceeded 2,000,000 pCi/l. DOE is currently in the process of constructing some of the wells for this low flow extraction system on Cornell Avenue and developing plans to extract the most concentrated part of the plume in front of the HFBR. The detailed operational parameters for this system will be developed during design.

In addition to the ones originally identified in Alternative T4 and proposed in the PRAP, a fourth contingency, an additional low flow extraction system will be installed and operated near Temple Place. This additional system was added in response to regulatory concerns about potential plume migration. The exact location, operational parameters and treatment and disposal options for the extracted water will be developed during design. Operation of the Temple Place extraction system will continue for up to one year. As these extraction wells operate, extensive monitoring will occur to evaluate the effect of extraction locally, as well as on the entire plume. Because of the inherent uncertainties of predicating plume behavior based on groundwater modeling, the actual monitoring data will be evaluated and used to help determine whether continued operation of this extraction system is needed to achieve the cleanup objectives. The criteria to continue system operation beyond one year will be developed during design and based on the attainment of the cleanup objectives.

Strontium-90

There are concentrated areas of strontium-90 contamination in the groundwater at three on-site locations; the Chemical Holes area, the Brookhaven Graphic Research Reactor (BGRR) Pile Fan Sump Area, and the Waste Concentration Facility. Strontium-90 is a radioactive element with a half-life of 29.1 years.

The selected remedy, alternative S5a, involves installing extraction wells and using ion exchange to remove the strontium-90 from the extracted water. Residual waste from the treatment process that contains strontium-90 will be disposed of at a licensed facility off-site.

Level of Community Support for the Preferred Alternative

From the comments received during the public-comment period, DOE and BNL believe that the public and local elected officials are in general agreement with the selected remedial alternatives.

Community members had the opportunity early in the process to discuss their concerns directly with the BNL and DOE project managers (BNL, 1998). Some of their input was incorporated into the Feasibility Study. For example, stakeholders requested consideration of an option that would complete VOC cleanup faster (in approximately ten years). This alternative was added to the list of those evaluated in the Feasibility Study. Concern was also expressed about the impact of VOCs on the Carmans River, and additional groundwater modeling was done and a new cleanup alternative developed which included possible treatment systems for the western low-level VOC plume.

During the sixty-day comment period, 28 written comments were received on the OU III documents. The majority of them focused on general concerns, such as the length of time required for cleanup, the length of the comment period, the volume and complexity of material, and the issue of property value. Concern was also voiced about the limited characterization of groundwater in the Magothy Aquifer and the potential for human exposures to VOCs transferred to air in the VOC air stripping and in-well stripping treatment processes. Several commentors wanted more specific information on the location of treatment wells and on the location and frequency of monitoring. There was some concern about using natural attenuation as part of the remedy, and some people felt that more active treatment in a shorter time should be undertaken. Several commentors also requested more detailed information on performance standards for the proposed treatment systems.

The modest number of comments received may reflect the level of outreach that has been undertaken by BNL and DOE. Over 2,300 people are on the ERD mailing list, and they receive the newsletter ***cleanupdate*** along with frequent mailings about specific remediation activities. Invitations to roundtables, information sessions or public meetings are often included in the mailings. BNL employees and retirees (a combined total of nearly 5,000) also receive ***cleanupdate*** and articles in the Brookhaven Bulletin which update them on specific remediation topics. The recently formed Community Advisory Council and the new Community Involvement Plan are avenues for stakeholder groups to have access to BNL and DOE management and to learn about BNL. While the public continues to be concerned about the contamination that BNL caused and is interested in tracking the progress of cleanup, trust appears to be growing that the contamination is being addressed appropriately.

Changes to the Proposed Alternatives

In response to requests by stakeholders, the comment period was extended an additional 30 days. The following modifications were made to the preferred remedial alternative based on regulators' and the public's concerns and input include:

- The selected remedy for VOC contamination in groundwater for OU III (V10c) is not the one proposed by DOE in the PRAP. The proposed remedy (V10b) did not include the treatment system to be located in the western low-level VOC plume. The additional system was added in response to community and regulator concerns about potential impacts to the Carmans River.

- The selected remedy for tritium contamination in groundwater (T4) is a modification of alternative T4, as originally proposed in the PRAP. The selected remedy is more specific about when the existing pump-and-recharge system would be put on stand-by. The selected remedy keeps the pump-and-treat system running for up to a maximum of one year after the ROD is signed. Also, three specific contingencies were identified in the PRAP, and a fourth has been added in this ROD address regulatory concerns. This fourth contingency, an additional low flow extraction system, will be installed and operated near Temple Place.

- Community and regulator concerns were raised on the adequacy of the proposed remedy for the Magothy aquifer. As a result of continued input, the proposed remedy for the Magothy aquifer that was contained in the FS/PRAP has been removed from the ROD. Additional characterization and installation of groundwater monitoring wells are planned. After the additional characterization of the Magothy aquifer has been completed the need for a remedy for the Magothy will be evaluated by DOE, EPA, and the NYS DEC. If a remedy for the Magothy aquifer is necessary, either this Record of Decision will be modified or another decision document will establish the selected action.

- The proposed remedy in the FS/PRAP for Building 96 was air sparging/soil vapor extraction (AS/SVE). Based upon additional technical evaluation, re-circulation wells with air stripping treatment was selected as the preferred remedy for the VOC groundwater contamination for Building 96.

2. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS

Community Profile

BNL is located in Brookhaven Town at the geographic center of Suffolk County, which encompasses the central and eastern part of Long Island. With a population of approximately 430,000, Brookhaven Town accounts for about sixteen percent of Long Island's 2.6 million residents. Suffolk County is operated by a county executive and an 18-member legislature. Brookhaven Town employs a town council (six at-large councilors) and a supervisor. Both governments maintain professional planning, development and environment departments, plus planning boards.

Many villages and hamlets dot Brookhaven Town's 260 square miles, and BNL is surrounded by the unincorporated communities of Yaphank, East Yaphank, Ridge, Middle Island, and Manorville. Most of these villages and hamlets have citizen-run civic- or taxpayer-organizations with large, active memberships. Most organizations join one or both of the area's two umbrella civic groups, Affiliated Brookhaven Civic Organization, and the Longwood Alliance. These same communities support service clubs, which represent the businesses, churches, and other aligned interests within the community.

The town of Riverhead is another Suffolk County town where BNL's activities generate interest. Located to the east of BNL beyond the Town of Brookhaven, it has a population of about 24,500 and an area of about 60 square miles of which 41 percent is farmed. Riverhead employs a supervisor-town council government, which maintains professional planning, development and environment departments, plus a planning board.

History of Community Involvement

Historically, public involvement in BNL's environmental restoration activities was low, but after a Community Relations program was established in 1991, public interest and contact with BNL increased. Two major "events" spiked public interest in the Laboratory restoration activities. First, the free public-water hookups offered to residents directly south of BNL in January, 1996 prompted over 700 people to attend a public meeting. Second, the identification of a leak in the spent-fuel pool of the High Flux Beam Reactor brought significant media attention and stakeholder concern. Interaction with the community has been a major focus of BNL's administration and employees. Surveys of employees and the community have provided a baseline of information on the status of community relations and revealed avenues for improving them: these avenues are being actively pursued.

Laboratory-wide, several new venues for community involvement were established. BNL employees now can join an "Envoy" program and represent BNL in community groups to which they already belong. The BNL Speaker's Bureau was re-instituted and employees are going out into the community and speaking on a wide variety of topics. An independent Community Advisory Council, composed of representatives of established stakeholders' groups on Long Island, BNL employees, and several other individuals, meets monthly to learn about and discuss

Laboratory issues and to offer recommendations to BNL's Director. A new "Community Involvement Plan" was jointly developed by community members, BNL's staff and the Department of Energy in April, 1999. The plan provides a framework for involving the community in decision-making at the Laboratory.

Established venues for exchanging information continue. The Brookhaven Executive Roundtable (BER), established in August 1997, is composed of elected officials (or their representatives), regulators, and the Suffolk County Water Authority. Community members routinely attend the monthly meetings and an opportunity for public comment is available at each meeting. The BER was created to facilitate and expedite the flow of information from BNL to some of its key stakeholders on significant environmental, operational, regulatory, and oversight issues. It has been very successful by providing up-to-date information (background, status, steps forward) and doing so early in the process.

Community-relations activities concerning the Environmental Restoration Division (ERD) have echoed the new emphasis on community involvement at the decision-making level. Ten roundtables and workshops were conducted to solicit input on groundwater remediation and sampling of the Peconic River before the final remedies or plans were selected. To emphasize the importance of environmental issues, BNL's Director scheduled an "Environmental Fair Day" in the fall of 1998 which 3,600 community members attended, including many families with children. Volunteers from ERD sponsored a "photo opportunity" for children (and adults) to have their photo taken on a huge drill rig, staffed a display about each of the Operable Units, and led tours of remediation sites.

The goals of the community relations program have been, and are, the following:

- To inform stakeholders (on-site employees and the public) about the issues being addressed by the Environmental Restoration Division.
- To solicit input from stakeholders about these issues.
- To provide stakeholder input to DOE/BNL senior management and regulators to be used as one of the decision-making criteria for evaluating cleanup alternatives.
- To develop good relationships with on-site employees, community members and leaders, and community environmental activists.
- To increase regular communication with stakeholders by expanding the ERD stakeholder mailing list.

A Community Relations Plan was finalized for the BNL CERCLA activities in September 1991. In accordance with this plan and CERCLA Section 113 (k) (2)(B)(I-v) and 117, the community relations program focused on public information and involvement. A variety of activities were used to provide information and to seek public participation, including the following:

- The compilation of a stakeholder mailing list.
- The issuance of the quarterly newsletter ***cleanupdate.***
- Meetings with stakeholders in the form of roundtables, workshops, public meetings, or

individual contacts.

- Maintenance of the ERD home page on the Internet.
- Attendance at, and updates provided, to civic organization monthly meetings.
- Mailings of fact sheets about specific projects.
- Establishment of an Administrative Record, documenting the basis for selecting removal and remedial actions at the BNL site, which is maintained at the local libraries listed below. The libraries also maintain site reports, press releases, and fact sheets.

Longwood Public Library
800 Middle Country Road
Middle Island, NY 11953

Mastic-Moriches-Shirley Library
301 William Floyd Parkway
Shirley, NY 11967

Brookhaven National Laboratory
Research Library
Bldg. 477A
Upton, NY 11973

The Administrative Record also is maintained at the EPA's Region II Administrative Records Room at 290 Broadway, New York, New York 10001-1866.

Summary of Community Participation Activities

There were five major areas of community-relations activities for OU III:

- The Removal Action V / Operable Unit I Groundwater Removal Action and Operable Units I and III Public-Water Hookups
- The HFBR Tritium Remediation Project
- The OU III Off-site Removal Action
- Early Community Input on OU III Cleanup Alternatives
- OU III Remedial Investigation/Risk Assessment Report, Feasibility Study, and Proposed Plan

Section 4 gives a chronology of the major community-relations activities for each of the above areas. A Community Relations Plan was developed for Operable Unit III and for the OU III Off-site Groundwater Removal Action.

Removal Action V / Operable Unit I Groundwater Removal Action and Operable Units I and III Public-Water Hookups

A public notice was published for review of and comment on the "Engineering Evaluation/Cost

Analysis" (EE/CA). The 30-day public comment period for this document began on January 2, 1996 and, as a result of requests from the community, was extended twice, ending on March 18, 1996. The January 16, 1996 public meeting also was announced in the public notice. Summary sheets were sent to the people on the stakeholder mailing list.

A public meeting was held on January 16, 1996 at BNL to discuss the findings of the OU I EE/CA; approximately 700 people attended. A press release was issued titled "U.S. Department of Energy Offers Public Water Hookups to Residences Just South of Brookhaven Lab".

An announcement of the extension of the public comment period was sent to the mailing list. A presentation to the Community Work Group about the public-water hookups and a briefing on the "Groundwater EE/CA" was held at BNL. An on-site briefing on the proposed groundwater treatment plant was given to the staff of the National Weather Service.

A Suffolk County legislator hosted a meeting to brief elected officials on the public-water hookup project and BNL groundwater contamination. Two question-and-answer sessions (February 5 and 6, 1996) were offered to BNL employees on issues regarding Operable Unit I groundwater. Also, four fact sheets on this project were distributed, as well as articles in six editions of the Brookhaven Bulletin (between February and March 1996). Several letters were received from the community and responded to by DOE.

HFBR Tritium Remediation Project

On January 18, 1997, the U.S. Department of Energy (DOE) and Brookhaven National Laboratory (BNL) announced that routine monitoring had identified tritium concentrations exceeding the drinking water standard in groundwater at the center of the Laboratory site, just south of BNL's High Flux Beam Reactor. This announcement, in combination with previously discovered groundwater contamination by volatile organic chemicals, led to a lack of public confidence in the Laboratory's commitment to public health and safety and the protection of the environment.

In response to this public concern, DOE and BNL actively sought and received feedback from stakeholders, and responded to the media to ensure that accurate information was disseminated in a timely and consistent manner. The following community outreach activities took place.

January - June 1997: To understand the community's concerns and to keep people informed, Community Relations representatives and subject-matter experts attended meetings of civic associations that surround BNL. Approximately 50 presentations and updates on tritium were given from January through June. In addition, presentations were given to numerous elected officials, regulators, environmental committees, Rotary clubs and chamber-of-commerce groups.

The community-at-large received two mailings that included a briefing page and a letter, and a question and answer fact sheet about tritium and letter. Five information / poster sessions were held in the surrounding area, including one at BNL for employees. These provided stakeholders the opportunity to interact one-on-one with BNL management and subject matter experts so that

BNL would be aware of the concerns of the community and could answer questions. All information sessions were advertised in local newspapers and in businesses, and announcement posters were sent to all Suffolk County libraries. Community Relations personnel visited local businesses to respond to their concerns.

Two input sessions were held to gather feedback from community leaders on the tritium remediation proposal, and briefings were conducted with regulators for input on the final discussion and approval of pump-and-recharge and public communication and involvement.

August - November 1997: A community involvement plan, "Deciding the Future of HFBR--Outreach, Involvement and Independent Verification Plan," was distributed to the community for comments. The plan outlined outreach and involvement activities in which BNL/DOE would participate to keep the community informed and involved in the decision regarding the HFBR.

Four information / poster sessions were held, and four roundtables with civic groups, interested individuals, and special interest groups were conducted to get feedback from stakeholders. Numerous presentations were given to the Brookhaven Executive Roundtable, elected officials, regulators, civics, chambers of commerce, and Rotarians. The High Flux Beam Reactor was opened to the public during Community Day and Family Day, as well as for numerous tours for interested groups and individuals. Over 900 people visited the facility.

Feedback on whether or not to restart the reactor was gathered from throughout the community and included in a "scrapbook" that was forwarded to Secretary of Energy Federico Pena. Once it was decided that an Environmental Impact Statement should be completed on the HFBR, information on this process was included in all outreach activities.

Superfund Activities: When the tritium remediation project was phased into BNL's Superfund activities, an Action Memorandum describing the pump-and-recharge system was issued. This Action Memorandum included a public notice, a newspaper advertisement, fact sheets and a community letter.

Three issues of the Office of Environmental Restoration's newsletter ***cleanupdate*** included information on tritium remediation. Two information / poster sessions (mentioned above) were conducted. In addition, a tritium-remediation poster was included and subject-matter expert attended all subsequent information sessions / poster sessions held on the HFBR, and at the Accelerated Cleanup 2006 poster session in July 1997.

Well over a dozen tours of the monitoring-well areas and remediation system were given to community groups.

Media Relations: Between January and December, 1997, media relations issued approximately 40 press releases on the tritium remediation project. Personnel from Public Affairs and Community Relations informed stakeholders before distributing these releases in order to maintain an open dialogue.

Approximately six press conferences/media availabilities, and approximately 1000 media requests were coordinated and handled. Briefing pages and fact sheets were written. Over 250 calls from concerned citizens were answered.

Internal Communications: Between January and December, 1997, employees were kept up-to-date on tritium remediation activities and related newsworthy developments through articles in the Bulletin, board displays, e-mails, and news briefs via Laboratory mail.

The most concentrated effort to communicate with employees took place between March and April, 1997. During March, representatives of all on-site groups were contacted to prepare for employee information meetings that were then held during April. Twenty-three employee information meetings were held. An HFBR Tritium Information Center was set up as a space for all employees to obtain answers to questions and receive the latest updates on the issues.

OU III Off-site Groundwater Removal Action

A community-relations plan for this removal action was prepared by the community relations staff in the Environmental Restoration Division and submitted to the DOE in March 1998.

Activities for the OU III Off-site Removal Action focused on informing stakeholders (the public and BNL employees) about the proposed construction of a groundwater treatment system in an industrial park south of the Laboratory.

The "Pre-Design Report for OU III Off-Site Removal Action" was entered into the Administrative Record on February 20, 1998. On June 24, 1998, the Final Action Memorandum for Operable Unit III Off-Site Groundwater Removal Action was entered into the Administrative Record.

An article in the January 1998 issue of the newsletter ***cleanupdate*** detailed the proposed cleanup technology. An update on progress of the construction was published in the May 1998 and the December 1998 issues.

The Project Manager for OU III Off-Site Groundwater Removal Action gave a presentation about the removal action to the Brookhaven Executive Roundtable in January, 1998, and elected officials were briefed during March 1998.

A mailing was sent to the people on the stakeholder mailing list and one to the tenants of the industrial park where the system was to be constructed. These mailings invited stakeholders to attend information/poster sessions to learn about the treatment system and included a fact sheet. Advertisements of the poster sessions were placed in local papers, and a BNL press release was issued. Twenty-two homes near the construction area were visited to be certain they knew about the poster sessions and the impending construction. Three poster sessions were held in early April--two in a local school and one at BNL; attendance at the poster sessions was very low.

Early Community Input on OU III Cleanup Alternatives

In the late summer and fall of 1998 BNL sought community input on the cleanup options being considered for groundwater contamination (BNL, 1998). The August 1998 issue of the newsletter ***cleanupdate*** featured an article titled "Lab to seek input from area residents on cleanup options" which detailed these cleanup options. Three approaches for gathering community input were used: roundtables, canvassing, and a workshop.

Four roundtables were held between August 25 and October 7 to which were invited key stakeholders and residents of the area directly south of the Laboratory, BNL employees, businesses, and local environmental groups such as "Trout Unlimited", which has "adopted" the nearby Carmans River. Twenty-four stakeholders in all attended the roundtables. Before the meetings, a fact sheet describing the contamination and the options being considered was mailed to each attendee. At the roundtables, OU III project managers introduced the cleanup options being considered. A question and answer period followed, during which the stakeholders were asked for input.

Canvassing was conducted of those people living south of the Laboratory in the area where groundwater treatment systems could be placed. One hundred and seventy residents were called--152 were reached on the phone. Sixty-nine were willing to provide input in some way--immediately on the phone, by attending a roundtable or the workshop, or by mailing comments back after receiving a fact sheet. Follow-up visits to gather their input were made to the homes of the 48 residents who were sent a fact sheet.

An update was provided to the Brookhaven Executive Roundtable on the Early Input initiative in September, 1998.

A Community Information Workshop was held on October 22, 1998. The workshop was advertised in local newspapers (Suffolk Life and Pennysaver), a flyer was mailed to the stakeholder mailing list and to 1,100 homes located south of the Laboratory. The meeting also was announced at three local civic organization meetings, and listed in the local school district PTA calendar. A presentation on the cleanup options was made by the OU III Project Manager followed by a question and answer period, and technical staff was available to explain posters, which detailed the cleanup options. Twenty-seven members of the public attended. Community input was gathered through comment cards left at the meeting or mailed in, and by recording the questions asked during the session.

An article in the December 1998 issue of the newsletter ***cleanupdate*** detailed both the process and the input gathered.

OU III Remedial Investigation/Risk Assessment Report, Feasibility Study and Proposed Plan

The Operable Unit III Remedial Investigation/Risk Assessment Report, Feasibility Study and Proposed Plan were released for public comment on March 1, 1999. A Public Notice and a display advertisement appeared in Newsday and in Suffolk Life. A mailing was sent to the stakeholder mailing list and to 1,100 homes south of the Laboratory containing a cover letter, fact sheets on the remedial investigation and on the feasibility study, and a complete copy of the Proposed Plan. A DOE press release announcing the beginning of the comment period was distributed to media contacts.

Several avenues were made available to the public and to employees for learning about the documents and commenting on them. The Executive Summary of the Remedial Investigation, the Executive Summary of the Feasibility Study, and the entire Proposed Plan were put on the ERD internet web page, and comments could be entered via e-mail.

The Brookhaven Executive Roundtable had a presentation on OU III tritium groundwater monitoring and project status in January 1999. The Community Advisory Council made OU III the only topic of their April 8, 1999 meeting. Eight civic associations were updated on the OU III meeting schedule, and questions from those attending the meetings were answered. Individual community members were briefed on request.

Elected officials were briefed in a letter in February. BNL and DOE representatives briefed the staffs of Congressman Forbes and Senators Schumer and Moynihan in March. An article about the OU III cleanup plan was printed in the Brookhaven Bulletin on March 5, 1999. The article included details about how employees could obtain a copy of the Proposed Plan and comment on the proposed remedy.

Three information/poster sessions were held: one lunchtime and one evening session at BNL and one evening session at the local high school. Laboratory-wide e-mails were sent out to remind employees of the dates for the poster sessions and the public meeting. Display advertisements, which detailed poster session and public meeting dates and gave the phone number to call for additional information were published in local newspapers.

The public meeting on OU III was held in Berkner Hall at BNL on March 24, 1999. One hundred and twelve people attended the poster sessions and/or the public meeting, including members of the public and BNL employees.

Following a request from several members of the public, the public-comment period was extended by thirty days, through April 30, 1999. An advertisement to this effect was placed in Newsday on March 31, 1999. The announcement was also made on the front page of the mailing about Operable Unit I which was sent to the stakeholder mailing list and to all BNL employees on March 31, 1999.

3. COMPREHENSIVE SUMMARY OF MAJOR QUESTIONS, COMMENTS, AND CONCERNS AND DOE RESPONSES

Overview

Several written questions and comments were received and others were made during the public meetings that did not relate to the proposed cleanup action that is the subject of this Record of

Decision. These comments were addressed by the panel at the public meeting, and are being followed up through community meetings. Only those questions and comments directly related to the OU III proposed remedial action are addressed in this Responsiveness Summary (RS).

Written comments and questions on the preferred remedy, and the OU III RI/FS received during the public-comment period and oral comments made during the public meeting are summarized and addressed below. The format of this RS combines similar questions or comments from different sources for a common response. The written comments are reproduced in Appendix A. A copy of the transcript of the public meeting is available in the Administrative Record.

Summary and Response to Questions and Comments

General Topics

Questions and Comments

1. Cleanup Objectives

1a. It is incumbent on DOE, the Laboratory and the State to do everything possible and reasonable to accelerate the cleanup of contamination. The treatment wells could be installed more rapidly than the plan anticipates.

BNL and DOE would like to implement the remedy faster than the plan indicates (2-5 years). Accordingly, BNL will try to do this, and will begin installing treatment systems in the highest priority areas first.

1b. As groundwater assessments proceed and improved technologies become available, bolder strategies should be considered or adopted.

The remedy will be periodically evaluated, and may be modified if new technologies become available. Should new information become available on the cost-effectiveness of new technologies during the remedial design or remedial action that could affect how the selected remedy is implemented, it may be modified and documented if the change does not constitute a fundamental change in the remedy.

1c. The remedies should meet drinking water standards in groundwater for volatile organic compounds, strontium-90, and tritium in a timely manner.

BNL plans to meet drinking water standards in a timely manner. The following are the cleanup objectives for Operable Unit III:

- Meet drinking water standards in groundwater for VOCs, strontium-90, and tritium.
- Complete the cleanup of the groundwater in a timely manner. For the Upper Glacial Aquifer, this goal is 30 years or less.
- Prevent or Minimize plume growth.

1d. The cleanup goals must seek to achieve the lowest contaminant levels attainable. If groundwater can be cleaned up beyond relevant standards it must be. A cleanup goal other than MCLs, such as the Maximum Contaminant Levels Goals (MCLGs) should be considered.

The cleanup goal is to achieve Maximum Contaminant Levels (MCLs) within 30 years in the Upper Glacial Aquifer. The achievement of MCLs will be confirmed through extensive groundwater monitoring. Once MCLs are met, natural attenuation will continue to reduce contaminant concentrations to levels that are below drinking water standards.

State and Federal Maximum Contaminant Levels (MCLs) were identified as relevant and appropriate to groundwater in OU III. The NYSDEC groundwater standards set forth standards based on the classification of the water body. Groundwater in OU III is classified as Class GA (fresh groundwaters). The Federal maximum contaminant levels (MCLs) in 40 CFR 141 (primary MCLs) and 40 CFR 143 (secondary MCLs) are promulgated standards applicable to public water systems. The stricter of the Federal and State standards were identified as appropriate cleanup goals for OU III groundwater.

1e. The statement that the proposed remedy restores the contaminated aquifer "as a source of drinking water" is misleading, since such areas are unlikely to ever again be used for potable purposes.

The statement was meant to convey that the goal is to restore the aquifer to drinking water standards.

1f. What specific VOCs were found in the Magothy aquifer? What was their concentration and at what depth were they found? Do concentrations in the Magothy exceed drinking water standards?

The VOCs found in the Magothy aquifer above the drinking water standard off-site in the OU III groundwater plume were carbon tetrachloride at 7090 ppb, chloroform at 45 ppb, and trichlorothene (TCE) at 30 ppb. These data are from the 1998 and 1999 sampling of an off-site monitoring well located 275 to 285 feet below land surface within the Magothy Aquifer that was sampled as part of our going groundwater monitoring program. The depth of the monitoring well is 275 to 285 feet below land surface (approximately 187 to 197 feet below mean sea level). The data reported in the OU III Remedial Investigation report which was collected in 1996 showed carbon tetrachloride from the same monitoring well at 970 ppb, chloroform at 15 ppb, and trichloroethene at 19 ppb. These data represent the highest concentrations of VOCs in the Magothy in the OU III groundwater plume. Lower concentrations of other volatile organic compounds have also been detected in the Magothy Aquifer. Additional characterization of the Magothy is planned.

1g. The proposed plan is completely inadequate and unacceptable with respect to protection and remediation of the Magothy Aquifer. Has an analysis of remedial alternatives been done? How long will it take to meet Remedial Action Objectives (RAOs)? A complete delineation of all plumes affecting the Magothy should be determined, including full lateral, vertical and downgradient extent. It is unreasonable to seek informed public opinion in the absence of relevant information.

The Remedial Investigation primarily focused on the Upper Glacial Aquifer because there was known contamination in the Upper Glacial Aquifer, the water moves much faster in the Upper Glacial Aquifer, and there is a higher potential for surface-water impacts and human exposure to contaminants in groundwater. Any potential exposure to the public from contamination in the Upper Glacial Aquifer was significantly reduced by the public water hookups instituted by DOE in 1996-1998. At present, limited characterization has been performed in the Magothy, so additional characterization and installation of groundwater monitoring wells are planned. This work will be done during the design of the remedy, and will be included in the site records. When this characterization and monitoring is completed, the need for a remedy for the Magothy aquifer, will be evaluated by DOE, EPA, and NYS DEC. If a remedy for the Magothy aquifer is necessary, either this record of Decision will be modified or another decision document will establish the selected action. In either case, the public will have an opportunity to review and comment in accordance with CERCLA. The on-site treatment system planned for the Middle road will prevent further migration of contaminants to the Magothy aquifer.

1h. The statement that the industrial groundwater treatment system "...will address further migration of the highest concentrations of the deep VOC plume" ignores the presence of high concentrations (4,180 ppb) of carbon tetrachloride in the upper Magothy south of BNL in well 000-130 at 205 feet below MSL. The extent of this contamination, and the need for remediation, still need to be determined.

The statement in the PRAP refers to the deep VOC plume in the Upper Glacial Aquifer. The proposed alternative will prevent migration and further contamination of the deeper Magothy Aquifer. As discussed in response 1g above, additional characterization of the Magothy aquifer is planned. Based on this new information the need for a remedy for the Magothy aquifer will be evaluated.

1i. Sixty years is far too long a time to wait for cleanup of the Magothy. Either further analysis of potential cleanup strategies for the Magothy layer should be performed or a more complete evaluation of why such strategies have been rejected should be provided. The record should be kept open on the issue of Magothy remediation so that there can be comment by the public.

Because of limited characterization, no remedy or time frame for the Magothy aquifer is being chosen at this time. One of our main objectives for the Magothy is to minimize plume growth through treatment systems located at Building 96 and at Middle Road. The treatment system to be constructed on-site at Middle Road will address an area which has been identified as a major pathway for the Magothy contamination. Additional groundwater monitoring will further evaluate the extent of this contamination. If the results suggest that further actions are required, alternatives for cleanup of the Magothy aquifer will be evaluated, including appropriate time frames.

1j. The Suffolk County Water Authority (SCWA) is concerned about contamination that is present in or may reach the Magothy Aquifer. The SCWA currently operates two shallow Magothy wells at Lambert Avenue, Mastic. We are concerned that these wells may be impacted by groundwater contamination from the BNL site. The SCWA prefers active remediation of Magothy contamination unless it can be demonstrated that the SCWA wells will not be impacted.

A treatment system as part of the proposed remedy will be located on the Middle Road on the Laboratory property. This treatment system will treat the Upper Glacier Aquifer before any contamination can enter the Magothy at this location. The groundwater modeling that was conducted as part of the Feasibility Study modeled the progression of the VOC contamination in the Magothy aquifer for 60 years. The modeling that was performed showed no impact to the SCWA Lambert Avenue supply wells. At present, limited characterization has been performed in the Magothy aquifer, so additional characterization and monitoring well are planned. Upon completion of this characterization and monitoring, the need for a remedy for the Magothy aquifer will be evaluated as discussed above.

1k. Please define what you mean by the time to cleanup.

The time to cleanup is the length of time it takes for the groundwater to meet drinking water standards. It includes the time during which active treatment is carried out, and the time needed for natural attenuation to reduce concentrations to drinking water standards.

1l. Why does it take 30-60 years to clean up the contaminants? The proposal for cleanup of contamination over a 30 year period is unsatisfactory and should be rejected by the EPA, NYSDEC, DOE and local residents. Couldn't it be done more quickly?

The time necessary for cleanup depends on both the concentration of the contaminant, and its mobility in groundwater. For example, strontium-90 is not mobile - it tends to stick to the soil, so extracting it takes longer than extracting VOCs, which are more soluble and mobile in groundwater.

The question of "a quicker cleanup" was raised during the community roundtables last fall. One alternative considered for VOCs was to clean them up in ten years to drinking water standards. This would have required installing approximately 120 treatment systems, which was not a reasonable alternative when all nine EPA decision criteria (which must be considered) were analyzed. The installation of this many treatment wells in the community south of the Laboratory was perceived to be intrusive and disruptive. This view was supported by community comments received during the Early Community Input roundtables held by the Laboratory in the Fall of 1998.

The current technologies available for cleanup make 25-30 years a realistic goal for the Upper Glacial Aquifer. BNL and DOE believe that the proposed alternatives represent the best way to effectively cleanup the groundwater contamination.

1m. The report says that it will take 30 years to complete the cleanup of groundwater. Does that mean the contamination will continue to travel in the groundwater for 30 years? How far will it move? What areas will be monitored during this period?

Even though the groundwater will continue to move at a rate of approximately .75 to 1 foot per day in the Upper Glacial Aquifer not all the groundwater will contain concentrations above the drinking water standards. For example, the majority of cleanup (amount of contaminant mass removed) for VOCs in the Upper Glacial Aquifer will take place in the first 5 to 15 years during the active treatment of the more highly concentrated areas.

The cleanup objective is to meet drinking water standards in groundwater for volatile organic compounds, strontium-90, and tritium. The cleanup objectives for VOCs and strontium-90 will include active treatment for the areas with higher concentrations of contaminants and natural attenuation for areas with lower concentrations that are above the drinking water standards. The groundwater velocity is affected by several parameters, such as geology, gradient, and depth within the aquifer. Even though the groundwater velocity varies from location to location, a useful range for the Upper Glacial Aquifer is about .75 to 1 foot per day.

Many areas will be monitored during the 30 year cleanup period for the Glacial Aquifer, including on-site and off-site locations. The exact location of the monitoring wells will be determined during the design phase.

1n. The Proposed Plan fails to include an analysis of the alternative to install approximately 100 sparging wells that would result in cleanup within 5 years. The residents of the community have the right to have a complete range of alternatives presented to them.

This alternative was included in the initial list developed for remediating VOCs in groundwater. The alternative was screened out early in the Feasibility Study, primarily because community input suggested that this number of wells in a residential area would be intrusive and unacceptable. This decision is documented in the Feasibility Study. The PRAP documents only those alternatives that received a full, detailed evaluation.

1o. Why haven't you done something to cleanup the groundwater yet?

Several actions were taken to remove sources of groundwater contamination. These included removing cesspools and cesspool contents, excavating contaminated soil and piping, removing underground storage tanks, replacing leaking sewer pies, and capping landfills.

In addition, the following seven interim removal actions have been, or are being, undertaken to immediately reduce the concentrations of, migration of and exposure to groundwater contaminants.

1. On-site OU III Southern Boundary Groundwater Interim Removal Action
2. Off-site OU III Industrial Complex Groundwater Interim Removal Action
3. Off-site Public Water Hookup Interim Removal Action
4. Tritium Groundwater Interim Removal Action
5. Building 830 Underground Storage Tanks Removal Action
6. On-site Removal Action V Southern Boundary Groundwater Interim Removal Action
7. Carbon Tetrachloride On-site Groundwater Interim Removal Action

1p. CERCLA includes a strong preference for using treatment as a principal element of any remediation plan. Natural attenuation is not a treatment and therefore should not be utilized as a guiding principle. The proposed plan distinguishes between no action and natural attenuation by including monitoring of the plumes in the natural attenuation alternative. It is misleading to separate these two alternatives; they should be listed as one. The plan relies all too heavily on natural attenuation and not enough on active, aggressive groundwater cleanup. We do not support those aspects of the plan that rely on natural attenuation. It is worth noting that some VOCs degrade into chemicals that are more *potent carcinogens than the original contaminant.*

DOE separated the "No Action" and "Natural Attenuation with Monitoring" alternatives because CERCLA requires that all evaluated alternatives be compared to a true "No Action" alternative. No action would include the natural attenuation that will take place, but does not include any monitoring.

Natural attenuation is one component of the selected remedy. However, we do agree that it cannot really be considered a "treatment".

Active treatment of the groundwater is part of the selected remedy where it will work. The selected remedy includes treatment by in-well stripping at locations where the concentrations of VOCs in the groundwater are high. In-well stripping or other active treatment technologies cannot efficiently reduce concentrations of VOCs in the aquifer to MCLs. This is the reason that the selected remedy also includes natural attenuation to reduce the concentrations to MCLs after active treatment is no longer effective, and provision of public water to ensure that there is no exposure to people living in the path of the plume.

Vinyl chloride is the degradation product of VOCs that is of most concern in terms of potential risks to human health. It results from the biological degradation of VOCs. BNL has seen no evidence of vinyl chloride in the area impacted by the Laboratory. It is also important to note that no exposure to contaminants nor to their by-products is likely to occur because of the public-water hookups in the area.

1q. The plan's use of the term "cleanup objectives" on page 2 is misleading, since attainment of these objectives relies heavily on natural attenuation for areas not subject to direct cleanup. A better term, which is used in Sections II and VIII, and elsewhere in the text, is "remedial action objective".

BNL and DOE use both terms to mean specific goals to protect human health and the environment. These objectives are based on available standards, such as applicable or relevant and appropriate requirements (ARARs), and risk-based levels established in the risk assessment. These "remedial action objectives" or "cleanup objectives" are independent of the means used to achieve them, which may include active remedies or a reliance on natural attenuation.

1r. BNL and BSA need to have a community forum focused on Superfund education emphasizing natural attenuation as a method of remediation.

As the Superfund process progresses at BNL, the need for continuing community outreach will be evaluated. Information about the cleanup and technologies to remediate groundwater will continue to be presented to the public through mailings, the newsletter ***cleanupdate***, workshops, and information sessions.

1s. Information on the success ratios of the various cleanup processes might be helpful.

Air stripping is a reliable and efficient method of treating contaminated groundwater. Pump-and-treat methods also are reliable ways to remove compounds that partition to the aqueous phase. The OU III Feasibility Study reviewed remedial technologies and outlined the pros and cons of each. Pump-and-treat technologies that are being used to remediate the groundwater contamination along the Laboratory's southern boundary have been shown to be highly effective in removing large amounts of contaminant mass from contaminated groundwater. This information was used to select the preferred alternatives for treating VOCs, tritium and strontium-90 in groundwater.

2. Public Outreach and the Proposed Plan

2a. The 30-day period provided for public comments is insufficient to allow a full review of the massive documentation.

The public comment period was extended by an additional 30 days.

2b. The material is extremely complicated and hard to follow. A better description is needed of the technical terms and abbreviations.

The characterization and remediation of groundwater contamination in Operable Unit III is a complex task. BNL tried to make the material accessible and understandable to the public. Many of the technical terms used in the RI and FS documents are explained in more detail in the PRAP.

2c. The Libraries that hold the Administrative Record are not convenient for me and are not set up for serious research. Why aren't the documents available in the Library at the State University of New York at Stony Brook? Why wouldn't you send me my own copy? You are adhering only the letter of the law here but is seems that you don't really want a serious public review of the document.

The Administrative Record is available in three local libraries: Mastic-Shirley, Longwood, and the Research Library at BNL. Material can be made available at other libraries if the request is made early in the review process. BNL would like to send copies of the documents to everyone who has an interest – but this is not practical considering the amount of material and the costs of copying and distributing it.

2d. The documents are poorly organized and it is hard to find referenced tables and figures.

The OU III Remedial Investigation/Risk Assessment and Feasibility Studies are long, complicated documents. We tried to organize the material in a way that will facilitate the public's review and analysis of them. Specific suggestions for organizing and presenting future documents would be appreciated.

2e. It would help to have a timetable figure for the actions planned for Operable Unit III.

Under the Inter-Agency Agreement, BNL is required to begin construction of the remedy within 15 months after the ROD is signed. After the ROD is approved, BNL will develop a Remedial Design Workplan outlining the timetables for designing the remedy, and a Remedial Action Workplan that will give timetables for implementing it. In general, the plan is to identify areas of highest priority and to address these first, with all treatment systems installed within 3-5 years.

2f. The proposed plan does not have enough detail and should be revised. Another table is needed that lists the work completed and remaining in each AOC and AAI, and to show the results of samples taken after cleanup was completed. The proposed plan should show contours above and below the drinking water standards both on and off-site as well as illustrated estimates of the impact of the various remedial alternatives on the groundwater contamination over time.

The Proposed Plan cannot contain the details of the Remedial Investigation, Risk Assessment and Feasibility Study performed for Operable Unit III. These extensive documents are available for review in the Libraries that hold the Administrative Record. The PRAP was developed to summarize the results of these reports, and present to the community, and to our regulators, DOE's proposed plan for remediating groundwater contamination in OU III. The PRAP is final and cannot be revised. However, the ROD will contain a table that lists the work completed and remaining in each AOC and AAI.

2g. I no longer trust the Laboratory. There should be more public meetings, more public notices, and more information in the news.

Significant efforts have been made during the past year to increase communication with the local communities and provide information on BNL's environmental restoration program. Both DOE and BNL have tried to improve communications with the community and have formally adopted policies of openness over the past few years. Brookhaven National Laboratory's mailing list has been greatly expanded and information and notices of important events are routinely distributed to keep the community up-to-date. Most reports and documents generated by BNL's environmental restoration program are made available for public review, and strong efforts are underway to make this information both understandable and easily available to the public. Publication of the BNL newsletter ***cleanupdate*** began in 1996, with a distribution of more than 5000 copies to BNL employees, local residents, the general public, and public officials. BNL's community-relations staff regularly attend local civic association meetings to hear community concerns. Informal roundtables have been held in the community, where local residents can question DOE's and BNL's staff in a friendlier environment; more are planned.

2h. The staffs at BNL and DOE are the experts. Why are you asking for our opinion?

DOE believes that the proposed alternatives represent the best way to remediate contaminated groundwater in OU III. The CERCLA law requires that public input be considered in choosing an alternative. Community acceptance is one of the criteria used in selecting cleanup alternatives. Your input is important in selecting remedial alternatives for OU III. Because of the importance of the remedy and the implications for groundwater quality off-site, DOE would have sought public involvement even if CERCLA did not require this step.

3. Human and Ecological Risk from Contaminants in Air and Groundwater

3a. Why hasn't my water been tested? There should be more testing of our drinking water.

Drinking-water wells south and east of BNL have been extensively tested, both by BNL and by the Suffolk County Department of Health Services. If you want to have your water tested, call the Suffolk County Department of Health Services. Plumes from BNL will not affect homes located north of the Laboratory because the groundwater and any contamination in the groundwater moves from north to south. For people still using private wells in the area south of the laboratory that was connected to public water, BNL will arrange for monitoring at the request of the homeowner.

3b. BNL should provide public-water hookups or bottled water.

BNL provided public-water hookups in the areas south of the Laboratory that may have been affected by groundwater contamination from BNL.

3c. Will BNL extend public water to future residents downgradient of BNL ?

BNL will not provide hookups to new developments downgradient of the site. Suffolk County Code requires that new developments with access to water mains be connected to public water. At the request of the homeowner, DOE may provide hookups to new residents in existing homes in the area that already was offered public-water hookups.

3d. Who is responsible for helping to get public water?

Public water in the area near BNL is provided by the Suffolk County Water Authority (SCWA). DOE paid for hookups to public water in the area south and east of the Laboratory that may be affected by groundwater contamination from BNL. The public water hookups were offered as a precautionary and preventative action to try and eliminate potential future exposures through use of private wells.

3e. How do I know the publicly supplied water is safe?

Public water is supplied by the SCWA. This water is tested regularly for a large number of contaminants. The SCWA monitors its wells for organic contaminants on a quarterly basis. The SCWA also monitors for radionuclides, and the frequency of monitoring was increased for wells in the vicinity of BNL to twice per year.

3f. Why should I have to pay for public water? If BNL hadn't contaminated the groundwater, I could have continued to use my private well.

The NYS Department of Health has recommended that homeowners in the area south of the Laboratory connect to the public water supply. This will prevent future exposures to contamination associated from BNL, as well as other contamination from private cesspools and industrial sources. Costs of maintaining a private well and paying for public water are comparable.

3g. The human health risk assessment found that the presence of VOCs in groundwater could present a public health concern to residents south of the Laboratory who have declined publicly supplied water. BNL should immediately supply those homes with on-site water-purification systems and then maintain them.

BNL offered a hookup to public water to residents who may be affected by VOC contamination from BNL. The characterization of the plumes of VOCs coming from the BNL property indicates that they are deeper in the Upper Glacial Aquifer than the depth of the typical private well. The public water hookups were offered to ensure that no exposure would occur in the future. BNL will not provide water purification systems. Residents concerned about the quality of their drinking water should be hooked up to the public water supply system. Residents who maintain a private well should have their drinking water tested periodically.

DOE and BNL also are concerned about homeowners who did not know about the offer to hookup their homes to public water, and new homeowners moving into the area. DOE will consider expanding its hookup program to include these people.

3h. The vertical depth of contamination in the plumes containing VOCs, tritium and strontium-90 is not consistently described. To understand the adequacy of methods for remediation, the vertical and horizontal extent of the plumes should be known. It would be best to have the description given in terms of both depth below land surface and depth below the water table.

The vertical and horizontal extents of the plumes are given in more detail in the Remedial Investigation Report (RI) for Operable Unit III. In the RI, there are tables that show sample locations in terms of both Below Mean Sea Level (BMSL) and/or Below Land Surface (BLS). Plume maps are always given in units of BMSL. We know that this can be difficult to understand, but it is standard practice. In future documents, we will try to provide additional information to help visualize contaminant plumes in terms of depth below land surface.

3i. How long has the VOC contamination from BNL been off-site?

Data from groundwater monitoring of off-site wells show that the high concentrations of solvents (above approximately 1,000 ppb) started to reach Carleton Drive over the last two to three years. From the current southern extent of contaminant migration from BNL and average groundwater-flow rates, we estimated that the low concentrations of solvents (above drinking water standards) may have migrated beneath Carleton Drive approximately thirteen to twenty years ago. Along Sleepy Hollow Drive, high concentrations of solvents have been offsite for 15-20 years and are now located near Strather Drive at a depth of approximately 200 feet. Low concentrations are beginning to reach Crestwood Drive and are estimated to have been off-site for 35-40 years. Further east, beneath the undeveloped property, moderate solvent concentrations have been off-site for approximately 10 years. Because the contamination is deep in the Glacial Aquifer before it reaches the BNL site boundary, we do not believe that people off-site have been exposed to this contamination.

3j. The public-water hookups will prevent future exposure to VOCs in groundwater. What about exposures to contaminants that occurred before BNL provided public water?

The characterization of the plumes of VOCs coming from the BNL property indicate that they are deeper in the Glacial Aquifer than the depth of the typical private well. We believe that residents south of BNL were not exposed to VOCs from BNL in their drinking water. The public water hookups were offered to ensure that no exposure would occur in the future.

3k. I can't make sense of the contour maps. I want to know what the levels in groundwater are near my house, and whether I am being exposed to these contaminants.

Contour maps can be difficult to interpret, but they are the best way to represent the concentrations of contaminants in the aquifer. The Remedial Investigation report contains more detailed maps and tables to help you interpret these data and locate your house.

3l. The Proposed Plan should detail the results and significance of any soil gas testing to evaluate the potential off-gassing of VOCs from contaminant source or plume areas. The potential for accumulation of such vapors in basements or within structures should be reviewed.

Under the right conditions of a solvent product floating on the shallow water table (such as in a gasoline spill), migration of contaminants in the soil and to the ground surface would be likely. However, this is not the case for BNL related VOC contamination in off-site groundwater. There is no floating product and the higher concentrations of solvents are located in the deep aquifer. The upward migration of solvents in the gas phase is further restricted because the aquifer above the contamination acts as a barrier. Because of these considerations, soil gas testing has not been done off-site.

3m. The impacts of releasing contamination from on-site stripping operations must be further examined. There must be an analysis of pathways of airborne contaminants to humans and the environment before the plan is approved. Air stripping is not adequately protective of the environment, nor does it comply with the third cleanup objective stated in the public comment information document – prevention and minimization of further migration of contaminants. Local agencies and private entities generally use granulated activated carbon filter towers to remove VOC contamination. There must be carbon filters on all systems.

Emissions from existing OU III on-site stripping operations are below New York State air emissions standards and BNL permits. These standards were developed by considering potential pathways of exposure to humans and the environment, and are considered safe levels of release. The BNL permits take into account the cumulative effect of all BNL permitted operational emissions. Many air-stripping operations on Long Island are operating without carbon filters. New on-site systems will be evaluated on a case-by-case basis to determine whether carbon filters will be needed. All off-site systems will have a closed loop design and will include carbon filters.

3n. I'm worried about my health. I need better information on the health effects of the contaminants.

The DOE and BNL understand the deep concern that people have for their health and that of their children. This is the reason that DOE took the precaution of connecting residents in the area south of BNL to public water.

The Agency for Toxic Substances and Disease Registry (ATSDR) is completing a groundwater public-health consultation. As an independent agency, ATSDR will be looking at environmental contamination and potential pathways of exposure, and addressing community concerns.

Government and private-sector scientific and medical organizations have generated substantial amounts of information and many studies of the characteristics and health effects of the chemicals of concern in BNL's Environmental Restoration Program.

The following is information to assist community members in learning more about the possible health and environmental effects of the chemicals of concern in BNL's cleanup. Five of the contacts are County, State, and Federal government agencies involved in public-health administration. Three of the contacts are databases (two governmental, one private).

Resources for scientific and health information on chemicals and radionuclides include:

1) ATSDR Public Health Statements
Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road, NE, Mail Stop E-29
Atlanta, GA 30333
Phone: (404) 639-6000, Fax: (404) 639-6315
Internet address: http://atsdrl.cdc.gov:8080/atsdrhome.html

2) The Centers for Disease Control and Prevention
1600 Clifton Road, NE
Atlanta, Ga 30333
Phone: (404) 639-1623
Internet address: http://www.cdc.gov:80//cdc.html

3) U.S. Environmental Protection Agency
Public Information Center, 3404
401 M Street, SW
Washington, DC 20460
Phone: (202) 260-2080
E-mail address: Public-Access@epamail.epa.gov or internet_support@unixmail.rtpnc.epa.gov

4) Suffolk County Department of Health Services
Bureau of Drinking Water
225 Rabro Drive
Hauppague, NY 11788
Phone: (516) 853-3092

5) New York State Department of Health/Bureau of Toxic Substance Assessment
2 University Place
Room 240
Albany, NY 12203
Phone: (800) 458-1158 ext.373 for Chemical Selection

6) Several databases available, and some of these are listed below. You can access the information by calling the source directly. Many local libraries and/or universities have the databases available for the general public.

a. IRIS (Integrated Risk Information System)
U.S. EPA Environmental Health and Safety Series, 1995
Public Information Center, 3404
401 M Street, SW
Washington, DC 20460
Phone: (202) 260-2080
E-mail address: Public-Access@epamail.epa.gov or internet_support@unix mail.rtpnc.epa.gov

b. HSDB (Hazardous Substances Databank)
Produced by the National Library of Medicine
8600 Rockville Pike
Bethesda, MD 20894
Phone: 800-272-4787 or (301) 496-6308
Internet address: http://www.nlm.nih.gov

c. CHRIS (Chemical Hazard Response Information System)
Produced by the U.S. Coast Guard (Hazardous Materials Branch, Office of Marine Safety)
U.S. Coast Guard
2100 Second St. SW
Washington, DC 20593
Phone: (202) 267-1577

3o. The proposed plan by BNL should address the new findings on low level radiation damage to DNA recently discovered by researchers at Columbia University's College of Physicians and Surgeons. Their findings were reported in the last issue of the Proceedings of the National Academy of Sciences. This study may be especially relevant for exposure through inhalation and ingestion, common pathways for radiation exposure originating at Brookhaven.

There is no current pathway for exposure to radionuclides in groundwater from BNL. Hookup of nearby offsite residents to the public-water supply will ensure that there is no future exposure. On-site groundwater contamination will be remediated to below drinking water standards. Many studies have been published discussing the effects of exposure to low level radiation. EPA and other agencies are continuously evaluating these studies and using them to update the dose-response functions that must be used in assessing potential risks at Superfund sites.

3p. The description of the risk assessment is superficial. A more detailed description including discussion of the conservative nature of the risk assessment might alleviate concerns about the credibility of the analysis.

A more detailed description of the risk assessment is given in the RI/RA Report for Operable Unit III. The PRAP is a summary document and cannot provide the entire risk assessment. The process used in the risk assessment is proscribed by EPA, and gives a conservative estimate of the risks associated with contamination in OU III. The conservative, or worst-case assumptions, included in the risk assessment include the land scenarios (e.g., future on-site residential use), exposure concentrations (mean or maximum levels over a lifetime), other standard exposure parameters (e.g. 2 liters/day drinking water), and the EPA's toxicity factors that include safety factors and other conservatisms.

3q. How will the VOC plume affect the New York State Department of Transportation's recharge basins located along the Long Island Expressway? We are concerned about potential health hazards for workers, as well as effects on wildlife, particularly the tiger salamander. Are there any potential impact studies completed for wildlife, and, if not, are they included within the management plan?

The VOC plume associated with BNL is too deep (150-200 feet BLS) to affect the water or sediment concentrations of VOCs in the DOT recharge basins. Consequently, there is no pathway for exposure to workers or to wildlife. Any hydraulic effects of the DOT recharge basins on the plume will be considered during design and construction of the remediation systems. Additionally, DOE will ensure that there are no short term effects on the DOT basins resulting from construction of the remediation systems.

The Remedial Investigation /Risk Assessment for OU III included an ecological risk assessment for the site. This analysis concluded that the only potential risk to on-site wildlife is from metals and PAHs in recharge basins, but that the benthic community expected to live in these basins is limited due to low water levels, the intermittent presence of water, high temperatures, and low oxygen levels. BNL is preparing a habitat management plan with the New York State Department of Environmental Conservation that will detail the routine maintenance of the on-site recharge basins.

4. Other Sources of Pollution and the Monitoring Plan

4a. Some of the pollution south of BNL comes from a source in the industrial park. BNL seems to be taking responsibility for groundwater contamination for which it is not responsible.

VOC contamination in the shallow Upper Glacial Aquifer south of BNL is from an industrial park and not from the Laboratory. The treatment systems proposed in the PRAP focus only on contamination coming from BNL. However, BNL provided public water to residents south of BNL who may have been be affected by contamination from a source other than BNL. This was to ensure that residents would not be exposed to VOC contamination from any source in the future.

4b. Where does excavated contaminated soil go? I am concerned over the issues of off-site disposal of the resin and soils being removed.

The contaminated soil excavated in OU III is being staged and stored pending shipment off-site later this year. The material will be sent to a licensed disposal facility. For any off-site disposal of CERCLA waste, such as resins from the strontium-90 treatment system, BNL must comply with EPA's Off-Site Policy. This Policy requires that the waste generator (BNL) contact EPA prior to shipment of the waste. EPA will then verify that the licensed disposal facility is in compliance with environmental laws. If acceptable, EPA will then provide approval to ship the waste.

4c. Verification of the cleanup action through monitoring is extremely important. I would like to know the location of the monitoring wells, the frequency of sampling, and how often the data will be reviewed. It is likely that a growing population in Brookhaven Town will cause a significant increase in water withdrawal within the planning horizon of 30-60 years. Therefore, a continued monitoring program of at least four times per year will be necessary to safeguard public health. There should be a clear statement that if contamination levels do not decrease, monitoring will increase and further active treatment will be provided.

We currently monitor the groundwater for all BNL's environmental restoration activities, which includes Operable Unit III, in accordance with the existing BNL Environmental Restoration Division Groundwater Monitoring Program Sampling and Analysis Plan. This plan identifies the number of monitoring wells that are sampled for the various plumes within Operable Unit III, the frequency of sampling, and the parameters analyzed. For most of the Operable Unit III plumes, we perform quarterly monitoring of these wells, but the frequency is certainly subject to change as the plume changes.

For the existing groundwater-treatment systems, we monitor their performance in accordance with the relevant discharge permit and the criteria developed during the design of each remedy. The criteria for how the system is monitored and its effectiveness evaluated is presented in the Operations and Maintenance Manual for each operating system. We typically monitor the system on a daily basis for operational parameters. System performance results are evaluated and submitted to the regulators quarterly at a minimum, and monthly for some systems. A detailed annual report also is prepared and submitted to the regulators which evaluates the system's performance and the effectiveness of its operation.

For the treatment systems that have yet to be installed, and the monitored natural attenuation remedies for Operable Unit III, details of the groundwater monitoring well program will be identified during the design of the project. The design typically includes collection of additional groundwater data in the specific area that is needed to support the detailed design of the system, as well as the associated network of monitoring wells. After the detailed monitoring network is determined, it will be added to the Groundwater Monitoring Program Sampling and Analysis Plan.

4d. A major failing of the entire Superfund process at BNL has been the reliance on groundwater modeling to the detriment of monitoring efforts. Three years ago (1996) the plume investigations discovered contamination in the Magothy Aquifer south of BNL. There has not yet been a major effort to characterize the contamination. Over the three-year time period, the model has been extensively exercised – but the groundwater has not been sampled. Similarly, years after the discovery of off-site contamination, the plume characterization still relies on "vertical profile well" samples to describe most of the plume characteristics. Use of vertical profile wells was quite correctly described as suboptimal in the Remedial Investigation report.

The lack of definition for the monitoring portion of the remedial program seems to be part of the overall lack of enthusiasm for sampling (except when under intense public pressure, as in the initial tritium plume investigation). Other RI/FS studies also have called for plume monitoring – as in the EDB plume resolution of some five years ago. Have reports been issued yet on the monitoring portion of that remediation effort? If so, they certainty have not been extensively publicized, nor were they evident at the Longwood library.

Since monitoring is identified as an important part of the remediation – the one part that actually determines if the remedial effort is working as anticipated – it should be carefully and explicitly spelled out. Locations, parameters, action levels and monitoring frequencies should all be specified. The remedial plan, as specified to date, is flawed absent such information.

BNL and DOE agree that monitoring is an important part of the remediation plan. We do not believe that we have relied too heavily on modeling analysis to the detriment of monitoring. BNL has an extensive monitoring network in place. A large number of geoprobes and vertical profile (both temporary wells) were drilled and sampled as part of the OU III Remedial Investigation. The data from these temporary wells helped determine the location and depth of the permanent monitoring wells. We used these data, along with groundwater modeling to help guide our decisions and formulate questions, not to make any final decisions when actual data would be more useful. The exact location and monitoring frequencies will be developed during the design phase. Monitoring data and additional groundwater modeling will be used to determine when cleanup goals have been reached.

The focus in the RI for OU III was on the Glacial Aquifer because there was known contamination in the Glacial Aquifer, water moves much faster in the Glacial Aquifer and there is a higher potential for surface water impacts, and there is more potential for human exposure to groundwater. Vertical profile wells were used in the initial characterization to help determine the location and depth of permanent wells. We are continuing to monitor the groundwater quality both on- and off-site, and plan additional monitoring and characterization of the Magothy Aquifer.

The EDB plume is being, and will continue to be, monitored. Reports have been submitted to the regulatory agencies. The 1997 BNL ERD Groundwater Monitoring Report presents the CERCLA monitoring data for all the projects, including the EDB plume. This document is available for review in the local libraries. All future annual groundwater monitoring reports will also be made available in the libraries.

5. Effect on Property Values

5a. My property values have been affected by the groundwater contamination from BNL. Brookhaven Town has assessed my property at a higher value than local real estate agents say I can get for my house. BNL should acknowledge the economic impact of the groundwater contamination and compensate homeowners for the reduction in property values.

It is our understanding that property values in the vicinity of BNL have not been affected. In a recent New York Times article (Sunday March 21, 1999), it was indicated that the property values directly south of BNL, in the area most impacted by groundwater contamination, actually increased 4% to 8% in 1998 compared with the previous year (1997). This increase is consistent with property values across Suffolk County. In the long term, the proposed groundwater cleanup efforts and the connections to public water will further benefit neighborhoods near BNL.

6. Remedial Action Alternatives

6a. How does in-well air sparging work?

The technology being implemented in the industrial park is called in-well air stripping. This system uses a groundwater pump and an air stripper tray located in the well vault to pump and treat the VOCs. Air stripping involves exposure of the extracted groundwater containing volatile organic compounds to the air. This allows the volatile components in the water to volatilize into the air stream. If concentrations of contaminants in the air exiting on-site air strippers exceed emissions criteria, the air is treated to remove these contaminants before release. All offsite systems will include a carbon filter.

6b. Once the water is cleaned, what prevents it from becoming contaminated again?

In the industrial park, contaminated water will be removed from the aquifer at depths of 125 to 240 feet. The clean water will be returned to the aquifer at the top of the zone of contaminated groundwater. This system is designed to treat all groundwater within the contaminated zone and the clean water above this area will not be impacted by the operation of this system.

6c. The proposal to use air sparging wells instead of extraction wells in combination with air stripping to remove contamination should be explained in the proposed plan. Extraction wells with air stripping treatment may remove contaminants more effectively by causing their movement towards the extraction well compared to the use of sparging wells which recirculate treated water and promote contaminant dilution within the aquifer.

The pump-and-treat systems were evaluated in detail in the OU III Feasibility Study. Extraction wells would require a recharge basin and an air-stripping tower on-site, and piping to transfer the extracted water to the recharge basin. The off-site area impacted by the VOC plume is in a residential area, and installing a groundwater recovery system piping network would involve disturbing properties and major roadways (i.e. the Long Island Expressway). Property acquisitions and permission would be required to install system components in certain areas. Performance data from the operation of in-well air stripping systems in similar hydrogeologic conditions has shown that they may be more effective at restoring the aquifer than pump-and-treat technology. These were the major reasons that the in-well air stripping systems were chosen. In addition, the effectiveness of the in-well air stripping system in the industrial park will be evaluated before installing other in-well air stripping systems.

6d. The treatment plan for VOCs doesn't go far enough. More air-stripping wells are required along the LIPA right of way, and the line of wells at the Industrial Park should be extended eastward and westward to completely cover the entire plume.

The exact number and placement of air-stripping wells for each location will be determined during the design phase for the remedy. During this step we will evaluate the need for additional wells. The number selected will be that required to meet the cleanup objectives (i.e. achieve MCLs within 30 years for the Glacial Aquifer).

6e. The plan should include the number of air stripping devices that will be utilized at each location, criteria to determine when the air stripper is unable to attain the groundwater standards and what the next step should be to meet standards, and criteria to determine the effectiveness of each treatment system.

Active treatment in the in-well stripping systems will be stopped when groundwater monitoring data show that the system is no longer effective, and concentrations of VOCs in the groundwater are no longer being significantly reduced. Specific decision criteria and performance standards will be developed during the design phase.

The performance goal for groundwater is the remediation of groundwater in OU III to Maximum Contaminant Levels (MCLs) or until monitoring indicates that continued operation of the in-well air stripping systems is not producing significant further reductions in the concentrations of contaminants in groundwater (i.e. until an asymptotic condition with respect to a decrease in contaminant concentrations is approached).

The results of groundwater sampling will be evaluated to predict rates of mass removal and to monitor the system's effectiveness. If monitoring indicates that continued operation of the air-stripping wells is not producing significant further reductions in the concentrations in the contaminants in groundwater, in accordance with the National Contingency Plan (NCP), DOE, NYSDEC and EPA will evaluate whether discontinuance of the remedy is warranted. The criteria for discontinuation will include an evaluation of the operating conditions and parameters as well as a determination that the remedy has attained the feasible limit of contaminant reduction and that further reductions would be impractical.

6f. Brookhaven National Laboratory's goal should be, wherever possible, to use active measures to clean up all groundwater in proposed volatile organic compounds in-well air stripping systems to New York State Drinking Water Standards or better. Complete cleanup of groundwater should be attained for the plumes. The drinking water standard of 5 ppb for VOCs should be the minimum standard accepted.

The selected alternatives will use active in-well air stripping systems to remove contaminants until the treatment systems are no longer effective. The goal is to reach drinking water standards, but we expect that these systems may not be able to reduce concentrations of VOCs all the way to drinking water standards. Natural attenuation will reduce the levels to drinking water standards within 30 years.

6g. Why are you treating the contaminated groundwater at the chemical holes for only five years, while other plumes will be treated for longer periods of time?

The Sr-90 plume at the chemical holes is smaller and requires treatment for a shorter period of time.

6h. How would the barrier work for Sr-90?

A permeable reactive barrier wall would be installed around the higher concentrations of groundwater contamination. The wall would consist of a three-foot thick bed of granular clinoptilolite that extends 1 foot above the water table to 40 feet below the water table surface. As the groundwater flows through the clinoptilolite, strontium will be adsorbed on the bed, and the exiting groundwater will contain less than 8 pCi/l of strontium.

Clinoptilolite is a naturally occurring zeolite mineral that is mined at several sites in the western United States. It is a natural ion-exchange material that exchanges sodium and potassium for the strontium in the groundwater. Clinoptilolite also acts as a molecular sieve, removing strontium by adsorption due to surface charge effects on the interior surfaces of the clinoptilolite micropores. The barrier was not selected to treat the strontium-90 groundwater plumes due to difficulties associated with the installation of a barrier wall near the BGRR and Pile Fan Sump. Also the barrier wall does not reduce the time for contamination to be reduced to below MCLs. The barrier wall traps the strontium-90 in place and holds it in place while it decays to below MCLs.

6i. There should be further discussion of what endpoint contamination levels will be required for the shut-down of the BGRR and WCF pumps as well as the pumps to be located in the chemical holes area.

Active treatment for strontium-90 will be stopped when groundwater monitoring data show that the system is no longer effective, and concentrations of Strontium-90 are no longer being significantly reduced. Specific decision criteria and performance standards will be developed during the design phase. No termination of active treatment will occur until it is approved by DOE, EPA, and the NYS DEC.

The performance goal is the remediation of groundwater in OU III to Maximum Contaminant Levels (MCLs) or until monitoring indicates that continued operation of the treatment systems is not producing significant further reductions in the concentrations of contaminants in groundwater (i.e. until an asymptotic condition with respect to a decrease in contaminant concentrations is approached). If after at least one year of groundwater treatment, concentrations of contaminants in designated monitoring and recovery wells appear to have leveled off, an assessment will be conducted to determine if further operation of the remediation system will yield any significant reductions in the levels of contaminants (i.e. whether an asymptotic condition has been reached). The assessment will consider whether complete and effective source control has been attained, an evaluation of the operating parameters and a determination that the remedy has attained the feasible limit of contaminant reduction.

6j. We are not in support of the Department of Energy's preferred alternative for tritium, T4. First, it appears than alternative T4, while meeting the cleanup objective of thirty years (20-25 years) is less aggressive in cleanup that alternative T5 (15-20 years). Second, it also appears that the cost of implementing T4, although less expensive in capital cost than T5 ($456,000:$853,000) is, overall, more expensive than T5 ($4,890,000: $3,669,000). Thus, it appears that the Department has chosen a more costly and time-consuming cleanup. It would appear prudent and protective to choose the more aggressive T5 alternative. The basis for preferring alternative T4 is unclear. If there is additional information why T4 should be preferred over T5, such information should be provided to the public.

BNL and DOE chose alternative T4 over T5 because it includes a contingency plan that considers uncertainties associated with the behavior of the tritium plume over the next 15-20 years. The cost of the contingency remedies was included in the total cost of the T4 alternative, even though these contingencies may not be activated. The cost of alternative T4 without the contingencies was estimated to be $1,997,000.

6k. The operation of the low-flow extraction system is contingent upon finding greater than 2,000,000 pCi/l at the front of the reactor. It should be indicated whether concentrations less than this are likely to trigger removal contingencies farther downgradient, i.e., 25,000 pCi/l at the Chilled Water Plant Road and/or 20,000 pCi/l at Weaver Drive.

The elements of the proposed tritium remedy address the remedial action objectives including limiting significant plume growth. To achieve this objective, concentration levels that would trigger one or more of the contingencies of the proposed remedy were identified for three transects of the plume (at the HFBR, at the Chilled Water Plant Road (CWPR), and at Weaver Drive). If 2,000,000 pCi/L is exceeded at the HFBR then the low-flow pumping contingency is triggered. If 25,000 pCi/L is exceeded at the CWPR then the evaluation to turn on the interim pump and recharge system is triggered. If 20,000 pCi/L at Weaver Drive is exceeded then the interim pump and recharge restart is triggered. These contingencies are independent of each other so that a concentration less than 2,000,000 pCi/L at the HFBR will not trigger the downgradient contingencies. Concentrations at the downgradient locations would trigger the activities described above at each downgradient location. In addition to the ones originally identified in the PRAP, a fourth contingency, an additional low flow extraction system, will be installed and operated near temple Place. The exact location and operational parameters will be developed during the design.

6l. The statement that "tritium will decay sufficiently to avoid off-site migration" is misleading; tritium contamination from the HFBR will eventually travel off-site, and the timing and ultimate concentration of this contamination need to be stated explicitly.

This statement meant that BNL expects tritium to be well below drinking water standards before it reaches the site boundary. The details of the modeling analysis are given in the RI/RA for OU III. The tritium plume is expected to reach its maximum extent, based on the 1,000 pCi/L concentration, approximately 10 years after the spent fuel pool is emptied. Subsequently, the plume is expected to shrink back towards the source. The furthest downgradient distance that the plume (as defined by the 1,000 pCi/L concentration) is expected to reach at 10 years is half way between Princeton Avenue and the site boundary (1,200 feet north of the site boundary). From decay alone, after traveling to the boundary, the concentration then is expected to be approximately 800 pCi/L and dispersion will reduce this concentration further. Therefore, concentrations of tritium greater than 1000 pCi/l are not expected to ever cross the site boundary. The elements of the selected tritium remedy address the remedial action objectives including limiting significant plume growth. To achieve this objective, concentration levels that would trigger one or more of the contingencies of the proposed remedy were identified for three transects of the plume (at the HFBR, at the Chilled Water Plant Road (CWPR), and at Weaver Drive). If 2,000,000 pCi/L is exceeded at the HFBR then the low-flow pumping contingency is triggered. If 25,000 pCi/L is exceeded at the CWPR then the evaluation to turn on the interim pump and recharge system is triggered. If 20,000 pCi/L at Weaver Drive is exceeded then the interim pump and recharge restart is triggered. A concentration level that would trigger a fourth contingency remedy of low flow pumping near Temple Place will be identified in the design. These contingencies are independent of each other so that a concentration less than 2,000,000 pCi/L at the HFBR will not trigger the downgradient contingencies. In addition, the OU III South Boundary pump-and-treat system will be in operation at the time (15 years) that the tritium is expected to cross the site boundary. Any remaining tritium will be captured by this system and recharged further north on the site property where it will be able to decay much below detectable levels before returning to the site boundary.

6m. Alternative T4 should be protective of public health, given the hookup of private wells in the downgradient area. The proposed monitoring network and removal contingencies, however, can not guarantee that all tritium that could migrate off-site at levels exceeding drinking water standards will be detected and captured. It is therefore recommended that all known tritium contamination in excess of 100,000 pCi/l be removed with low-flow pumps and disposed off-site, so that tritium levels leaving the site in 25 years (2 half lives) will not exceed standards. It is also recommended that the proposed monitoring using permanent wells be augmented periodically with profile wells using short screens to reduce the likelihood that maximum plume concentrations and downgradient migrations will go undetected.

In response to regulatory concerns about potential plume migration, a fourth contingency was added consisting of a low flow extraction system near Temple Place. The operational parameters will be developed during design. The proposed remedial alternative addresses the cleanup objective of limiting significant plume growth. Stated another way, this objective means that concentrations higher than those measured today will remain at their current locations or shrink in the upgradient direction. Downgradient migration of the higher concentrations would violate the cleanup objective. If higher than anticipated concentrations are detected then one of the contingency remedies may be triggered. The DOE agrees that this remedy depends on an adequate monitoring system. The existing network of 88 permanent monitoring wells is being enhanced by installing up to 34 additional permanent monitoring wells preceded by an assessment by 42 temporary wells with short screens (BNL 1999 Draft MNA Work Plan). This type of assessment may be undertaken periodically, if necessary, to verify the location of the higher plume concentrations. The method to determine when the trigger levels have been exceeded will be determined during the design phase.

6n. Alternative S5a should be protective of public health and the environment. It is important that the proposed additional monitoring wells be carefully placed so as to accurately characterize recovery system efficacy and plume migration control.

BNL and DOE agree that monitoring of the remedial action is important. Thirty-five monitoring wells were recently installed, and the location of any additional monitoring wells will be determined during the design phase.

6o. Why is the VOC cleanup so much more expensive than the tritium or Sr-90 cleanup?

The cleanup of VOCs is more expensive primarily because the plume is so much larger than the Strontium-90 and tritium plumes.

6p. Anecdotes suggest iron fouling as a serious problem at deeper production wells operated by the Suffolk County Water Authority (SCWA). Has this phenomenon been addressed in the choice of technology? Fouling of the well screens in the pumping wells and the creation of iron precipitates as anoxic water becomes oxidized (if that occurs in this treatment) may be anticipated from others' experiences on Long Island.

Iron fouling was considered in selecting the technology and it was determined that these concentrations could be managed through normal routine maintenance of the systems. The basis of this evaluation was the following. Two groundwater pump-and-treat systems have been operating on the BNL site since January 1997 and June 1997. Both systems have operated without any maintenance problems related to iron fouling. The system being used in the industrial park is a closed-loop air system with carbon treatment to remove VOCs from the air. The carbon will also substantially reduce the amount of oxygen present in the air. This oxygen reduction will reduce the extent of any iron fouling. Other in-well air stripping systems that have been operating have not had significant iron fouling problems.

4. COMMUNITY RELATIONS ACTIVITIES

Following is a chronology of the major general and OU III focused community relations activities at BNL.

September 26, 1991
Public meeting held on September 26, 1991 at BNL to solicit comments and questions on the "DOE Environmental Restoration and Waste Management five-year Plan" and the "BNL Site Specific Plan." Additional presentations were made at the meeting and a 30-day public comment period was held on the draft "Response Strategy Document," the draft "Site Community Relations Plan," and the draft "Remedial Investigation/Feasibility Study Work Plan" for OU IV.

March 26, 1993
"Final Scope of Work for Operable Unit III Remedial Investigation/Feasibility Study Work Plan" entered in Administrative Record.

October 16, 1994
"Operable Unit III Final RI/FS Work Plan", "Health and Safety Plan for Operable Unit II RI/FS Work Plan", and "Sampling and Analysis Plan for Operable Unit III RI/FS Work Plan" entered in Administrative Record.

January 16, 1996
Public meeting held at BNL on the OU I EE/CA.

January 8, 1997
Public notice of availability for Action Memorandum for OU I Groundwater Removal Action and Operable Units I and III Public Water Hookups published.

May 14 and 21, 1997
Public notice of availability of the "Action Memorandum for Tritium Removal Action" published in local Newspapers.

February 20, 1998
Pre-Design Report for OU III Off-Site Removal Action entered into Administrative Record.

June 24, 1998

Final Action Memorandum for OU III Off-site Groundwater Removal Action placed in Administrative Record.

February 16, 1999
Entered OU III Carbon Tetrachloride Action Memo into Administrative Record.

March 1- April 30
Public comment period held for the OU III RI/RA, FS and Proposed Plan. Public notice and a display advertisement about the documents were published in Newsday and Suffolk Life. Upon request from several stakeholders, the public comment period was extended through April 30.

March 24
Public Meeting on OU III Proposed Plan held at Berkner Hall, BNL.

5. REFERENCES

BNL, 1998. Final Report, OU III Early Community Input. Prepared by the Community Involvement/Public Affairs Division, Brookhaven National Laboratory.

BNL, 1999. *OU III Proposed Remedial Action Plan.* Brookhaven National Laboratory, Upton, New York.

IT , 1999a. *Operable Unit III Remedial Investigation Report.* Prepared by International Technology Corporation for Brookhaven National Laboratory, Upton, New York.

IT, 1999b. *Operable Unit III Feasibility Study Report.* Prepared by International Technology Corporation, prepared for Brookhaven National Laboratory, Upton, New York.

IV. REFERENCES

EPA, 1992. Letter: J. DeMurley, EPA to F. Crescenzo, DOE Brookhaven Group. Subject: *"Brookhaven National Laboratory (BNL) Interagency Agreement – Building 479 PCB Soil Cleanup"*, August 6, 1992.

ANL, 1993. *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0.* Environmental Assessment Division, Argonne National Laboratory, Draft ANL/EAD/LD-2, September 1993.

BNL, 1993. *Removal Action IV – Building 479 Remediation Final Report.* Brookhaven National Laboratory, March, 1993.

BNL, 1994a. *Removal Action III – Cesspools/Septic Tanks Action Memorandum.* Brookhaven National Laboratory. January 1994.

BNL, 1994b. *Action Memorandum Building 464 Mercury Remediation.* Brookhaven National Laboratory. February 1994.

BNL, 1994c. *Action Memorandum Landfill Removal Action Phase I – Current Landfill.* Brookhaven National Laboratory. December 1994.

BNL, 1996a. *Action Memorandum Landfill Closure Removal Action Former Landfill Area.* Brookhaven National Laboratory. April 8, 1996.

BNL, 1996b. *Action Memorandum Operable Unit I Groundwater Removal Action and Operable Units I and III Public Water Hookups.* Brookhaven National Laboratory. December 1996.

BNL, 1997a. *Final Action Memorandum Operable Unit III Groundwater Removal Action.* April 1997.

BNL, 1997b. *Final Action Memorandum Phase III – Landfill Closure Removal Action.* Brookhaven National Laboratory. June 16, 1997.

BNL, 1997c. *Final Action Memorandum Operable Unit III Tritium Removal Action.* Revised July 18, 1997.

BNL, 1998a. *Final Action Memorandum Operable Unit III Off-Site Groundwater Removal Action.* Brookhaven National Laboratory. June 12, 1998.

BNL, 1998b. *Final Report, OU III Early Community Input.* Brookhaven National Laboratory. November 5, 1998.

BNL, 1998c. *Final Action Memorandum for Building 830 Underground Storage Tank Removal Action.* November 1998.

BNL, 1999a. *Final Action Memorandum Carbon Tetrachloride Tank Groundwater Removal Action.* January 1999.

BNL, 1999b. *Proposed Plan for Operable Unit III Brookhaven National Laboratory.* Brookhaven National Laboratory. March 1999.

DOE, 1988. *Environmental Survey Preliminary Report.* U. S. Department of Energy. 1988.

EPA, 1994. *OSWER Directive 9355.4-23. Soil Screening Guidance: User's Guide.* U. S. Environmental Protection Agency, December 1994.

EPA, 1997. *OSWER Directive 9200.4-18. Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination.* U.S. Environmental Protection Agency. August 1997.

Geraghty & Miller, Inc., 1998. *Pre-design Report for the Operable Unit III Off-Site Removal Action.* Geraghty & Miller, Inc., February 1998.

IT, 1994. *Operable Unit III Remedial Investigation/Feasibility Study Work Plan.* International Technology Corporation. September 26, 1994.

IT, 1997. *Pre-design Investigation Report.* International Technology Corporation.

IT, 1999a. *Operable Unit III Remedial Investigation Report.* International Technology Corporation. March 1, 1999.

IT, 1999b. *Operable Unit III Feasibility Study Report.* International Technology Corporation. March 1, 1999.

NYSDEC, 1994a. *Technical and Administrative Guidance Memorandum HWR-94-4046:- Determination of Soil Remediation Objectives and Remediation Levels.* New York State Department of Environmental Conservation, Division of Hazardous Waste Remediation. January 24, 1994 (revised).

PWG, 1999. *Draft Building 96 Predesign Report.* P.W. Grosser Consulting, June 1999.

V. TABLES

TABLES

Table 1. OU III Areas of Concern and Additional Areas of Investigation.	
Paint Shop (AOC 7)	Paint- and thinner stained soils excavated and backfilled. Septic tank and cesspools; septic tank removed, cesspool pumped and backfilled.
Building 830 Pipe Leak (AOC 11)	Leak in transfer line between building and underground storage tanks. Pipe and contaminated soil removed.
Building 830 Underground Storage Tanks (AOC 12)	Underground storage tanks containing liquid and sludge contaminated with radionuclides. Tanks and their contents have been removed. Soils are currently being removed.
Bubble Chamber Spill Area (AOC 14)	Hazardous materials handling and storage area with documented spills.
Potable, Supply and Monitoring Wells (AOC 15)	Contamination in potable and supply wells from source areas in OU III. Leaking sewer pipes and cesspools probable source. Wells are out of service or are being treated with activated carbon. Monitoring well at the southern boundary contains VOCs above MCLs.
TCE Spill Area (AOC 19)	Approximately 1,800 gallons of TCE discharged on the ground between 1951 and 1953.
Leaking Sewer Pipes (AOC 21)	Pipes carried laboratory and sanitary wastes. Poor condition may have resulted in exfiltration of wastewater to soil and groundwater.
Old Firehouse (AOC 22)	Radiation levels above background under concrete floor. Following demolition, soil was excavated.
Process Supply Wells and Recharge Basins (AOC 24)	Process supply wells for the Brookhaven Medical Research Reactor contaminated with VOCs. One well shut down; the other treated with carbon adsorption unit. One recharge basin with organic compounds above limits, source is probably contamination pumped by supply well. Potential discharge of radiologically contaminated wastewater to a second recharge basin.
Heavy Machine Shop (AOC 25)	Historical use of hydraulic oils, cutting fluids, and lubricants. Documented leaks and spills. PCB-contaminated soil excavated.
Building 208 (AOC 26A)	TCA detected in sewer lines leading to old vapor degreasing pit. No soil remediation required. Vapor degreaser removed.
Building 96 (AOC 26B)	The primary source of VOCs in the groundwater is an area south of Building 96. PCBs detected in surface soils above screening levels.
Building 464 (AOC 27)	Abandoned catch basin containing high levels of mercury and detectable PCBs in soils. Soils were excavated.
High Flux Beam Reactor Spent Fuel Pool and Tritium Plume (AOC 29)	The High Flux Beam Reactor spent fuel pool leaked tritium to the groundwater. Fuel pool was emptied. There is an on-site plume of tritium downgradient of the HFBR.
Brookhaven Graphite Research Reactor (AOC 9)	Potential for leakage of radioactively contaminated liquid from the spent fuel canal. Potential releases of radioactive materials to underground duct-work and subsequent flooding with rainwater and leakage. Spill area may have been inadequately remediated and may have impacted groundwater.
Brookhaven Graphite Research Reactor, Pile Fan Sump (AOC 9D)	The sump, located near the BGRR and Building 80, may have acted as a source of tritium and strontium-90 groundwater contamination. This was added to the remedial investigation to further define the tritium plume.
Waste Concentration Facility (AOC 10)	Temporary storage area for liquid radioactive waste that is distilled to remove particulates, suspended solids and dissolved solids. Tanks have leaked into vault area. Aboveground tanks dismantled. Six USTs still contain sludge. Waste transfer line may have released radioactive liquid. Line removed and replaced.
AGS Scrapyard (Boneyard) (AOC 18)	Improper storage of radioactive materials, particles of radioactive steel may have contaminated soil.
North End of Linear Accelerator (AOC 20)	Improper discharge of waste into a recharge basin.
OU I Former Landfill (Glass Holes) (AAI-1)	High levels of strontium-90 detected in monitoring wells south of the Glass Holes.
OU I/IV Groundwater Investigation (AAI-2)	VOCs above MCLs detected in off site groundwater downgradient from Operable Units I & IV

Table 2: Summary of Selected Remedies and Previous Actions

Previous Decisions and Action Memoranda					
AOC No.	**Name**	**Past and/or Continuing Response Actions**	**Monitoring / Maintenance**	**Remedial Action Reference**	**Current Status**
N/A	OU III Groundwater Removal Action (at BNL South Boundary)	Extraction of contaminated groundwater from a series of extraction wells at the southern boundary, treatment via air stripping and discharge to a new recharge basin. This Action will continue as part of the selected remedy.	Continued operation and maintenance of groundwater treatment system. Groundwater monitoring	BNL, 1997a.	Began operation in June 1997.
N/A	OU III Off-Site Groundwater Removal Action	In-well stripping to hydraulically contain and treat the highest concentrations of TVOC off-site in industrial complex south of BNL. This Action will continue as part of the selected remedy.	Continued operation and maintenance of groundwater treatment system. Groundwater monitoring	BNL, 1998a.	Began operation in September 1999.
AOC - 27	On-Site OU III Carbon Tetrachloride Tank Groundwater Removal Action	Extraction of contaminated groundwater, treatment via an activated carbon filter and discharge on-site. Off site disposal of the spent carbon. This Action will continue as part of the selected remedy.	Continued operation and maintenance of groundwater treatment system. Groundwater monitoring.	BNL, 1999a.	Began operation in January 1999.
N/A	Public Water Hookup Removal Action	Connection of private well users south of BNL to the public water supply.	The Suffolk County Water Authority monitors the public water quality on a regular basis.	BNL, 1996b.	Started in 1996 and completed in 1998.
AOC-11 & 12	Building 830 Underground Storage Tanks Removal Action	Excavation and removal of contaminated soils, valve pit, pipes, trees, and tanks has been completed. Off-site disposal of waste materials is underway.	Groundwater monitoring.	BNL 1998d.	Excavation completed in February 1999.
AOC-29	Tritium Groundwater Interim Removal Action	Removal of spent fuel and tritium contaminated water from the spent fuel pool in 1997; installation of a stainless steel liner prior to reuse; elimination of other potential sources of leakage; and installation and operation of a pump and recharge system for tritium contaminated groundwater at the leading edge of the plume. The pump and recharge system will become part of the contingency remedy for this plume and will continue operation for a maximum of 1 year past the signing of the OU III ROD.	Well sampling and groundwater monitoring, and installation of a new pool liner for the Spent Fuel Pool.	BNL, 1997c.	Pump and recharge system began operation in 1997.

Table 2: Summary of Selected Remedies and Previous Actions (continued)

AOC No.	Name	Past and/or Continuing Response Actions	Monitoring / Maintenance	Remedial Action Reference	Current Status
Previous Decisions and Action Memoranda (continued)					
AOC-14	Cesspools/Septic Tanks Removal Action	Cesspools and septic tanks were filled for these following buildings: 919/919A-1, 919/919A-2, 919/919A-ST, 919B/975-1, and 919B/975-2.	None required.	BNL, 1994a.	Completed in 1994.
Current Decisions in OU III ROD: Strontium-90 Contaminated Groundwater					
AOC-9	Brookhaven Graphite Research Reactor (BGRR) including Pile Fan Sump (AOC 9D)	Alternative S5a will provide groundwater extraction, treatment via ion exchange, and on-site discharge. Contaminated soils associated with the BGRR and the Pile Fan Sump will be addressed in the ROD for the BGRR.	Operation and maintenance of groundwater treatment system. Groundwater monitoring.	Groundwater only: IT, 1999b. BNL, 1999b.	Planned action upon OU III ROD approval.
AOC-10	Waste Concentration Facility	Alternative S5a will provide groundwater extraction, treatment via ion exchange, and on-site discharge. Source remediation for the contaminated soils and out-of-service tanks at the Waste Concentration are addressed in the OU I ROD.	Groundwater monitoring.	Groundwater only: IT, 1999b. BNL, 1999b. Source Areas: BNL, 1999c.	Planned action upon OU III ROD approval.
AAI-1	Strontium-90 Groundwater Plume at the Former Landfill Area (AOC 2) in OU I	Alternative S5a will provide groundwater extraction, treatment via ion exchange and on-site discharge. The Former Landfill and Slit Trench (AOCs 2A and E) were capped in 1996; the Chemical/Animal Pits and Glass Holes (AOCs 2B and C) were excavated in the summer of 1997 and the Interim Landfill (AOC 2D) was capped in September 1997 as Removal Actions. These removal actions are adopted as final remedies in the OU I ROD.	Operation and maintenance of groundwater treatment system. Groundwater monitoring. Maintenance of landfill caps as part of OU I.	Groundwater only: IT, 1999b. BNL, 1999b. Source Areas: BNL, 1996a. BNL, 1997b.	Planned action upon OU III ROD approval.

Table 2: Summary of Selected Remedies and Previous Actions (continued)

AOC No.	Name	Selected Remedial Actions	Monitoring / Maintenance	Remedial Action Reference	Current Status
Current Decisions in OU III ROD – Tritium Contaminated Groundwater					
AOC-29	Spent Fuel Pool at the HFBR	Alternative T4 will provide monitored natural attenuation with contingencies using the existing pump and recharge system and a low-flow extraction system to be installed close to the HFBR.	Groundwater monitoring.	IT, 1999b. BNL, 1999b.	Planned action upon OU III ROD approval.
Current Decisions in OU III ROD - VOC Contaminated Groundwater					
AOC-14	Bubble Chamber Spill Area	VOC Alternative 10c will provide a combination of active groundwater treatment using in-well air stripping and pump and treat technologies and groundwater monitoring to meet remedial action objectives both on and off the BNL site. Cesspools and septic tanks were previously removed as part of the Cesspool/Septic Tank Removal Action.	Groundwater monitoring. Institutional controls.	IT, 1999b. BNL, 1999b.	Planned action upon OU III ROD approval.
AOC-15	Potable, Supply and Monitoring Wells	VOC Alternative 10c will provide a combination of active groundwater treatment using in-well air stripping and pump and treat technologies and groundwater monitoring to meet remedial action objectives both on and off the BNL site.	Groundwater monitoring. Institutional controls. Potable wells are monitored quarterly for compliance with the Safe Drinking Water Act. A number of BNL's potable and supply wells have well head protection.	IT, 1999b. BNL, 1999b.	Planned action upon OU III ROD approval.
AOC-24A	Process Supply Wells	VOC Alternative 10c will provide a combination of active groundwater treatment using in-well air stripping and pump and treat technologies and groundwater monitoring to meet remedial action objectives both on and off the BNL site.	Groundwater monitoring. Institutional controls. A number of BNL's potable and supply wells have well head protection and these wells are monitored for compliance with the Safe Drinking Water Act.	IT, 1999b. BNL, 1999b.	Planned action upon OU III ROD approval.
AOC-26A	Building 208	VOC Alternative 10c will provide a combination of active groundwater treatment using in-well air stripping and pump and treat technologies and groundwater monitoring to meet remedial action objectives both on and off the BNL site. Remedial Investigation and PA/SI groundwater sampling did not indicate levels of VOCs in the groundwater at Building 208 that require active remediation.	Groundwater monitoring. Institutional controls.	IT, 1999b. BNL, 1999b. PWG, 1999b.	Planned action upon OU III ROD approval.
AOC-26B	Building 96	A source removal system using re-circulation wells with air stripping treatment of VOC contaminated groundwater at this AOC will be provided as part of VOC Alternative 10c.	Groundwater monitoring. Operation and maintenance of groundwater treatment system.	IT, 1999b. BNL, 1999b. PWG, 1999a.	Planned action upon OU III ROD approval.

Table 2: Su[illegible]ary of Selected Remedies and Previous Actions (continued)

AOC No.	Name	Selected Remedial Actions	Monitoring / Maintenance	Remedial Action Reference	Current Status
Current Decisions in OU III ROD – VOC Contaminated Groundwater (continued)					
AAI-2	OU I/IV Groundwater Investigation	VOC Alternative 10c will provide a combination of active groundwater treatment using in-well air stripping and pump and treat technologies and groundwater monitoring to meet remedial action objectives both on and off the BNL site. Removal Actions were conducted on the following source areas for these groundwater plumes: The Current Landfill (AOC 3) was capped in 1995. The Former Landfill and Slit Trench (AOCs 2A and E) were capped in 1996. The Chemical/Animal Pits and Glass Holes (AOCs 2B and C) were excavated in the summer of 1997. The Interim Landfill (AOC 2D) was capped in September 1997. These removal actions are adopted as final remedies in the OU I ROD for these source areas.	Groundwater monitoring. Public water has been provided to the area south of BNL where these plumes are. Suffolk County Building codes require new construction to connect to public water where available.	Groundwater: IT, 1999b. BNL, 1999b. Source Areas: BNL, 1994c. BNL, 1996a. BNL, 1997b.	Planned action upon OU III ROD approval.
Suspected Source Area Decisions in OU III ROD					
AOC-7	Paint Shop	The Building 244 (Paint Shop) excavation for paint contaminated soils was completed in May 1989. Post excavation and Operable Unit III Remedial Investigation soil samples showed no significant contamination. The post excavation data is documented in SAIC, 1991.	Groundwater monitoring.	IT, 1999b. BNL, 1999b.	Documented in OU III ROD.
AOC-18	AGS Scrapyard	Soil contamination is addressed in the OU I ROD. The OU III Remedial Investigation did not indicate contaminated groundwater from this AOC that required remediation.	Groundwater monitoring.	IT, 1999b. BNL, 1999b.	Documented in OU III ROD.
AOC-19	Trichloroethene (TCE) Spill Area	The OU III Remedial Investigation work did not locate a source area that required remediation.	Groundwater monitoring.	IT, 1999b. BNL, 1999b.	Documented in OU III ROD.
AOC-20	North End of Linear Accelerator (LINAC) including Recharge Basin HT	Contaminated soil at this AOC is addressed in the OU I ROD. Basin HT receives once-through cooling water and cooling water blowdown from the AGS and is permitted by NYSDEC. It is also a potential Tiger Salamander habitat. Sediment sampling conducted during the Remedial Investigation showed elevated contaminant levels and that additional sampling is required. A minimum of five surface water and sediment samples will be collected in spring 2000. The Basin will also be evaluated during spring and summer 2000 to determine if it is a tiger salamander breeding habitat. If the results of this evaluation and the additional data indicate to the DOE, EPA or NYSDEC that additional investigation or remediation is needed, the three parties will meet to discuss what additional actions need to be taken.	Continue monitoring and maintenance as required by BNL's SPDES permit (Outfall 006, in permit NY-0005835) from NYSDEC and as outlined in BNL's Wildlife Management Plan. This Plan contains activities designed to reduce potential impacts to the Tiger Salamander by BNL activities. Groundwater monitoring.	IT, 1999b. BNL, 1999b.	Documented in OU III ROD.

Table 2. Summary of Selected Remedies and Previous Actions (continued)

AOC No.	Name	Selected Remedial Actions	Monitoring / Maintenance	Remedial Action Reference	Current Status
		Suspected Source Area Decisions OU III ROD(continued)			
AOC-21	Leaking Sewer Pipes	Approximately 18,000 linear feet of old sewer lines have been replaced or upgraded to date. An additional 10,000 linear feet are scheduled to be replaced and/or upgraded by the end of 2000 as part of BNL's construction and maintenance program.	Groundwater monitoring.	IT, 1999b. BNL, 1999b.	Documented in OU III ROD.
AOC-22	Old Firehouse	Excavation of contaminated soils/concrete at the Old Firehouse was completed in March 1986. The OU III Remedial Investigation confirmed that no further action is required at this AOC. Post excavation data is documented in SAIC, 1991.	None required.	IT, 1999b. BNL, 1999b.	Documented in OU III ROD.
AOC-24B	Recharge Basin HP	This basin receives once-through cooling water from the Brookhaven Medical Research Reactor, which is permitted by NYSDEC as Outfall 004 under BNL's SPDES permit, and is also a potential Tiger Salamander habitat. Sediment sampling conducted during the Remedial Investigation indicated no need for sediment removal.	Continue monitoring and maintenance as required by BNL's SPDES permit (NY-0005835) and as outlined in BNL's Wildlife Management Plan. This Plan contains activities designed to reduce potential impacts to the Tiger Salamander by BNL activities.	IT, 1999b. BNL, 1999b.	Documented in OU III ROD.
AOC-24C	Recharge Basin HN, Alternating Gradient Synchrotron (AGS)	This basin receives once-through cooling water and cooling tower blow-down from the AGS and stormwater runoff. These discharges are permitted by NYSDEC (Outfall 002 on BNL's SPDES permit). This is also a potential Tiger Salamander habitat. Sediment sampling conducted during the Remedial Investigation indicated no need for sediment removal.	Continue monitoring and maintenance as required by BNL's SPDES permit (NY-0005835) and as outlined in BNL's Wildlife Management Plan. This Plan contains activities designed to reduce potential impacts to the Tiger Salamander by BNL activities.	IT, 1999b. BNL, 1999b.	Documented in OU III ROD.
AOC-25	Heavy Machine Shop	Excavation of PCB contaminated soils completed in August 1992. Soils were disposed of off-site. Cleanup approved by EPA and NYSDEC.	Groundwater monitoring.	BNL, 1993. IT, 1999b. BNL, 1999b.	Documented in OU III ROD.
AOC-26A	Building 208 in Warehouse Area	Vapor Degreaser removed. Oil/water separators removed in 1999 as part of the Facility Site Review project at Buildings 206, 208 and 209. This work was performed under the supervision of the Suffolk County Department of Health Services.	Groundwater Monitoring.		Documented in OU III ROD.
AOC-26B	Building 96 (PCB soil contamination)	Excavation and off site disposal of the PCB contaminated soils above the New York State cleanup level (1 ppm) will be performed.	Not applicable.	PWGa, 1999.	Planned action upon OU III ROD approval.
AOC-27	Building 464 (Former Chemistry Complex)	Excavation of mercury/PCB contaminated soil was completed in September 1993. Contaminated soil was disposed of off-site. An old carbon tetrachloride tank was removed in 1998 as part of the Facility Site Review Project. Neutralization Pits will be located and remediated if necessary as part of the Facility Site Review Project. This work will be performed under the oversight of Suffolk County Department of Health Services.	Groundwater monitoring.	BNL, 1994a. BNL, 1998b. IT, 1999b. BNL, 1999b.	Documented in OU III ROD.

Table 3. Source Removal Actions		
Location	**Action**	**Major Contaminants**
Cesspools/Septic Tanks Removal Action	Cesspools removed, tanks emptied.	Solvents (TCA)
Building 464 Removal Action	Contaminated soil removed.	Mercury
Paint Shop	Soil removed.	Solvents (TCA)
Brookhaven Graphite Research Reactor	Canal drained and covered with concrete. Deep drain sump pumped out.	Sr-90, Tritium, Cs-137
Waste Concentration Facility	Tanks, underground piping and soil removed or removal planned under OU I.	Sr-90, Cs-137
Building 830 Pipe Leak and Underground Storage Tanks.	Tanks pumped out, contaminated soils under waste transfer line removed. Tanks removed and soils excavated. Removal and disposal of contaminated soil is underway.	Co-60, Cs-137
Old Firehouse, Bubble Chamber Spill Area, Heavy Machine Shop	Contaminated soil removed. Cesspools removed.	Cs-137, Sr-90, Solvents, PCBs
BGRR Pile Fan Sump	Sump pumped out.	Sr-90, Cs-137, Tritium
Central Shops, Building 208	Solvent/degreaser pit removed..	Solvents (TCA)
Current/Former Landfills, Glass Holes	Landfills capped. Glass holes excavated. Contaminated soils addressed under OU I.	Solvents, Mercury, Sr-90

Table 4
Specific Screening Criteria for Contaminants Exceeding Screening Criteria in Any Media in Operable Unit III

Contaminant	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)	Surface Water (µg/L)	Sediment (mg/kg)	Groundwater (µg/L)
Inorganics					
Aluminum	16491	16491	--	24500	200
Antimony	13.1	13.1	--	25	3
Arsenic	2.8	7.5	36	33	25
Barium	300	300	--	86.4	1000
Beryllium	0.43	0.43	--	1.6	3
Cadmium	1.5	1.5	0.76	9	5
Calcium	434	434	--	41400	--
Chromium	14.2	14.2	528.5	110	50
Cobalt	30	30	110	3.6	--
Copper	25	25	4.51	110	200
Lead	15.8	15.8	13.1	110	15
Magnesium	2122	2122	--	24000	35000
Manganese	148	148	--	1100	50
Mercury	0.15	0.15	0.2	0.71	2
Nickel	13	13	611.6	50	100
Potassium	628	628	--	1240	--
Silver	2	2	0.33	2.2	50
Sodium	196	196	--	218	20000
Thallium	0.35	0.35	20	--	2
Zinc	22.4	22.4	34.5	270	300
Pesticides and PCBs					
delta-BHC	0.3	0.3	2	0.0014	ND
Volatile Organic Compounds					
1,1-Dichloroethene (DCE)	0.07	0.06	--	--	5
1,1,1-Trichloroethane (TCA)	0.8	0.8	--	--	5
1,1,2,2-Tetrachloroethane	0.6	0.003	--	--	5
Carbon Tetrachloride	0.3	0.07	--	--	5
Chloroform	0.3	0.3	--	--	7
Methylene chloride	0.1	0.02	--	--	5
Tetrachloroethene (PCE)	1.4	0.06	--	--	5
Toluene	1.5	1.5	1	--	5
Trichloroethene (TCE)	0.7	0.06	11	--	5
Xylenes (total)	1.2	1.2	--	--	5
Semi-Volatile Organic Compounds					
Acenaphthene	50	50	--	0.5	20
Benzo(a)anthracene	0.224	0.224	--	1.6	0.002
Benzo(a)pyrene	0.061	0.061	.0012	1.6	ND
Chrysene	0.4	0.4	--	2.8	0.002
Fluoranthene	50	50	--	5.1	50
Fluorene	50	50	--	0.54	50
Phenanthrene	50	50	--	1.5	50
Pyrene	50	50	--	2.6	50

-- no standard available, no screening criteria
ND not detected

Table 4 (cont.)

Contaminant	Surface Soil (pCi/g)	Subsurface Soil (pCi/g)	Surface Water (pCi/L)	Sediment (pCi/g)	Groundwater (pCi/L)
Radionuclides					
Cesium-137	13.89	13.89	--	13.89	120
Cobalt-60	720.6	720.6	--	720.6	100
Lead-210	31.42	31.42	--	31.42	1.2
Potassium-40	--	--	--	--	280
Radium-226	1	1	3	1	3
Strontium-89	--	--	8	--	20
Strontium-90	448.2	448.2	8	448.2	8
Thallium-208	--	--	--	--	16
Thorium-232	--	--		--	2
Thorium-230	1.8	1.8	1.8	1.8	12
Thorium-234	--	--	--	--	400
Tritium	9.41E+15	9.41E+15	20000	9.41E+15	20000
Gross Beta	--	--	--	--	50
Gross Alpha	--	--	--	--	15

-- no standard available, no screening criteria
ND not detected

Table 5
Detected Concentration Range for Constituents of Potential Concern in OU III

Constituents of Potential Concern	Surface Soil	Subsurface Soil	Surface Water	Sediment	On-site Groundwater	Off-site Groundwater
Inorganics	(mg/kg)	(mg/kg)	(mg/l)	(mg/kg)	(mg/l)	(mg/l)
Arsenic	1.30E+00 - 8.10E+00	6.10E-01 - 3.20E+00	-	-	2.40E-03 - 6.57E-02	-
Barium	9.40E+00 - 1.65E+02	-	1.54E-02 - 2.09E-02	3.60E+00 - 1.60E+02	-	-
Beryllium	1.00E-01 - 4.90E-01	-	8.00E-04	-	-	-
Cadmium	2.20E+00	-	3.20E-03	-	2.40E-03 - 2.02E-02	-
Chromium VI	5.90E-01 - 2.27E+00	1.30E-01 - 4.37E+00	-	2.30E-01 - 6.70E+00	6.60E-04 - 1.59E-01	-
Manganese	4.96E+01 - 5.19E+02	1.83E+01 - 4.96E+02	6.70E-03 - 2.34E-02	3.41E+01 - 4.52E+02	2.00E-03 - 6.82E+00	-
Volatile Organics	(mg/kg)	(mg/kg)	(mg/l)	(mg/kg)	(mg/l)	(mg/l)
1,1,1-Trichloroethane	-	-	-	-	2.00E-04 - 9.20E-01	5.00E-04 - 1.00E-01
1,1-Dichloroethene	-	-	-	-	2.00E-04 - 2.80E-01	-
Carbon Tetrachloride	-	-	-	-	3.00E-04 - 3.60E-01	6.00E-04 - 5.10 E+00
Tetrachloroethene	-	-	-	-	2.00E-04 - 7.50	-
Semivolatile Organics	(mg/kg)	(mg/kg)	(mg/l)	(mg/kg)	(mg/kg)	(mg/kg)
Benzo(a)Anthracene	-	-	6.00E-03	1.90E-01 - 5.30E+00	-	-
Benzo(a)Pyrene	-	4.40E-02 - 3.70E-01	5.00E-03	2.10E-01 - 4.10E+00	-	-
Benzo(b)Fluoranthene	-	-	7.00E-03	4.40E-01 - 5.70E+00	-	-
Indeno(1,2,3-cd)Pyrene	-	-	3.00E-03	-	-	-

Table 5 (cont.)
Detected Concentration Range for Constituents of Potential Concern in OU III

Constituents of Potential Concern	Surface Soil	Subsurface Soil	Surface Water	Sediment	On-site Groundwater (pCi/l)	Off-site Groundwater (pCi/l)
Radionuclides	(pCi/g)	(pCi/g)	(pCi/l)	(pCi/g)		
Americium 241-A	-	7.00E-02 - 8.90E-01	-	-	4.6E-02 - 3.17E-01	-
Americium 241-G	-	3.11E-01 - 9.20E-01	3.10E-01	5.30E-02 - 5.30E-02	-	-
Cesium 137	3.90E-01 - 6.76E+01	2.50E-02 - 1.05E+02	2.50E-02	3.80E-02 - 2.57E+00	1.49E+00 - 2.35E+01	-
Cobalt 57	-	-	-	5.00E-02 - 6.80E-02	-	-
Cobalt 60	1.63E+00 - 3.06E+00	9.00E-02 - 3.63E+01	-	1.20E-02 - 1.50E-01	4.99E+00 - 2.42E+02	-
Europium 155	-	-	-	9.90E-02	-	-
Lead 210	1.21E+00 - 1.95E+00	2.20E-01 - 8.70E-01	-	2.30E-01 - 1.05E+01	-	-
Manganese 54	-	-	-	6.50E-02 - 2.90E-01	-	-
Neptunium 237	-	-	-	2.40E-01	-	-
Protactinium-231	-	-	-	3.60E-01	-	-
Radium-226	2.70E-01 - 5.20E-01	1.10E-01 - 5.10E-01	-	1.30E-01 - 6.10E-01	9.21E+00 - 1.6E+01	-
Strontium 90	9.40E-01	3.30E-01 - 7.30E-01	3.30E-01	-	5.4E-01 - 5.66E+02	-
Thorium-228	1.70E-01 - 2.80E-01	9.00E-02 - 5.00E-01	-	-	1.49E-01	-
Thorium-230	-	5.66 E+00 - 5.66E+00	-	-	6.90E-02 - 3.04E+00	-
Thorium-232	1.90E-01 - 2.50E-01	1.3E-01 - 5.40E-01	-	-	6.40E-02 - 4.81E+00	-
Tritium	5.20E-02 - 1.00E-01	2.20E-02 - 1.41E-01	2.20E-02 - 2.64E+02	1.05E-03 - 1.29E+02	2.39E+02 - 5.03E+06	
Uranium-238	-	-	-	-	1.23E-01 - 6.23E+00	-

Table 6. Exposure Scenarios Evaluated in the Chemical Baseline Human Health Risk Assessment.

Location	Receptor	Age	Media	Exposure Route
CURRENT LAND USE				
On-site	Industrial worker	Adult	Surface Soil	Ingestion Dermal Contact Inhalation of particulates and vapors
On-site	Trespasser	Older child	Surface Soil Sediment Surface Water	Ingestion Dermal Contact Inhalation of particulates and vapors Dermal Contact Dermal Contact
Off-site Plume	Resident	Adult	Groundwater	Ingestion
Off-site Plume	Resident	Young child	Groundwater	Ingestion
FUTURE LAND USE				
On-site	Industrial worker	Adult	Surface Soil	Ingestion Dermal Contact Inhalation of particulates and vapors
On-site	Construction worker	Adult	Surface/Subsurface Soil	Ingestion Dermal Contact Inhalation of particulates and vapors
On-site	Resident	Adult	Surface Soil Groundwater	Ingestion Dermal Contact Inhalation of particulates and vapors Ingestion Inhalation of VOCs Dermal Contact
On-site	Resident	Young child	Surface Soil Groundwater	Ingestion Dermal Contact Inhalation of particulates and vapors Ingestion Inhalation of VOCs Dermal Contact
On-site Plume	Resident	Adult	Groundwater	Ingestion Inhalation of VOCs Dermal Contac
On-site Plume	Resident	Young child	Groundwater	Ingestion Inhalation of VOCs Dermal Contact

Table 7. Exposure Scenarios Evaluated in the Radiological Baseline Human Health Risk Assessment.

Location	Receptor	Age	Media	Exposure Route
CURRENT LAND USE				
On-site	Industrial worker	Adult	Surface Soil	Ingestion Direct radiation Inhalation of particulates and radon
On-site	Trespasser	Adult	Surface Soil	Ingestion Direct radiation Inhalation of particulates and radon
Off-site	Resident	Adult	Groundwater	Ingestion
FUTURE LAND USE				
On-site	Industrial worker	Adult	Soil	Ingestion Direct radiation Inhalation of particulates and radon
On-site	Construction worker	Adult	Surface/Subsurface Soil	Ingestion Direct radiation Inhalation of particulates and radon
On-site	Resident	Adult	Soil Groundwater	Ingestion Direct radiation Inhalation of particulates and radon Ingestion Home-grown vegetables Ingestion of game/livestock
On-site Plume	Resident	Adult	Groundwater	Ingestion

Table 8. Non-carcinogenic Effects: Toxicity Values and Effects of Constituents of Potential Concern

Constituent of Concern	Oral RfD (mg/kg/day)	Inhalation Chronic RfC (mg/kg/day)	Uncertainty Factor (Oral; Inhalation)	Source (Oral; Inhalation)	Critical Effect (Oral; Inhalation)
Inorganics					
Arsenic	3.00E-04	NA	3; NA	IRIS; NA	keratosis; NA
Barium	7.00E-02	1.43E-04	3; 1000	IRIS; HEAST	blood pressure; fetotoxicity
Beryllium	5.00E-03	NA	100; NA	IRIS; NA	None; NA
Cadmium	5.00E-04	5.70E-05	10; NA	IRIS; EPA 1996	proteinuria; NA
Chromium VI	5.00E-03	NA	500; NA	IRIS; NA	None; NA
Manganese	2.30E-02	1.43E-05	1; 1000	EPA, 1996; IRIS	central nervous system
Volatile Organics					
1,1-Dichloroethene	9.00E-03	NA	1000; NA	IRIS; NA	hepatic lesions; NA
1,1,1-Trichloroethane	NA	NA	NA	NA	NA; NA
Carbon tetrachloride	7.00E-04	NA	1000; NA	IRIS; NA	liver lesions; NA
Tetrachloroethene	1.00E-02	NA	1000; NA	IRIS; NA	Hepatotoxicity; weight gain; NA
Semivolatile Organics					
Benzo(a)Anthracene	NA	NA	NA; NA	NA; NA	NA; NA
Benzo(a)Pyrene	NA	NA	NA; NA	NA; NA	NA; NA
Benzo(b)Fluoranthene	NA	NA	NA; NA	NA; NA	NA; NA
Indeno(1,2,3-cd)Pyrene	NA	NA	NA; NA	NA; NA	NA; NA

NA: not available
IRIS: Integrated Risk Information System (IRIS), on-line, 4th quarter 1996.
HEAST: Health Effects Assessment Summary Tables, OERR 9200.6-303 (93-1), 1995.
EPA, 1996: General comments on the OU V Draft Report, September 3, 1996.

Table 9. Carcinogenic Effects: Toxicity Values and Effects of Constituents of Potential Concern

Constituent of Concern	Weight of Evidence	Oral Slope Factor $(mg/kg/day)^{-1}$	Inhalation Slope Factor $(mg/kg/day)^{-1}$	Source (Oral; Inhalation)	Tumor Site (Oral; Inhalation)
Inorganics					
Arsenic	A	1.50E+00	1.51E+01	IRIS; IRIS	skin; respiratory tract
Barium	NA	NA	NA	NA;NA	NA; NA
Beryllium	B2	4.30E+00	8.40E+00	IRIS; IRIS	total tumors; lung
Cadmium	B1	NA	6.30E+00	NA; IRIS	NA; respiratory tract
Chromium VI	A	NA	4.20E+01	NA; IRIS	NA; lung
Manganese	D	NA	NA	NA	NA; NA
Volatile Organics					
1,1-Dichloroethene	C	6.00E-01	1.75E-01	IRIS;IRIS	mutagen; lung
1,1,1-Trichloroethane	D	NA	NA	NA	NA; NA
Carbon tetrachloride	B2	1.30E-01	5.25E-02	IRIS; IRIS	liver
Tetrachloroethene	C-B2	5.20E-02	2.00E-03	ECAO; ECAO	
Semivolatile Organics					
Benzo(a)Anthracene	B2	7.30E-01	NA	EPA, 1993; NA	respiratory tract; NA
Benzo(a)Pyrene	B2	7.30E+00	NA	EPA, 1993; NA	respiratory tract; NA
Benzo(b)Fluoranthene	B2	7.30E-01	NA	EPA, 1993; NA	respiratory tract; NA
Indeno(1,2,3-cd)Pyrene	B2	7.30E-01	NA	EPA, 1993; NA	respiratory tract; NA

NA: not available
IRIS: Integrated Risk Information System (IRIS), on-line, 4th quarter 1996.
HEAST: Health Effects Assessment Summary Tables, OERR 9200.6-303 (93-1), 1995.
ECAO: USEPA Environmental Criteria and Assessment Office
EPA, 1993: Provisional guidance for quantitative risk assessment of Polycyclic Aromatic Hydrocarbons, EPA/600/R-93/089, July 1993..

Table 10. Cancer Risk Slope Factors For Radionuclides Of Potential Concern.

Radionuclide of Concern		**Increased Lifetime Cancer Risk Slope Factors**		
		Ingestion Risk/pCi	**Inhalation Risk/pCi**	**External Exposure Risk/yr-pCi/g soil**
H-3	Tritium	7.15E-14	9.59E-14	0
Co-57	Cobalt-57	9.71E-13	2.88E-12	2.07E-07
Co-60	Cobalt-60	1.89E-11	6.88E-11	9.76E-06
Sr-90	Strontium-90	5.59E-11	6.93E-11	0
Cs-137	Cesium-17	3.16E-11	1.91E-11	2.09E-06
Pb-210	Lead-210	1.01E-09	3.86E-09	1.45E-10
Ra-226	Radium-226	2.96E-10	2.75E-09	6.74E-06
Np-237	Neptunium-237	3.00E-10	3.45E-08	4.62E-07
Pr-231	Protactinium-231	1.49E-10	2.42E-08	2.71E-08
Am-241	Amercium-241	3.28E-10	3.85E-08	4.59E-09
Eu-155	Europium-155	1.65E-12	9.60E-12	6.08E-08
Mn-54	Manganese-54	1.96E-12	3.69E-12	3.26E-06
Th-228	Thorium-228	2.31E-10	9.68E-08	9.94E-07
Th-230	Thorium-230	3.75E-11	1.72E-08	4.40E-11
Th-232	Thorium-232	3.28E-11	1.93E-08	1.97E-11

Table 11. Chemical Risk Assessment: Total Cancer Risk and Hazard Index and Major Contaminants For Reasonable Maximum Exposure (RME) Scenario.

Location	Receptor	Age	Media	Total Cancer Risk Major Contaminant	Total Hazard Index (HI) Major Contaminant
CURRENT LAND USE					
On-site	Industrial worker	Adult	Soil	2×10^{-6} Arsenic	0.08 Manganese
On-site	Trespasser	Older child	Soil Sediment Surface Water	2×10^{-6} Arsenic; Benzo(a)pyrene	0.00
Off-site Plume	Resident	Adult	Groundwater	8×10^{-3} Carbon tetrachloride	200 Carbon tetrachloride; 1,1,1 TCA*
Off-site Plume	Resident	Young child	Groundwater	4×10^{-3} Carbon tetrachloride	470 Carbon tetrachloride; 1,1,1 TCA*
FUTURE LAND USE (30 years)					
On-site	Industrial worker	Adult	Soil	2×10^{-6} Arsenic	0.08 Manganese; Cadmium
On-site	Construction worker	Adult	Soil	5×10^{-8} Arsenic; Chromium VI	0.01 Arsenic, Manganese
On-site	Resident	Adult	Soil Groundwater	3×10^{-4}** Arsenic; Tetrachloroethene 1,1, Dichloroethene	3.4*** Manganese; Tetrachloroethene
On-site	Resident	Young child	Soil Groundwater	2×10^{-4}** Arsenic; Tetrachloroethene 1,1, Dichloroethene	8.5 *** Manganese; Tetrachloroethene
On-site Plume	Resident	Adult	Groundwater	6×10^{-3} PCE; Carbon tetrachloride	34 PCE; Carbon tetrachloride 1,1,1 TCA*
On-site Plume	Resident	Young child	Groundwater	2×10^{-3} PCE; Carbon tetrachloride	81 PCE; Carbon tetrachloride 1,1,1 TCA *
Off-site Plume	Resident	Adult	Groundwater	8×10^{-3} Carbon tetrachloride	200 Carbon tetrachloride; 1,1,1 TCA*
Off-site Plume	Resident	Young child	Groundwater	4×10^{-3} Carbon tetrachloride	470 Carbon tetrachloride; 1,1,1 TCA*

Note: EPA's acceptable Hazard Index is 1.0, and the acceptable cancer risk range is 1×10^{-4} to 1×10^{-6}.
* 1,1,1 TCA has no oral RfD and no HI can be calculated but concentrations offsite exceed the MCL.
**Arsenic risks are over-estimated because of conservative toxicity value. Arsenic is not considered to present a health threat and no cleanup for As is proposed.
***Manganese is not considered to present a health threat and no cleanup for Mn is proposed.

Table 12. Radiological Risk Assessment: Total Cancer Risk and Major Contaminants For Reasonable Maximum Exposure (RME) Scenario.

Location	Receptor	Age	Media	Cancer Risk Major Contaminant
CURRENT LAND USE*				
On-site	Industrial worker	Adult	Soil	4×10^{-4} Cs-137
On-site	Trespasser	Adult	Soil	4×10^{-5} Cs-137
Off-site	Resident	Adult	Groundwater	NR
FUTURE LAND USE**				
On-site	Industrial worker	Adult	Soil	1×10^{-4} Cs-137
On-site	Construction worker	Adult	Soil	2×10^{-7} Cs-137
On-site	Resident	Adult	Soil	3×10^{-4} Cs-137
On-site Plume	Resident	Adult	Groundwater	2×10^{-3} Tritium 1×10^{-4} Sr-90

Note: EPA's acceptable cancer risk range is 1×10^{-4} - 1×10^{-6}.
NR: no radionuclides of potential concern were detected in off-site groundwater
*Current land use risks are for year 1, assessment also done for years 5, 30, 50, 100, and 1000
**Future land use risks are for year 30, assessment also done for years 50, 100, and 1000.

Table 13. Ecological Constituents of Potential Concern in Environmental Media of OU III.

Constituent	Surficial Soil	Surface Water	Sediment
Inorganics			
Arsenic	X		
Beryllium	X		
Barium	X		X
Cadmium		X	
Chromium	X		
Copper	X	X	X
Lead	X		X
Mercury	X		X
Selenium	X		
Silver			X
Thallium	X		
Zinc	X		X
Semivolatile Organics			
2-Methylnaphthalene			X
Benzo(a)anthracene	X	X	X
Benzo(a)pyrene	X	X	X
Benzo(b)fluoranthene	X	X	X
Benzo(g,h,i)perylene	X	X	X
Benzo(k)fluoranthene	X	X	X
Bis(2-ethylhexyl)phthalate	X		
Butylbenzylphthalate			X
Chrysene	X	X	X
Di-n-octylphthalate			X
Dibenzofuran			X
Fluoranthene	X	X	
Fluorene			X
Indeno(1,2,3-c,d)pyrene	X	X	X
Naphthalene			X
Phenanthrene	X		X
Pyrene	X	X	X

Table 13. (cont.)

Constituent	Surficial Soil	Surface Water	Sediment
Volatile Organics			
1,1,1-Trichloroethane		X	
2-Butanone			X
4-methyl-2-pentanone			X
Acetone	X		X
Bromodichloromethane		X	
Bromoform		X	
Chloroform		X	
Chloromethane	X		
Dibromochloromethane		X	
Toluene			X
Pesticides/PCBs			
4,4'-DDE	X		
4,4'-DDT	X		
Aroclor-1260	X		
delta-BHC			X
gamma-Chlordane	X		

Table 14. VOC Remedial Alternatives

Alternative	Description	Years to RAOs	Years Active Pumping	Cost Capital/ Present Worth
V1	No Action	30+	--	$0/$0
V2	On-site In-well Air-stripping (B96)/ Off-site Natural Attenuation	30+*	--	$1,697,000/ $11,786,000
V7	On-Site In-Well Air-stripping/Off-Site In-Well Stripping With Hot Spot Containment (4 wells in RA V) and 4 Wells in Western OU III Low Level VOC Plume	30+	5	$10,814,000/ $25,598,000
V10b	On-Site In-Well Air-stripping/Off-Site In-Well Air-stripping at Hot Spots (1 well in RA V)	30	25	$9,728,000/ $23,880,000
V10c	On-Site In-Well Air-stripping/Off-Site In-Well Air-stripping With Hot Spot Containment (1 well in RA V) and 2 Wells in Western OU III Low Level VOC Plume	30	25	$10,513,000/ $25,142,000
V11	On-Site In-Well Air-stripping and Off-Site In-Well Air-stripping with no Residential Wells	30+	25	$9,142,000/ $23,615,000
V13	On-Site/Off-site Extraction and Treatment/On-Site Discharge	30+	25	$8,261,000/ $25,056,000

* Assumes Building 96 air stripping system operates for 5 years

Table 15. Strontium-90 Remedial Alternatives

Alternative	Description	Years to RAOs	Years Active Pumping	Cost Capital/ Present Worth
S1	No Action	60+	0	$0/$0
S2	Natural Attenuation	60+	0	$157,000/ $949,000
S4	In-situ precipitation/Natural Attenuation	60+	0	$1,040,000/ $2,001,000
S5a	Groundwater Extraction/Ion Exchange/On-Site Recharge/Off-site Disposal of Residual Waste	30	30 (25-30)	$1,552,000/ $5,840,000
S7	Groundwater Extraction/Ion Exchange at BGRR/Permeable Reactive Wall at Glass Holes/ Off-site Disposal of Residual Waste	30+	30 (25-30)	$2,191,000/ $6,011,000

Table 16. Tritium Remedial Alternatives

Alternative	Description	Years to RAOs	Years Active Pumping	Cost Capital/ Present Worth
T1	No Action	20-25	0	$0/$0
T2	Natural Attenuation/No IRA	20-25	0	$0/$1,997,000
T3	Natural Attenuation/ IRA	20	20	$0/ $3,257,000
T4	Natural Attenuation with Contingency Based Remediation	20-25	0/20*	$456,000/ $4,890,000
T5	Extraction/Recirculation/No IRA	15	0/15**	$853,000/ $4,802,000
T6	Continuous Hot Spot Removal/On-Site Storage/Natural Attenuation/No IRA	20	1	$1,349,000/ $3,664,000
T7	Continuous Hot Spot Removal/Off-Site Evaporation/Natural Attenuation/No IRA	20	1	$331,000/ $26,776,000
T8	Continuous Hot Spot Removal/On-Site Evaporation/Natural Attenuation/No IRA	20	1	$628,000/ $3,654,000

*Contingency alternative, cost estimates assume pumping in front of the HFBR for 2 years, pumping the tritium IRA for 20 years

** Cost estimates based on pumping at Princeton Avenue for 15 years

Table 17: Summary of Comparative Analysis of TVOC Alternatives

Assessment Factors	V1 - No Action	V2 - Natural Attenuation	V7 - On-site In-well Air Stripping/Off-site In-well Air Stripping at Hot Spots and at Brookhaven Airport	V10b - On-site In-Well Air Stripping/Off-site In-well Air Stripping at Hot Spots and at Brookhaven Airport	V10c - On-site In-well Air Stripping/Off-site In-well Air Stripping at Hot Spots and at Brookhaven Airport	V11- On-site In-well Air Stripping/Off-site In-well Air Stripping at Non-residential Areas/No Treatment at LIPA	V13- On-site and Off-site Extraction Wells with Treatment System On-site
Key Components	Regulatory requirements mandate detailed evaluation of the No Action alternative.	Source removal system using re-circulation wells with air stripping treatment near Building 96 and continued operation of on/off-site IRAs. Reduction of contaminants through naturally occurring means.	On- and off-site IRA systems and source removal system using re-circulation wells with air stripping treatment near Building 96 and on-site in-well air stripping at Middle Road. Off-site in-well air stripping wells at LIPA (1), Airport (8), North St. (3), North St. East (1) and the western low-level VOC plume (4). Monitoring and natural attenuation	On- and off-site IRA systems and source removal system using re-circulation wells with air stripping treatment near Building 96 and on-site in-well air stripping at Middle Road. Off-site in-well air stripping wells at Industrial Park (1), LIPA (3), Airport (7), North St. (4), and North Street East (1). Monitoring and natural attenuation	On-site and off-site IRA systems, including the On-Site Southern Boundary IRA and the Off-Site Industrial Complex IRA, and source removal system using re-circulation wells with air stripping treatment near Building 96. Installation of new in-well air stripping systems at the Industrial Park (1), LIPA (3), Airport (7), North St. (4), North Street East (1), an additional treatment system on-site at Middle Road, and either in-well air stripping and/or expansion of the existing on-site pump & treat system for the Western low-level VOC plume (2). Monitoring and natural attenuation	On- and off-site IRA systems and source removal system using re-circulation wells with air stripping treatment near Building 96 and on-site in-well air stripping at Middle Road. Off-site in-well air stripping wells at Industrial Park (1), Airport (10), North St. (3), and North Street East(1). No treatment at LIPA. Monitoring and natural attenuation	On- and off-site IRA systems and source removal system using re-circulation wells with air stripping treatment near Building 96 and on-site extraction well at Middle Road. On- and off-site extraction wells at Industrial Park (1), LIPA (3), Airport (7), North St. (4), and North Street East (1). Monitoring and natural attenuation
Short-Term Effectiveness	Provides short-term protection of human health and the environment. Remedial action objectives cannot be achieved.	Potential risk to workers through dermal contact and inhalation.	Potential risk to workers through dermal contact and inhalation.	Potential risk to workers through dermal contact and inhalation.	Potential risk to workers through dermal contact and inhalation.	Potential risk to workers through dermal contact and inhalation.	Potential risk to workers through dermal contact and inhalation.
Long-Term Effectiveness	Contaminants may continue to migrate and possibly impact downgradient receptors including Carmans River at 5-15 ppb. Health risks have been minimized through institutional controls like public water hookups Since no long term monitoring and modeling are available, long-term effectiveness cannot be ensured.	Significant contaminant removal from the aquifer through on/off site IRAs and source control. Long term monitoring and modeling will verify long-term effectiveness.	Significant contaminant removal from the aquifer through on/off site IRAs and source control. Long term monitoring and modeling will verify long-term effectiveness	Significant contaminant removal from the aquifer through on/off site IRAs and source control. Long term monitoring and modeling will verify long-term effectiveness	Significant contaminant removal from the aquifer through on/off site IRAs and source control. Long term monitoring and modeling will verify long-term effectiveness	Significant contaminant removal from the aquifer through on/off site IRAs and source control. Long term monitoring and modeling will verify long-term effectiveness	Significant contaminant removal from the aquifer through on/off site IRAs and source control. Long term monitoring and modeling will verify long-term effectiveness
Reduction of Toxicity, Mobility and Volume	No direct reduction of contaminant toxicity, mobility or volume since no treatment is involved. Plume migrates down to Sunrise Highway at concentrations up to 50 ppb. Significant plume migration occurs offsite in this alternative.	Natural attenuation does result in reduction of contaminants through naturally occurring means, but the process is slow. Plume migrates down to Sunrise Highway at concentrations up to 50 ppb. Significant plume migration occurs offsite in this alternative.	Significant contaminants removed from aquifer. MCLs are reached in Upper Glacial in slightly over 30 years. Plume migration down to Brookhaven Airport (6,000 feet).	Significant contaminants removed from aquifer. MCLs are reached in Upper Glacial in 30 years. Alternative meets RAOs for plume growth and cleanup of Upper Glacial within 30 years.	Significant contaminants removed from aquifer. MCLs are reached in Upper Glacial in 30 years. Alternative meets RAOs for plume growth and and cleanup of Upper Glacial within 30 years.	Significant contaminants removed from aquifer. MCLs are reached in Upper Glacial in slightly over 30 years.	Significant contaminants removed from aquifer. MCLs are reached in Upper Glacial in 30 years. Alternative meets RAOs for plume growth and and cleanup of Upper Glacial within 30 years.
Implementability	No technical difficulties will be experienced.	No major construction involved. Construction of off-site IRA and source removal system should pose no difficulties.	Requires the installation of wells in residential areas (LIPA, North St.). Requires access for installation of North Street East wells on private property.	Requires the installation of wells in residential areas (LIPA, North St.). Requires access for installation of North Street East wells on private property.	Requires the installation of wells in residential areas (LIPA, North St.). Requires access for installation of North Street East wells on private property.	Requires access for installation of North Street East wells on private property. Less difficult to implement due to the lack of wells in residential areas.	Requires the installation of wells in residential areas (LIPA, North St.). Requires access for installation of North Street East wells on private property. Requires the installation of piping throughout residential neighborhood. Requires installation of piping under the Long Island Expressway and railroad tracks.
Cost - Capital/ Total Present Worth	$0.00/$0.00	$1,697,000/$11,786,000	$10,814,000/$25,598,000	$9,728,000/$23,880,000	$10,513,000/$25,142,000	$9,142,000/$23,615,000	$8,261,000/$25,056,000
Compliance with ARARs	Chemical specific ARARS will not be achieved.	ARARS will not be achieved in 30 years in the aquifer.	ARARS will not be achieved in 30 years because MCLs will still be exceeded at small areas near the airport.	ARARS are met within Upper Glacial aquifer within 30 years.	ARARS are met within Upper Glacial aquifer within 30 years.	ARARS are met within Upper Glacial aquifer slightly after 30 years.	ARARS are met within Upper Glacial aquifer within 30 years.
Overall Protection of Human Health and the Environment	This alternative will not protect human health and the environment. Possible receptors to be impacted by the VOC plume include the Carmans River. Risks have been minimized through public water hookups	The IRAs provide for the protection of human health and the environment by capturing the high-level VOCs on- and off-site. The source removal will prevent any further deterioration of the aquifer. VOCs will continue to migrate and impact the Carmans River within 30 years, but at low levels (5-15 ppb). Contaminants will continue migrating off-site, down to Sunrise Highway at concentrations exceeding 50 ppb.	Will protect human health and the environment through contaminant reduction both on- and off-site. Further plume migration and discharges to the Carmans River are reduced. MCLs are reached in the Upper Glacial aquifer in slightly over 30 years.	Will protect human health and the environment through contaminant reduction both on- and off-site. MCLs are reached in the Upper Glacial aquifer in 30 years.	Will protect human health and the environ-ment through contaminant reduction both on- and off-site. Further plume migration and discharges to the Carmans River are reduced. MCLs are reached in the Upper Glacial aquifer in 30 years. Low level VOC migration and discharge to the Carmans River has been reduced.	Will assist in protection of human health and the environment through contaminant reduction both on- and off-site. MCLs are reached in the Upper Glacial aquifer in slightly over 30 years. Provides for less protection against plume growth and migration but easier to implement due to no wells located in residential areas.	Will assist in protection of human health and the environment through contaminant reduction both on- and off-site. MCLs are reached in the Upper Glacial aquifer in 30 years.
State Acceptance					General State acceptance.		
Community Acceptance					General community acceptance. See the Responsiveness Summary in this document for more details.		

Table 18: Summary of Comparative Analysis of Strontium Alternatives

Assessment Factors	S1 - No Action	S2 - Natural Attenuation		S4 - In-situ Precipitation	S5a - Groundwater Extraction/ Ion Exchange/On-site Discharge/ Natural Attenuation	S7 -Pump-andTreat at WCF/Reactive Wall at Glass Holes
Key Components	Regulatory requirements mandate the detailed evaluation of the No Action alternative.	Reduction of contaminants through natural means. Public awareness program and long-term monitoring. Installation of additional monitoring wells to monitor the degradation of the strontium-90 plume. Institutional controls.		Immobilize Sr-90 by the injection of sodium phosphate and lime to precipitate the Sr-90 from groundwater. Instituional controls.	Installation of a Groundwater Extraction/Ion Exchange system to capture Sr-90 plumes at WCF/PFS and Chemical Holes and discharge to on-site recharge basins.	Installation of a two-well extraction system, treatment via ion exchange, and discharge to a basin for the WCF/PFS Sr-90 plume. Installation of a barrier wall at the Chemical Holes to prevent migration of Sr-90. Institutional controls.
Short-Term Effectiveness	No impacts.	Potential risks to workers during drilling of monitoring wells, material handling and sampling activities.		Potential risks to workers during drilling of injection wells, material handling and sampling activities.	Potential risk to workers through dermal contact and inhalation.	Potential risk to workers through dermal contact and inhalation.
Long-Term Effectiveness	Cannot verify the long-term effectiveness without long-term monitoring and modeling. Strontium present in aquifer above MCLs beyond 30 years.	Minimal migration expected due to low mobility in aquifer Long-term effectiveness is verified by long term monitoring and modeling results.		Reduces the migration of Sr-90 within the aquifer. However, due to low mobility and flat gradient at Chemical Holes, Sr-90 migrates very little under natural attenuation conditions. Effective for the Chemical Holes area, preventing migration of the plume.	Complete treatment after 25-30 years of treatment down to MCLs at WCF/PFS. Complete treatment at Chemical Holes after 10 years. Rad waste from the ion exchange system will need to be disposed of.	Complete treatment after 25-30 years of treatment down to MCLs at WCF/PFS. Complete treatment at Chemical Holes after 10 years. Rad waste from the ion exchange system will need to be disposed of. Sr-90 at Chemical Holes allowed to decay in-situ without any plume migration.
Reduction of Toxicity, Mobility and Volume	No direct reduction since no treatment is involved.	Natural attenuation results in reduction of toxicity and volume without significant migration.		Mobility of the strontium-90 is reduced by the precipitation of the strontium-90. Radio-active decay will reduce toxicity and volume.	A permanent reduction down to the 8 pCi/l MCL is achieved at all areas after 25-30 years resulting in the reduction of toxicity. Mobility and plume growth is reduced at the Chemical Holes area.	A permanent reduction down to the 8 pCi/l MCL is achieved at all areas after 25-30 years resulting in the reduction of toxicity. Mobility and plume growth is reduced at the Chemical Holes area.
Implementability	No technical difficulties will be experienced.	No major construction involved. Requires monitoring which can be easily implemented.		Drilling contractors readily available. Injection wells are shallow wells. A pilot study is required for final design. Sampling for treatment effectiveness and groundwater monitoring can be implemented.	Treatment equipment readily available. A treatability study is required for final design. Sampling for treatment effectiveness and ground-water monitoring can be implemented.	Pump and treat equipment readily available and implementable. Reactive wall may be difficult to install.
Cost - Capital/ Total Present Worth	$0.00/$0.00	$157,000/$949,000		$1,040,000/$2,001,000	$1,552,000/$5,840,000	$2,191,000/$6,011,000
Compliance with ARARs	Groundwater quality ARARS are not achieved at the Chemical Holes, WCF and BGRR in 30 years.	Groundwater quality ARARS are not achieved at the Chemical Holes, WCF and BGRR in 30 years. RAOs are not met as Sr-90 exceeds MCLs after 30 years.		Groundwater quality ARARS may be met as Sr-90 is removed from the groundwater into the soil matrix, but not removed from the environment.	Chemical-specific ARARS of 8 pCi/l are reached at all locations within 25-30 years. Treated discharge will comply with action-specific ARARs. Ion exchange is a proven technology for Sr-90 removal.	Chemical-specific ARARS of 8 pCi/l are reached at all locations within 25-30 years. Reactive wall will remove Sr-90 down to below MCLs as water passes through for approximately 30 years. Sr-90 remains in ground beyond 30 years as it decays
Overall Protection of Human Health and the Environment	Does not insure	Provides for protection of human health through public awareness programs, land-use controls, and on-site monitoring.		This alternative is protective of human health and the environment as Sr-90 is treated in-situ without the potential exposure to Sr-90 associated with ex-situ alternatives.	This alternative will protect human health and the environment through contaminant reduction, and minimize further migration of Sr-90. Potential exposure to Sr-90 will increase due to O&M activities for the treatment systems and the manage-ment, transportation and disposal of residual waste.	Potential exposure to Sr-90 has increased in this alternative due to O&M activities for the treatment systems and the management, transportation and disposal of residual waste. Risks would be reduced as a result of less teatment at the Chemical Holes.
State Acceptance					General State acceptance.	
Community Acceptance					General community acceptance. See the Responsiveness Summary in this document for more details.	

Table 19: Summary of Comparative Analysis of Tritium Alternatives

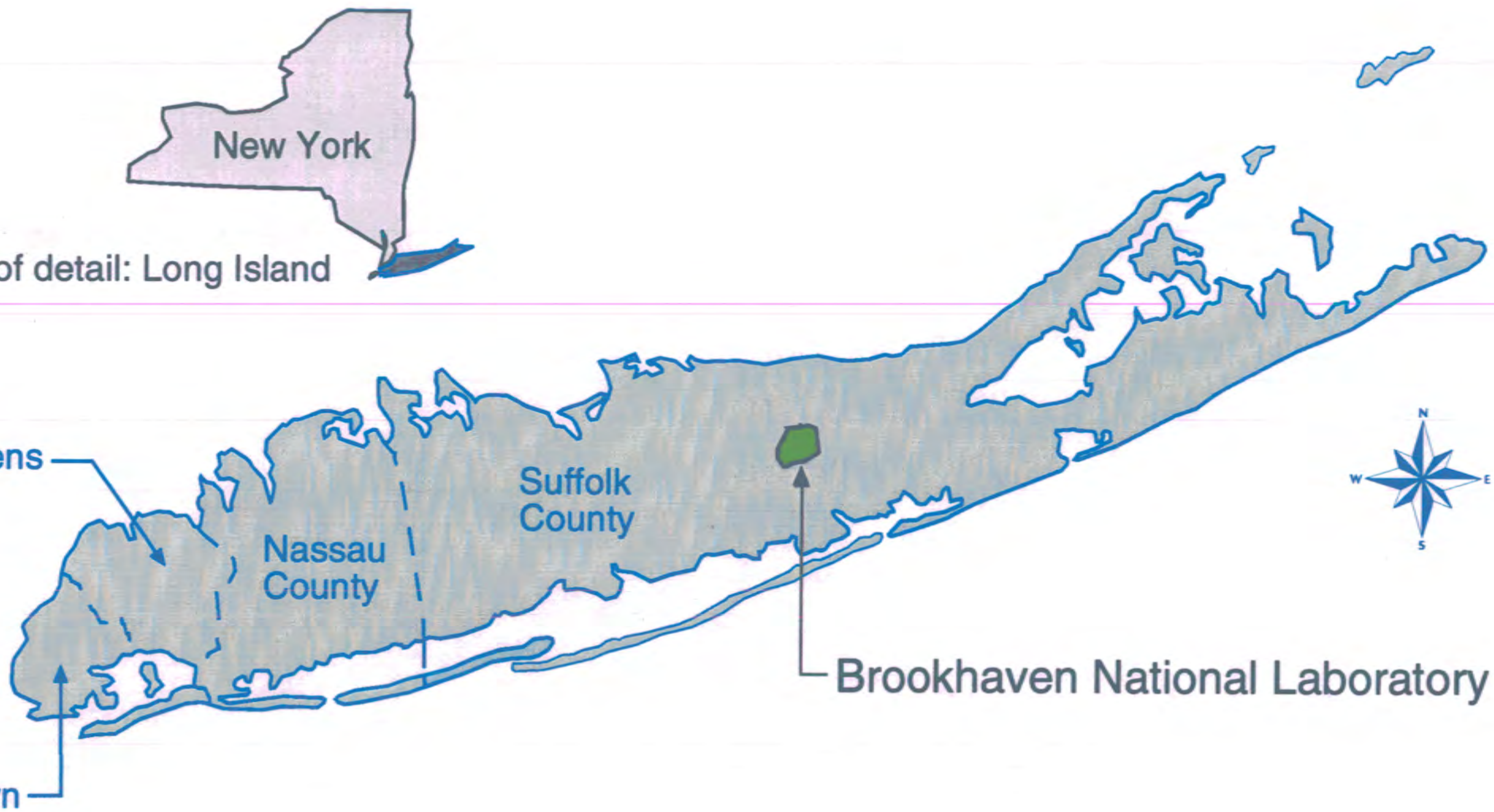
Assessment Factors	T1 - No Action	T2 - Natural Attenuation	T3 - Natural Attenuation with Tritium IRA System	T4 - Contingency Based Remediation	T5 - Extraction/ Recirculation	T6 - Hot Spot Removal/ On-Site Storage	T7 - Hot Spot Removal/ Off-Site Evaporation T8 - Hot Spot Removal/ On-Site Evaporation
Key Components	Regulatory requirements mandate detailed evaluation of the No Action alternative.	Reduction of contaminants through naturally occurring means with the existing Tritium IRA in standby. Groundwater monitoring.	Reduction of contaminants through naturally occurring means with the existing Tritium IRA. Groundwater monitoring.	Contingency based remediation if tritium concentrations exceed 2,000,000 pCi/l at the reactor, or if tritium exceeds 25,000 pCi/l at the Chilled Water Plant Road and/or 20,000 pCi/l at Weaver Drive. Remediation based on reactivation of IRA system or start-up of 10 extraction well low flow pumping systems with off-site disposal.	Installation of four extraction wells to contain the 20,000 pCi/l tritium concentrations. Extracted water will have TVOCs removed via air stripper and discharged to RA-V recharge basins. Tritium IRA in standby. Groundwater monitoring.	Contain the highest tritium concentrations with two low flow extraction wells pumping for one year. Extracted water will be stored in an on-site storage tank for 50 years. Tritium IRA in standby. Groundwater monitoring.	Both alternatives contain the highest tritium concentrations with two low flow extraction wells pumping for one year. T7- Extracted water will be disposed of off-site by evaporation. T8- Extracted water will be disposed of on-site by evaporation. Tritium IRA in standby. Groundwater monitoring.
Short-Term Effectiveness	This alternative would provide for short-term protection of human health and the environment. Remedial action objectives cannot be achieved.	Possible risk to workers exists through dermal contact.	Possible risk to workers exists through dermal contact.	Potential risk to workers through dermal contact and inhalation.	Potential risk to workers through dermal contact and inhalation.	Potential risk to workers through dermal contact and inhalation.	Potential risk to workers through dermal contact and inhalation.
Long-Term Effectiveness	Long-term effectiveness cannot be verified without long-term monitoring and modeling results.	Tritium plume size and levels will decrease to below MCLs within 20-25 years. Plume does not significantly migrate. No long-term exposure to residuals.	Tritium plume size and levels will decrease to below MCLs within 20-25 years. Plume does not significantly migrate. No advantage to the operation of the IRA system. No long-term exposure to residuals. Carbon for the treatment of VOCs can be regenerated and re-used.	Tritium plume size and levels will decrease to below MCLs within 20-25 years. Plume does not significantly migrate. No long-term exposure to residuals. Carbon for the treatment of VOCs can be regenerated and re-used.	Tritium plume size and levels will decrease to below MCLs within 15-20 years. Plume does not migrate off site. No long-term exposure to residuals.	Tritium plume size and levels will decrease to below MCLs within 20 years. Plume does not migrate off site. Possible exposure to stored tritium for up to 50 years.	Tritium plume size and levels will decrease to below MCLs within 20 years. Plume does not migrate off site. Possible off-site exposure to evaporated tritium, below air discharge limits.
Reduction of Toxicity, Mobility and Volume	Some reduction of tritium achieved, but cannot be evaluated without monitoring and modeling results.	Tritium concentrations are reduced to be below MCL concentrations within 20-25 years. Further groundwater sampling and modeling will confirm the rate of attenuation.	Tritium concentrations are reduced to below MCL concentrations within 20-25 years. Further groundwater sampling and modeling will confirm the rate of attenuation.	This alternative offers additional protection from plume migration. Tritium concentrations are reduced to below MCL concentrations within 20-25 years. Further groundwater sampling and modeling will confirm the rate of attenuation.	Tritium concentrations are reduced to below MCL concentrations within 15-20 years. Further groundwater sampling and modeling will confirm the rate of attenuation. No great reduction in migration when compared to T2.	Tritium concentrations are reduced to below MCL concentrations within 20 years. Further groundwater sampling and modeling will confirm the rate of attenuation. No great reduction in migration when compared to T2.	Tritium concentrations are reduced to below MCL concentrations within 20 years. Further groundwater sampling and modeling will confirm the rate of attenuation. No great reduction in migration when compared to T2.
Implementability	No technical difficulties will be experienced.	No major construction involved. Groundwater monitoring can be easily implemented. Requires acceptance by regulatory agencies.	No major construction involved. IRA system is currently in operation. Groundwater monitoring can be easily implemented.	No major construction involved. IRA system is currently in operation. The technologies and equipment required are readily proven and commercially available. Coordination for transportation of tritium might pose some difficulties. Groundwater monitoring can be easily implemented.	The technologies and equipment required are readily proven and commercially available. Groundwater monitoring can be easily implemented.	The technologies and equipment required are readily proven and commercially available. Groundwater monitoring can be easily implemented.	The technologies and equipment required are readily proven and commercially available. Groundwater monitoring can be easily implemented. Permitting difficulties with approvals for the discharge of tritium to the atmosphere.
Cost - Capital/ Total Present Worth	$0.00/$0.00	$0.00/$1,997,000	$0.00/$3,257,000	$456,000/$4,890,000	$853,000/$4,802,000	$1,349,000/$3,669,000	T7- $331,000/$26,776,000 T8- $628,000/$3,654,000
Compliance with ARARs	May not comply.	Complies after 20-25 years.	Complies after 20-25 years.	Complies after 20-25 years.	Complies after 15-20 years.	Complies after 20 years.	Complies after 20 years.
Overall Protection of Human Health and the Environment	May not be protective of human health and the environment.	Protective: Groundwater is reduced to below MCLs without migrating off site.	Protective: Groundwater is reduced to below MCLs without migrating off site.	Protective: Groundwater is reduced to below MCLs without migrating off site. Tritium requiring off-site evaporation will result in small exposures.	Protective: Groundwater is reduced to below MCLs without migrating off site.	Protective: Groundwater is reduced to below MCLs without migrating off site.	Protective: Groundwater is reduced to below MCLs without migrating off site. Tritium requiring on- and off-site evaporation will result in small exposures.
State Acceptance				General State acceptance.			
Community Acceptance				General community acceptance. See the Responsiveness Summary in this document for more details.			

Table 20

SUMMARY OF ESTIMATED COSTS ($000)*

Alternative	Description	Capital Cost	O&M Cost Present Worth	Total Cost Present Worth
Site-Wide Groundwater Contaminated with Volatile Organic Compounds				
V1	No Action	$0	$0	$0
V2	Natural Attenuation	$1,697	$10,089	$11,786
V7	On-Site In-Well Air-stripping/Off-Site In-Well Air-stripping With Hot Spot Containment (4 wells in RA V) and 4 Wells in Western OU III Low Level VOC Plume	$10,814	$14,784	$25,598
V10b	On-Site In-Well Air-stripping/Off-Site In-Well Air-stripping at Hot Spots (1 well in RA V)	$9,728	$14,152	$23,880
V10c	On-Site In-Well air-stripping/Off-Site In-Well Air-stripping With Hot Spot Containment (1 well in RA V) and 2 Wells in the Western OU III Low Level VOC Plume	$10,513	$14,629	$25,142
V11	On-Site In-Well Air-stripping/Off-Site In-Well Air-stripping at Hot Spots	$9,142	$14,473	$23,615
V13	On-Site/Off-site Extraction and Treatment/On-Site Discharge	$8,261	$16,795	$25,056
On-Site Groundwater Contaminated with Strontium				
S1	No Action	$0	$0	$0
S2	Natural Attenuation	$157	$792	$949
S4	In Situ Precipitation/Natural Attenuation	$1,040	$961	$2,001
S5a	Groundwater Extraction/Ion Exchange/On-Site Discharge	$1,552	$4,288	$5,840
S7	Extraction and Treatment at BGRR/Permeable Reactive Wall at Glass Holes	$2,190	$3,820	$6,011
On-Site Groundwater Contaminated with Tritium				
T1	No Action	$0	$0	$0
T2	Natural Attenuation/No Interim Removal Action (IRA)	$0	$1,997	$1,997
T3	Natural Attenuation/IRA	$0	$3,257	$3,257
T4	Natural Attenuation with Contingency Based Remediation	$456	$4,434	$4,890
T5	Extraction/Recirculation/No IRA	$853	$3,949	$4,802
T6	Low Flow Pumping, Hot Spot Removal/On-Site Storage/Natural Attenuation/No IRA	$1,349	$2,320	$3,669
T7	Low Flow Pumping, Hot Spot Removal/Off-Site Evaporation/Natural Attenuation/No IRA	$331	$26,445	$26,776
T8	Low Flow Pumping, Hot Spot Removal/On-Site Evaporation/Natural Attenuation/No IRA	$628	$3,026	$3,654

* Cost estimates typically provide an accuracy of +50% to -30%.



Prepared By:
Environmental Restoration Division
Brookhaven National Laboratory

Figure 1
Regional Site Location Map

Modified by: P. Genzer, C. Lafon (BNL)

Date: 12/23/98

Prepared By:

Environmental Restoration Division
Brookhaven National Laboratory

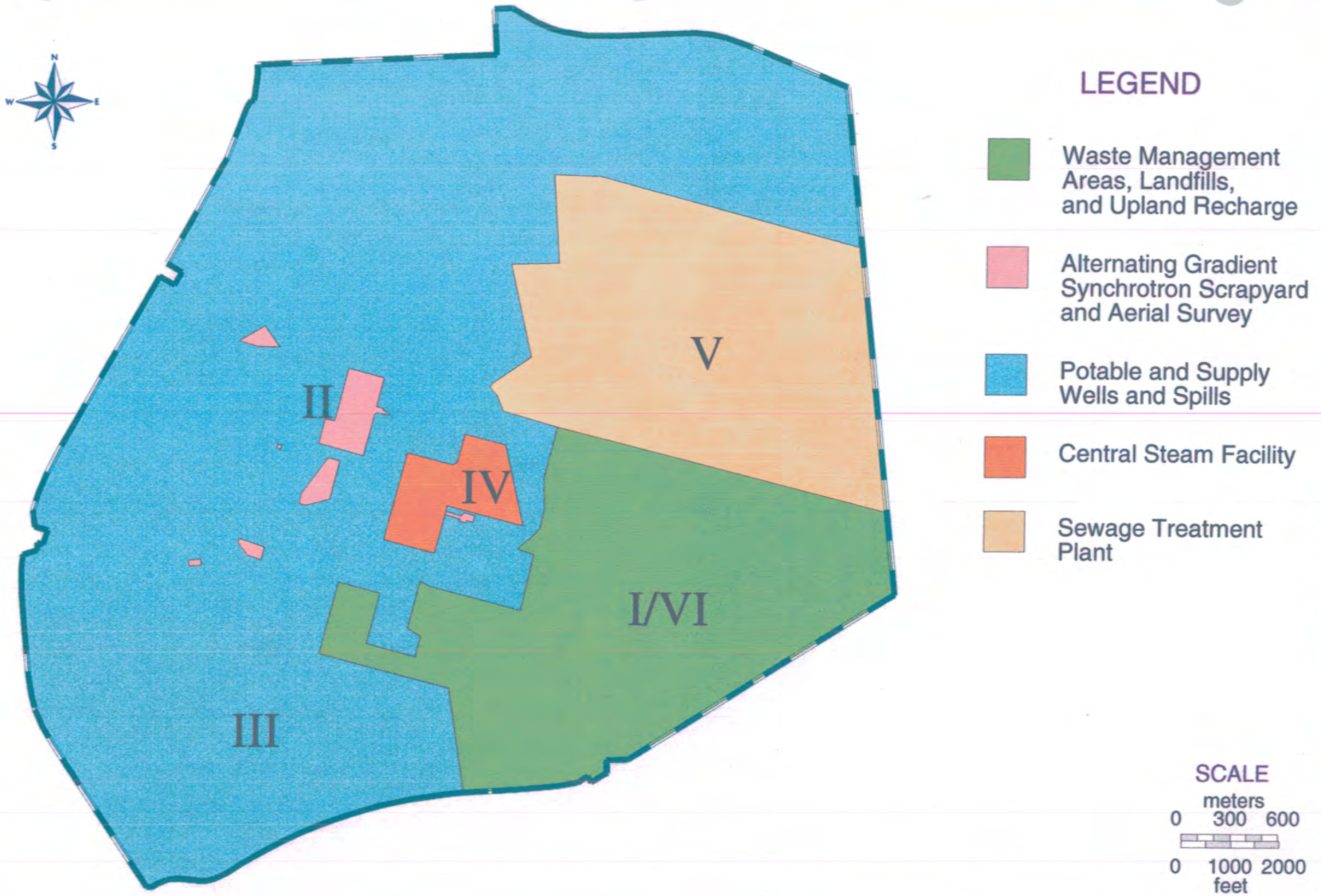
Figure 2
Current Land Use at BNL

Created by: M. Daum (BNL-ERD)

Date: 1/4/99

Program: /home4/oeraml/sitelu.aml

Graphics File: OU III/ROD/Fig 2 - land use



Prepared By:

Environmental Restoration Division
Brookhaven National Laboratory

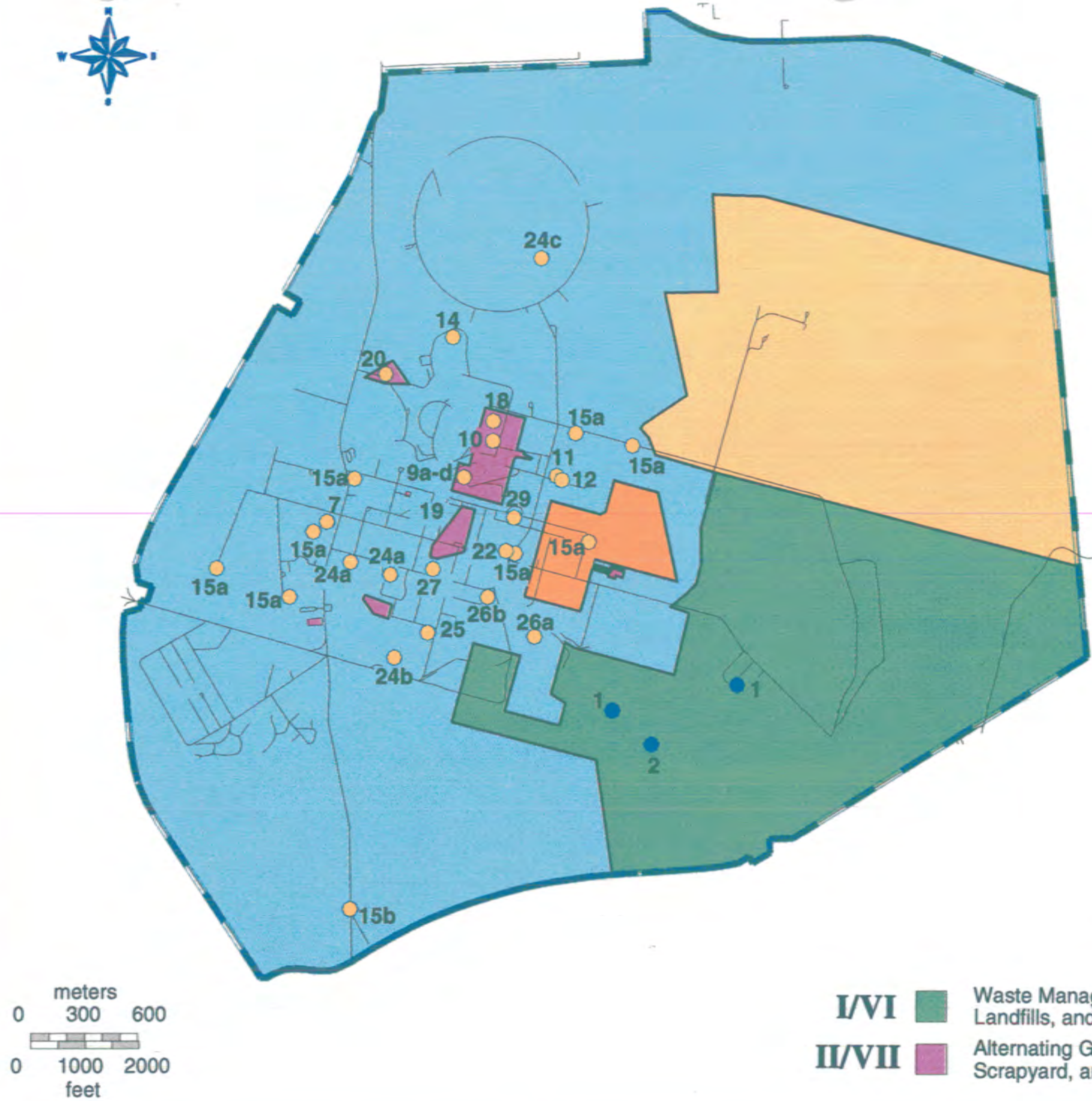
Figure 3
BNL Operable Units

Created by: M. Daum (BNL-ERD)

Date: 1/4/99

Program: /home4/oeraml/ou-vg.aml

Graphics File: OU III/ROD/Fig 3 - OUs



● **AREAS OF CONCERN**

7	Paint Shop
9	Brookhaven Graphite Reactor
9a	Canal
9b	Underground Duct Work
9c	Spill Sites
9d	Pile Fan Sump
10	Waste Concentration Facility
11	Building 830 Pipe Leak
12	Building 830 USTs
14	Bubble Chamber Spill Area
15a	Potable/Supply Wells
15b	Monitoring Well 130-02
18	AGS Scrapyard (Boneyard)
19	Building T-111 TCE Spill Area
20	Particle Beam Dump, North End of Linear Accelerator
21	Leaking Sewer Pipes (not shown)
22	Old Firehouse
24a	Process Supply Wells 104, 105
24b	Recharge Basin HP
24c	Recharge Basin HN
25	Building 479
26a	Building 208
26b	Building 96
27	Building 464
29	HFBR Spent Fuel Pool and Tritium Groundwater Plume

● **ADDITIONAL AREAS OF INVESTIGATION**

1	OU I Former Landfill (Glass Holes) and Hazardous Waste Management Facility
2	OU I/IV Groundwater Investigation

Operable Units

I/VI	Waste Management Areas, Landfills, and Upland Recharge
II/VII	Alternating Gradient Synchrotron, Scrapyard, and Aerial Survey
III	Potable and Supply Wells and Spills
IV	Central Steam Facility
V	Sewage Treatment Plant

Prepared By:

Environmental Restoration Division
Brookhaven National Laboratory

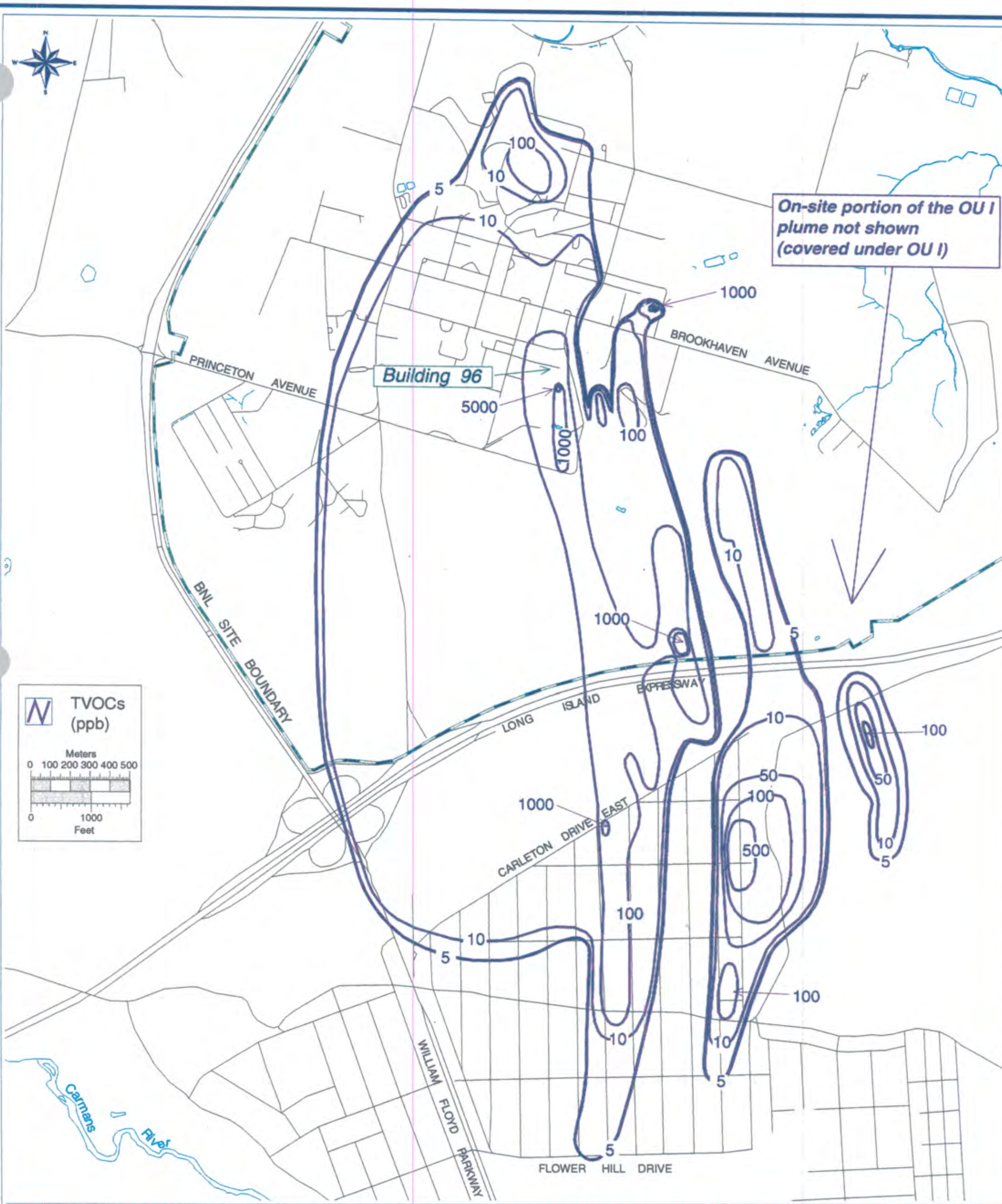
Figure 4
AOCs and AAIs Addressed In This Record Of Decision

Created by: M. Daum (BNL-ERD)

Date: 8/18/99

Program: [mygis]/ou3/ou3_aoc.aml

Graphics File:
OU III/ROD/Fig 4 - AOCs Rev. 1



Prepared By:

Environmental Restoration Division
Brookhaven National Laboratory

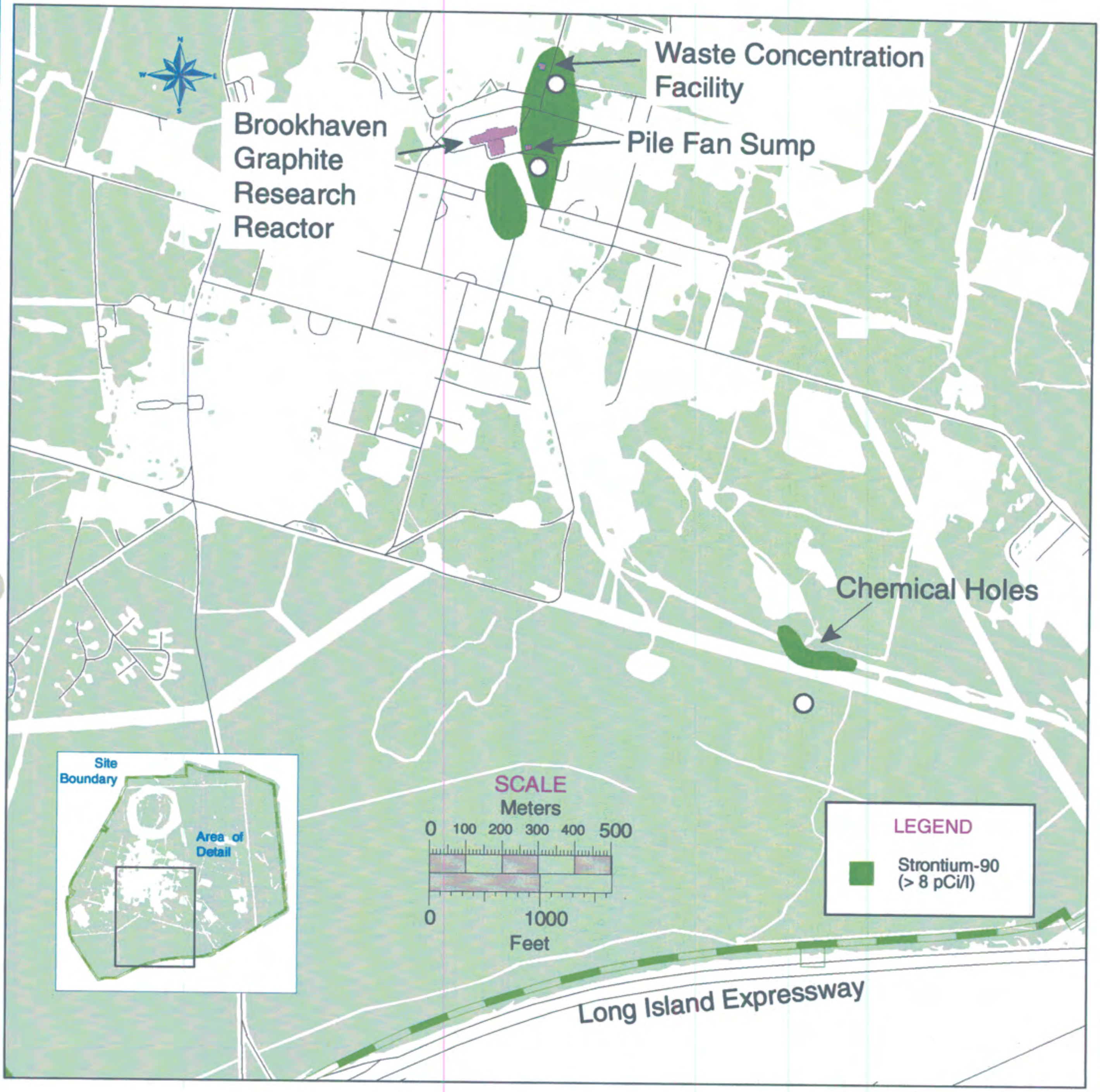
Figure 5
Areal Extent of TVOC Contamination in Groundwater

Created by: M. Daum (BNL-ERD)

Date: 1/4/99 Revised: 1/27/99

Program: [mygis]/ou3/rod_plumes.aml

Graphics File: OU III/ROD/Fig 9 - plumes Rev. 2

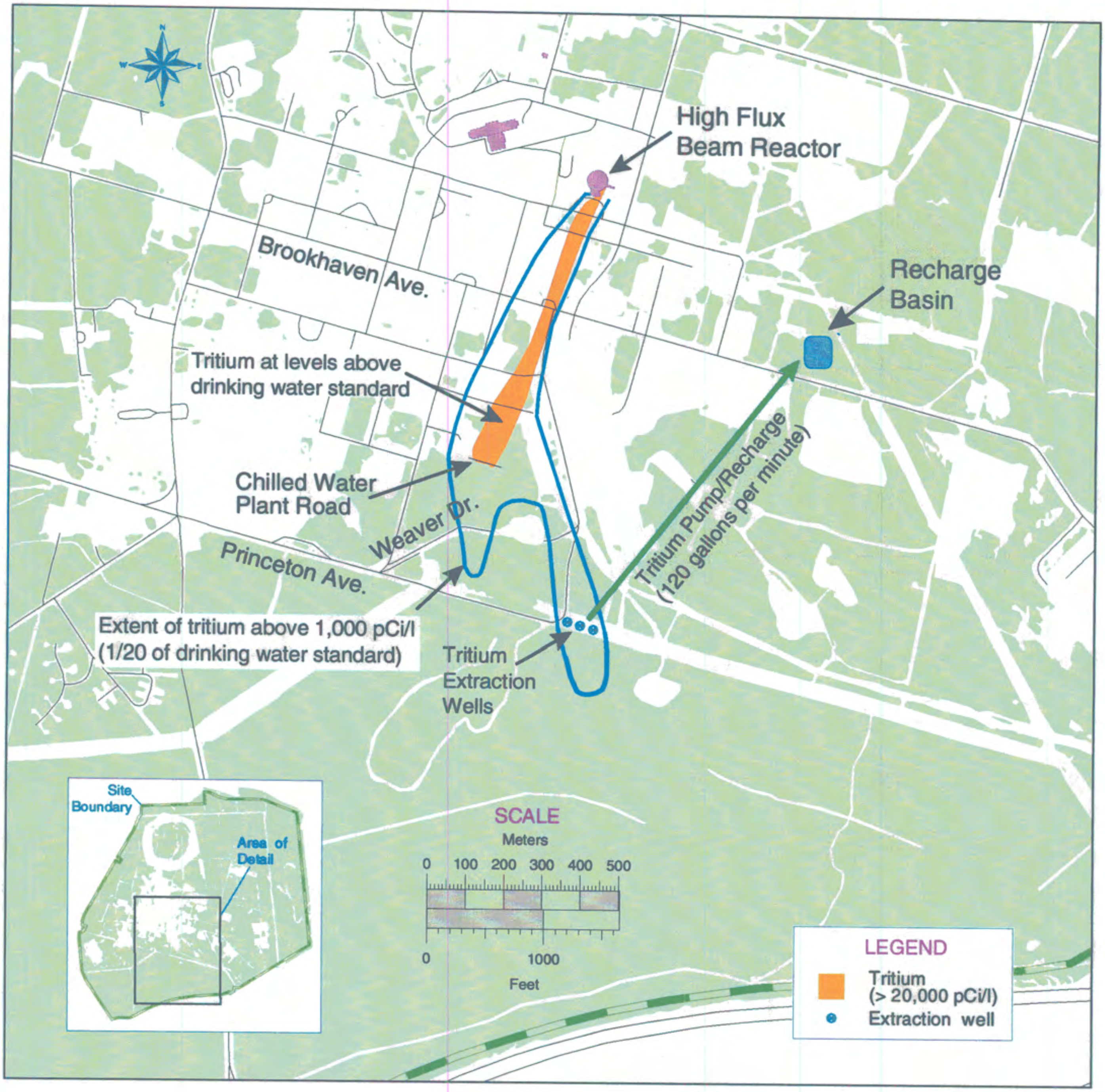


Prepared By:
Environmental Restoration Division
Brookhaven National Laboratory

Figure 6
Areal Extent of Strontium-90 Contamination in Groundwater

Modified by:
P. Genzer, C. Lafon (BNL)

Date: 12/23/98



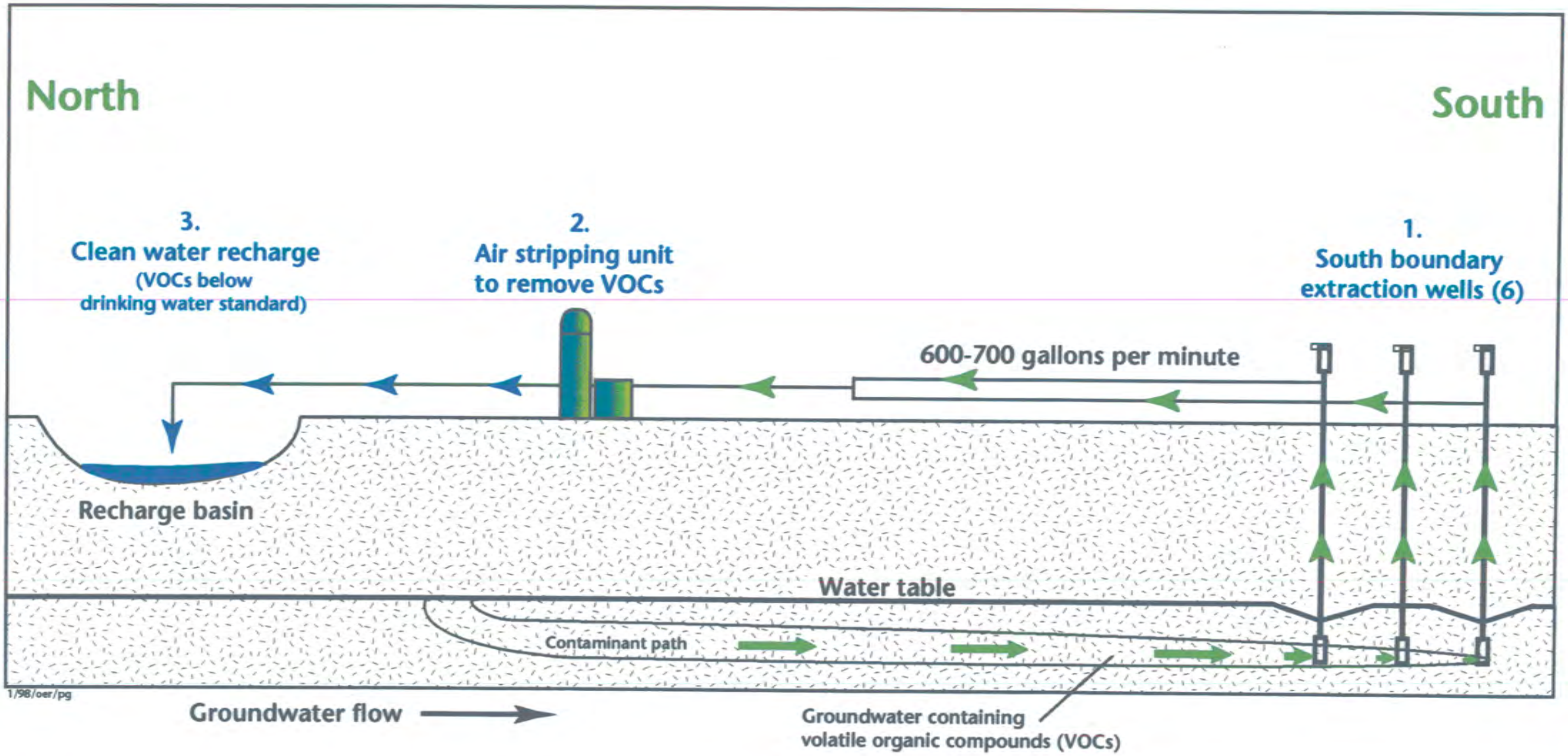
Prepared By:

Environmental Restoration Division
Brookhaven National Laboratory

Figure 7
Areal Extent of Tritium Contamination in Groundwater

Modified by:
P. Genzer, C. Lafon (BNL)

Date: 12/23/98

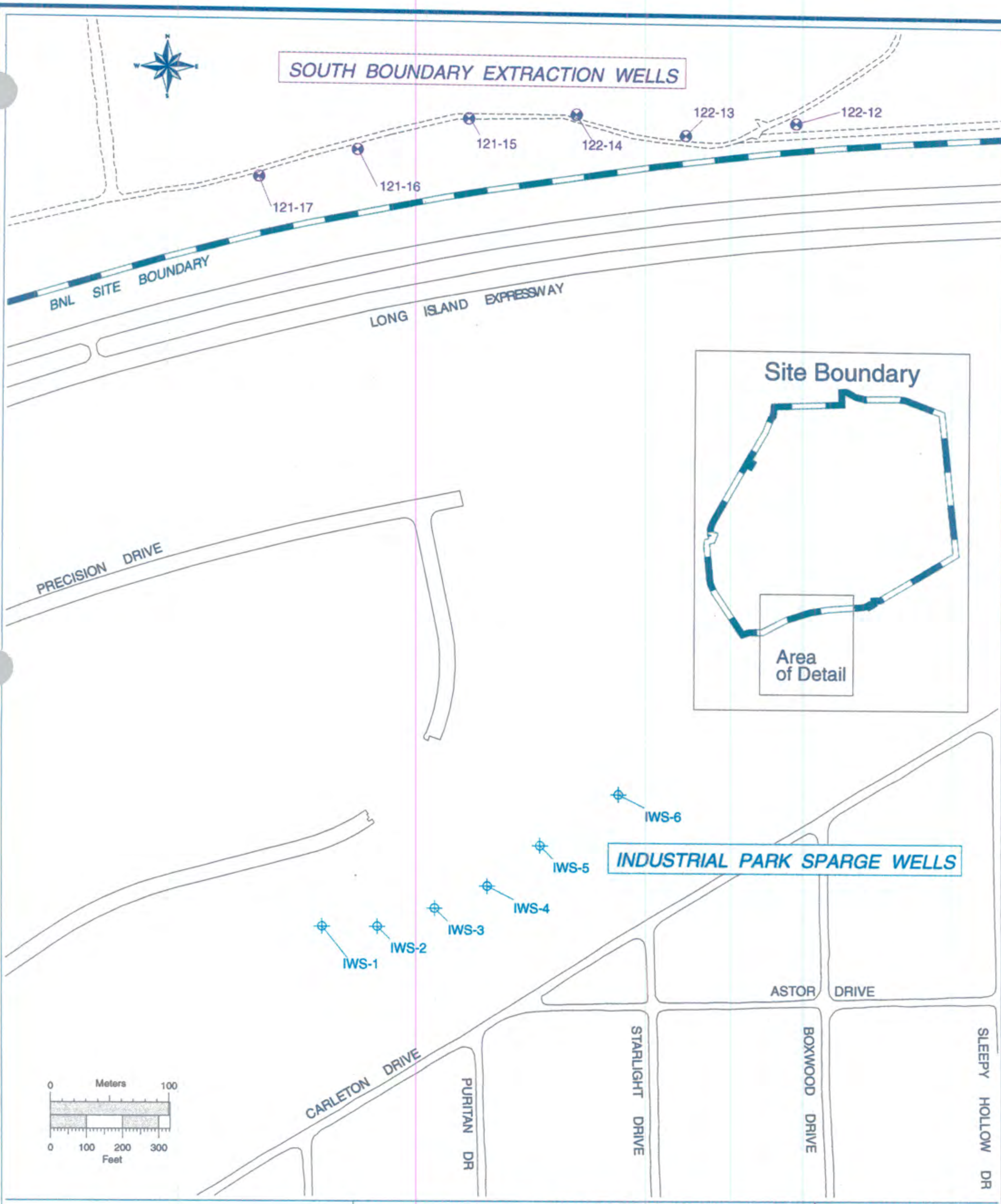


Prepared By:
Environmental Restoration Division
Brookhaven National Laboratory

Figure 8
South Boundary Pump-and-Treat System Schematic

Modified by: P. Genzer, C. Lafon (BNL)

Date: 12/23/98



Prepared By:

Environmental Restoration Division
Brookhaven National Laboratory

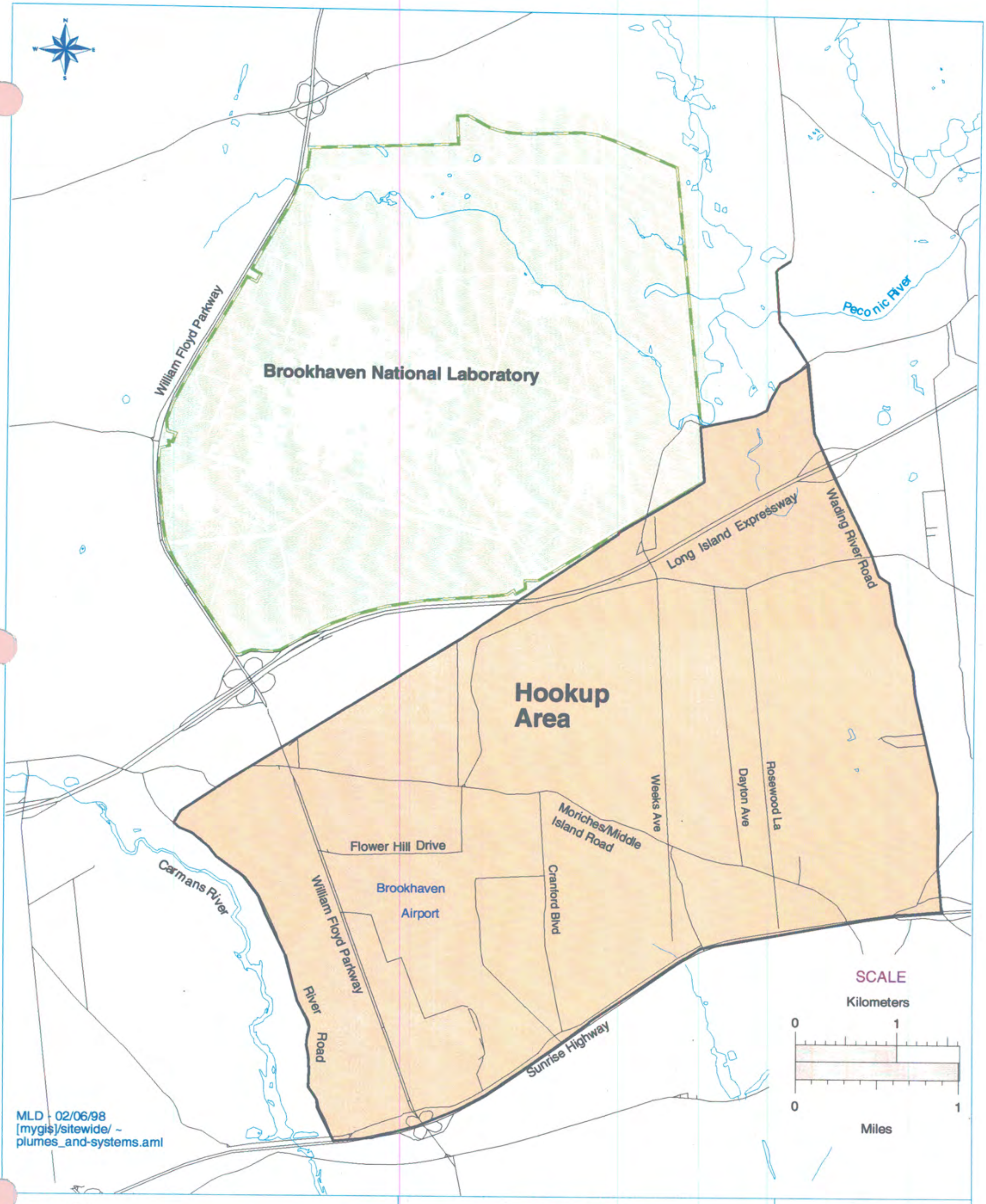
Figure 9
Southern Boundary and Industrial Complex Interim Removal Action TVOC Treatment Well Locations

Created by: M. Daum (BNL-ERD)

Date: 1/4/99

Program: [mygis]/ou3/rod_treatment.aml

Graphics File: [ALH-oernt] OU III/ROD/ Fig 9 - treatment



Prepared By:

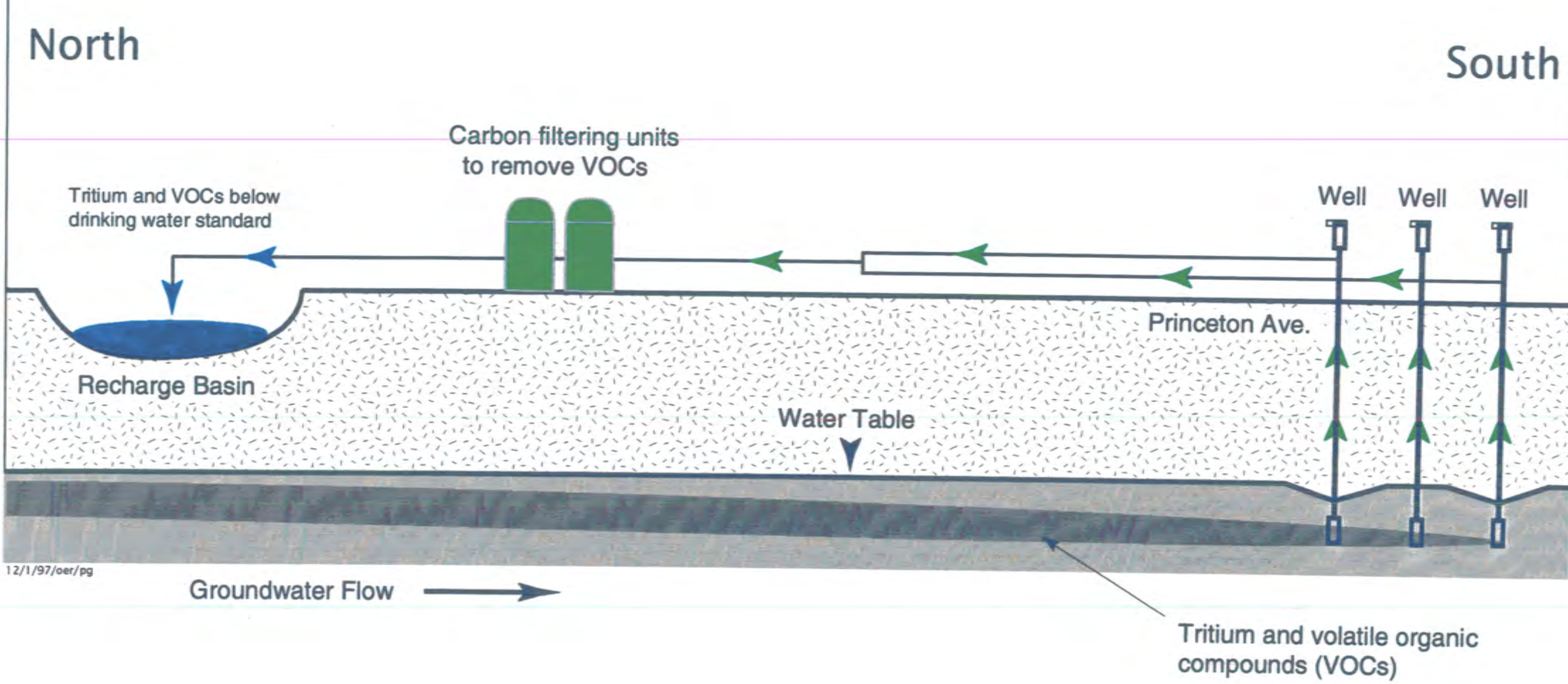
Environmental Restoration Division
Brookhaven National Laboratory

Figure 10
Public Water Hookup Areas

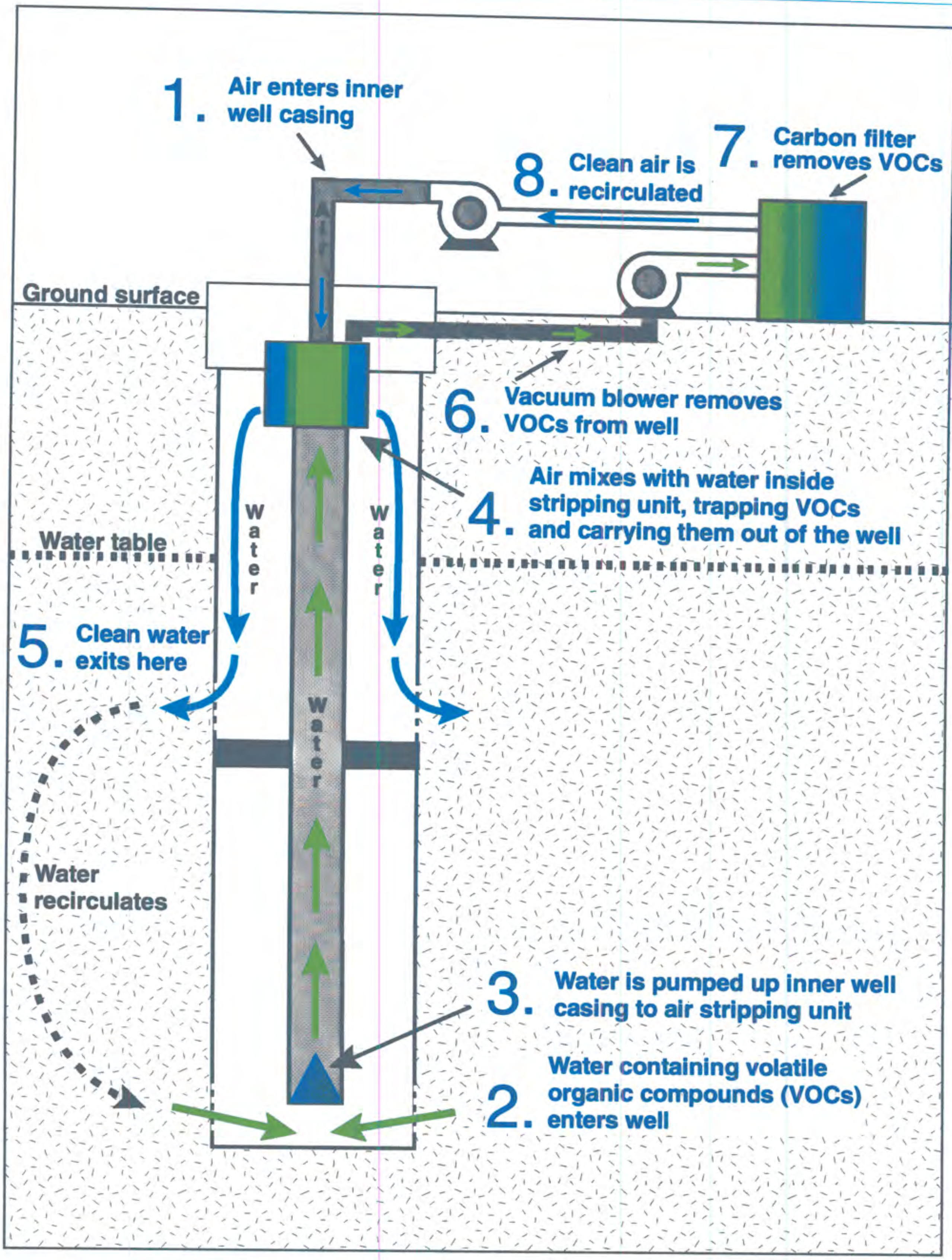
Modified by: P. Genzer, C. Lafon (BNL)

Date: 12/23/98

Tritium and Volatile Organic Compound Pump-and-Treat/Recharge System



Prepared By: Environmental Restoration Division Brookhaven National Laboratory	**Figure 11** Tritium Pump-and-Recharge System Schematic	Modified by: P. Genzer, C. Lafon (BNL) Date: 12/23/98



Prepared By:

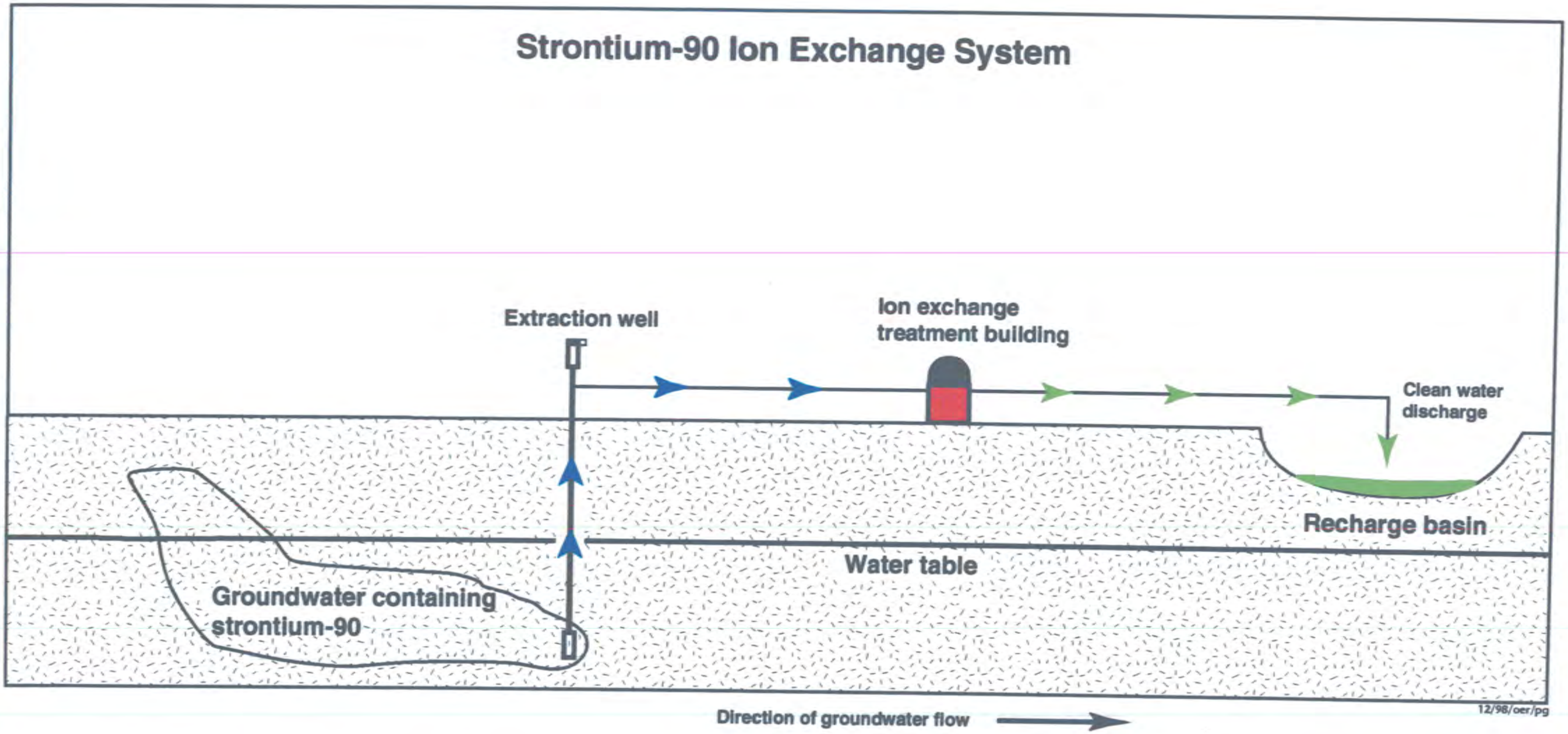
Environmental Restoration Division
Brookhaven National Laboratory

Figure 12

In-Well Air Stripping System Schematic

Modified by: P. Genzer, C. Lafon (BNL)

Date: 12/23/98

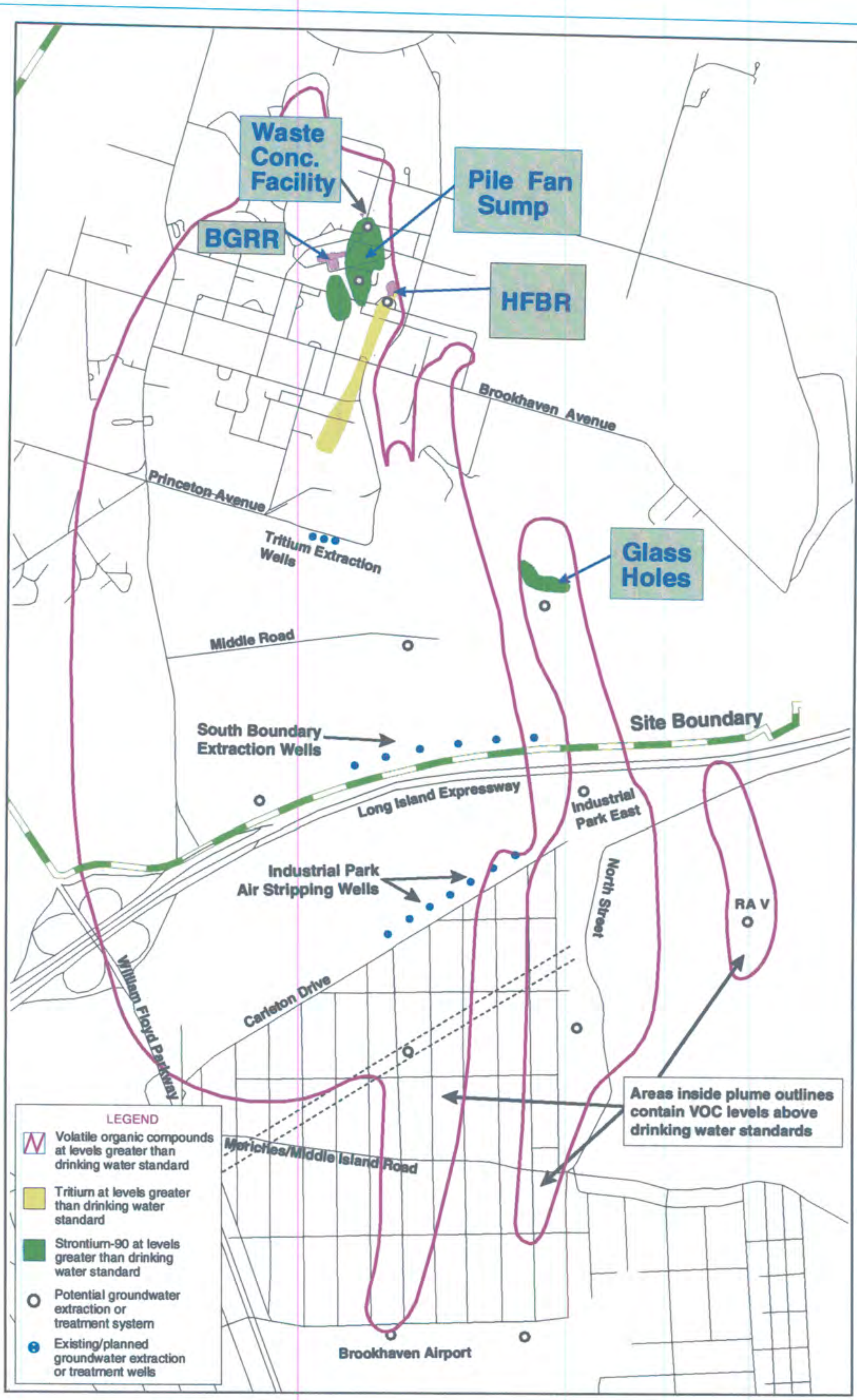


Prepared By:
Environmental Restoration Division
Brookhaven National Laboratory

Figure 13
Strontium-90 Ion Exchange System Schematic

Modified by: P. Genzer, C. Lafon (BNL)

Date: 12/23/98



Prepared By:
Environmental Restoration Division
Brookhaven National Laboratory

Figure 14

Areal Extent of Tritium, Strontium-90 and TVOC Plumes with Existing and Proposed Treatment Locations

Modified by:
P. Genzer, C. Lafon (BNL)

Date: 12/23/98

APPENDIX A

COMMENT LETTERS

Citizens Campaign for the Environment

☐ 225A Main Street • Farmingdale, New York 11735
516-390-7150
☐ 199 Main Street, Suite 319 • White Plains, NY 10601
914-997-0946
☐ 170 Washington Ave., 3rd Floor • Albany, New York 12210
518-434-8171
☐ 560 Delaware Ave., Suite 303 • Buffalo, New York 14202
716-886-1233

April 28, 1999

George Malosh
U.S. Department of Energy-Brookhaven Group
P.O. Box 5000
Brookhaven National Laboratory
Upton, NY 11973-5000

RE: Proposed Plan for Operable Unit III

Dear Mr. Malosh,

Citizens Campaign for the Environment (CCE) is an independent, member supported, not-for-profit organization whose mission includes the protection and prudent management of Long Island's sole source aquifer system. CCE represents over 80,000 households, nearly 40,000 of which are on Long Island.

The purpose of this letter is to provide comments on the **Proposed Plan for Operable Unit III** which describes remedies for addressing contaminated groundwater in the central and southern portions of Brookhaven National Laboratory and in the vicinity of residential homes off site, beyond the southern BNL property boundary.

Comment #1. The vertical depth of contamination in the plumes containing volatile organic compounds, strontium-90 and tritium is not characterized in a consistent, clear manor. For instance, the summary of the plan characterizes the carbon tetrachloride plume as being detected in the deep-glacial zone (60-150 ft. *below sea level*). The strontium-90 plumes are *only described by width and length*. The tritium plume depth is only characterized for the portion that exceeds the standard of 20,000 pCi/l and is described at depths ranging from *40 to 150 feet below land surface*. In order to correctly understand the adequacy of methods responding to the contamination, the vertical and horizontal extent of the plumes should be known. The most beneficial characterization of plumes should include a depth of feet below land surface as well as depth below the water table.

Comment #2. CERCLA includes a strong preference for the use of treatment of contamination as a principle element for any remediation plan. ***Natural attenuation is not a treatment and therefore should not be utilized as a guiding principle for clean up.*** The proposed plan distinguishes between no action and natural attenuation by including monitoring of the plumes in the natural attenuation alternative. It is misleading to separate these two alternatives and therefore, they should be listed as one. The plan relies all to heavily on natural attenuation and not enough on active, aggressive groundwater clean up. This point is especially appropriate when considering the sole source aspects of the Long Island groundwater system.

CCE does not support those aspects of the plan that rely on natural attenuation as a clean up method. It is worth noting that some VOCs degrade into chemicals that are more potent carcinogens than the original contaminant.

Comment #3. The plan states "At present, limited characterization has been performed in the Magothy Aquifer, so additional characterization and groundwater monitoring wells are planned. Upon completion of this characterization and monitoring, the selected remedy for the Magothy Aquifer will be reevaluated." A complete delineation of all plumes effecting the Magothy should be determined including full lateral, vertical and downgradient extent. It is unreasonable to seek informed public comment in the absence of relevant information. CCE requests that the record be kept open on the issue of Magothy remediation so that there can comment by the public on this critical matter.

The proposed plan is completely inadequate and unacceptable with respect to the protection and remediation of the Magothy aquifer.

Comment #4. The current plan does not include clear performance standards for the in-well air stripping systems. It merely says that it is expected these systems, in combination with natural attenuation, will reduce the concentration of contaminates over time. Complete clean up of groundwater should be attained for the plumes utilizing the in-well air stripping devices. **The drinking water standard of 5 ppb for VOCs should be the minimum standard accepted.** Natural attenuation should be utilized to reduce the contamination below standards after aggressive, active treatment measures have been utilized.

The plan should include the following components;

- The number of in-well air stripping devices, which will be utilized at each treatment location. This number should be based on attaining the standard of 5 ppb for VOCs
- A criteria to determine when the in-well air stripper are unable to attain the groundwater standard and what the next step should be to reach drinking water quality.
- A clear criteria to determine the effectiveness of each treatment system.

- Criteria which determines when the clean up process has been completed and the pumps will be shut down.
- Any groundwater modeling illustrating the plumes' characterization for the next 30 – 60 years.

Comment #5. The current plan calls for monitoring the plumes four times per year for the first five years and then a reduced monitoring program of once per year afterwards. It is likely that a growing population in Brookhaven Town will cause a significant increase in water withdrawal within the planning horizon of 30-60 years. Therefore, a continued monitoring program of at least four times per year will be necessary to safeguard public health. There should be a clear statement that if contamination levels do not decrease, monitoring will increase and further active treatment will be provided.

Comment #6. The human health risk assessment found that the presence of VOCs in groundwater could present a public health concern to residents south of the lab who have declined publicly supplied water. **It is CCE's strong recommendation that BNL immediately supply those home with on site water purification systems to adequately protect the health of those community members.** These systems should be provided and maintained by BNL for every member of the public who has declined to be hooked up to the public water supply.

Comment #7. Health risks from radiation exposure: CCE requests the proposed plan by BNL address the new findings on low level radiation damage to DNA recently discovered by a researchers at Columbia University's College of Physicians and Surgeons. Their findings were reported in the last issue of the Proceedings of the National Academy of Sciences. This study may be especially relevant for exposure through inhalation and ingestion, common pathways for radiation exposure originating at BNL. (See attached article.)

Thank you for the opportunity to comment.

Sincerely,

Adrienne Esposito
Associate Executive Director

Cc: Joe Baier, SCDHS
Mary Logan, EPA
Fred Towle, SC legislator
John Marburger, BSA

ENVIRONMENTAL
DEFENSE FUND

National Headquarters
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New York, NY 10010
(212) 505-2100
Fax: 212-505-2375
www.edf.org

April 29, 1999

George Malosh
United States Department of Energy
Brookhaven Group, P.O Box 5000
Brookhaven National Laboratory
Upton New York 11973-5000

Re: Proposed Plan for Operable Unit III, Brookhaven National Laboratory.

Dear Mr. Malosh:

The Environmental Defense Fund ("EDF") serves as a member to the Brookhaven National Laboratory Community Advisory Council ("CAC"), and has reviewed the above-referenced proposed plan for remediation of Operable Unit III offered by the Department of Energy (the "Department"). This correspondence constitutes EDF's public comment on this proposed plan It is our understanding that the public comment period was extended until the end of April 1999. The proposed plan proposes clean up objectives and addresses three specific types of contaminants of concern: volatile organic compounds ("VOC's") tritium and strontium 9O. Accordingly, we will address each proposed remedy. We ask that this comment be added to the administrative record of this matter sad be included, and responded to as necessary, in any Record of Decision on this proposed plan.

Accelerating cleanup

It is incumbent on DOE, the Lab and the State to do everything possible and reasonable to accelerate the cleanup of contamination. With respect to Operable Unit III, these parties should proceed to a ROD as quickly as possible to proceed with the best possible remediation plan available now (see our comments, below). This does not mean that, as groundwater assessments proceed and improved technologies become available, bolder strategies should not be considered or adopted. The point is to get going in the right direction, with the opportunity to make revisions in the future. Second, the treatment wells described in the plan could be installed more rapidly than the plan anticipates.

Cleanup objectives

As an initial matter, we note that the cleanup objectives for the proposed plan are threefold. First, remediation of the groundwater for the three contaminants of concern to meet drinking water standards is proposed. Second, the cleanup of the groundwater is to proceed "in a timely manner" which is defined for the Upper Glacial Aquifer as thirty years or less and for the Magothy aquifer sixty years. Third, the prevention and minimization of further migration of contaminants through groundwater is to be assured.

Drinking Water Standards - With regard to the first of the stated cleanup objectives, EDF is in agreement that drinking water standards, at a minimum, must be achieved. We note that the underlying aquifer complex has been identified by the federal as a "sole aquifer and is, therefore, deserving of the highest protection and restoration possible. Indeed, the groundwaters of the Magothy layer and the aquifer contained in the Lloyd Sand Member are of the highest quality. In that light, EDF suggests that the proposed monitoring and, if necessary, remediation plan should include additional study into the depth of any contamination plumes in these aquifers so that that contamination can be fully characterized with the potential for active remediation of any contamination of the Magothy layer rather than remediation by natural attenuation.

Cleanup in a Timely manner - With regard to this cleanup objective, we recognize that technical and economic limitations dovetail to impact any anticipated cleanup timeframe. Nevertheless, with regard to the proposed cleanup objective for the Magothy layer, we believe the time period of 60 years is far too long a time to wait for cleanup. Either further analysis of potential cleanup strategies for the Magothy layer contamination should be performed or a more complete explanation of why such strategies have been rejected should be provided. Moreover, we note that, at least with respect to one proposed remedy (Tritium T4), the suggested proposal requires more time and, ultimately, is more expensive than another proposal (Tritium T5). This issue is addressed in the tritium remediation section below.

Prevention of further Migration - EDF is in full accord with this cleanup objective.

Strontium-90 Contaminated Groundwater Cleanup:

Upon review of the alternatives analyzed by the Department, EDF is in accord with the Department's preferred alternative (Strontium S-5a). This proposed remediation meets the proposed cleanup timeframe of 30 years and appears to be cost-effective as compared with the other alternatives. Among the most important factors to EDF is the short timeframe, as compared with the other alternatives, and the fact that active remediation will occur in the form of ion exchange with recharge. EDF would, however, like to see further discussion of what endpoint contamination levels will be required for shut-down of the BGRR and WCF pumps as well as the pumps to be located at the "Chemical Holes" area.

Tritium Contaminated Groundwater Cleanup:

Upon review of the alternatives analyzed by the Department EDF is not in support of the Department's preferred alternative Tritium T4. First, it appears that alternative Tritium T-4, while meeting the cleanup objective of thirty years (20-25 years), is less aggressive in cleanup than alternative Tritium T-5 (15-20 years). Second, it also appears that the cost of implementing Tritium T-4, although less expensive in capital cost than Tritium T-5 ($456,000:$853,000) is, overall, more expensive than Tritium T-5 ($4,890,000: $3,669,000). Thus, it appears that the Department has chosen a more costly and more time-consuming

ENVIRONMENTAL
DEFENSE FUND

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April 30, 1999

George Malosh
United States Department of Energy
Brookhaven Group
P.O. Box 5000
Brookhaven National Laboratory
Upton, New York 11793-5000

Dear Mr. Malosh:

In addition to the comments we sent you yesterday, please include the attached memo as part of our submission to you.

Sincerely,

James T.B. Tripp, General Counsel

April 20, 1999

Mr. James Tripp
Environmental Defense Fund
257 Park Avenue South
New York, NY 10010

Dear Mr. Tripp:

I reviewed the Proposed Plan for Operable Unit III you gave me for the Brookhaven National Laboratory site on Long Island. I have not reviewed the Feasibility Study yet. I have had difficulty arranging a time with the EPA Records room. However, I can provide a couple of comments in the interim.

The Proposed Plan presents a summary of the types and extent of compounds present at Operable Unit III, remedial investigation activities, risk assessments of the compounds present, actions to date, remedial alternatives, and analysis and comparison of alternatives. The media affected at this site include surface soil, subsurface soil, surface water, sediment, and groundwater. Table 2 of the Proposed Plan identifies contaminants of potential concern. The surface and subsurface soils are currently being removed as part of the Operable Unit III Removal Action. The sediment soils remediation is being addressed under Operable Unit II/VII. Groundwater contamination issues at Operable Unit III include on- and off-site volatile organic compounds (VOC's), on-site tritium, and on-site strontium-90. Interim removal actions that address both on- and off-site groundwater treatments are currently operating.

The proposed groundwater remedial alternatives for Operable Unit III are;

1) Removal of Strontium-90 in groundwater involves the installation of a Groundwater Extraction/Ion Exchange system to capture strontium-90 plumes and discharge treated water to recharge basins.
2) Removal of Tritium in groundwater involves natural attenuation through radioactive decay.
3) Removal of the VOC's in groundwater involve; a) on-site treatment of the shallow aquifer (Upper Glacial Aquifer) through the use of a groundwater recovery system, extraction of groundwater, and treatment through air stripping; and b) on- and off-site treatment at various locations through hydraulic control, extraction, and treatment of groundwater using in-well air stripping.

Issues pertaining to the above proposed treatment solutions include:

1) Contaminant transfer vs. contaminant destruction
2) Pump and treat concerns
3) Source control of tritium and accurate model of groundwater flow
4) Proper off-site disposal of media containing hazardous compounds.

The air stripping treatment proposed is a reliable efficient groundwater treatment option. However, this process transfers the compound from one media to another. The VOC's are removed from the groundwater and discharged into the atmosphere. Modeling of the behavior of compounds in the atmosphere is difficult. The risk to human exposure associated with the VOC's is lowered based on assumptions; 1) The compound concentrations are lower through atmospheric dispersion by mixing and turbulent flows; and 2) The ability of the VOC's to contact humans through atmospheric transport is lowered. Although, the risk to human exposure may decrease, the total quantity of the VOC's in the environment does not decrease. Treatment methods that utilize technologies such as microbial degradation, reactive barrier degradation, and ultra-violet oxidation remove the VOC's from the environment. These treatment methods reduce the VOC's to carbon dioxide and water through reductive dechlorination. The Superfund Innovative Technology Evaluations (SITE) program operated by the EPA has demonstrated the ability of various treatment systems to destroy the VOC's. Companies such as Biotrol and SBP Technologies Inc. each participated in the SITE program to field test "Biological Aqueous Treatment Systems" and "Membrane Filtration and Bioremediation", respectively. A technique termed "Metal Enhanced Abiotic Degradation of Dissolved Halogenated Organic Compounds" was also field-tested through the SITE program. VOC's are halogenated compounds.

Pump and treat methods are also reliable methods to remove compounds that partition to the aqueous (water) phase. In addition, pump and treat methods achieve hydraulic control of the aquifer to control the direction and rate of groundwater flow. The context of the pump and treat system in this case involves pumping water to the surface, providing a treatment system to remove VOC's, reinjection of water to the ground. However, compounds that partition to the vapor (air), soil, or, non-aqueous phase liquid (NAPL) phase are more difficult to remove through pump and treat methods. Compounds transfer between the phases depending upon the chemical and physical characteristics. Partitioning of VOC's from the NAPL phase to the aqueous phase depends upon aqueous solubility characteristics. Generally, VOC's are moderately soluble in water. The NAPL phase of VOC's requires remains relatively immobile with respect to groundwater flow direction within the subsurface. Natural groundwater velocities typically range between 0.01 and 10 ft/day. During groundwater pumping, groundwater velocities in the range of 0.5 to 5,000 ft/day can be achieved. This amount of pumping may or may not significantly affect the NAPL. Characteristics of the subsurface determines the rate at which groundwater will flow. Therefore the amount of groundwater velocities achievable through pumping will depend upon subsurface materials. The amount of water, or pore volumes, removed to obtain treatment goals depends upon average linear velocity of groundwater flow achievable through pumping, the horizontal length of the affected area, physical aquifer characteristics, and mass of compound in the aqueous phase. Pump and treat methods may require removal of over 30 times the amount of total water volume in the hydraulic control area to reduce VOC's to desired levels. Removal of VOC's from the soil phase requires greatly elevated temperatures. Techniques involving subsurface heating are applied to supply the required activation energy to remove the VOC's from the soil. Once removed from the soil the VOC's may then partition to the vapor phase, NAPL, or aqueous phase.

Pump and treat methods and in-well treatments provide a reliable alternative for deep aquifers such as the Magothy Aquifer. However, for shallower aquifers, technologies such as a reactive barrier and/or a barrier that utilizes microbial degradation may provide less intrusive alternatives. The dimensions of an insitu barrier will depend on factors such as vertical and horizontal extent of contamination, contact time within the barrier, groundwater flow velocities, number of gates involved, etc. The barriers or "funnel and gate" type systems channel the natural flow of the aquifer through an area that contains a treatment technology to destroy the VOC's through dechlorination.

The treatment for the tritium involves monitoring the horizontal extent of the plume and monitoring the concentration of tritium near the Brookhaven Graphite Research Reactor (BGRR), natural decay of the tritium, and returning to the interim removal action if certain conditions occur. This seems like a reasonable option considering the current status of the tritium plume. However, the Department of Energy does not seem too confident with the integrity of the source removal action and/or the accuracy of the groundwater models. Table 4 of the Proposed Plan indicates that the source removal action for tritium involved "canal drained and covered with concrete. Deep drain sump pumped out."

Finally, the same concerns, outlined above, apply for pump and treat of strontium-90. Removal of strontium through utilization of ion resin is a reliable treatment option. I am concerned over the issues of off-site disposal of the resin as well as the soils being removed off-site. A situation occurred with a Superfund project in New Jersey in which the EPA contractor did not follow the proper procedure for backfill material. The specifications indicated "clean fill" of a certain soil grain size. The contractor did not follow the specifications and knowingly backfilled the areas with contaminated soil and construction debris obtained from a State of New Jersey remediation site. The owners of the Superfund property, not the EPA, notified the New Jersey Department of Environmental Protection of the situation.

I hope this is something in the direction of comments you had in mind. I will try to contact you in a couple of days or if you have any questions email me at shanedavidmichael@yahoo.com.

Sincerely,

Shane Michael

SUFFOLK COUNTY WATER AUTHORITY

Administrative Offices: 4060 Sunrise Highway, Oakdale, New York 11769-0901
(516) 589-5200
Fax No.: (516) 563-0370

April 30, 1999

George Malosh, Brookhaven Group Manager
U.S. Department of Energy
Brookhaven Group, Bldg. 464
P.O. Box 5000
Upton, NY 11973-5000

Re: Proposed Plan for Operable Unit III

Dear Mr. Malosh:

Following are comments of the Suffolk County Water Authority regarding the above referenced Proposed Plan.

First, the Suffolk County Water Authority (SCWA) is concerned about the groundwater contamination that is present in or that may reach the Magothy aquifer. Pages 3 to 5 of the Proposed Plan emphasize natural attenuation as an essential constituent of the Magothy remediation. They also mention a sixty year time frame for cleanup.

As you know, the SCWA currently operates two shallow Magothy wells at Lambert Avenue, Mastic. We are concerned that these wells may be impacted by groundwater contamination from the BNL site. The SCWA prefers active remediation of Magothy contamination unless it can be demonstrated that SCWA wells will not be impacted by Magothy contamination.

Second, page 3 of the Proposed Plan states the following about Maximum Contaminant Levels:

> **Maximum Contaminant Levels** - standards set by the EPA and the DEC for contaminants in drinking water. These concentrations represent levels that the regulatory agencies believe are safe for people to drink. DEC standards often apply a safety factor and are more stringent than the Federal standards. MCLs used in this document are the more stringent of the EPA or DEC standards for a contaminant.

Contrary to this statement, the EPA defines Maximum Contaminant Level (MCL) as "the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using best available treatment technology." The EPA defines Maximum Contaminant Level Goal (MCLG) as "the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety."

In light of this distinction, a cleanup objective other than the specified MCL may be appropriate for certain contaminants. An analysis of how the MCL was set for each contaminant of concern may facilitate a determination as to whether it adequately protects human health and the environment.

Thank you for providing an opportunity to comment on the Proposed Plan for Operable Unit III.

Very truly yours,

Timothy J. Hopkins
Attorney

cc: Michael A. LoGrande
Steven R. Colabufo

SCWA

cleanup. As the difference in funds could be better applied to cleanup elsewhere on-site, it would appear prudent and protective to choose the more aggressive Tritium T-5 alternative.

The basis for preferring this alternative is unclear. Upon review of the Table 10 comparisons we note that "small" exposures" will occur for Tritium T-4 and that they will not occur with Tritium T-5. Obviously, elimination of a health concern should be high on the Department's list of preferred alternatives. Moreover, while we do note that the Tritium T-4 alternative "offers additional protection from plume migration" it is our understanding that the plume will not increase in length under either of these two alternatives and, at any rate, no receptors of tritium-laden groundwater are anticipated as no water wells exist in the area of the tritium plume.

Given the limited information provided in the public comment information document EDF cannot support the Department's preferred alternative and supports the Tritium T-5 alternative. If there is additional information why T-4 is preferred over T-5, such information should be provided to the public.

VOC Contaminated Goundwater Cleanup:

Upon review of the alternatives analyzed by the Department EDF is in general support of the Department's preferred alternative VOC V- 10b with the following exception. Air stripping is not adequately protective of the environment, nor does it comply with the third cleanup objective stated in the public comment information document -prevention and minimization of further migration of contaminants. Indeed, it appears that the use of air-stripping merely exchanges groundwater VOC contamination for airborne VOC contamination. It is not enough to say that injection of air-stripped VOCs into the atmosphere comply with State DEC air quality standards for those contaminants because the volume of air in the atmosphere will quickly disperse any such pollutant. Even to make that determination it would be necessary to have tests on site of background levels of those contaminants in the air, and such tests have not been conducted. More important, air pollutants, even if dispersed, settle to the ground onto soil that then becomes available for ingestion, particularly by children, and other forms of human exposure. EDF notes that local agencies (Suffolk County Water Authority) and private entities involved in VOC remediation generally use granulated activated carbon ("GAC") filter towers to remove VOC contamination. In light of the remediation's cleanup objective of not spreading contamination further it is incumbent upon the Department to assess the possibility of substituting the use of GAC filters for air-stripping alternatives.

Thank you for the opportunity to comment on this important project. Should you have any questions in regard to the above comments please to not hesitate to contact me.

Very truly yours,

James T. B. Tnpp,
General Counsel

25

Date sent: Tue, 9 Mar 1999 10:52:43 -0500 (EST)
To: d'ascoli@bnl.gov, kgeiger@bnl.gov, genzer@bnl.gov
From: Kara Villamil <karav@bnl.gov>
Subject: OU3comments

>From: SSantorell@aol.com
>Date: Tue, 9 Mar 1999 08:31:48 EST
>To: pubaf@bnl.gov
>Cc: meersman@bnl.gov
>Mime-Version: 1.0
>Subject: OU3comments
>
>I attempted to locate the E mail address quoted in your last mailing but it
>was not accepted . I would like to comment on the last proposal by BNL for on-
>site and off-site cleanup.
>My name is Severino Santorelli and I reside at 63 Flowerhill Drive in Shirley.
>I feel compelled to write to you at this time. Since 1996 my family has been
>fighting a battle with a cancer(synovial sarcoma) which struck my wife. My
>feelings for the Lab and whatever goes on at this site is well documented. YOU
>SHOULD ADMIT YOUR GUILT AND CLOSE DOWN NOW. Why would you be concerned abou
>cleanup if the people involved knew what they were doing ? Just a few years
>ago we were told by a cast of noted scientists NOT TO WORRY EVERYTHING IS JUST
>FINE. Later we were told that we needed to worry because the lab had lied
>about spills etc. etc. The ISSUE is not cleanup....IT'S T R U S T ...And I
>and many others NO LONGER TRUST YOUR SCIENTISTS OR YOUR ADMINISTRATION.
>IF YOUR MAILINGS TO ME ARE COSTING ME MONEY IN ANYWAY REFRAIN FROM MAILIN
>THESE PACKETS OF TRASH IMMEDIATELY.
>

What's Your Opinion?

The DOE wants and needs to hear from you to effectively decide what actions to take at Brookhaven National Laboratory.

Comments: The undersigned has read the proposed plan for OU III and makes the following comments:

(1) Having read many cleanup plans in the past, I must comment that this is one of the most lucid and well prepared document I have seen on this subject.

(2) The only criticism I can make is that your description of the risk assessment is superficial. I believe that some stakeholders suspect the Risk Assessment process & doubt the credibility of the assessors. A more detailed description with a stress on the conservative nature of the process might help alleviate their suspicions.

(3) Information on the success ratios of the various cleanup processes might be helpful.

Harold D. Berger
30 Eastwood Lane
Valley Stream, N.Y. 11581
516-791-7179

Long Island Association, Inc.
80 Hauppauge Road
Commack, Long Island, NY
11725-4495

March 31, 1999

Mr. George Malosh, Brookhaven Group Manager
U.S. Department of Energy
Brookhaven Group, Bldg. 464
P.O. Box 5000
Upton, NY 11973-5000

Dear Mr. Malosh:

The Long Island Association (LIA), the region's largest business and civic organization is writing in support of the Brookhaven National Laboratory's (BNL) Proposed Plan for Operable Unit III for on-site and off-site cleanup of groundwater contamination. The LIA serves on the Community Advisory Council and has carefully reviewed the materials presented including the Operable Unit III Remedial Investigation Report (RI), the Operable Unit III Feasibility Study ...rt (FS) and the Operable Unit III Proposed Plan.

The LIA strongly supports the Proposed Plan for Operable Unit III which will address the cleanup of groundwater contamination both on-site and off-site of volatile organic compounds, tritium and strontium-90. The LIA is supportive of the plan to remove volatile organic compounds (VOC's) by constructing a groundwater treatment system on the BNL property, and off-site at the Long Island Power Authority right-of-way. The plan to institute source removal actions on-site is also supported by the LIA. The LIA believes that the plan to address the tritium contamination through natural decay and attenuation, while keeping the existing tritium pumping system on standby, is an appropriate method of cleanup. The LIA supports the remedy proposed for strontium -90 which includes constructing groundwater extraction and treatment systems. Overall, the LIA is completely supportive of the remedies detailed in the Proposed Plan for Operable Unit III for cleanup of the groundwater contamination at BNL.

The Long Island Association believes that Brookhaven National Laboratory is one of Long Island's greatest assets and that the science conducted at the Laboratory should be encouraged to continue. The LIA believes that the Proposed Plan for cleanup is a careful and thorough document which clearly dictates exactly how cleanup should proceed and will ensure that proper monitoring is conducted. The LIA wholeheartedly supports this Plan.

Amy Engel

Amy Engel

Legislative Affairs Administrator

Serving Long Island since 1926

Long Island Builders Institute, Inc.
400 Corporate Plaza, Islandia, NY 11722 • TEL: 516-232-2345 • FAX: 516-232-2349

March 17, 1999

Mr. George Malosh
U.S. Department of Energy – Brookhaven Group
P.O.Box 5000
Brookhaven National Laboratories
Upton, NY 11973-5000

Subject: Comments on the Proposed Plan Operable Unit III – Brookhaven National Laboratories

Gentlemen:

The Long Island Builders Institute represents approximately 600 members consisting of 200 builders and building organizations doing most of the residential development in Suffolk County as well as another 400 companies and organizations supporting or serving the building industry. All tolled, we employ approximately 11,000 people which equates to approximately 40,000 Long Island residents.

It appears to us that the Proposed Plan is practical and cost effective; it will go a long way to cleaning up existing problems and contribute to preventing future problems. We are not particularly happy that the clean-up time-frame is 25 to 30 years, but it is also apparent that the various alternative scenarios do not shorten the time significantly and in some cases could be dramatically more costly.

It also appears that the environment and public health and safety are not threatened by the existing pollution provided the remedial actions described in the Proposed Plan are implemented. This has also gone into our cost/benefit analysis and conclusion supporting the Proposed Plan.

It is important to emphasize that with a 20 to 30 year clean-up plan, and given changing of budgets, public concerns, politics etc., that the Plan be implemented and followed vigorously.

It is also instructive to take a look at how we got into this situation. Although there is a heightened sensitivity to protecting the environment and public health and safety, we do not believe that prior occupants of the Lab's property disregarded public health and safety, yet we have problems. Hopefully, the Plan will emphasize to the present and future operators of the Lab, from the General Manager through the scientific community, to the mechanics and custodial staff, how critical it is to work very, very hard at not allowing further degradation of our environment or further threats to public health and safety.

We fully endorse the Proposed Plan and the continued, very constructive and positive work that goes on at the laboratory. We believe that the advances in science and research that the Lab contributes to are vital to local, national and world progress and believe that the continued operation and success of the Lab is vitally important to Long Island.

Thank you for the opportunity to express ourselves.

Very truly yours,

LONG ISLAND BUILDERS INSTITUTE

RICHARD L. RASKIN
Community Advisory Committee Member

RLR: sw

cc: Congressman Forbes
Suffolk County Committee on BNL
.....Mr.JoeBaier, Suffolk Dept. of Health Services
.....Ms.Mary Logan, EPA
.....Assemblywoman P. Acampora
.....Senator K. LaValle
.....Assemblyman F. Thiele
.....Bob Wieboldt (LIBI)

What's Your Opinion? 3-15-99

The DOE wants and needs to hear from you to effectively decide what actions to take at Brookhaven National Laboratory.

Comments: To have more open honest meetings a lists of Abbreviation of what exactly the words mean & the terms of Contamination to the human body & list the boundaries of locations that are contaminated, block by block, not a graph with no names & land marks. What the levels and exposure are in that immediate area. More public notices (ex) News - (Television) More on site water testing on the home site.

What is the respond of helping people with contaminated water (City Water). Also know as drinking water. Is the lab willing to supply bottle water as in the past - (3 years ago)

What is your opinion? "to those whom are objective of buying a home in this area" with awareness of the contamination of water & risk of the welfare being of there health, as result of this the value of the home is less although (value) of our taxes are still at higher standards compare to other homes of our surrounding areas.

P.S. I greatly would appreciate a respond of this letter!

Yours Truly
Louise M Lopez

Louise M. Lopez
428 Sleepy Hollow Dr.
Shirley, N.Y. 11967
516-399-0562

Cm

What's Your Opinion?

The DOE wants and needs to hear from you to effectively decide what actions to take at Brookhaven National Laboratory.

Comments: TERENCE B. HOGAN 185 ROWLINSON DR SHIRLEY N.Y. 11967 516-924-7532 -

SIR: BEFORE THE LAB ADMITTED TO AND TELLING THE PUBLIC ABOUT THE VOC PLUMES IN MY AREA. AND NOT TELLING THE PUBLIC WHY WE WERE GETTING FREE CITY WATER HOOKUP SEVERAL YEAR AGO. MY HOUSE & PROPERTY WAS ~~WAS~~ ASSESSED AT 165,000 DOLLARS BY BROOKHAVEN TOWN. THIS WAS SEVERAL YEARS AGO. SINCE THEN YOU HAVE BEEN IN THE NEWS CONSTANTLY. ABOUT YOUR VARIOUS CONTAMINATIONS - NO ONE WANTS TO BUY A HOUSE IN THIS AREA. MY HOUSE HAS BEEN FOR SALE BY 3 DIFFERENT REAL ESTATE. AND ALSO A SIGN WAS PLACE IN FRONT OF MY HOUSE FOR 1 YEAR WITH MY NAME FOR SALE BY OWNER BY APPOINTMENT AND MY PHONE NUMBER I AM STILL WAITING FOR THE FIRST CALL - NO PRICE WAS MENTIONED ON THE SIGN. THE PRICE OF MY HOUSE WENT FROM ASKING 150,000 TO 130,000, TO 125,000 BY THE REAL ESTATE'S THANKS TO YOUR SPILLAGE, & CONTAMINATION PEOPLE IN MY AREA CAN NOT GET 90,000 FOR OUR HOUSES. IT SEEMS TO ME THAT THE LAB SHOULD BE RESPONSIBLE FOR THE ECONOMICAL HARDSHIP THAT THE PEOPLE OF OUR AREA HAVE SUFFERED. IN TRYING TO SELL OUR HOMES.. NO ONE HAS EVEN MENTIONED THIS FACT. THE PEOPLE IN THE AREAS EFFECTED BY YOUR SPILLAGE & CONTAMINATION ARE LOSING MUCH OF THEIR LIFE SAVINGS INVESTED IN THEIR HOMES. YOU PEOPLE AT THE LAB DON'T CARE OR GIVE A DAMN. ABOUT THE PEOPLE WHO ARE BEING PENALIZED FOR YOUR NEGLIGENCE AND CAUSING AN ECONOMICAL HARDSHIP TO OUR AREA.

Terence B Hogan

STATE OF NEW YORK
DEPARTMENT OF TRANSPORTATION
VETERANS MEMORIAL HIGHWAY
HAUPPAUGE, N.Y. 11788

CRAIG SIRACUSA, P.E.
REGIONAL DIRECTOR

JOSEPH H. BOARDMAN
COMMISSIONER

April 2, 1999

Mr. George Malosh
U.S. Department of Energy-Brookhaven Group
P.O. Box 5000
Brookhaven National Laboratory
Upton, NY 11973-5000

Dear Mr. Malosh:

We have reviewed the Proposed Plan for Operable Unit III- Brookhaven National Laboratory and have the following comments:

The New York State Department of Transportation is concerned whether the VOC plume that extends South of the Long Island Expressway, between exits 68 and 69, will adversely affect our recharge basins #176 - #181, see attached map. These basins have "standing water" in them, which is exposed groundwater. We are concerned with the groundwater, surface run-off waters and the sediments collected in the bottom of the basins. Periodically, maintenance and construction activities are performed in these basins and we must be aware of potential health hazards.

In addition, there is the issue of the endangered tiger salamanders, which have been known to historically breed in our recharge basins in this general area. Are there any potential impact studies completed upon wildlife and, if not, are they included within the management plan?

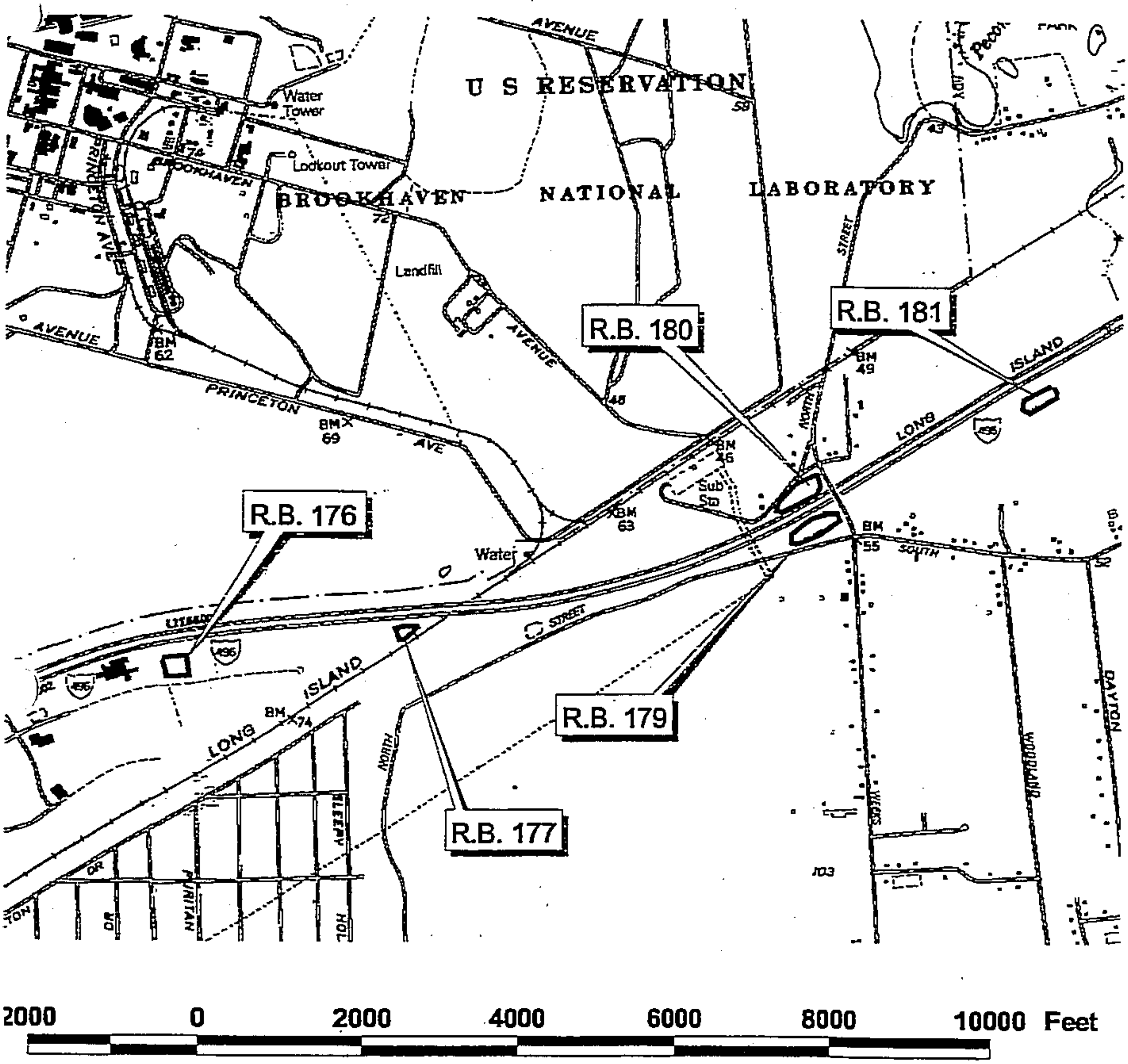
If you have any questions regarding this information you can at (516)-952-6652.

Sincerely yours,

Darrel J. Kost, P.E.
Environmental Unit

Attachment

NYSDOT Recharge Basins on I-495



Hand delivered from J. Brady 4/30/99 8:20 AM

Robert B. Conklin
70 Pleasure Drive
Riverhead, NY 11901
Home Phone 516-727-0076

April 29, 1999

George Malosh
U.S. Department of Energy-Brookhaven Group
PO Box 5000
Brookhaven National Laboratory
Upton, NY 11973-5000

Dear Mr. Malosh;

In response to DOE's request for public comment on OU III's operations before April 30th, a quick note.

At the April 8th CAC meeting, I raised the question of the removal of VOCs from ground water by air stripping with their subsequent release to the atmosphere. I am referring to those strippers not fitted with carbon filters.

I followed up my inquiry with an information meeting with Jeff Williams and Vinny Racaniello on April 16th. I came away from this two hour meeting with the understanding that the amounts of VOCs released are very minuscule compared to other sources and well below any regulatory requirements. I had questions about the breakdown products of the various VOCs , their toxicity, how long they last in the air stream, how precipitation may affect their movements etc. To date, these questions have been unanswered. Under the time restraint imposed, this is very understandable. I am also sure that there are no easy answers to these inquiries but before I would suggest a continuance of these unfiltered practices, I would be more comfortable with solid, reasonable assurances that you are not exchanging one point source for another.

Not being able to compare the quantities of release of VOCs from your two sources to other outside BNL sources and their cumulative effect leaves the lingering question as to whether I would suggest the expense of carbon filtration for these and future air strippers.

A zero air emission would be a positive factor.

Thank you for your considerations,

Bob Conklin

Bob Conklin
Town of Riverhead

cc: Vincent G. Villella, Supervisor
Kim Skinner, Riverhead Alternate, CAC

STAR foundation

STANDING FOR TRUTH ABOUT RADIATION

April 26, 1999

Mr. George Malosh
U.S. Department of Energy
Building 464
P.O. Box 5000
Upton, NY 11973

Re: Comments to the Operable Unit III Proposed Plan

Dear Mr. Malosh:

1) The impacts of releasing contamination from on-site stripping operations must be further examined. There must be an analysis of pathways of airborne contaminants to humans and the environment before the plan is approved.

2) More examination of contamination in the Magothy acquifer is necessary.

3) The cleanup must seek to achieve the lowest contaminant levels attainable. Therefore, we believe that if the groundwater can be cleaned up beyond relevant standards it must be done.

4) There must be carbon filters on all systems.

5) The plan must specify performance standards for in-well air systems.

Thank you for the opportunity to comment.

Sincerely,

Scott M. Cullen
Counsel

66 NEWTOWN LANE SUITE 2
P.O. BOX 4206 EAST HAMPTON, NY 11937
PHONE: 516-324-0655 FAX: 516-324-2203

BROOKHAVEN
NATIONAL LABORATORY

Stakeholder Evaluation

Meeting: OUIII – Groundwater Cleanup, Information Session
Date: March 10, 1999
Location: Brookhaven National Laboratory

Please complete this evaluation form and leave it at the door *or* mail the form to the address on the back of this form. DOE and/or BNL project managers will review your comments and use your ideas to improve our public involvement.

On a scale of 1 to 5 (5 being the highest), please rate the following.

1. I received sufficient advanced information to notify me of this meeting.

1 2 3 4 (5)

Use this space for your comments and suggestions:
Received mailing, saw ads in papers

2. The meeting location, time, and facility were appropriate for this meeting and topic.

1 2 3 (4) 5

Use this space for your comments and suggestions:
There were sufficient times & days for sessions. Are people afraid of coming on BNL property? There should be some signs posted for directions, e.g. [Poster Session →], along incoming route.

3. The materials provided for this meeting were informative and easy to understand.

1 2 3 (4) 5

Use this space for your comments and suggestions:
There should be some literature written for the Non-Technical. Perhaps a Show & Tell (see attached). Can the children be invited to bring along the adults. A Science show on the side.

4. The meeting format allowed me to exchange information with DOE and/or BNL representatives.

1 2 3 (4) 5

Use this space for your comments and suggestions:

5. Throughout the meeting, my questions were answered to my satisfaction.

1 2 3 (4) 5

Use this space for your comments and suggestions:

6. I believe DOE and/or BNL representatives listened to my ideas and will consider them in their decisions.

1 2 3 (4) 5

Use this space for your comments and suggestions:

Circle all that apply.

7. The most effective way(s) to notify me of meetings like this is/are...
   - ✓ Newspaper advertisements
   - ✓ News stories
   - Radio advertisements
   - ✓ Direct mail
   - cleanupdate
   - Other

8. The length of the meeting was:
   - Too long
   - Too short
   - ✓ Just right — could leave as I desired

9. Communication methods to help me better understand and comment on this issue are:
   - ✓ Fact sheets
   - Open houses
   - ✓ News articles
   - Videos
   - Focus groups
   - cleanupdate
   - Workshops
   - Public meetings
   - ✓ Civic group updates
   - ✓ Presentations
   - Other

Additional Comments

Please give us your name and address if you've asked for a response or want to be on BNL's mailing lists for future information.

If you prefer to mail your form, send it to:

Eloise Gmur
Brookhaven National Laboratory
Office of Environmental Restoration
Building 51
Upton, NY 11973

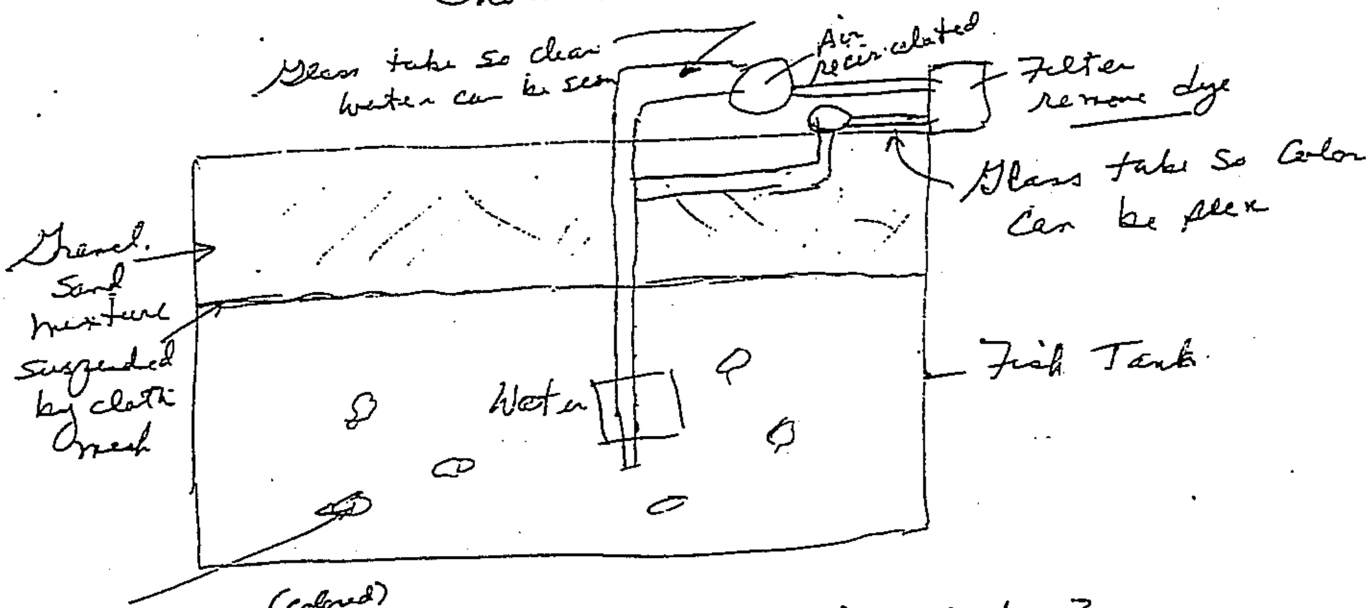
or

John Carter
U.S. Department of Energy
Brookhaven Group
Building 464
Upton, NY 11973

Thank you!

R Bias

Show & Tell



1- What dye (colored) will remain suspended in water?
2. What filter will remove colored dye? There must be some membranes that will remove or retain globs of dye.

VCO's what are They?

VCOs
- Gasoline
- Solvents
  - carbon Tetrachloride
  - paint Thinner
  - nail polish remover
  - oven cleaners

What do They do?
- Contaminant water (ground)
- Move in the underground water with its natural flow.
- Destroy are drinking water supply

How can They be removed?
- Do not carelessly Throw away or spill VCO's.
- Can be filtered out but at great cost.

What's Your Opinion?

The DOE wants and needs to hear from you to effectively decide what actions to take at Brookhaven National Laboratory.

Comments:

It seems like a well designed, well thought out plan.

My concern is that few if any public persons (neighbors) will actually read the document. Its written well, but way too technical for the average neighbor.

BNL/DOE always has the problem of talking too technical when we try to explain things to our neighbors or even our own non-scientific personnel.

What's Your Opinion?

The DOE wants and needs to hear from you to effectively decide what actions to take at Brookhaven National Laboratory.

Comments:

I agree with your proposed remedies for VOCs, Strontium-90 and Tritium at Brookhaven National Laboratory dated 3/1/99.

Also, I believe the High Flux Beam Reactor should be re-activated.

Richard S. DeTurk

(RICHARD S. DETURK)

Regional Clean Association

14 [illegible] Lane

Stony Brook, NY 11790

What's Your Opinion?

The DOE wants and needs to hear from you to effectively decide what actions to take at Brookhaven National Laboratory.

Comments:

9 March 199[illegible]

I am very impressed with this comprehensive study and evaluation of the areas of contamination, together with the various alternative solutions. As a taxpayer I favor the choice of least cost for equal effectiveness.

I am troubled by the failure to segregate the pollution due to the former industrial area south of the laboratory, from that of BNL. I can recall having seen a map of the plume from that site which clearly showed that significant spill area to be unrelated to BNL. I also recall that the Suffolk County Water Authority had publicly stated that BNL was not responsible. I believe it was the principal cause of drinking water contamination in that area.

It seems to me that BNL has enough problems, for which it is responsible, without the gratuitous inclusion of that industrial area.

Sincerely,

N Blair Munhofen

N. Blair Munhofen
349 Beaver Dam Rd.
Brookhaven, NY 11719-9674

P.S. Though an electrical engineer, my major professional career was spent as Department Administrator in the Chemistry Department. I was also the Safety Coordinator. I retired in 1990 after 37½ years.

What's Your Opinion?

The DOE wants and needs to hear from you to effectively decide what actions to take at Brookhaven National Laboratory.

Comments:

From: LYNN MUSCARELLO
2 Marginwood Drive
Ridge NY 11961

Phone - 345 3815
Work Phone - 272-5958

The BNL STAFF would KNOW WHAT ACTIONS TO TAKE FOR the Cleanup Better than myself. The Report is Detailed & Lengthy - Somewhat Confusing for Residents to Understand. My Opinion is that BNL Cleanup should Be your #1 Priority! I WANT TO KNOW if my Area That I Live in has Been Tested For Contamination? I have well Water! I AM Afraid of getting Cancer from the Contaminents coming from you Nearby Site. I want my Area Tested and I want to personally see the Results. BNL Should Provide Funding for city water if my Street where I Live is Contaminated. The Report says underwater Contamination will take 30 years to Complete! Does that mean the contamination will travel underground for 30 years? How far do you think the contamination will travel? What areas will Be Continuous Tested? Why did BNL let this happen? How was it ignored for so long? How could you put Eastend Residents (Like my home) At peace, I need to know if where I Live if I am At Risk. I just moved here in September 1998 & I have Well Water, Why hasn't my Well Been Tested? I will Attend the March 10th Meeting At Berkner Hall to learn more About the Cleanup Efforts taking place. It's very nice of BNL to ask for our opinion about which cleanup options should be done, But we Are not the Experts, You Are!

Lynn Muscarello

What's Your Opinion?

The DOE wants and needs to hear from you to effectively decide what actions to take at Brookhaven National Laboratory.

Comments: AS USUAL THE STUDY OF THIS GROUND WATER CONTAMINATION AND ITS EFFECTS ON HUMANS IS MINIMIZED. MOST OF THE RESIDENTS IN THE AREA HAVE PUBLIC WATER, BUT WHAT ABOUT THOSE OF US WHO HAVE LIVED IN THIS AREA BEFORE THE WATER WAS PUT IN, WHAT ABOUT OUR CHILDREN?

I THINK ITS GREAT THAT SOMEONE IS FINALLY GOING TO DO SOMETHING ABOUT THE CONTAMINATION, FROM THE HEATH STANDPOINT IT WILL PROTECT FUTURE RESIDENTS AS YOU DESCRIBE, WHAT I WOULD LIKE TO KNOW IS WHAT PERSON IN THEIR RIGHT MIND PURCHASE A HOME IN THIS AREA KNOWING THAT THE WATER IS CONTAMINATED? REGARDLESS OF GOVERNMENT STUDIES AND GUARANTEES TO SAY THAT THERE IS NO DANGER. THERE IS ENOUGH HISTORICAL DATA TO SHOW THAT THE GOVERNMENT MORE OFTEN THAN NOT ACTS IN ITS OWN BEST INTEREST AND NOT THAT OF THE CITIZENS, I.E. AGENT ORANGE, 3 MILE ISLAND, LOVE CANAL etc.

I WOULD LIKE TO KNOW ALSO, WHAT THE ECONOMIC IMPACT WILL BE? NOT WHAT ITS GOING TO COST THE DOE, WHAT WILL THIS DO TO THE VALUE OF MY HOME? IF I CANT SELL MY HOME AT A REASONABLE PRICE BECAUSE OF BNL POLLUTION WILL THE LAB OR DOE MAKE AN OFFER. WHY SHOULD WE HAVE TO PAY FOR WATER WHEN WE COULD HAVE CONTINUED TO USE OUR WELLS IF BNL HADN'T POLLUTED THE WATER. HOW DO WE KNOW THAT THE PUBLIC WATER ISN'T COMING FROM THE SAME POLLUTED GROUND WATER SOURCE? ITS OBVIOUS THAT EVERYONE REALIZES THERE IS A WATER PROBLEM, WHAT WILL BE DONE FOR THE CITIZENS WHO WERE EFFECTED?

[signature]

What's Your Opinion?

The DOE wants and needs to hear from you to effectively decide what actions to take at Brookhaven National Laboratory.

Comments: PLEASE DEVINE WHAT THE TIME FRAME OF CLEANUPS IS ALL TIME FRAMES IN LITERATURE SUPPLIED IS 25 TO 30 YRS DON'T YOU THINK THAT IS A LITTLE OBSURD

W. Jackson
265 WARRS AVE
MANOR VILLE N.Y 11949

CERTILMAN BALIN ADLER & HYMAN, LLP
THE FINANCIAL CENTER AT MITCHEL FIELD
90 MERRICK AVENUE
EAST MEADOW, NY 11554
TELEPHONE (516) 296-7000
TELECOPIER (516) 296-7111

Brookhaven National Laboratory
Environmental Restoration Division
Date Rec'd: 3/22/99
File Code:
Copies To: Howe, Ali
Butler

HERBERT M. BALIN
PARTNER
DIRECT DIAL NUMBER
(516)-296-7018
E-MAIL hbalin@cbah.com

March 19, 1999

Mr. Michael Hauptmann
Project Manager
Brookhaven National Laboratory
Environmental Restoration Division
P.O. Box 5000
Upton, New York 11973-5000

Dear Michael:

In answer to your letter and the information sent to me, our Environmental Consultant has raised a number of questions.

I am enclosing a copy of his letter and would appreciate a reply.

Sincerely,

Herbert M. Balin

HMB:sm
Enc.

Aldo Andreoli, P.E.
Environmental Consultant

(516) 325-0582
(516) 325-1866

P.O. Box 898 Remsenburg, N.Y. 11960

March 15, 1999

Herbert M. Balin
Certilman Balin Adler & Hyman, LLP
The Financial Center at Mitchel Field
90 Merrick Avenue
East Meadow, NY 11554

Re: Brookhaven National Laboratory

Dear Herb:

I have reviewed the three documents that you forwarded to me: the Operable Unit III Remedial Investigation Report, the Operable Unit III Feasibility Study Report and the Operable Unit III Proposed Plan. They do represent a comprehensive approach on how BNL intends to remediate groundwater contamination.

Notwithstanding their approach, the key, to the remedial proposals is its verification through a monitoring program. I believe that it would be of interest to know the location of the monitoring wells, the frequency in which samples will be collected, and a periodic review of the results of this data. Also of particular interest will be the location of these monitoring wells in relationship to your clients' property, especially since BNL is proposing to add additional wells.

I think another point needs clarification: although BNL has extended public water to existing residents, will they provide the same services, at their expense, to future developments down gradient from their site?

Should you need any additional information, please advise.

Sincerely yours:

Aldo Andreoli, P.E.

48 Oakwood Rd.
Huntington, NY 11743
March 29, 1999

Mr. George Malosh
US Department of Energy – Brookhaven Group
PO Box 5000
Brookhaven National Laboratory
Upton, NY 11973-5000

Dear Mr. Malosh:

Enclosed please find my comments on the Proposed Plan for Operable Unit III at Brookhaven National Laboratory. It is obvious that many talented and skillful people worked on this plan. On the whole, as far as I could determine, it is well thought-out and protective of human health and the environment. However, I have a question and a comment on technical elements of the plan, and I also have some comments on the Department's approach to this project.

I hope to hear from you with regard to these comments, and I hope that the comments will be of some use to you as this process continues.

Sincerely,

David J. Tonjes, Ph. D.
Research Scientist
Waste Reduction and Management
Institute
Marine Sciences Research Center
SUNY at Stony Brook

cc. Mary Logan, USEPA
Jim Lister, NYSDEC
John Marburger, BSA

Comments on the Proposed Plan for Operable Unit III
Brookhaven National Laboratory
Upton, NY

By:
David J. Tonjes
48 Oakwood Rd.
Huntington, NY 11743

Research Scientist
Waste Reduction and Management Institute
Marine Sciences Research Center
SUNY at Stony Brook

March 29, 1999

These comments on the Proposed Plan for Operable Unit III (OU III) at Brookhaven National Laboratory (BNL) are divided into two sections: technical: and procedural. The technical comments are actually a series of related questions, and a series of comments. They will be addressed first. The procedural comments are complaints about the process adopted for the review of the proposed plan.

It should be understood that my review, although not as thorough and careful as I would have liked, generally found that the plans for OU III were protective of human health and the environment, and that the choices made in the RI/FS process were well-considered.

I. Technical Comments

A. Questions Concerning the Stripping Process for the Off-site Plume(s)

The discussion of sampling data for the offsite plume(s) said the contaminated groundwater is anoxic. My experience with well-oxidized Upper Glacial aquifer ground water has shown that iron concentrations typically are much less than the 300 μg/l standard used by the New York State Department of Environmental Conservation. The sampling data for the furthest downgradient wells in the OU III investigation had iron concentrations above this standard – sometimes at the 1-2 mg/l level. It seems reasonable to assume that the anoxic conditions of the ground water have resulted in iron reduction (from insoluble Fe(III) to soluble Fe(II)).

My questions center on the ability of the in-well stripping system to manage dissolved iron. Anecdotes suggest iron fouling is a serious problem at deeper production wells operated by the Suffolk County Water Authority (SCWA). The SCWA wells, set in deeper strata, and so probably drawing on older, more oxygen-depleted ground water, may be pumping anoxic water. Sampling data from these formation waters generally do not show extremely high (tens of mg/l) iron values. It seems that the high rates of pumping at these wells somehow leads to greater iron concentrations in the water, and to related problems with screens and pumping equipment (various hypotheses can be made to account for these processes).

Has this phenomenon been addressed in the choice of technology? I did not see any discussion of this potential problem. Fouling of the well screens in the pumping wells and the creation of iron precipitates as anoxic water becomes oxidized (if that occurs in this treatment) may be anticipated, judging from others' experiences on Long Island.

B. Comments Concerning Monitoring Plans

Part and parcel of each of the remedial approaches in OU III are extensive groundwater monitoring. Often, the plan did not (and could not) provide specifics for the monitoring to be done.

If the location and depth of each remedial point can be determined at this time, then the same should be determined for the points that monitor the effects of the remediation. It is not satisfactory for a comprehensive plan, especially one that specifies much of the work effort, to describe monitoring points as "to be determined based on later characterizations" (or words to that effect).

A major failing of the entire Superfund process at BNL has been the reliance on groundwater modelling to the detriment of monitoring efforts. Three years ago (1996) the plume investigations discovered contamination in the Magothy aquifer south of BNL. There has not yet been a major effort to characterize the contamination. Over the three-year time period, the model has been extensively exercised – but the ground water has not been sampled. Similarly, years after the discovery of off-site contamination, the plume characterization still relies on "vertical profile well" samples to describe most of the plume chartacteristics. Use of vertical profile wells was quite correctly described as suboptimal in the Remedial Investigation report.

The site groundwater model was extensively modified to analyze the region to be remediated, and to support the goals of the remedial program. This, no doubt, was an expensive undertaking (judging from the descriptions provided in the reports). Thus, money has been spent to determine plume behavior – but it has been modelling dollars, not sampling dollars.

The lack of definition for the monitoring portion of the remedial program seems to be part of the overall lack of enthusiasm for sampling (except when under intense public pressure, as in the initial tritium plume investigation). Other RI/FS studies also have called for plume monitoring – as in the EDB plume resolution of some five years ago. Have reports been issued yet on the monitoring portion of that remediation effort? If so, they certainly have not been extensively publicized, nor were they evident at the Longwood library.

Since monitoring is identified as an important part of the remediation – the one part that actually determines if the remedial effort is working as anticipated – it should be carefully and exactly spelled out. Locations, parameters, action levels, and monitoring frequencies should all be specified. The remedial plan, as specified to date, is flawed absent such information.

II. Procedural Complaints

Associated Universities (AUI) was fired as the BNL operator because of failings – some of which centered on public outreach and information efforts. The coalition that was appointed to replace AUI, Brookhaven Sciences Associates (BSA), made promises that the old mistakes would not be repeated.

This has not been my experience, especially with regard to the OU III review process. On March 1, I made a request to receive the technical documentation associated with the plan (partly on behalf of my colleagues, Drs. Swanson and Brownawell, who serve on the New York State BNL cleanup review board). Instead, I was mailed three copies of the OU III handout packet.

This packet, while informational, does not support any kind of technical review of the remediation plan. I again requested copies of more technical information. I was told that my request could not be met, and I was directed to one of the four document repositories (the BNL library, Longwood library, Mastics-Moriches library, or the US Environmental Protection Agency, in New York City).

All of these locations are inconveniently located for me, given requirements of work attendance, library hours, locations that I work (either at Stony Brook or in Medford), and my home in Huntington. This level of outreach effort satisfies regulatory and procedural necessities, and goes no further – the letter of the law.

I was able to find time to go the Longwood library. There I found that the technical letter of the law had not been met. The document set was missing Volume 2 of the Feasibility Study. However, this lack did not affect the level of review that I made, and so I will not make a formal complaint.

The Longwood library, as a repository for BNL documents, was especially unsuitable for serious work. The documents are stored on the 2nd floor; tables and study carrels are on the 1st floor, as are the photocopiers. The library did have the documents fairly well organized.

The documents for the RI/FS were unsuitable for quick or easy review. They are poorly organized, with relevant tables and figures placed in other volumes. Documents were sometimes referenced, but not included in the particular set of volumes, or, if included as an Appendix or addendum, were difficult to locate. I found myself taking up two tables with maps and volumes opened to different sections, and still I could not find relevant information easily. The text was repetitious, and varied from overly simplistic to technically bracing. Basic information (adequate descriptions of the particular remedial equipment) was not included, but extremely technical discussions of the groundwater model adjustments were. It took me over an hour to find some of the actual groundwater sampling data, and it proved to be immensely frustrating to try to relate the sampling data sets to the well location maps. Basic descriptors used in the text (such as roads) were often left unlabelled on maps.

The lack of available research tools at a community library like Longwood, such as might have been available at a research university like SUNY at Stony Brook, made a truly in-depth examination of the report impossible. The subtext, therefore, is that a serious review was not desired – at least by anyone outside of the regulatory community, and that community was involved in the development of the plan in the first place.

The material was not friendly to those who might not be technically adept, as well. I cannot imagine a concerned citizen without an advanced degree in engineering or an environmental science making heads or tails of the report. Clean, crisp descriptions of the problems were notably lacking, and simple differentiations between the remedial options were hard to discern. It was clear that I had been the first to look at the many maps and figures in the document set, on day 25 of the month-long review process. The size and organizational mish-mash that constituted the document set may have intimidated any other prospective reviewer. In fact, when I requested the technical documentation from BNL, the size of the document set was used to try to intimidate me, and deter me from making a serious attempt to affect the process.

The new management team at BNL should be ashamed to be associated with such a poorly-executed project. This should serve as a warning that future attempts to involve the community, such as reporting on the remediation work, should be more carefully designed, and not written to satisfy regulators solely.

Michael J. Alarcon
441 Sleepy Hollow Drive
East Yaphank, New York 11967
516-399-0829

March 30, 1999

George Malosh, Brookhaven Group Manager
US Department of Energy
Brookhaven Group, Building 464
PO Box 5000
Upton, New York 11973

Re: Comment on the BNL Proposal for
Cleanup of Groundwater Contamination

As requested, I am providing the following comments concerning the review of the Brookhaven National Laboratory proposal for the on-site and off-site cleanup of groundwater contamination which was presented in the Proposed Plan for Operable Unit III:

1. The information presented in Table I OU Areas of Concern and Areas of Investigation is inadequate because it fails to demonstrate that all areas of potential soil and groundwater contamination on and off-site have been completely investigated, and have been or will be cleaned up as may be necessary. Another table or summary is needed which will list all the work completed and all the cleanup work remaining in each area. Such a table or summary should also indicate if soil endpoint samples were collected for laboratory analysis after contaminated soils were removed, and list results of this testing which were not in compliance with NYSDEC Soil Cleanup Objectives.

2. The Proposed Plan for Operable Unit III report does not provide information concerning the specific ranges of groundwater Total VOC, individual VOC (PCE, TCA and Carbon Tetrachloride) and radiation contamination levels on or off-site . The Proposed Plan only provides a simple contaminant contour concentration line showing areas in which the groundwater contamination is in excess of drinking water standards. The Proposed Plan should be revised to show the additional moderate and extremely high ranges of the contaminant contour concentrations in groundwater (e.g. for VOCs of 10 ppb, 100 ppb, 1,000 ppb, and 10,000 ppb or greater) both on and off-site including the residential areas as depicted in the Operable Unit III Feasibility Study Report Appendix A - Figures (found at the Longwood Public Library).

3. The Proposed Plan for Operable Unit III also fails to provide illustrated estimates of the impact of the various Remedial Alternatives on the groundwater contamination contours over 5, 10, 20, and 30 year or greater periods of time. Although these types of estimates based on modeling at various aquifer depths are included in the Feasibility Study Report Appendix A - Figures, they should be included in a revised Proposed Plan and should be submitted to residents for evaluation.

4. The Proposed Plan for Operable Unit III fails to include an analysis of the alternative of rapid or accelerated cleanup of the groundwater both on and off-site to restore groundwater quality to pre-spill or pre-contamination conditions or to restore groundwater so that it meets drinking water standards. In my review of Appendix A-Figures, I noted that there apparently exists an alternative V12 which provides for an Off-site Accelerated 5 Year Cleanup of Groundwater Contamination. This alternative which calls for the installation of approximately 100 sparging wells was not even presented or analyzed in the Proposed Plan. The residents of the community have the right to have a complete range of cleanup alternatives presented to them particularly one which results in the most rapid or 5 year cleanup of the plume as compared to the alternatives proposed which allows continued migration of portions of the contamination plumes and provides for a prolonged cleanup period estimated at thirty years (or more depending on the accuracy of the predictions). The Proposed Plan should be revised to include consideration of this alternative.

5. The proposal to use air sparging wells instead of extraction wells in combination with air stripping to remove contamination from various areas of the contamination plumes is not explained or justified in the Proposed Plan. Extraction wells with air stripping treatment may provide for more effective removal of contaminants by causing movement of contaminants towards the extraction well as compared to the use of sparging wells which re-circulate treated water and promote contaminant dilution within the aquifer. The basis for selection of sparging wells should be addressed in a revised Proposed Plan for Operable Unit III.

6. The Proposed Plan should detail the results and significance of any soil gas testing performed on or off-site to evaluate the potential off-gassing of VOCs from contaminant source or plume areas in industrial and residential areas. The potential for accumulation of such vapors in basements or within structures should also be reviewed and the results of testing should be compared to ambient guideline concentrations for each contaminant of health concern.

7. The 30 day time period provided for public comments regarding the Proposed Plan for Operable Unit III, as well as the Feasibility Study and the Remedial Investigation is insufficient to allow residents or their representatives to fully review the Proposed Plan and the basis for its recommendations. It is unreasonable to expect that the plan report and supporting documentation which is massive and which have been years in the making can be fully reviewed within the short period of time provided. In view of the recommended revisions detailed above, the report should be revised and presented for public review with a public comment period provided of at least 60 additional days.

Conclusion/Recommendations

The Proposed Plan for Operable Unit III is deficient and should be revised and clarified as detailed in the above comments. In addition it is recommended that the Brookhaven National Laboratory reconsider and revise the Proposed Plan for Operable Unit III so as to select VOC and Radiation cleanup alternatives which call for the most rapid cleanup of contaminants in the plume - over no more than a 5 to 10 year period. The proposal for clean up of contamination areas over a 30 year period is unsatisfactory and should be rejected by the USEPA, NYSDEC and the Department of Energy, and by the residents of East Yaphank and Shirley. These residents who have had the quality of their environment and value of their property degraded, and have faced the potential risks posed by consumption of contaminated drinking water from private wells, deserve to have the contamination plumes rapidly cleaned up.

Thank you for the opportunity to comment in this matter.

Sincerely yours,

Michael J. Alarcon

Michael J. Alarcon, P.E.
Resident of East Yaphank

copies: East Yaphank Civic Association
PO Box 566, Yaphank, New York 11980
Attn: Michael Giacomaro, President

Hon. Michael Forbes, First Congressional District
Member of the US House of Representatives

United States Environmental Protection Agency
Region II, 290 Broadway, New York 10007-1866
Attn: Mary Logan

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York
Attn: Mr. Jim Lister

bnl2.doc

CAC

Community Advisory Council to Brookhaven National Laboratory

Brookhaven National Laboratory
Environmental Restoration Division
Date Rec'd: JUN 07 1999
File Code: OU III - Corr.
Copies To: J. Meersman

June 4, 1999

Mr. George Malosh
U.S. Department of Energy - Brookhaven Group
Brookhaven National Laboratory
Building 464
Upton, New York 11973

Dear Mr. Malosh:

Subject: Errata to Recommendation 1 for Operable Unit III

During the May 13, 1999, meeting of the Brookhaven National Laboratory Community Advisory Council, there was further discussion on Recommendation 1 for Operable Unit III which was sent to you:

> The remedies put in place by Brookhaven National Laboratory should meet drinking water standards in groundwater for volatile organic compounds, strontium-90, and tritium.

Please note that the Community Advisory Council wishes to issue an errata to Recommendation 1 to read:

> **The objective of remedies put in place by Brookhaven National Laboratory should be to meet drinking water standards in groundwater for volatile organic compounds, storntium-90, and tritium.**

Sincerely,

Community Advisory Council
To Brookhaven National Laboratory

c: CAC
J. Marburger
J. Meersman
M. Schlender

CAC Community Advisory Council to Brookhaven National Laboratory

Members

April 26, 1999

Mr. George Malosh
U.S. Department of Energy - Brookhaven Group
Brookhaven National Laboratory
Building 464
Upton, New York 11973

Dear Mr. Malosh:

At the April 8, 1999, meeting of the Brookhaven National Laboratory Community Advisory Council, the Council reached consensus to make the following recommendations on clean up for Operable Unit III:

1. The remedies put in place by Brookhaven National Laboratory should meet drinking water standards in groundwater for volatile organic compounds, strontium-90, and tritium.

2. Brookhaven National Laboratory should complete cleanup of the groundwater in a timely manner.

3. The Proposed Plan for Operable Unit III should specify the decision criteria or methods for stopping active volatile organic compounds clean up in in-well air-stripping systems and specify the process for monitoring and reactivating treatment systems if contaminant levels increase.

4. Brookhaven National Laboratory's goal should be, wherever possible, to use active measures to clean up all groundwater in proposed volatile organic compounds in-well air-stripping systems to New York State Drinking Water Standards or better.

Sincerely,

Community Advisory Council
To Brookhaven National Laboratory

c: CAC
J. Marburger
J. Meersman
M. Schlender

East Yaphank Civic Association
P.O. Box 566, Yaphank, New York 11980

April 26,1999

To: George Malosh
U.S. Department of Energy-Brookhaven Group
P.O. Box 5000
Brookhaven National Laboratory
Upton New York 11973 - 5000

Comments on propose plan for Operable Unit III

We approve of your plan treatment for Tritum and Strontium-90.

As for your plans for the Volatile Organic Compounds, we don't think they go far enough.

As to the Air Stripping Wells at the industrial Park, we think the line of wells should be extended East ward and Westward to include several more air stripping wells to completely cover the entire plume.

Concerning the proposed air stripping wells located on the LIPA right of way, we think the more wells are required.

We thank you for this opportunity to express our views.

Signed,

Jerry Minasi, for the East Young Yaphank Civic Association

THE ASSEMBLY
STATE OF NEW YORK
ALBANY

HOMAS P. DINAPOLI
Member of Assembly
16th District
Nassau County

CHAIR
Standing Committee on
Governmental Operations

CHAIR
Task Force on Long Island Sound

CO-CHAIR
Legislative Commission on
Water Resource Needs of
New York and Long Island

COMMITTEES
Ways & Means
Education
Environmental Conservation
Veterans Affairs

April 8, 1999

Mr. George Malosh
US DOE – Brookhaven Group
P.O. Box 5000
Brookhaven National Laboratory
Upton, NY 11973-5000

RE: Operable Unit III Comments

Dear Mr. Malosh:

The following comments regarding the Proposed Plan for Operable Unit III at Brookhaven National Laboratory are submitted on behalf of the New York State Legislative Commission on Water Resource Needs of Long Island. We thank you for the periodic updates and information regarding progress in remedial activities at BNL. Our comments and questions are limited to treatment of off gases from the operating or proposed air stripping system for treatment of Volatile Organic Compounds (VOCs) and the decision regarding low level VOCs discharging to the Carmans River.

Presently there are several on and off site VOC treatment systems designed to remove contamination from the groundwater using air stripping and air sparging/soil vapor extraction. The proposed remedy includes several more off site VOC treatment systems. There is no mention in the Proposed Plan for OUIII of off gas treatment for any of these systems, the levels of VOC's released to the atmosphere from individual systems or the collective discharges to the air from all systems, currently operating or proposed. In the summary of Site Risks the atmosphere is not listed as a pathway of exposure. If, in fact, there is no treatment of off gases, the contamination removed from the groundwater is transferred and released to the air. This becomes an exposure pathway that did not previously exist. At a minimum, the amount of contamination released to the atmosphere from all groundwater treatment systems individually and collectively should be calculated and the health effects assessed.

[illegible], Legislative Office Building, Albany, New York 12248, (518) [illegible], FAX (518) 455-4921
[illegible] Middle Neck Road, Suite 200, Great Neck, New York 11021, (516) [illegible], FAX (516) 482-6975

Given the precedent of BNL offering public water hookups to community members not directly impacted by groundwater contamination, presumably to take every measure to protect the public, to be pro-active and to engender better community relations, BNL should add off gas treatment to all operating or proposed groundwater treatment systems. This should be done whether or not air quality standards are exceeded at individual wells or with all wells considered collectively.

In section X, analysis and comparisons of alternativas, the statement is made that "most alternatives do not directly remediate VOC contamination present in the Magothy aquifer (P.32). Does the VOC contamination in the Magothy exceed drinking water standards? Has the horizontal and vertical extent of this contamination been determined? Has an analysis of various remedial options been undertaken to address VOC contamination in the Magothy? Under a no action/natural attenuation alternative, have the years to RAOs been determined or the final plume configuration been estimated?

Finally, we strongly urge that alternative VIOC be designated as the VOC remedial action because they will mitigate impacts from the VOC plume which discharges to the Carmans River. Every effort should be made to protect the Carmans River, considering segments have been classified as having statewide importance for scenic and recreational use under the Wild, Scenic and Recreational River Act, Article 15, Title 27 of the NYS Environmental Conservation Law.

The policy of the state as defined in this law declares that designated rivers "shall be protected for the benefit and enjoyment of present and future generations." Therefore, it is appropriate to select the remedial alternative which will mitigate the direct impacts on the Carmans River rather than the proposed alternative VIOB which will allow the VOC plume to continue to migrate toward and discharge into the Carmans River.

Thank you for the opportunity to submit these comments. If there are any questions regarding them, please contact Rosemary Konatich, Senior Environmental Analyst on the Commission staff at (516) 829-3368.

Sincerely,

Thomas P. DiNapoli
Member of Assembly

TPD:2RK

COUNTY OF SUFFOLK

Attachment A

ROBERT J. GAFFNEY
SUFFOLK COUNTY EXECUTIVE

DEPARTMENT OF HEALTH SERVICES

CLARE B. BRADLEY, M.D., M.P.H.
COMMISSIONER

TO: Joseph H. Baier, P.E.

FROM: Sy F. Robbins, C.P.G.

DATE: January 8, 1999

SUBJECT: BNL OU III PROPOSED PLAN: ON & OFF-SITE GROUNDWATER PLUMES

I have reviewed BNL's draft proposed plan for Operable Unit III, On- and Off-site Groundwater Plumes, dated December 16, 1998 and have the following comments:

Section II. Proposed Remedy

1. The plan's use of the term "cleanup objectives" on page 2 is misleading, since attainment of these objectives relies heavily on natural attenuation for areas not subject to direct cleanup activities. A better term, which is used in Sections II and VIII, and elsewhere in the text, is "remedial action objectives."

2. The statement (page 4) that the proposed remedy restores the contaminated aquifer segments "as a source of drinking water" is also misleading, since such areas are unlikely to ever again be used for potable purposes (in large part due to the uncertainties inherent in even the most extensive monitoring program).

VOC Remediation

3. The statement (pages 4 & 18) that the industrial complex groundwater treatment system "will address further migration of the highest concentrations of the deep VOC plume" ignores the presence of high concentrations (4,180 ppb) of carbon tetrachloride in the upper Magothy aquifer south of BNL in well 000-130 at 205 feet below MSL. The extent of this contamination, and the need for remediation, still need to be determined.

4. Alternative V10b should be protective of public health, given the hookup of private wells in the downgradient area; provided, that the necessary monitoring is conducted and additional treatment systems are ~~installed to~~ prevent further VOC plume migration. I cannot comment, however, on whether impacts to the Carmans River from discharges of uncontrolled, low-level VOCs within the western portion of the OU III plume will adversely affect ecological systems; further modeling and assessment of these impacts is needed.

DIVISION OF ENVIRONMENTAL QUALITY
OFFICE OF WATER RESOURCES ■ 225 RABRO DRIVE EAST, HAUPPAUGE, N.Y. 11788-4290 ■ TEL (516) 853-3076
FAX (516) 853-3075

Tritium Remediation

5. Low-flow extraction system operation is contingent upon the finding of greater than 2,000,000 pCi/l at the front of the reactor. It should be indicated whether concentrations less than this are likely to trigger removal contingencies farther downgradient, i.e., 25,000 pCi/l at the Chilled Water Plant Road and/or 20,000 pCi/l at Weaver Drive (according to BNL's tritium plume model).

6. The statement (page 5) that "tritium will decay sufficiently to avoid off-site migration" is misleading; tritium contamination from the HFBR will eventually travel off-site, and the timing and ultimate concentration of this contamination need to be stated explicitly.

7. Alternative T4 should be protective of public health, given the hookup of private wells in the downgradient area. The proposed monitoring network and removal contingencies, however, can not guarantee that all tritium that could migrate off-site at levels exceeding drinking water standards will be detected and captured. It is therefore recommended that all known tritium contamination in excess of 100,000 pCi/l be removed with low-flow pumps and disposed off-site, so that tritium levels leaving the site in 25 years (2 half lives) will not exceed standards. It is also recommended that the proposed monitoring using permanent wells be augmented periodically with profile wells using short screens to reduce the likelihood that maximum plume concentrations and downgradient migrations will go undetected.

Strontium-90 Remediation

8. I concur that alternative S5a should be protective of public health and the environment. It is important that the proposed additional monitoring wells be carefully placed so as to accurately characterize recovery system efficacy at plume migration control.

Resent-Message-Id: <199904292026.QAA04646@bnl.gov>
Resent-from: "MOHAMMAD ALI" <mali@mail.bnl.gov>
Resent-to: MALLETTE.464.BHG@bnl.gov, schlender@bnl.gov, meersman@bnl.gov, mali@bnl.gov, kwwhite@bnl.gov, egmur@bnl.gov, burke@bnl.gov, howe@bnl.gov, jcarter@bnl.gov
Resent-date: Thu, 29 Apr 1999 16:25:02 -0400
X-PH: V4.4@bnl.gov
From: PEDNEAULT@aol.com
X-PH: V4.4@bnl.gov
Date: Thu, 29 Apr 1999 16:05:05 EDT
Subject: OU III
To: mali@bnl.gov

Dear Mohammad:

I truly appreciate you and Tom Burke taking the time to try a meet with me on Monday the 26th. Unfortunately my daughter broke her thumb and both my girls had a severe reaction to poison sumac. It is just "one of those weeks".

I did want to ask questions on some of the technical points for remediation and the overall treatment systems. These questions can remain for another day for they will neither hamper or help the overall RI/FS.

I did take many trips to the Library and get accquainted with the volumes. It was tedious, but worth it for me. We have come a long way together and communication has definitely become more open.

My basic comments for OU III are delivered in the CAC's points submitted for review.

However, on a personal level and after all this time of being involved to some degree, I should like to publically comment the following:

I could not find any technical data gaps of serious concern.

I believe the document to be one of the most carefully written thus far of this unit.

I distinctly recognize the work involved to publish a more communicative document, but there is need to polish this part of the presentation. The material needs to be more user friendly and use of language would be the easiest to change.
Many interested people find technical jargon to be intimidating and therefore, don't bother to participate.

I feel it necessary for BSA Community Affairs and OER to once again hold a community forum focused on Superfund Education with accent on Natural Attenuation as a viable and resourceful method of remediation.

It would help me if an action time table graph like thing could be added to the final document. This way the community could always have finger tip knowledge of how OU III should progress with treatment, monitoring and natual attenuation.

I trust the above meets with approval and again thanks for all your nsiderations.

As always,

Jean E. Mannhaupt