Five-Year Review Report

for

Brookhaven National Laboratory Superfund Site

Town of Brookhaven, Hamlet of Upton
Suffolk County, New York

March 31, 2011

PREPARED FOR:
The United States Department of Energy
Office of Environmental Management

PREPARED BY:
Environmental Protection Division
Brookhaven National Laboratory
Upton, New York 11973

Registered to ISO 14001

Executive Summary

The U.S. Department of Energy (DOE) owns the Brookhaven National Laboratory (BNL) site in Upton, New York, and is the lead agency for the Five-Year Review. DOE entered into a Federal Facilities Agreement (also referred to as the Interagency Agreement, or IAG) for the BNL site, along with the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC). Brookhaven Science Associates (BSA), under contract with the DOE, manages and operates BNL.

The remedies for the BNL Superfund site in Upton include excavation and off-site disposal of contaminated soil, sediment, tanks, and structures, capping of landfills, installation and operation of groundwater treatment systems, groundwater monitoring, and implementation of institutional controls. All of the remedies for the nine signed Records of Decision (RODs) and two Explanation of Significant Differences (ESDs) have been fully implemented except for remaining remedial actions at the Brookhaven Graphite Research Reactor (BGRR) and the High Flux Beam Reactor (HFBR).

The first comprehensive Five-Year Review was submitted to the regulatory agencies in July 2005, and issued as a final document in August 2006. The 2010 Five-Year Review covers all of the operable units (OUs) and Reactor-related *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) actions.

According to data reviewed from the closeout reports, the annual *BNL Groundwater Status Reports*, site inspections, and regulatory interviews, the remedies were implemented in accordance with the RODs and the two *OU III Explanation of Significant Differences* (ESD). The soil cleanup levels have been met and the groundwater remediation systems continue to meet the remedial action objectives identified in each ROD.

Since the last Five-Year Review, several additional remedy optimizations were accomplished. These include the Building 96 Tetrachloroethylene (PCE) Source Remediation, Peconic River Sediment Remediation, and improved groundwater remediation with the addition of extraction wells at the HFBR Tritium Pump and Recharge System, the OU III Chemical Holes Sr-90, BGRR/Waste Concentration Facility (WCF) Sr-90, and Airport Groundwater treatment systems.

Long-term protectiveness of the Peconic River remedy will be verified by continuing to monitor the sediment, surface water, and fish, and by completing the revegetation in areas cleaned up in the winter of 2010/2011. In addition to annual reporting of the analytical results, the effectiveness of the remedy in meeting the cleanup and restoration objectives will be evaluated during the third sitewide Five-Year Review in 2016.

For OU I, the soil excavation remedies are protective since the work was performed in accordance with the ROD, applicable design documents, and Remedial Action Work Plans. The remedies for groundwater are expected to be protective upon attainment of the groundwater cleanup goals.

A comprehensive sitewide protectiveness determination covering all the OUs and the reactors (BGRR and HFBR) must be reserved at this time because:

- Remedy implementation at the BGRR and HFBR has not yet been completed.
- Work is not complete for the BGRR bioshield and final engineered cap.
- Work is not complete for the HFBR stack and Building 802 demolition.

The third comprehensive Five-Year Review in 2016 will include all OUs, the BGRR, HFBR, and the g-2/ Brookhaven Linac Isotope Producer (BLIP) Tritium Plume remedy. The table below provides a summary of each OU's issues and recommendations from the 2010 Five-Year Review. The recommendations are subject to regulatory review, and implementation will be based on the availability of funding.

Table E-1: Recommendations and Follow-up Actions

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Capture of remaining VOCs in OU I Plume	Implement pulse pumping of extraction wells. Continue pumping until 2015 to meet VOC capture goal.	BNL	DOE, EPA, NYSDEC, SCDHS	July 2011	N	N
Sr-90 in OU I Groundwater	Enhance monitoring well network to track Sr-90.	BNL	DOE, EPA, NYSDEC, SCDHS	June 2011	N	N
OU III Building 96 Source Removal Effectiveness	Continue treatment system operations. Monitor plume and determine if continuing source remains.	BNL	DOE, EPA, NYSDEC, SCDHS	September 2012	N	N
Monitoring of downgradient OU III Industrial Park East Plume	Install additional downgradient monitoring well.	BNL	DOE, EPA, NYSDEC, SCDHS	August 2011	N	N
OU III Industrial Park Treatment System Shutdown	Install additional temporary well between UVB-3 and UVB-4 in support of anticipated system shutdown.	BNL	DOE, EPA, NYSDEC, SCDHS	August 2011	N	N
OU III North Street Treatment System Shutdown	Increase system operation through 2013 due to continued high VOCs	BNL	DOE, EPA, NYSDEC, SCDHS	October 2012	N	N
OU III North Street East Treatment System Shutdown	Characterize contamination upgradient of NSE-1 and monitor for achievement of capture goal. Extend system operation through 2013 to achieve system capture goal.	BNL	DOE, EPA, NYSDEC, SCDHS	September 2011	N	N
OU III Middle Road Treatment System	Assess contamination to west of RW-1 and need for additional extraction well.	BNL	DOE, EPA, NYSDEC, SCDHS	September 2012	N	N
OU III South Boundary deep VOC contamination	Install additional extraction well(s) to capture and treat deeper contamination. Extend system operation until 2017.	BNL	DOE, EPA, NYSDEC, SCDHS	September 2012	N	N
OU III Western South Boundary TCA/Freon contamination	Extend operation of extraction well WSB-1 to 2019 to capture high TCA concentrations. Characterize extent of Freon contamination and develop path forward.	BNL	DOE, EPA, NYSDEC, SCDHS	November 2012	N	N
OU III HFBR contingency pumping termination	Determine shutdown of pump and recharge system based on characterization of high-concentration slug.	BNL	DOE, EPA, NYSDEC, SCDHS	March 2012	N	N
OU IV Sump Outfall Sr-90	Install additional monitoring wells as per *2009 Groundwater Status Report* Recommendations.	BNL	DOE, EPA, NYSDEC, SCDHS	October 2011	N	N

Continued...

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
OU V Groundwater	Petition regulatory agencies to conclude groundwater monitoring program pending 2011 perchlorate results.	BNL	DOE, EPA, NYSDEC, SCDHS	December 2011	N	N
Potential continuing Sr-90 source at BGRR	Monitor to determine existence and assess feasibility of in-situ source stabilization. Monitor the effectiveness of new extraction wells.	BNL	DOE, EPA, NYSDEC, SCDHS	July 2012	N	N
Potential continuing Sr-90 source at Chemical Holes	Monitor to determine existence and assess feasibility of in-situ source stabilization and/or removal.	BNL	DOE, EPA, NYSDEC, SCDHS	July 2012	N	N
Peconic River Monitoring Program	Modify monitoring program following remedy optimization.	BNL	DOE, EPA, NYSDEC, SCDHS	September 2011	N	N
OU VI EDB	Add new monitoring well to bound the east side of the plume	BNL	DOE, EPA, NYSDEC, SCDHS	September 2011	N	N
BGRR Decommissioning	Complete remaining remedial actions and submit closeout report(s) to the regulators	BNL	DOE, EPA, NYSDEC, SCDHS	October 2012	N	N
HFBR	Complete remaining remedial actions and submit closeout report(s) to the regulators	BNL	DOE, EPA, NYSDEC, SCDHS	October 2011	N	N
HFBR	Explore the feasibility of reducing the 65-year safe storage (decay) period and completing the removal of large activated components earlier.	BNL	DOE, EPA, NYSDEC, SCDHS	Recurring	N	N
OUs III & VI - Deeds not reflecting operating treatment systems	Complete survey/mapping of treatment systems off of BNL property and record updated deeds with County	BNL	DOE, EPA, NYSDEC, SCDHS	June 2005 (survey/mapping completed 6/30/05)	N	Y
Former HWMF Perimeter Soils	Phase III - Assess soil contamination Additional cleanup if necessary	BNL	DOE, EPA, NYSDEC, SCDHS	September 2012 September 2014	N	N

Notes :
Recommendations are subject to regulatory review, and implementation will be based on the availability of funding
BGRR = Brookhaven Graphite Research Reactor
DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
HFBR = High Flux Beam Reactor
NYSDEC = New York State Department of Environmental Conservation
SCDHS = Suffolk County Department of Health Services
VOCs = volatile organic compounds

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: Brookhaven National Laboratory Superfund Site		
EPA ID *(from WasteLAN)*: NY7890008975		
Region: 2	**State:** NY	**City/County:** Upton, Suffolk
SITE STATUS		
NPL status: ☒ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☒ Under Construction ☒ Operating ☒ Complete		
Multiple OUs?* ☒ YES ☐ NO	**Construction completion date:** ___ / ___ / ______	
Are the properties associated with this site in use or are they suitable for reuse? ☒ YES ☐ NO		
REVIEW STATUS		
Lead agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency (DOE)		
Author name: John Sattler		
Author title: DOE Federal Project Director and IAG Remedial Project Manager	**Author affiliation:** U.S. DOE, Office of Environmental Management, Upton, NY	
Review period:** 7/19/2005 to 12/31/2010		
Date(s) of site inspection: 6/15/10 through 11/18/10		
Type of review: ☒Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐Non-NPL Remedial Action-site ☐ NPL State/Tribe-lead ☐Regional Discretion		
Review number: ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify) __________		
Triggering action: ☐ Actual RA Onsite Construction at OU I ☐ Construction Completion ☐ Other (specify) ☐ Actual RA Start at OU#____ ☒ Previous Five-Year Review Report		
Triggering action date *(from WasteLAN)*: 7/19/2006		
Due date *(five years after triggering action date)*: 7/13/2011		

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Report
Table of Contents

Table of Contents *(Continued)*

List of Tables

List of Figures

List of Attachments

List of Acronyms

ALARA	As Low As Reasonably Achievable
AOC	Area of Concern
AS/SVE	Air Sparging/Soil Vapor Extraction
BER	Brookhaven Executive Round Table
BGD	below-ground duct
BGRR	Brookhaven Graphite Research Reactor
BHSO	Brookhaven Site Office
BLIP	Brookhaven Linac Isotope Producer
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
CAC	Community Advisory Council
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFR	*Code of Federal Regulations*
CSF	Central Steam Facility
DOE	U.S. Department of Energy
DQO	Data Quality Objective
EDB	ethylene dibromide
EPA	U.S. Environmental Protection Agency
ESD	*Explanation of Significant Differences*
gpm	gallons per minute
HFBR	High Flux Beam Reactor
HWMF	Hazardous Waste Management Facility
IAG	Interagency Agreement
IP	Industrial Park
Linac	Linear Accelerator
LIPA	Long Island Power Authority
LUCMP	*Land Use Controls Management Plan*
LU/IC	Land Use/Institutional Controls
mCi	milliCuries
MCL	maximum contaminant level
mRem	milliRem
MTBE	methyl tertiary-butyl ether

NCP	*National Contingency Plan*
NEAR	Neighbors Expecting Accountability and Remediation at Brookhaven National Laboratory
NEPA	National Environmental Policy Act
NPL	*National Priorities List*
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	operation and maintenance
ORISE	Oak Ridge Institute for Science and Education
OU	Operable Unit
pCi/L	picoCurie(s) per liter
pCi/g	picoCurie(s) per gram
PCBs	polychlorinated biphenyls
PCE	tetrachloroethylene
ppm	part(s) per million
RA	Removal Action
RAO	Remedial Action Objective
ROD	Record of Decision
SCDHS	Suffolk County Department of Health Services
SCWA	Suffolk County Water Authority
SPDES	State Pollutant Discharge Elimination System
Sr-90	strontium-90
STP	Sewage Treatment Plant
SVOC	semivolatile organic compound
TAG	Technical Assistance Grant
TBC	Items "to be considered"
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TVOC	total volatile organic compound
UST	underground storage tank
VOC	volatile organic compound
WCF	Waste Concentration Facility
WSB	Western South Boundary
µg/L	microgram(s) per liter

Glossary

Administrative Record: A file that contains the documents, including technical reports, which form the basis for selection of a final remedy and acts as a vehicle for public participation.

Area of Concern: A geographic area of BNL where there has been a release or the potential for a release of a hazardous substance, pollutant, or other contaminant. There are 31 areas of concern at BNL.

Closeout Report: A report that documents the completion of construction of the remedy and how it complies with the requirements of the remedial design plans, specifications, and the ROD. The report includes post-excavation confirmatory sampling results.

Institutional Controls: Measures or restrictions established to prevent exposure of workers or the public to hazards. These may include the establishment of fencing, posting of signs, prevention of unplanned alteration of contaminant plume flow pathways, etc.

Interagency Agreement: A legal binding document established under the *Comprehensive Environmental Response, Compensation, and Liability Act,* that presents the framework for implementing the cleanup activities at a particular site. At BNL, the IAG was signed in 1992 by the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the New York State Department of Environmental Conservation.

Maximum Contaminant Level: A standard set by the U.S. Environmental Protection Agency and the New York State Department of Environmental Conservation for contaminants in drinking water. These contaminants represent levels that the regulatory agencies believe are safe for people to drink. NYSDEC standards often apply a safety factor and are more stringent than the Federal standards.

Operable Unit: Groups of areas within a site containing the same or similar contamination. The areas within one operable unit are not necessarily adjacent. BNL has six operable units.

PicoCurie Per Liter: A unit of measure of radioactivity per liter of water.

Record of Decision: Documents the decision by DOE and the regulators on a selected remedial action. It includes the responsiveness summary and a bibliography of documents that were used to reach the remedial decision. When the record of decision is finalized, the remedial design and construction can begin.

Brookhaven National Laboratory
Five-Year Review Report

1.0 Introduction

The purpose of this Five-Year Review is to determine whether the remedies implemented at Brookhaven National Laboratory (BNL) continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review Reports. In addition, Five-Year Review Reports identify potential problems with the ability of the remedial actions to meet the cleanup objectives, if any, and provide recommendations to address them.

The U.S. Department of Energy (DOE) prepared this Five-Year Review Report pursuant to the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

DOE interpreted this requirement further in the NCP; *40 Code of Federal Regulations* (CFR) §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

Brookhaven Science Associates (BSA), under contract with the DOE, manages and operates BNL. BSA's Environmental Protection Division (EPD) and Environmental Restoration Projects (ERP) conducted this Five-Year Review of the remedial actions implemented at the BNL site under the direction of the DOE Remedial Project Manager. This report documents the results of the review.

This is the second sitewide Five-Year Review for the BNL site and includes all the Operable Units (OUs), the Brookhaven Graphite Research Reactor (BGRR), the High Flux Beam Reactor (HFBR), and the g-2 Tritium Plume and Brookhaven Linac Isotope Producer (BLIP) Areas of Concern (AOCs). The triggering action for this 2010 sitewide statutory Five-Year Review is the completion of the first sitewide review in July 2006. This review is required because hazardous substances, pollutants, or contaminants at the site are above levels that allow for unlimited use and unrestricted exposure. This second sitewide Five-Year Review includes an evaluation of all the AOCs at BNL. Previous Five-Year Reviews were:

- Five-Year Evaluation Reports prepared for the Current and Former Landfills in 2001 and 2002 in accordance with New York State Part 360 requirements (BNL 2001a and 2002).
- A Five-Year Review focused specifically on the OU IV remedy in September 2003 (BNL 2003a).
- The first sitewide Five-Year Review submitted as draft to the regulators in July 2005, with the final Report issued in July 2006. The triggering action for this review was initiation of the remedial action for OU I contaminated landscape soils in July 2000. This Review did not include the g-2/ BLIP or HFBR RODs.

2.0 Site Chronology

Remedial actions at the BNL site are currently being addressed under RODs for six OUs, the BGRR, the HFBR, and g-2/BLIP, covering 31 AOCs. The chronology in **Table 2-1** first identifies general site information, and then breaks each OU down by major event. **Table 2-2** presents each OU and Removal Action AOC.

Table 2-1: Chronology of Site Events

General Site Information	
Site of future BNL serves as Army Camp Upton for World Wars I and II, operated by the Civilian Conservation Corps between wars	1917 – 1940s
Site transferred to the Atomic Energy Commission, BNL developed	1947
BNL transferred to the Energy Research and Development Administration	1975
BNL transferred to the Department of Energy	1977
BNL added to NYSDEC list of Inactive Hazardous Waste Sites	1980
BNL listed on EPA National Priorities ("Superfund") List	1989
DOE entered into Interagency Agreement with EPA and NYSDEC under CERCLA	1992
Operable Unit I	
Removal Action (RA) for "D-waste" tanks removal	1994
RA for Landfill capping	1995–1997
RA for South Boundary groundwater treatment system construction, and public water hookups	1996
RA for Chemical/Animal Pits and Glass Holes excavation	1997
ROD signed	1999
Completed excavating landscape soil; Closeout Report issued	2000/2001
Completed excavating sludge from Building 811 underground storage tanks (USTs); Closeout Report issued	2001
Completed excavating soil and pipeline associated with Building 650; Closeout Report issued	2002
Completed capping Ash Pit; Closeout Report issued	2003/2004
Completed excavating soil and reconstructed Upland Recharge and Meadow Marsh; Closeout Report issued	2003/2004
Completed excavating former Hazardous Waste Management Facility (HWMF) soil; Closeout Report issued	2005
Completed excavating Building 811 USTs/soils; Closeout Report issued	2005
Completed excavating former Chemical Holes residual surface soils; Addendum to Closeout Report issued	2005
Operable Unit II/VII	
RA for BLIP Facility (AOC 16K) cap, drainage control, grout injection; Closeout Report issued	1998/2002
Remedial Investigation (RI); RA Report issued	1999
Evaluation of alternatives included under OU I Feasibility Study (FS)	1999
Operable Unit III	
RA for Building 479 PCB-contaminated soil excavation	1992
RA for Building 464 mercury-contaminated soil excavation	1993
RA for cesspools/septic tanks completed; Closeout Report issued	1994–1999
RA for USTs completed; Closeout Report issued	1994–1999
RA for public water hookups	1996–1998
RA for South Boundary groundwater treatment system construction	1997
RA for High Flux Beam Reactor (HFBR) tritium plume groundwater treatment system	1997
RA for Carbon Tetrachloride groundwater treatment system construction	1999
RA for Industrial Park groundwater treatment system construction	1999
ROD signed	2000
Completed constructing Building 96 groundwater treatment system	2000
Completed constructing Middle Road groundwater treatment system	2001
Completed constructing low-flow pumping system for HFBR tritium plume	2001

Continued…

Table 2-1: Chronology of Site Events *(continued)*

Completed constructing Western South Boundary groundwater treatment system	2002
Completed constructing Chemical Holes Sr-90 groundwater treatment system (Pilot Study)	2003
Petition approved for shutdown of the Carbon Tetrachloride treatment system	2004
Completed constructing four remaining off-site groundwater treatment systems: Industrial Park East, North Street, North Street East, LIPA/Airport	2004
Completed constructing BGRR/Waste Concentration Facility (WCF) Sr-90 groundwater treatment system	2004
Completed excavating and off-site disposal of Building 96 PCB-contaminated soil; Closeout Report issued	2005
Explanation of Significant Differences (ESD) issued for Magothy, Sr-90, Bldg. 96 geophysical anomalies	2005
Building 96 Groundwater Treatment System Shutdown Petition Issued	2005
Completed construction of additional extraction wells for the HFBR, Chemical Holes, and Airport groundwater treatment systems	2007
Explanation of Significant Differences (ESD) issued for Bldg. 96 VOC soil excavation	2009
Petition approved for shutdown of the Industrial Park East groundwater treatment system	2009
Petition approved for closure of the Carbon Tetrachloride groundwater treatment system; system dismantled	2009-2010
Completed excavating and off-site disposal of Building 96 VOC-contaminated soil	2010
Completed construction of additional extraction wells for the WCF Sr-90 groundwater treatment system	2011
Operable Unit IV	
RA for fence around Building 650 Sump Outfall area soil	1995
ROD signed	1996
Completed constructing AS/SVE remediation system	1997
Petition approved for shutdown of AS/SVE remediation system	2000
Five-Year Review submitted to EPA and NYSDEC	2002
Petition for closure of AS/SVE Remediation System approved by EPA and NYSDEC; system dismantled	2003
Final Five-Year Review issued	2003
Operable Unit V	
RA for Imhoff Tanks	1995
ROD signed for Sewage Treatment Plant (STP)	2002
Completed excavation: STP soils; Completion Report issued	2003/2004
RA for Peconic River sediment excavation on site (Phase 1); Completion Report issued	2004/2005
RA for Peconic River sediment excavation off site (Phase 2); Completion Report issued	2004/2005
ROD signed for Peconic River	2005
Closeout Report for Peconic River Phase 1 and 2 Remediation issued	2005
Initiated post-cleanup Peconic River monitoring program to demonstrate the effectiveness of the cleanup	2006
Completed ROD-required sediment trap removal and Peconic River remedy optimization	2011
Operable Unit VI	
RA for public water hookups	1996–1997
ROD signed	2001
Completed constructing EDB groundwater treatment system off site	2004
Brookhaven Graphite Research Reactor	
RA for BGRR primary cooling fans and equipment	1999
RA for pile fan sump	1999–2000
RA for above-grade ducts	2000–2002
RA for canal house and water treatment house	2001–2002
RA for coolers and filters	2002–2003
RA for BGD primary liner	2004
RA for fuel canal and subsurface soils	2005
ROD signed	2005
Graphite pile removal; Closeout Report issued	2010
Biological shield removal	In Progress
Engineered cap installation	In Progress

Continued...

Table 2-1: Chronology of Site Events *(continued)*

g-2/BLIP/USTs	
Impermeable caps placed over BLIP and g-2 source areas	1997 and 1999
Groundwater monitoring, cap inspections and maintenance	1999-2010
ROD signed	2007
High Flux Beam Reactor	
Dismantlement and removal of several ancillary buildings	2006
RA completed for excavating former HWMF Waste Loading Area soils; Completion Report issued	2007-2009
ROD signed	2009
Removal of Bldg. 801-811 underground waste transfer lines (A/B waste lines with co-located piping) and associated soil; Closeout Report issued.	2009
RA for removal/disposal of control rod blades and beam plugs; Completion Report issued	2009-2010
Began Long-Term Surveillance and Maintenance (S&M)	2010
Fan house (Bldg. 704), above- and below-ground structures, and associated soil removal	2010
Confinement Building stabilization	2010
Underground utilities and associated soil removal	In Progress
Stack and Bldg. 802 fan house demolition	In Progress
Other Actions	
RA completed for excavating the former HWMF Phase I Perimeter Soils; Completion Report issued	2009
Completed excavating the former HWMF Phase II Perimeter Soils; Completion Report Addendum issued	2010

Notes
AOC = Area of Concern
AS/SVE = Air Sparging/Soil Vapor Extraction
BLIP = Brookhaven Linac Isotope Producer
BGD = below-ground duct
CERCLA = *Comprehensive Environmental Response, Compensation and Liability Act*
EPA = U.S. Environmental Protection Agency
EDB = ethylene dibromide
ESD = Explanation of Significant Differences
FS = Feasibility Study
HWMF = Hazardous Waste Management Facility
IAG = Interagency Agreement
LIPA = Long Island Power Authority
NYSDEC = New York State Department of Environmental Conservation
RA = Removal Action
RI = Remedial Investigation
ROD = Record of Decision
S&M = Surveillance and Maintenance
STP = Sewage Treatment Plant
USTs = underground storage tanks
VOC = volatile organic compound
WCF – Waste Concentration Facility

Table 2-2 Operable Unit (OU) AOCs

Category	AOC #	Description and Status
OU I (ROD approved)	AOC 1 (A,C,D,E,F,G,H,I)	Hazardous Waste Management Facility – complete
	AOC 1B	Spray Aeration site – removal action complete
	AOC 2 (A,B,C,D,E,F)	Former Landfill Area – complete
	AOC 3	Current Landfill – complete
	AOC 2 and 3	Former and Current Landfill Closures – removal actions complete
	AOC 6	Buildings 650 Sump and Sump Outfall – complete
	AOC 8	Upland Recharge Area/Meadow Marsh – complete
	AOC 10A	Waste Concentration Facility – Tanks D-1, D-2, and D-3 – complete
	AOC 10B,C	Waste Concentration Facility – Underground pipelines and Six A/B USTs - complete
	AOC 12	Underground Storage Tanks at Bldg. 445 – removal action complete
	AOC 23	Off-Site Tritium Plume (southern component) – complete
	Sub AOC 24E	Recharge Basin HS, Outfall 005 – complete
	Sub AOC 24F	New Stormwater Runoff Recharge Basin – complete
OUs II/VII (addressed in OU I ROD; approved)	AOC 10A,B,C	Waste Concentration Facility (Building 811) – complete
	AOC 16 (A,B,C,D,E,F,G,H,I,J,L,M, N,O,P,Q,S)	Aerial Radioactive Monitoring System Results – complete
	AOC 17	Area Adjacent to Former Low-Mass Criticality Facility – complete
	AOC 18	AGS Scrapyard ("Boneyard") – complete
	AOC 20	Particle Beam Dump, north end of Linac – complete
OU III (ROD approved)	AOC 7	Paint Shop – groundwater monitoring ongoing
	AOC 9	BGRR (groundwater) – treatment system operating
	AOC 10	Waste Concentration Facility (groundwater) – treatment system operating
	AOC 11	Building 830 Pipe Leak – complete; groundwater monitoring ongoing
	AOC 12	Underground Storage Tanks at Bldg. 830 – removal action complete
	AOC 13	Cesspools – removal action complete
	AOC 14	Bubble Chamber Spill Areas – groundwater monitoring ongoing
	Sub AOC 15A	Supply/Potable Wells 1, 2, 3, 4, 6, 7, 10, 11, 12
	Sub AOC 15B	Monitoring Well 130-02 – treatment system operating
	AOC 16R	Aerial Radioactive Monitoring System results– Nuclear Waste Management Facility, Building 830 – complete (covered under AOCs 11 and 12)
	AOC 18	AGS Scrapyard (groundwater) – groundwater monitoring ongoing
	AOC 19	TCE Spill Area, Building T-111 – groundwater monitoring ongoing
	AOC 20	Particle Beam Dump, north end of Linac (includes Basin HT) – monitor and maintain per SPDES permit/*Natural Resource Management Plan* (NRMP)
	AOC 21	Leaking sewer pipes (sitewide, not investigated under other OU study areas) – groundwater monitoring ongoing
	AOC 22	Old Firehouse – no further action per ROD
	Sub AOC 24A	Process Supply Wells 104 and 105 – treatment systems operating, groundwater monitoring ongoing
	Sub AOC 24B	Recharge Basin HP, Outfall 004 – monitor & maintain per SPDES permit & NRMP
	Sub AOC 24C	Recharge Basin HN, Outfall 002 – monitor & maintain per SPDES permit & NRMP

Continued…

Table 2-2 Operable Unit (OU) AOCs *(continued)*

Category	AOC #	Description and Status
	AOC 25	Building 479 PCB soil removal complete; groundwater monitoring underway
	AOC 26	Building 208 – removal action complete
	AOC 26A	Building 208 (groundwater) - groundwater monitoring complete
	AOC 26B	Former Scrapyard/Storage Area south of Bldg. 96 – treatment system operating; soil removal complete
	AOC 27	Building 464 mercury soil removal complete; groundwater monitoring ongoing
	AOC 29	Spent fuel pool in HFBR and associated groundwater plume of tritium – pump and recharge system operating; groundwater monitoring ongoing
OU IV (ROD approved)	AOC 5 (A,B,C,D)	Central Steam Facility – treatment system decommissioned
	AOC 6	Reclamation Facility Interim Action – complete
	AOC 12	Underground Storage Tanks at Bldg. 650 – removal action complete
	AOC 21	Leaking Sewer Pipes (in study area) – complete
	Sub AOC 24D	Recharge Basin HO, Outfall 003 – complete
OU V – STP (ROD Approved)	AOC 4 (A,B,C,D,E)	Sewage Treatment Plant - complete
	AOC 21	Leaking sewer pipes (in the study area) – complete
	AOC 23	Off-site tritium plume (eastern component) – groundwater monitoring ongoing
OU V – Peconic River (ROD Approved)	AOC 30	Peconic River – cleanup on and off of BNL property complete; additional sediment removed in 2010/2011; river monitoring ongoing
OU VI (ROD approved)	AOC 28	EDB groundwater contamination – treatment system operating, groundwater monitoring ongoing
BGRR (ROD Approved)	AOC 9	Graphite Pile – complete
		Biological Shield/Engineered Cap – in progress
	AOC 9A	Canal – complete
	AOC 9B	Underground duct work – complete
	AOC 9C	Spill sites – complete
	AOC 9D	Pile Fan Sump – complete
g-2 and BLIP (ROD Approved)	AOC 12	Underground Storage Tanks, Bldgs. 462, 463, 527, 703, 927, 931B – complete
	AOC 16K	Aerial Radioactive Monitoring System results – BLIP, Building 931B – Source area protection and groundwater monitoring ongoing
	AOC 16T	Aerial Radioactive Monitoring System results - g-2 Source Area and Tritium Groundwater Plume – source area protection and groundwater monitoring ongoing
HFBR (ROD Approved)	AOC 31	Waste Loading Area – complete
		Control Rod Blades and Beam Plugs – complete
		Building 801-811 Waste Transfer Lines - complete
		HFBR Stabilization – complete; Closeout Report in review
		Fan Houses (Buildings 704 and 802) – in progress
		Underground Utilities – in progress
		Stack – in progress
Other Removal Action	Not applicable	Former HWMF Perimeter Soils – Phase I – complete; Phase II – complete; Phase III – pending
	Not applicable	Central Steam Facility Lead-Contaminated Soil – complete

Notes
AGS = Alternating Gradient Synchrotron
AOC = Area of Concern
BGRR = Brookhaven Graphite Research Reactor
BLIP = Brookhaven Linac Isotope Producer
HFBR = High Flux Beam Reactor
NRMP = *Natural Resource Management Plan*
ROD = Record of Decision
SPDES = State Pollutant Discharge Elimination System
VOC = volatile organic compound

3.0 Facility-Wide Background

3.1 Physical Characteristics

The BNL site is located in Upton, Suffolk County, New York, near the geographic center of Long Island. The BNL property approximates a square, 3 miles on each side, comprising an area of approximately 5,265 acres (about 8 square miles). The boundaries of BNL are either near or adjacent to neighboring communities. Approximately 150 people live in apartments on site, and many of the approximately 4,000 scientists and students who visit each year stay in the Lab's dormitories. The site's terrain is gently rolling, with elevations varying between 40 and 120 feet above mean sea level. The land lies on the western rim of the Peconic River watershed, with a tributary of the river rising in marshy areas in the northern part of the site.

3.2 Geology/Hydrogeology

BNL is underlain by unconsolidated glacial and deltaic deposits that overlie gently southward sloping, relatively impermeable, crystalline bedrock. The deposits are about 2,000 feet thick in central Suffolk County. The aquifer beneath BNL is comprised of three water-bearing units: the Upper Glacial, the Magothy, and the Lloyd aquifers. 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 EPA and serve as the primary source of drinking water for Nassau and Suffolk counties.

3.3 Land and Resource Use and Institutional Controls

The site where BNL is located was formerly occupied by the U.S. Army as Camp Upton during World Wars I and II. Between the wars, the Civilian Conservation Corps operated the site. In 1947, the Atomic Energy Commission established BNL. The Laboratory was transferred to the Energy Research and Development Administration in 1975 and to the DOE in 1977. BNL is currently a federal facility that conducts research in physical, biomedical and environmental sciences, and energy technologies.

The developed region of the site includes the principal BNL facilities which are near the center of the site on relatively high ground. These facilities comprise an area of approximately 900 acres, of which 500 acres were originally developed for Army use. Outlying facilities occupy approximately 550 acres and include an apartment area, former Hazardous Waste Management Facility (HWMF), Sewage Treatment Plant (STP), firebreaks, and former landfill areas. A significant portion of land on the eastern portion of the site has been designated as the Upton Ecological Reserve. DOE is also leasing approximately 200 acres of land on the east and southeast portion of the site to BP Solar for the development of a 32 megawatt (MW) direct current solar power plant.

The current land-use designations for the BNL site as of March 2010 are shown on **Figure 3-1**. This includes industrial use in the central portion of the site, with open space borders. Although not shown on this map, a small portion of the site is residential and agricultural. Further detail of the land use designations for specific remediation areas is identified in the *BNL Land Use and Institutional Controls* (LUIC) website (https://luic.bnl.gov/website/landcontrols/). These land use settings are projected to remain the same. These include:

- Soil Remediation Complete - Unrestricted Land Use (A)
- Soil Remediation Complete - Restricted Land Use (B)
- Capped/Controlled Contaminated Soils - Restricted Land Use (C)
- Known or Potentially Contaminated Soils, Remediation Pending - Restricted Land Use (D)
- Groundwater Contamination Areas - Restricted Groundwater Use (E)
- Radiological Facility, Decontamination & Demolition Pending - Restricted Land Use (F)
- Sensitive Areas, Biologically/Culturally Sensitive - Restricted Land Use (G)

Institutional controls are administered as per the *BNL Land Use Controls Management Plan* (LUCMP) (BNL 2009e, Rev. 3) which was initially issued in 2003. LUICs will be maintained for as long as necessary in order to ensure performance of the completed remedies as described and documented in the BNL RODs. The AOC-specific institutional controls are documented on fact sheets stored on the *BNL Land Use and Institutional Controls* (LUIC) website (https://luic.bnl.gov/website/landcontrols/). This is a secure website that is available for regulatory use but is not open to the general public. The website is BNLs tool for internally managing Institutional Controls (ICs) and consists of an interactive Graphic Information Systems (GIS) base map that is linked to the AOC-specific fact sheets. Planning for any work at the site that may potentially disturb a formerly remediated area requires a review of the website. ICs are deployed at BNL to prevent exposure to residual environmental contamination, and to ensure the long-term effectiveness of the remedies.

This Plan is a living document and is periodically updated by BNL and reviewed by the regulators in an effort to stay current with evolving management techniques. The Plan was updated three times since 2005 with the latest update in June 2009 (BNL 2005d, 2007a and 2009e). LUICs are evaluated from a sitewide standpoint on an annual basis and issues from the previous year are summarized in a letter report to the regulatory agencies. A summary of findings from the required annual inspections of former AOCs is included in this report. The Plan also details notification criteria in the event of a LUIC breach or unauthorized change in land use. Specific ICs for each area are detailed in the fact sheets and are summarized by OU in **Section 7.0** of this Report.

Because of chemical contamination in the Upper Glacial aquifer, DOE provided public water hookups for homes in the area south of BNL. Ten homeowners within the designated public water hookup area declined the free DOE hookup offer in 1996-1997 and continued to use their private wells for drinking purposes. That number was reduced to seven homeowners in 2005 and six in early 2006. In mid 2006, two additional homes were identified that were previously thought to be connected to public water. This brings the number of homes not connected to public water to eight (four in OU III, one in OU V, and three in OU VI). Annually, DOE formally offers those homeowners free testing of their private drinking water wells.

3.4 History of Contamination

Much of the environmental contamination at BNL is associated with past accidental spills and historical storage and disposal of chemical and radiological materials. These past operations, some of which may date back to when the site was an Army training camp, have caused soil and groundwater contamination that can be categorized into four main areas. These areas are 1) the groundwater contamination (primarily volatile organic compounds [VOCs]), ethylene dibromide [EDB], strontium-90 [Sr-90], and tritium), 2) soils contamination (primarily polychlorinated biphenyls [PCBs], tetrachloroethylene [PCE], metals, cesium-137 [Cs-137] and Sr-90) and landfills, 3) the Peconic River sediment contamination (primarily metals and PCBs), and 4) the BGRR (primarily radioactivity). Contamination in the Peconic River and VOC groundwater contamination have extended off the BNL property. The most significant environmental concern is that BNL lies above a sole-source aquifer that is used for drinking water purposes both on and off site. Brief descriptions of the nature of contamination associated with each OU, the BGRR, g-2/ BLIP/underground storage tanks (USTs), and the HFBR covered under this Five-Year Review are as follow:

- OU I – Former landfills, disposal pits, and soils contaminated with metals such as mercury and lead, and radionuclides including Cs-137 and Sr-90; above- and below-ground leaking storage tanks; and VOC-contaminated groundwater such as 1,1-dichloroethane, on BNL property.
- OU II/VII – Radiologically contaminated soils on BNL property such as Cs-137 identified as part of aerial radiological surveys. The AOCs in this OU were documented under the OU I and III RODs (except for BLIP [AOC 16K] which was documented in a separate ROD).

- OU III – Groundwater contaminated with VOCs such as carbon tetrachloride, 1,1,1-trichloroethane (TCA), and PCE, and radionuclides such as tritium and Sr-90 on BNL property; VOC-contaminated groundwater off of BNL property including PCE and carbon tetrachloride; and PCE soil contamination at one location on BNL property.
- OU IV – Soil and groundwater contaminated with VOCs such as toluene and ethylbenzene, and semivolatile organic compounds (SVOCs) from former oil/solvent tank spill on BNL property. Groundwater contaminated with Sr-90 located in central portion of BNL property.
- OU V – Radiological- and metal-contaminated soil at the Sewage Treatment Plant (STP) such as Cs-137, mercury, and silver; metal (mercury, silver, copper) and PCB-contaminated sediment in the Peconic River; and VOC-contaminated groundwater including trichloroethene (TCE) on and off of BNL property.
- OU VI – EDB-contaminated groundwater off of BNL property.
- BGRR – Activated components including the pile and bioshield, radiologically contaminated soils, sumps, ducts, piping, and standing water including Cs-137 and Sr-90; and Sr-90 in groundwater on the BNL site.
- g-2/BLIP/USTs – Radioactive soil shielding and contaminated groundwater at the g-2 and BLIP experiment areas, and removal of underground storage tanks.
- HFBR – Activated components, contaminated structures, systems, underground pipes/ducts, ancillary buildings and associated soils. Tritium-contaminated groundwater.

3.5 Initial Response

In 1980, the BNL site was placed on the NYSDEC list of Inactive Hazardous Waste Sites. In 1989, BNL was also included on the EPA National Priorities List because of soil and groundwater contamination. Subsequently, EPA, NYSDEC, and DOE entered into a Federal Facilities Agreement (also referred to as the Interagency Agreement, or IAG). While not formal IAG partners, the Suffolk County Department of Health Services (SCDHS) and the New York State Department of Health (NYSDOH) are also actively involved with BNL cleanup decisions. The IAG became effective in 1992, and it identified AOCs that were grouped into OUs to be evaluated for response actions. The IAG established the framework and schedule for characterizing, assessing, and remediating the site in accordance with the requirements of CERCLA. There are 31 AOCs and six OUs at the BNL site.

As noted in **Table 2-1** in **Section 2.0**, prior to the approval of the RODs, DOE used its removal action authority in many situations to help reduce risks to human health and the environment. In most cases, these actions were taken to address source areas of contamination. These activities include the closure/capping of landfills, fencing, tank removals, soils remediation, groundwater treatment, public water hookups, STP remediation, Peconic River sediment remediation, and response actions at the BGRR and HFBR. In several cases, the removal action ended up being the final remedial action. These actions are documented in the RODs.

3.6 Basis for Taking Action

The nature of the contamination as well as the risks to human health and the environment for each OU are summarized below.

Operable Unit I. Radioactively contaminated soil is the principal threat. In addition, several Removal Actions were conducted to address buried waste at several AOCs.

<u>Soils:</u> The former HWMF (AOC 1) contained most of the radioactively contaminated soil at BNL. The predominant radionuclide was Cs-137, which is the primary source of risk from direct exposure. Sr-90 was

also present, and most of the contamination was at or near the surface although in some locations it extended to 12 feet below grade. Other contaminated soil areas included the Waste Concentration Facility (WCF, AOC 10) (which also contained leaking tanks), Building 650 Sump and Sump Outfall (AOC 6), and several areas throughout the site that were the result of contaminated soils that were unknowingly once used for landscaping purposes. The Former (AOC 2), Interim (AOC 2D), and Current (AOC 3) landfills, as well as the Chemical/Animal Pits and Glass Holes (AOC 2B and 2C), received waste generated at the BNL site from 1917 through 1990. These disposal areas were unlined and had a direct impact on groundwater quality prior to their being capped or excavated in the mid 1990s. Contaminants at the Former Landfill Area include VOCs, metals such as mercury, and Sr-90.

The ash pits (AOC 2F), which once received ash and slag from a solid-waste incinerator located on the BNL site, have lead concentrations above cleanup goals. The Upland Recharge/Meadow Marsh Area (AOC 8) contained sediment with low levels of pesticides and metals below cleanup standards for human health but presented an exposure risk to eastern tiger salamanders, an endangered species in New York State.

Groundwater: The groundwater beneath the Former Landfill area contains VOCs and Sr-90, while groundwater beneath the Current Landfill contains VOCs and metals. Sr-90 and VOCs have also entered the groundwater from the former HWMF. Volatile organic compound contamination from these areas has migrated beyond the site's boundary.

Operable Unit II/VII. The principal threat is from radioactively contaminated soils.

Soils: Cs-137 is the major radiological contaminant of concern in soil where it can exceed specified risk or radiation dose limits. Cs-137 was found in the WCF soils as well as several areas identified from the aerial radioactive monitoring system results (i.e., landscaping soils [AOC 16S]). During the remedial investigation, no Cs-137 soil contamination in the landscape soils was found greater than 2 feet below grade. This soil contamination was included under the OU I project. Sr-90 soil contamination was found deeper than two feet at the WCF, as was tritium contamination in soil at the BLIP.

Groundwater: The BLIP (AOC 16K) contains an area of soil and groundwater contamination (see discussion on g-2 and BLIP areas below).

Operable Unit III. Groundwater contamination is the most significant concern; however, there are several soil AOCs.

Groundwater: VOC-contaminated groundwater extends south from the central portion of BNL off site to the Brookhaven Airport area, a distance of approximately three miles. The VOC plumes originated from a variety of sources including various small spill areas in the central industrial/research areas of the site, former Building 96, the Former Landfill, the Central Steam Facility (OU IV), Former Building 208 warehouse area, and the former Carbon Tetrachloride UST. The primary contaminants are TCA, PCE, and carbon tetrachloride. Tritium and Sr-90 are also present above the maximum contaminant levels (MCLs) on the BNL site. There is no radiological contamination off of BNL property that exceeds MCLs. The potable drinking water supply wells on and off of the BNL site are currently not impacted, nor are they expected to be impacted from the contamination. Although these plumes were not found to have impacted any off-site private drinking water supply wells, in the 1990s DOE provided public water connections to most of the homes located in North Shirley. Although eight homeowners elected to continue to use their private wells for drinking water purposes, DOE offers free annual testing of their well water, which is conducted by the SCDHS.

Soils: PCB-contaminated soils above the New York State Technical and Administrative Guidance Memorandum (TAGM) cleanup levels, as well as high concentrations of PCE in soil were found at the former Building 96 Scrapyard (AOC 26B). Other smaller contaminated soil areas included mercury at Building 464 (AOC 27) and PCBs at Building 479 (AOC 25).

Operable Unit IV. Soil and groundwater are the concerns.

Groundwater: VOCs and SVOCs such as benzene, toluene, and ethylbenzene from an historical oil/solvent spill, contaminated the groundwater at this OU. Strontium-90 was released to groundwater at the Building 650 Sump Outfall and the plume is located in the central portion of the site.

Soil: VOCs and SVOCs were also present in the soils from the historical oil/solvent spill. Radiological contamination of soils was identified at the Building 650 Sump Outfall. This soil contamination was included under the OU I project.

Operable Unit V. Radioactively and metal-contaminated soil, and metal and PCB-contaminated river sediment are the principal threats.

Soil/Sediment: The STP berms soil (AOC 4) presented concern due to potential impacts to future on-site residents from Cs-137 and mercury. In addition, concentrations of mercury and PCBs in fish may have posed a health hazard to people consuming fish taken from certain locations on the Peconic River (AOC 30). Sediment within certain depositional areas of the Peconic River was contaminated with mercury, silver, and copper, and posed a potential ecological concern. Surface sediment in depositional areas up to 1.5 miles downstream of the STP contained the PCB Aroclor-1254. Trace amounts of Cesium-137 were co-located in the sediment, but did not pose a risk to people or aquatic organisms.

Groundwater: VOCs (e.g., TCE) were the primary contaminants in the groundwater on and off of the BNL site. Low levels of tritium were also found, but at concentrations below the 20,000 picoCuries per liter (pCi/L) MCL.

Operable Unit VI. Groundwater contamination is the primary threat.

Groundwater: The pesticide EDB is the contaminant of concern (AOC 28). It has been found in groundwater on and off of BNL property significantly above the MCL of 0.05 micrograms per liter (µg/L). The EDB originates from application in the Biology Fields in the 1970s.

BGRR

Structures and Soils: There are several radiologically contaminated and activated structures and components at various locations within the BGRR complex (AOC 9). These include the graphite pile and surrounding biological shield, contaminated concrete within the fuel-handling system's deep pit and fuel canal (AOC 9A), and contaminated steel and concrete within the below-ground ducts (BGD, AOC 9B). Additionally there are isolated pockets of contaminated soils adjacent to the BGD secondary cooling air bustle and expansion joints, fuel canal outer walls and construction joint, the reactor building pipe trench, and the reactor building drains. Concerns also include rainwater infiltration and subsequent leaching into the soil/groundwater. Most nonradiological hazardous materials associated with the BGRR were removed through previous interim stabilization measures. Isolated pockets of nonradiological hazardous material contamination are present within the reactor building pipe trench, and within embedded drain lines. Hazardous materials intrinsic to construction materials, such as floor tiles, paint, and insulating materials, remain within the reactor building.

Groundwater: Groundwater contaminated with Sr-90, included under OU III, is present beneath the BGRR complex, at concentrations significantly above the 8 pCi/L MCL. The Sr-90 contamination extends up to 1,500 feet south of this area.

g-2/BLIP/USTs

Structures and Soils: The former g-2 experiment area (AOC 16T) and BLIP facility (AOC 16K) contain soil contamination. Research operations have resulted in the activation of soil used for shielding. The primary contaminants of concern at this area are tritium and sodium-22. The threat results from the infiltration of rainwater through the activated soils, and the leaching of tritium and sodium-22 into the groundwater. To reduce the ability of rainwater to infiltrate the activated soils, a number of stormwater management controls have been implemented. In addition, eight underground storage tanks from several locations across the site were removed between 1988 and 1996, and confirmatory soil sampling following the tank removals indicated no environmental impacts.

Groundwater: Groundwater in the vicinity of the former g-2 experiment area (AOC 16T) and BLIP facility (AOC 16K) has been contaminated with tritium at concentrations that exceeded the 20,000 pCi/L MCL. Although sodium-22 concentrations occasionally exceed the 400 pCi/L MCL, it decays to nearly non-detectable levels within a short distance from the source areas. There are no groundwater impacts associated with the former USTs.

HFBR

Activated Components, Contaminated Structures and Soils: Past operations resulted in the formation of radioactive material (i.e., activation products) within the metal and concrete of the large reactor components (reactor vessel/internals, thermal shield and biological shield). Smaller quantities of radioactive material were also found in ancillary structures (fan houses and stack), underground pipes/ducts, and associated soils.

Groundwater: Groundwater contaminated with tritium, included under OU III, is present in the vicinity of the HFBR complex and extends discontinuously up to several thousand feet to the south, at concentrations above the 20,000 pCi/L MCL. Tritium has not been detected above the MCL beyond the BNL property boundary.

4.0 Remedial Actions

4.1 Remedy Selection

To date, nine Records of Decision have been signed at BNL. The first was signed in 1996 and the last in 2009. The nine RODs are:

1. OU I – Radiologically contaminated soils on the BNL site
2. OU III – Groundwater on and off of the BNL site
3. OU IV – Soil and groundwater on site

4/5. OU V – STP and the Peconic River (two RODs)

6. OU VI – EDB in groundwater off of the BNL site
7. BGRR – Radiologically contaminated structures and soil on site
8. g-2/BLIP/USTs – Radiologically contaminated soil shielding and groundwater
9. HFBR – Radiologically contaminated structures and soil

Individual site locations are shown on **Figure 4-1**. Brief descriptions of the ROD remedial action objectives and the major remedy components are described below.

<u>Operable Unit I ROD, signed August 1999 (BNL 1999a)</u>

- Objectives are to prevent or minimize:
    - Leaching of contaminants (radiological and chemical) from soil into the groundwater.
    - Migration of contaminants present in surface soil via surface runoff and windblown dust.
    - Human exposure including direct external exposure, ingestion, inhalation, and dermal contact, and environmental exposure to contaminants in the surface and subsurface soils.
    - Uptake of contaminants present in the soil by ecological receptors.
- OU I Remedy Components:
    - Excavate soils that are radiologically and chemically contaminated above the selected cleanup goals at the former HWMF, WCF, Building 650 Sump and Sump Outfall, and the Chemical/Animal Pits and Glass Holes, and dispose of soil at an approved off-site facility. Reconstruct wetlands at the former HWMF.
    - Remove out-of-service facilities, tanks, piping, and equipment at the former HWMF and WCF.
    - Install soil caps to address metal contamination at ash pits.
    - Excavate chemically contaminated sediment from the Upland Recharge/Meadow Marsh Area and dispose of sediment at an approved facility off the BNL site. Reconstruct wetlands and monitor.
    - Implement long-term institutional controls and monitoring to ensure that planned uses are protective of public health.
    - All of the previous removal actions that were implemented, such as landfill capping, waste and soil excavation, and groundwater pump and treat systems, were selected as final remedies under the ROD.

Groundwater contamination associated with the Former Landfill Area and off-site groundwater associated with other Operable Unit I AOCs were addressed in the OU III ROD (BNL 2000a). An evaluation of remedial alternatives for contaminated soil and groundwater associated with the BLIP facility (AOC 16K) was completed. The final remedy for contaminated soils and groundwater at BLIP is documented in the g-2/ BLIP/USTs ROD (BNL 2007b).

Operable Unit II Decisions

Remedial actions for the OU II AOCs are documented in the OU I ROD (BNL 1999a) and OU III ROD (BNL 2000a).

Operable Unit III ROD, signed June 2000 (BNL 2000a)

- Objectives are to:
  - Meet drinking water standards (i.e., maximum contaminant levels [MCLs]) in groundwater for VOCs, Sr-90, and tritium.
  - Complete cleanup of the groundwater in the Upper Glacial aquifer within 30 years (by 2030) or less.
  - Prevent or minimize further migration of VOCs, Sr-90, and tritium in groundwater.
- OU III Remedy Components:
  - For VOCs – Install treatment systems at the Long Island Power Authority (LIPA) right-of-way, North Street, Airport, North Street East, Industrial Park East, Middle Road, and Western South Boundary. All of the previously implemented VOC removal actions (including treatment systems at the South Boundary and Industrial Park) were selected as final remedies under the OU III ROD.
  - For tritium (AOC 29) – Institute contingency plans to reactivate the Princeton Avenue pump and recharge system, and low-flow groundwater extraction of high tritium concentrations at the HFBR with approved off-site disposal of the water.
  - For Sr-90 – Install treatment systems using ion exchange at the Chemical Holes and the BGRR/WCF plumes. Prior to implementation, perform a pilot treatability study to evaluate the effectiveness of extraction and treatment, and modify the remedy, if needed.
  - Magothy aquifer – Perform additional characterization and determine the need for a remedy. If a remedy for the Magothy is necessary, either the OU III ROD would be modified or another decision document would establish the selected action (see OU III ESD below).
  - The previous removal action that was implemented for public water hookups was selected as a final remedy under the ROD.
  - Groundwater monitoring program to monitor and verify the cleanup over time.
  - Source Areas – Source removal system at Building 96 for VOCs in groundwater and PCBs in soil, remediation of groundwater at the former Carbon Tetrachloride UST spill area, and removal of Building 830 USTs (AOC 12).
  - Deferred Decisions – The final remedy for potential source areas such as the Building 96 geophysical anomalies (AOC 26B) was documented in a subsequent ROD (see OU III ESD below). The final remedy for AOC 9D, the Pile Fan Sump, was documented in the BGRR ROD.

Operable Unit III Explanation of Significant Differences, signed May 2005 (BNL 2005a)

- OU III Remedy Components:
  - Magothy aquifer – Add two Magothy aquifer extraction wells off of BNL property in addition to the three wells already installed. Meet drinking water standards within 65 years of the signing of the OU III ROD (by 2065).
  - Sr-90 – Continue to operate the “pilot study” remediation facility treatment system at the Chemical Holes and meet the drinking water standards within 40 years (by 2040). Install an ion exchange treatment system for the BGRR/WCF plume, and meet the drinking water standards within 70 years (by 2070).
  - Building 96 Scrapyard – No further action for the geophysical anomalies.
  - Institute long-term institutional controls and monitoring to ensure that planned uses are protective of public health.

Operable Unit III Explanation of Significant Differences, signed August 2009 (BNL 2009a)

- OU III Remedy Components:
  - Building 96 Scrapyard – Changes to the Building 96 groundwater remedy to include excavation and off-site disposal of PCE-contaminated soils. This will optimize the remedy by reducing the number of years of active treatment and enable BNL to achieve the ROD cleanup goal for this groundwater plume (by meeting drinking water standards for volatile organic compounds by 2030).

Operable Unit IV ROD, signed March 1996 (BNL 1996)

- Objectives are to restore the groundwater quality at the most contaminated portion of the AOC 5 plume to MCLs or background levels, and prevent or minimize:
  - Leaching of contaminants (radiological and chemical) from the soils into the groundwater.
  - Volatilization of contaminants from surface soils into the ambient air.
  - Migration of contaminants present in surface soil via surface runoff and windblown dust.
  - Human exposure including ingestion, inhalation, and dermal contact, and environmental exposure to contaminants in the surface and subsurface soil and groundwater.
  - Uptake of contaminants present in the soil and/or groundwater by plants and animals.
- OU IV Remedy Components:
  - Treat chemically contaminated soil in the vadose zone of the spill area (AOC 5A) and the fuel unloading area (AOC 5D) using soil vapor extraction.
  - Treat groundwater at the most contaminated portion of the spill area using soil vapor extraction and air sparging.
  - Use an engineering enhancement option for the groundwater if soil vapor extraction and air sparging alone will not achieve the desired performance levels.
  - As an Interim Action, install a fence around the radiologically contaminated soil at Building 650 Sump and Sump Outfall area with institutional controls and monitoring. The final remedy for these soils is documented in the OU I ROD as discussed above.
  - Monitor the natural attenuation of Sr-90 contamination in groundwater originating from the former Sump Outfall area.

Operable Unit V Sewage Treatment Plant ROD, signed January 2002 (BNL 2001b)

- Objectives are to:
  - Protect public health and the sole source aquifer, continue to monitor the groundwater, and to prevent or minimize:
    - Migration of contaminants present in surface soil via surface runoff and windblown dust.
    - Human and environmental exposure to contaminants in surface and subsurface soil.
    - Potential for uptake of contaminants present in the soil by ecological receptors.
    - Potential for migration of contaminants (radiological and chemical) from the soil to groundwater.
  - Reduce the levels of contamination in the sand filter beds (AOC 4B)/berms and adjacent areas.
- OU V STP Remedy Components:
  - Excavate radiologically and chemically contaminated soil at the sand filter beds and berms, firing range berms, and the sludge drying beds, and dispose of soil at an approved off-site facility.
  - Remove sludge from manholes along a retired section of the sanitary sewer line leading to the STP.
  - Monitor the groundwater for VOCs and tritium.

    - A previously implemented removal action for the Imhoff Tank is selected as the final remedy (AOC 4C).
    - Implement institutional controls on BNL property such as preventing the installation of pumping wells that may interfere with groundwater monitoring. Implement Suffolk County's Sanitary Code regarding limitations of private well installations.
    - Any sale or transfer of BNL property will meet the requirements of 120(h) of CERCLA to ensure that future users are not exposed to unacceptable levels of contamination.

<u>Operable Unit V Peconic River ROD, signed January 2005 (BNL 2004a)</u>

- Objectives are to:
    - Reduce site-related contaminants (e.g., mercury) in sediment to levels that are protective of human health.
    - Reduce or mitigate, to the extent practicable, existing and potential adverse ecological effects of contaminants in the Peconic River.
    - Prevent or reduce, to the extent practicable, the migration of contaminants off the BNL property.
- OU V Peconic River Remedy Components:
    - Removal and disposal of mercury-contaminated sediment above agreed upon cleanup levels from designated depositional areas on and off of BNL property.
    - Implement a monitoring program to demonstrate the effectiveness of the cleanup. Near-term monitoring results will establish the basis for the long-term monitoring program. The program includes monitoring for methylmercury in the water-column, sediment sampling, and fish sampling on and off of BNL property.
    - Conduct an annual review for the first five years after commencement of the remedial action to ensure that the remedies continue to provide adequate protection of human health and the environment.
    - Sampling results for each annual review and the formal Five-Year Review will be evaluated with the regulators, and appropriate modifications will be made, as necessary, for subsequent sampling.

<u>Operable Unit VI ROD, signed March 2001 (BNL 2000b)</u>

- Objectives are to:
    - Meet the MCL for EDB in groundwater (0.05 µg/L).
    - Complete cleanup of the groundwater in a timely manner. For the Upper Glacial aquifer, this goal is 30 years (by 2030) or less.
    - Prevent or minimize further migration of EDB in groundwater vertically and horizontally.
- OU VI Remedy Components:
    - Install a treatment system to extract EDB from the groundwater with subsequent treatment via activated carbon filtration.
    - The previous removal action that was implemented for public water hookups was selected as a final remedy under the ROD.
    - Develop groundwater monitoring program to monitor and verify the cleanup over time.
    - Implement institutional controls on the BNL property to prevent use of contaminated groundwater in the OU VI area, as well as continued implementation of Suffolk County Sanitary Code Article 4 that prohibits the installation of additional residential wells where public water mains exist.

<u>BGRR ROD, signed March 2005 (BNL 2005b)</u>

- Objectives are to:
    - Ensure protection of human health and the environment, without undue uncertainties, from the potential hazards posed by the radiological inventory that resides in the BGRR complex.

    - Use the As Low As Reasonably Achievable (ALARA) principle, while implementing the remedial action.
    - Following completion of the remedial activities, implement long-term monitoring, maintenance, and institutional controls to manage potential hazards to protect human health and the environment.
- BGRR Remedy Components:
    - Remove the BGD primary liner.
    - Remove a portion of the fuel canal outside the structural footprint of the reactor building. Remove accessible subsurface contaminated soil in the vicinity of the fuel canal, BGD expansion joint #4, and the secondary cooling air bustle.
    - Isolate the BGD and demolish the instrument house.
    - Install water infiltration control (i.e., engineered cap) and monitoring system (including the installation of groundwater monitoring wells) for remaining structures and subsurface contaminated soil.
    - Remove the graphite pile and biological shield.
    - Complete final status surveys to document that cleanup objectives are met and to document final conditions.
    - Develop and implement land use and institutional controls that include routine inspection and surveillance of the BGRR complex, maintenance and upkeep of Building 701 and surrounding water infiltration control system, and reporting requirements to ensure that planned uses are protective of public health.
    - Submit an annual certification to NYSDEC that institutional and engineering controls are in place, are unchanged from the previous certification, and nothing has occurred that would impair the ability of the control to protect public health and the environment.
    - All of the previous removal actions that were implemented prior to the ROD signing, such as removal and disposition of accumulated contaminated water, Pile Fan Sump and soils, above-ground ducts, canal and water treatment house, accessible contaminated soils, and exhaust cooling coils and filters, were selected as final remedies under the ROD.

g-2/BLIP/USTs ROD, signed May 2007 (BNL 2007b)

- Objective is to:
    - Prevent additional rainwater infiltration into activated soil shielding at g-2 and BLIP.
- g-2/BLIP/USTs Remedy Components:
    - Inspect and maintain the caps and other stormwater controls at the g-2 and BLIP source areas. Submit an annual certification to NYSDEC that institutional and engineering controls are in place, are unchanged from the previous certification, and nothing has occurred that would impair the ability of the control to protect public health and the environment.
    - Conduct routine groundwater monitoring to verify the effectiveness of the stormwater controls. Monitor the downgradient portion of the g-2 plume until tritium concentrations decrease to below the 20,000 pCi/L MCL.
    - For the former UST areas, no additional remedial actions are required.

High Flux Beam Reactor ROD, signed April 2009 (BNL 2009b)

- Objectives are to control, minimize, or eliminate:
    - All routes of future human and/or environmental exposure to radiologically contaminated facilities or materials.
    - The potential for future release of non-fixed radiological or chemical contamination to the environment.
    - All routes of future human and/or environmental exposure to contaminated soils.
    - The future potential for contaminated soils to impact groundwater.

- HFBR Remedy Components:
  The HFBR remedy incorporates many completed interim actions, several near-term actions, and the segmentation, removal, and disposal of the remaining HFBR structures, systems, and components following a safe storage decay period (not to exceed 65 years).

  Completed interim actions:
  - The HFBR fuel was removed and sent to an off-site facility.
  - The primary coolant was drained and sent to an off-site facility.
  - Scientific equipment was removed and is being reused.
  - Shielding and chemicals were removed and are being reused at BNL and other facilities.
  - The cooling tower superstructure was dismantled and disposed of.
  - The confinement structure and spent fuel canal were modified to meet Suffolk County Article 12 requirements.
  - The Stack Monitoring Facility (Building 715) was dismantled and disposed of.
  - The Cooling Tower Basin and Pump/Switchgear House (Building 707/707A) was dismantled and disposed of.
  - The Water Treatment House (Building 707B) was dismantled and disposed of.
  - The Cold Neutron Facility (Building 751) contaminated systems were removed and the clean building has been transferred to another organization for re-use.
  - The Guard house (Building 753) was dismantled and disposed of.
  - Soil excavation and disposal of the former HWMF Waste Loading Area (WLA) was performed.
  - Control rod blades and beam plugs were removed and disposed of.

  Near-term Actions:
  - Removal of ancillary buildings and associated soils.
    - Stack (Building 705)
    - Fan houses (Buildings 704 and 802)
  - Removal of contaminated underground pipes and ducts.
  - Preparation of Reactor Confinement Building (Building 750) for safe storage.

  Removal after Safe Storage Decay Period:
  - Large activated components (reactor vessel and internals, thermal shield and biological shield).
  - Reactor Confinement Building structures, systems and components.
  - Cleanup of associated soils.

In addition, the final remedy specifies the requirements for surveillance and maintenance to manage the inventory of radioactive material during the safe storage period. Land use and institutional controls, including periodic certification to EPA and NYSDEC, are also specified.

4.2 Remedy Implementation

With the exception of the removal of the biological shield and installation of the engineered cap for the BGRR, and the decommissioning and decontamination (D&D) of the remaining HFBR structures (e.g., stack), systems, and components, all soil, groundwater, and D&D remedies for the nine signed RODs at the site have been implemented. This includes the excavation and approved off-site disposal of all contaminated soil, sediment, and tanks, the installation and operation of all groundwater treatment systems, and Long-Term Surveillance and Maintenance of the BGRR and HFBR. A chronology of the previous removal actions undertaken for each OU, and post-ROD remedial actions, is presented in **Table 2-1** (see **Section 2.0**). A brief summary of the status of remedy implementation since the signing of each ROD is identified below.

Operable Unit I: Excavation and off-site disposal of radiologically contaminated soil was initiated in 2000 with the landscape soil (approximately 2,800 cubic yards), followed by the Building 650 Sump and Sump Outfall (approximately 1,800 cubic yards), and Upland Recharge/Meadow Marsh (approximately 500 cubic yards). In 2005, removal of the former HWMF (approximately 13,000 cubic yards), Building 811 soil (approximately 4,000 cubic yards), and former Chemical Holes residual surface soil (approximately 4,000 cubic yards) was completed. Of the total contaminated soil volume, approximately 24,000 cubic yards were disposed of at Envirocare of Utah, and 2,500 cubic yards were disposed of at Niagara Falls Landfill Facility. (Furthermore, approximately 11,000 cubic yards of soil were excavated from the Chemical/ Animal Pits and Glass Holes during 1997 as part of a Removal Action that was conducted prior to the ROD being signed.) In 2003, the ash pits were capped with a soil cover to prevent direct contact risks, and the removal and disposal of the Building 811 USTs was completed in 2005. The Oak Ridge Institute for Science and Education (ORISE), an independent contractor to DOE, verified that the cleanup effort at these radiologically contaminated soils areas attained the cleanup goals defined in the ROD. Closeout reports were issued for the landscape soil, Building 650 and Sump Outfall, Upland Recharge/Meadow Marsh, the former HWMF, and Building 811 soil, and an addendum to the existing Chemical Holes Closeout Report was also issued. In March 2007, the decontamination of the Merrimack Holes at the former HWMF was completed.

As noted in the *Final Closeout Report for Area of Concern 16 Landscape Soils* (BNL 2001c), monitoring conducted after the calendar year 2000 and the excavation of the landscape soil indicates that the potential exposure to workers and future site residents is less than the 15 milliRem (mRem)/year above background criteria.

Operable Unit III: Fourteen of BNL's 16 groundwater treatment systems are included under OU III. Following the signing of the OU III ROD in June 2000, eight groundwater treatment systems were designed and installed between 2000 and 2005 both on and off of the BNL property, for a total of 14 systems. These treatment systems were installed to address VOC and Sr-90 groundwater contamination. The performance of these systems in meeting the overall groundwater cleanup goals is evaluated in the annual *BNL Groundwater Status Reports.* Through 2009, the OU III treatment systems have removed 6,045 pounds of VOCs from the aquifer, a total of 6,433 pounds have been removed by all of the treatment systems.

In accordance with the ROD, several low-flow extraction events were performed between 2000 and 2001 for the high-concentration segments of the HFBR tritium plume. Approximately 100,000 gallons of tritium-contaminated water were pumped from the aquifer and disposed of at an approved off-site facility. Contingency remedies continue to remain in place for the HFBR tritium plume. In response to the November 2006 triggering of the OU III ROD contingency plan, the HFBR Pump and Recharge system was re-started in December 2007. As part of this action, a new extraction well was constructed to improve control and capture of the plume. This well began operation in November 2007 and currently remains in operation.

The regulatory agencies approved Petitions for Shutdown of the Carbon Tetrachloride, Building 96, and Industrial Park East treatment systems in 2004, 2005, and 2009, respectively. These systems were subsequently turned off and placed in standby mode. However, in 2008, the Building 96 groundwater treatment system was turned back on and Well RTW-1 was modified from a recirculation well to surface discharge of the effluent due to a rebound of VOC concentrations in source area monitoring wells. Subsequent investigations identified a localized source of VOC contamination within vadose zone. In accordance with the OU III ESD approved in 2009, the VOC-contaminated soils were excavated in 2010 and disposed of at an approved off-site facility. Hexavalent chromium was also detected in Building 96 area monitoring wells in 2008 as a byproduct of potassium permanganate injections. The well RTW-1 modification also included treatment for the hexavalent chromium. Following regulatory agency approval for closure in October 2009, the Carbon Tetrachloride treatment system was dismantled in 2010.

Between 1999 and 2005, approximately 2,200 cubic yards of PCB-contaminated soil from the former Building 96 Scrapyard area were excavated and disposed of off site. This was accomplished in accordance with the ROD to reduce the risk of direct contact with contaminated soils in this area.

In accordance with the OU III ESD approved in 2005, two additional Magothy aquifer groundwater extraction wells were installed to address VOC contamination at the LIPA and Industrial Park East treatment system areas. Between 2007 and 2010, additional extraction wells were installed at the LIPA/Airport, Chemical Holes Sr-90, HFBR Tritium Pump and Recharge, and BGRR/WCF Sr-90 systems. These additional extraction wells were necessary to address changing plume conditions identified as part of the long-term groundwater monitoring program.

Operable Unit IV: In accordance with the March 1996 OU IV ROD, a groundwater treatment system was installed in 1997 to remediate VOC and SVOC soil and groundwater contamination at a former oil/solvent spill area. A CERCLA Five-Year Review performed for OU IV in 2003 (BNL 2003a) found that the remedy was highly effective in remediating soil and groundwater contamination. The system met its cleanup objectives and the regulatory agencies approved its dismantlement in 2003.

Operable Unit V: Following issuance of the OU V STP ROD (BNL 2001b), the contaminated soil at the plant was excavated and disposed of off site in 2003. A closeout report for this effort was issued in 2004 (BNL 2004b). Prior to issuance of the OU V Peconic River ROD (BNL 2004a), the excavation of on- and off-site contaminated sediments in the River (approximately 21,000 cubic yards) was performed in 2004 and 2005 under the authority of a Removal Action (BNL 2004c). The closeout report for the Peconic River Phases 1 and 2 was issued in 2005 (BNL 2005c). Based on Peconic River monitoring data collected between 2005 and 2009, the need for supplemental sediment removal in the River was determined necessary by DOE and the regulatory agencies. In late 2010/early 2011, an additional 800 cubic yards of contaminated sediment were excavated. A draft Completion Report will be submitted to the regulatory agencies in the spring of 2011. Natural attenuation monitoring of the low-level VOC groundwater plume that originated from the STP area continues.

Operable Unit VI: In 2004, a groundwater treatment system was installed in accordance with the OU VI ROD, and began operations to remediate the plume of EDB located beyond the site boundary. This was the last of the planned systems to be installed beyond the BNL site property. Per the OU III and VI RODs, DOE continues to offer homeowners not connected to public water free annual testing of their private wells.

BGRR: All of the cleanup actions performed at the BGRR prior to the ROD approval in 2005 were conducted through removal actions or *National Environmental Policy Act* (NEPA) categorically excluded actions. Since ROD approval, the cleanup actions at the BGRR (e.g., removal of the graphite pile) were performed as remedial actions under the ROD (BNL 2005b). Remedial activities associated with the Graphite Pile Removal Project commenced in December 2009 and were completed in May 2010. The following summarizes the scope of activities:

- Removal and Disposal of Control Rods.
- Removal and Disposal of Boron Shot.
- Removal and Disposal of Shield Plugs.
- Removal and Disposal of upper portion of Air Tight Membrane.
- Removal and Disposal of Invar Rods.
- Removal and Disposal of Graphite Pile.

Removal of the biological shield and installation of the final engineered cap are in progress.

g-2/BLIP/USTs: BNL routinely inspects and maintains the caps and other stormwater controls at the g-2 and BLIP source areas. Routine groundwater monitoring is conducted to verify the effectiveness of the stormwater controls. The downgradient portion of the g-2 plume is monitored using permanent and temporary wells. For the former UST areas, no additional remedial actions are required.

HFBR: Prior to the ROD approval in 2009, all of the cleanup actions at the HFBR were performed through removal actions or *National Environmental Policy Act* (NEPA) categorically excluded actions. Since ROD approval, stabilization of the reactor confinement building for safe storage and the cleanup actions at the HFBR, such as the removal of Building 801-811 waste transfer lines (A/B waste lines with co-located piping) and associated soil, was performed as remedial actions under the ROD (BNL 2009b). Other remedial actions associated with the removal of ancillary structures (e.g., fan houses and stack) and underground utilities (e.g., pipes and ducts) are in progress.

Groundwater Monitoring: An essential component of the groundwater remediation program is continued monitoring of the groundwater to ensure the cleanup is progressing as planned. The effectiveness of the groundwater remediation systems' performance is evaluated monthly, quarterly, and annually. Comprehensive summaries of the annual monitoring and evaluations of the systems and plumes are documented in quarterly progress reports and the annual *BNL Groundwater Status Reports* (Volume II of the *BNL Site Environmental Report*). Recommendations are made on an annual basis for modifications to groundwater monitoring programs in response to changing plume conditions. These recommendations are developed with regulatory agency input. The treatment systems and monitoring programs are optimized with the goal of meeting drinking water standards within 70 years (2070) for the BGRR/WCF Sr-90 plume, within 65 years (2065) for the Magothy aquifer, within 40 (2040) for the Chemical Holes Sr-90 plume, and within 30 years (2030) for VOCs in the Upper Glacial aquifer.

Property Access: Eight access agreements are currently in place with the county, town, local utility, college, and private landowners. Seven of these agreements enable BNL to perform groundwater remediation activities for contamination that has migrated beyond the property boundary of BNL. The eighth agreement is with Suffolk County and allows for the supplemental remediation of the Peconic River sediment. The terms of these agreements must be adhered to by BNL, such as maintaining adequate liability insurance, and in some cases, making annual monetary payments.

4.3 System Operations/Operation and Maintenance

All 16 of the planned groundwater treatment systems have been constructed. The first system became operational in January 1997, and the last system was placed in service in mid 2005. The location of each of the treatment systems and their operational status is shown on **Figure 4-2**. The operational status of each of the extraction wells is provided on **Figure 4-3**. The OU IV and Carbon Tetrachloride systems met their cleanup goals and were dismantled, and the Industrial Park East system is in standby mode awaiting closure. (The Industrial Park system can be restarted if concentrations rebound.) The remaining 13 systems are in active operation. The requirements for ongoing operation and maintenance (O&M), as well as performance monitoring frequencies of these systems, are identified in the O&M manuals (BNL 2002-2009). The O&M Manuals are updated as needed to reflect changes to the treatment systems, such as the installation of additional extraction wells. BNL performs routine inspections and maintenance of these systems.

Groundwater has been extracted from the Upper Glacial and Magothy aquifers using 61 wells. Currently, 15 of these wells are in standby mode, 10 are in pulse pumping mode, and 3 were recently decommissioned (i.e., abandoned by sanding and grouting the well in place). Average individual extraction well flow rates range from approximately 5 gallons per minute (gpm) for the Sr-90 systems to up to 450 gpm for some of the VOC systems. System treatment for VOCs consists primarily of air stripping or carbon adsorption. Ion exchange is used for the Sr-90 groundwater contamination. To monitor system performance, the influent, midpoint (if appropriate), and effluent are routinely sampled. Treated water from the systems is returned to the Upper Glacial aquifer via recharge basins, injection wells, or dry wells. These discharges are regulated by New York State Pollutant Discharge Elimination System (SPDES) discharge equivalency permits.

The annual O&M costs for the treatment systems during 2005-2009 were as follow:

Table 4-1: System O&M Costs for FY 2005 to 2009

			($ in K)			
System	FY05	FY06	FY07	FY08	FY09	Comments
OU I South Boundary	98	104	93	102	94	Air stripping
OU III South Boundary/ Middle Road	222	312	155	173	249	Air stripping
OU III Industrial Park	340	301	372	344	343	Uses in-well air stripping with vapor-phase carbon treatment, with recirculation wells
OU III Building 96	133	74	23	295	139	Air stripping treatment. Three of four wells in standby FY06-07. Modified well RTW-1 in FY08 and added hexavalent chromium treatment.
OU III Carbon Tetrachloride	12	10	10	7	24	In standby mode since 2004
OU III Western South Boundary	101	48	55	145	158	Air stripping treatment. Pulse pumped in FY06-07, additional characterization in FY08-09.
OU III Industrial Park East	149	168	131	44	34	Carbon treatment, began pulse pumping in FY08
OU III North Street/ North Street East	375	381	367	353	401	Carbon treatment
OU III Airport/LIPA	550	511	491	259	334	Carbon treatment
OU III HFBR Tritium	207	171	237	237	185	Pump and recharge. Includes annual temporary wells.
OU III Sr-90 Chemical Holes	270	215	274	156	114	Ion-exchange treatment
OU III Sr-90 BGRR/WCF	550	544	335	306	356	Ion-exchange treatment
OU VI EDB	192	131	197	220	219	Carbon treatment

The largest components of the annual O&M cost for the treatment systems are electric, system sampling and analysis, maintenance, and spent carbon or ion exchange resin disposal. These are direct costs of operation and do not include, monitoring well sampling and analysis, project oversight and project management costs.

5.0 Progress Since the Last Review

This is the second sitewide Five-Year Review for the BNL site that covers all of the OUs. The protectiveness statement for each OU, the BGRR, the HFBR, and progress in accomplishing the cleanup goals since the previous Five-Year Review (BNL 2006a) are:

Operable Unit I: The remedy is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Soil Remediation:

- Decontamination of the Merrimack Holes at the former HWMF was completed in July 2006.
- Stormwater controls and re-vegetation of the former HWMF have been improved since the soil remediation effort was completed in 2005.

Groundwater Remediation:

- Hydraulic control of the VOC plumes is being accomplished by the OU I South Boundary treatment system. The off-site segment of the plume is controlled by the North Street East system (discussed under OU III). The South Boundary treatment system, capping of the Current Landfill, remediation of the former HWMF, and natural attenuation have all contributed to a significant reduction in the overall extent and concentrations of the VOC plume, as shown on **Figure 5-1**. The operational duration of the extraction wells at the south boundary is being extended from the planned shutdown in 2011 to 2015 due to the slower than expected migration of an area of elevated VOC concentrations located approximately 500 feet to the north. The reduced migration rates appear to be due to plume migration through a zone of lower permeability materials (the Upton Unit) that characterize the deep section of the Upper Glacial aquifer in this area of the site. Extending the operational duration of the two extraction wells will ensure that the area of elevated VOCs is captured and treated, and that the ROD cleanup goals are achieved.
- An area of Sr-90 contamination in the Upper Glacial aquifer south of the former HWMF that was originally identified in 2001 was re-characterized during 2010 using temporary wells. This effort was to assess the potential for Sr-90 to reach the site boundary at concentrations above the 8 pCi/L MCL. Updated groundwater modeling using the 2010 characterization data predicts that Sr-90 concentrations will be less than the 8 pCi/L MCL upon reaching the site boundary.
- Groundwater quality downgradient of the capped landfills continues to improve. VOCs were not detected above MCLs at the Former Landfill over the previous two years. In addition, monitoring for the Former Landfill indicates that there is no longer significant leachate being generated. Several VOCs continue to be detected at levels above MCLs at the Current Landfill along with evidence of low-level leachate generation.

Operable Unit III: The remedy is expected to be protective of human health and the environment upon meeting groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- The extent of the high-concentration segments of the OU III VOC plumes has decreased both on and off site as the result of groundwater remediation system operations and the effects of natural attenuation (see **Figure 5-1**).
- In 2007, an additional extraction well was installed for the Airport treatment system to allow for the capture and treatment of carbon tetrachloride contamination that was migrating further to the west than originally anticipated during the design of the system. The rest of the Airport extraction wells show very low VOC concentrations and are currently being operated in a pulse pumping

mode. These wells can be returned to full-time operations in the event VOC concentrations are observed to significantly increase.

- The Western South Boundary system is remediating an area of elevated VOC concentrations. In 2008, an area of higher than expected concentrations of TCA was characterized between Middle Road and South Boundary extraction well WSB-1 (which had previously been placed in standby mode). Monitoring of this contamination continues, and full-time operation of WSB-1 has resumed, insuring the capture of the TCA slug as it migrates to the site boundary. It is expected that the operation of this extraction well will need to be extended until approximately 2019 in order to completely capture the TCA slug and allow the system to achieve the ROD cleanup goal. An area of higher than expected Freon was also detected by the monitoring program in 2008, and characterization is ongoing to determine its extent.
- The Industrial Park East system was placed in standby mode in 2009 following regulatory approval of a petition to shutdown the system. BNL will continue to monitor the predicted natural attenuation of a small area of elevated VOC concentrations in the Upper Magothy aquifer that is positioned south of the extraction wells.
- The excavation of PCE-contaminated soils at the former Building 96 area was completed in late 2010. It is anticipated that the treatment system will have to be operated full-time for another three to six years (2013 – 2016) in order to achieve the capture goal (50 µg/L) and allow for it to be placed in standby mode. As noted in **Section 4.2**, extraction well RTW-1 modification in 2008 also included treatment for hexavalent chromium. Due to reduced hexavalent chromium in the monitoring wells and RTW-1, in January 2010 the resin treatment was bypassed and placed in standby mode. Monitoring will continue and treatment will be restarted if necessary.
- The Middle Road treatment system continues to effectively capture VOCs using three of the six extraction wells. VOCs in the eastern segment of the plume have dropped below the 50 µg/L capture goal, and extraction wells RW-4, RW-5, and RW-6 are currently in standby mode.
- VOC contamination downgradient of the Middle Road treatment system is being hydraulically contained by the South Boundary treatment system. The four easternmost extraction wells are currently in standby mode due to VOC concentrations dropping to below the capture goal.
- The North Street and Industrial Park treatment systems continue to effectively capture VOCs in this area. Significant reductions in the off-site VOC plume concentrations have been observed.
- VOC capture goals have been achieved in one of the two North Street East System extraction wells, which has been placed in standby mode. However, groundwater monitoring is showing an area of persisting elevated VOCs that may require operating extraction well NSE-1 beyond its planned shutdown date of 2011.
- The BGRR/WCF Sr-90 treatment system captures and treats Sr-90-contaminated groundwater originating from several source areas utilizing a network of five extraction wells. Three of the extraction wells are capturing Sr-90 originating in the Building 701 area of the site from multiple sources including the BGRR below-ground ducts. In addition to the routine monitoring well sampling program, additional characterization was undertaken in 2008 and 2009 to identify the leading edge of the contaminant plume originating from the below-ground duct area and also to verify the continuing presence of high concentrations of Sr-90 at the source area. The leading edge of this plume was characterized using temporary wells. Updated groundwater modeling based on this recent data indicates that the ROD cleanup goals can still be met for the downgradient segment of this plume. Source area characterization indicates that elevated concentrations of Sr-90 are still present in the source area. The system was designed based on the source no longer being present due to capping of the area via both the BGRR building structure and an engineered cap. Monitoring of the source area will continue. It is possible that Sr-90 contamination below the facility structures in the vadose zone is being periodically released to the aquifer by water-table elevation increases. This water-table flushing process has been observed at several other BNL source areas including the HFBR and g-2. The two extraction wells located immediately downgradient of the former WCF area continue to capture and treat Sr-90. Concentrations at the source area remain elevated although

they are showing a slowly decreasing trend. An area of higher than expected Sr-90 concentrations was detected in the downgradient portion of this plume (in the vicinity of the HFBR) as part of the groundwater monitoring program in 2008. Additional characterization of this area followed by updated groundwater modeling, determined that additional extraction wells would be necessary to actively treat this area in order for the ROD cleanup goals to be achieved. Four additional extraction wells were added to the system in 2010/2011 and are expected to become operational in 2011.

- The HFBR tritium plume has significantly attenuated over the previous five years. Tritium concentrations immediately downgradient of the facility have remained largely below the MCL of 20,000 pCi/L over the past several years. The only remaining downgradient segment of the plume with concentrations exceeding the MCL is being captured by the HFBR Pump and Recharge System and is approximately 500 feet in length (see **Figure 5-2**). Concentrations in pump and recharge extraction well EW-16 have been below 2,000 pCi/L since 2009.

Operable Unit IV: The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- Post-closure groundwater monitoring continues to indicate that the OU IV air sparging/soil vapor extraction (AS/SVE) system effectively remediated the VOC-contaminated soils and groundwater.
- Monitoring continues for a plume of Sr-90 which originated at the Sump Outfall and is slowly migrating and attenuating within the central portion of the site.
- The lead-contaminated soil at the Central Steam Facility (CSF) Outfall is not identified in the OU IV ROD since it is not an AOC. However, it was identified as a recommendation/follow-up action during the OU IV Five-Year Review in 2003. Since that time, BNL developed a remediation plan for the CSF Outfall that included the excavation and disposal of all soils containing lead concentrations greater than the 400 milligrams per kilogram (mg/kg) residential use cleanup standard. Details on this remedial action plan are included in the final report titled *Remedial Investigation and Soil Remediation Evaluation and Cost Estimate for the Central Steam Facility Storm Water Outfall* (BNL 2004f). In September 2006, a contractor was hired to assist BNL in the excavation, cartage and disposal of lead-contaminated soil from the CSF Storm Water Outfall. Confirmatory sampling was performed throughout the entire project to demonstrate that lead concentrations in excavated areas satisfied the cleanup objective of 400 mg/kg. The remediation generated approximately 1,500 tons of lead-contaminated soil (60 truckloads). The last endpoint sample was collected on November 29, 2006 and analytical results indicated that cleanup objectives were met for the entire area downstream of the CSF Outfall. Details on this remedial action can be found in the *Central Steam Facility Storm Water Outfall Remediation Closeout Report* (BNL 2007c).

Operable Unit V: The remedy currently protects human health and the environment because the contaminated soil at the STP filter beds and contaminated sediment in the Peconic River have been excavated to meet the appropriate cleanup levels. Re-vegetation of the originally remediated areas has been completed. However, for the remedy to be protective in the long-term, the monitoring program must demonstrate the effectiveness of the Peconic River cleanup to mitigate potential ecological effects.

- After two consecutive years of wetland vegetation monitoring, the NYSDEC determined that the Equivalency Permit conditions have been satisfied and further wetland monitoring/maintenance was not required.
- Peconic River sediment monitoring indicated that additional sediment removal was required to meet the cleanup goals for mercury. In late 2010/early 2011, approximately 800 cubic yards of contaminated sediment were excavated from three areas, the sediment trap was removed, and a draft Completion Report will be submitted to the regulators for review in the summer of 2011.

- The low-level VOC plume continues to naturally attenuate in the aquifer, and VOC concentrations in most areas have dropped to below applicable MCLs.

Operable Unit VI: The remedy is expected to be protective of human health and the environment upon attainment of the groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- The EDB treatment system continues to effectively remediate the EDB plume. The plume continues to migrate as predicted by the groundwater model during the system design.

BGRR: The BGRR ROD was finalized in March 2005. The removal and disposal of the graphite pile was completed in 2010. The remaining work required under the ROD, including the removal of the biological shield and the installation of an engineered cap, are currently in progress. Land use and institutional controls and monitoring of groundwater in accordance with the Operable Unit III ROD are part of the final remedy. The completed remedy is expected to be protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

HFBR: The HFBR ROD was finalized in April 2009. The final remedy incorporates many completed interim actions, several near-term actions, and the long-term segmentation, removal, and disposal of the remaining HFBR structures, systems, and components, including the reactor vessel. The near-term actions include dismantling the remaining ancillary buildings, removing contaminated underground utilities, and preparing the reactor confinement building for safe storage. The ROD requires that these near-term actions be completed no later than 2020. Several actions have been taken since closing of the reactor in 1999 to prepare the HFBR for decommissioning. Specific activities completed for the HFBR include:

- HFBR fuel was removed and sent to an off-site facility.
- Primary coolant was drained and sent to an off-site facility.
- Scientific equipment was removed and is being reused.
- Shielding and chemicals were removed and are being reused at BNL and other facilities.
- Cooling tower superstructure was dismantled and disposed of.
- Confinement structure and spent fuel canal were modified to meet Suffolk County Article 12 requirements.
- Stack Monitoring Facility (Building 715) was dismantled and disposed of.
- Cooling Tower Basin and Pump/Switchgear House (Building 707/707A) was dismantled and disposed of.
- Water Treatment House (Building 707B) was dismantled and disposed of.
- Cold Neutron Facility (Building 751) contaminated systems were removed and the clean building has been transferred to another organization for re-use.
- Guard House (Building 753) was dismantled and disposed of.

The completion date for the near-term actions was accelerated to 2011 as a result of funding made available through the American Recovery and Reinvestment Act (ARRA). Removal of the Building 801-811 waste transfer lines (A/B waste lines with co-located piping) and contaminated soil was completed in 2009, as well as the removal of the control rod blades. Dismantling of Building 704 (Fan House), preparing the reactor confinement building for safe storage, and removal of contaminated underground utilities were completed in 2010. Dismantling of Building 802 (Fan House) is currently in progress. Planning for the demolition of the stack is also under way.

The Waste Loading Area (WLA) was part of the former HWMF, AOC 1. It is an area (of about two acres) along the eastern boundary of the former HWMF that was left in place so that it could be used as a waste staging and railcar loading area for the BGRR and HFBR decommissioning projects. The WLA was transferred to the HFBR scope of work in September 2005 through a modification to the *Remedial Design Implementation Plan* (RDIP) for the former HWMF. In February 2009, AOC 31, comprising the HFBR complex and the WLA, was established. The cleanup of the WLA was performed as a non-time-critical removal action authorized by the Action Memorandum *High Flux Beam Reactor, Removal Action for Waste Loading Area* (BNL 2007d). The cleanup of this area used the same cleanup goals and methodology required for AOC 1 in the OU I ROD. Soil remediation was performed from November 2007 to May 2008, and the cleanup goals for both chemicals and radionuclides were achieved. The maximum projected dose to an industrial worker after 50 years of institutional controls is 3.8 mRem/yr. The maximum projected dose to a resident (non-farmer) after 100 years of institutional controls is 8.9 mRem/yr. The results of the dose assessment are below the dose objective of 15 mRem/yr established by the OU I ROD and the NYSDEC *Technical and Administrative Guidance Memorandum (*TAGM) 4003 guideline of 10 mRem/yr. This work is summarized in the document *High Flux Beam Reactor, Area of Concern 31, Final Completion Report for Waste Loading Area Soil Remediation* (BNL 2009d). The WLA continues to be used for waste rail car loading.

The ROD also lays out a plan for the long-term segmentation, removal, and disposal of the remaining HFBR structures, systems, and components (including the reactor vessel and thermal and biological shields). These long-term actions will be conducted following a safe storage period (not to exceed 65 years) to allow for the natural reduction of high radiation levels to a point where conventional demolition techniques can be used to dismantle these reactor components. Land use and institutional controls and monitoring of groundwater in accordance with the Operable Unit III ROD are also part of the final remedy. The completed remedy is expected to be protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Other Actions:

Soil Remediation:

In 2005, radiological contamination was identified in surface soil in several areas adjacent to the former HWMF, referred to herein as the former HWMF Perimeter Area. Since that time, several investigations have been conducted to determine the extent and nature of contamination. See *Investigation and Characterization of the Brookhaven Avenue Cs-137 Contamination* (BNL 2007e). These investigations identified radiological contamination along Brookhaven Avenue, within a contiguous area northeast of the former HWMF (approximately 18,750 ft^2) as well as several other discrete locations within wooded areas along the perimeter of the former HWMF boundaries. The contamination is believed to be a result of historical operations associated with the transfer and management of wastes to and within the former HWMF and stormwater runoff from contaminated soils within the facility. Results of the investigations revealed the following:

- Cs-137 is the primary contaminant of concern. Gamma spectroscopy results for Cs-137 ranged from not detected (ND) to 322 picoCuries per gram (pCi/g).
- Except for one area located immediately north of the roadway used to enter the former HWMF (Original Cs-137 result, 786 pCi/g), all other locations indicate that contamination is limited to the top six inches to one foot of soil.
- Most of the elevated Cs-137 results appear to be discrete soil contamination locations except for the one area immediately northeast of the former HWMF that exhibited a larger, more uniform area of contamination with Cs-137 concentrations above 23 pCi/g.
- No groundwater impacts.

The cleanup of identified radiological contamination has occurred in various stages since being discovered in October 2005. In the fall of 2008 and early winter 2009, BNL was able to address some of the easily accessible, discrete areas of contamination found along the roadway and in the woods. In late 2009, a more extensive cleanup of previously identified discrete soil contamination areas and the 18,750 ft^2 contiguous area was completed. This area was then backfilled, regraded and seeded with native grass. The cleanup of these areas, considered as Phase I of the cleanup, was documented in the April 2010 *Final Completion Report for the Former Hazardous Waste Management Facility Perimeter Area Soil Remediation* (BNL 2010a). In 2010, cleanup of an 11-acre section of the Long Island Solar Farm (LISF) Project area, located to the southeast of the former HWMF and adjacent to the previously remediated former HWMF Perimeter Area, was completed. This area is designated as Phase II and documented in the December 2010 *Addendum to the Former Hazardous Waste Management Facility Perimeter Area Completion Report* (BNL 2010b). Both Phase I and Phase II projects were remediated to meet OU I cleanup goals and were performed as non-time-critical removal actions authorized by the June 2009 Action Memorandum, *Removal of Contaminated Soil from the Former Hazardous Waste Management Facility Perimeter Area* (BNL 2009c). Remedial activities were performed in accordance with *Closeout Procedures at National Priority Sites, OSWER Directive 9320.2-09A-P*, which included:

- The excavation of contaminated soil above site cleanup goals.
- The completion of a Final Status Survey and sampling, including Oak Ridge Institute for Science and Education independent verification survey and sampling.
- The post-closure dose assessment in accordance with the Residual Radioactivity Computer Code (RESRAD).
- The characterization, transportation and disposal of excavated soil at Energy Solutions Disposal Facility of Clive, Utah.
- The implementation of institutional controls.

In December 2010, authorization for construction of the LISF Project in the 11-acre parcel of land adjacent to the former HWMF Perimeter Area was granted in accordance with an easement between the U.S. Department of Energy (DOE) and the LISF, LLC, with the control that no soil be removed from the affected area. In addition, the area was added to the *BNL Land Use Controls Management Plan,* as well as to the BNL website and BNL maps for tracking of the administrative controls. Under the easement, DOE retains responsibility for any pre-existing conditions and access to the property as needed.

Additional discrete areas of soil contamination within the former HWMF Perimeter Area that were not addressed in Phase I and II investigations will be investigated and remediated, as necessary, in future remedial efforts, referred to as Phase III. The Interagency parties will continue to be provided an opportunity to review, comment, and approve any future remedial activities proposed for this area.

Table 5-1: Actions Taken Since the 2005 Five-Year Review

Issue	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Action Completion Date
Document OU I and OU V monitoring and maintenance requirements in one document	Prepare and submit the OU I Soils and OU V Long-Term Monitoring and Maintenance Plan to the regulators	BNL	July 2005	Draft Plan issued to regulators; comments incorporated and Final issued	8/12/05 Draft 5/31/06 Final
Some USTs in AOC 12 are not documented as final remedies in a ROD	Document the final remedy for remaining AOC 12 USTs in the g-2/BLIP ROD	BNL	October 2006	g-2/BLIP/UST ROD signed	5/10/07
OU I - Animal burrows in Current Landfill cap, and gates broken	Repair current burrows and fix gates	BNL	July 2005	Repaired gates and animal burrows	12/16/05 Gates 2/27/06 Burrows

Continued...

Issue	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Action Completion Date
OU I - Consistent long-term results from Wooded Wetland Monitoring	Evaluate the need to continue the annual sampling or reduce the frequency	BNL	September 2005	Evaluated in 2004. Landfill Report prepared. No changes at that time. Reduced sampling frequency to every other year per the 2008 Report.	8/12/05 2004 Rpt. 9/2/09 2008 Rpt.
Institutional controls documentation needs updating	Update *BNL Land Use Controls Management Plan* and web-based database	BNL	September 2005	Updated Plan issued in 2005, 2007, and 2009; database updated since 7/14/06	6/17/05 8/3/07 6/23/09
OU I - Consistent low VOCs in OU I extraction wells	Implement pulse pumping of treatment system to optimize performance	BNL	October 2005	Began pulse pumping (1 month on and 1 month off). Back to full-time operations in 2007. Performed additional groundwater characterization and installed monitoring wells to better assess plume.	9/6/05
OUs III & VI - Deeds not reflecting operating treatment systems	Complete survey/mapping of treatment systems off of BNL property and record updated agreements with County	BNL	June 2005	Survey/mapping completed. One agreement was recorded to date.	6/30/05 Mapping
OU III - Consistent low VOCs in Western South Boundary extraction wells	Implement pulse pumping of treatment system to optimize performance	BNL	October 2005	Began pulse pumping (1 month on and 2 months off).	9/6/05
OU III - Consistent low VOCs in Industrial Park recirculation well	Implement pulse pumping of UVB-1 to optimize performance	BNL	October 2005	Placed UVB-1 in standby mode.	10/05
OU III - Consistent low VOCs in Airport recirculation wells	Implement pulse pumping of treatment system to optimize performance	BNL	October 2005	Began pulse pumping Airport wells (1 week on and 3 weeks off).	10/3/05
Enhance monitoring well network	Implement changes to various well networks based on *2004 Groundwater Status Report*	BNL	October 2005	Implemented changes to monitoring well network each year since 2005 based on Annual Groundwater Report recommendations.	10/05

Continued...

Issue	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Action Completion Date
OU V – Restore haul roads	Per the NYSDEC equivalency permit, remove stone/fabric	BNL	September 2005	Removed stone and fabric on haul roads. Excellent vegetation recovery.	9/30/05
Housekeeping	Dispose of miscellaneous monitoring well materials at Meadow Marsh & 650 Outfall, remove Spray Aeration piping and RA V tanks	BNL	August 2005	Emptied tanks; Removed Spray Aeration piping; Disposed of well materials.	8/4/05 Tanks empty 1/11/06 Piping 8/1/07 Well Material

Table 5-1 shows the status of the actions recommended in the 2005 Five-Year Review. There are two issues that were identified in **Table 5-1** above from the 2005 Five-Year Review that affected future protectiveness. The first was to update the institutional controls documentation. The follow-up action of updating the *BNL Land Use Controls Management Plan* was completed three times starting in 2005 with the latest update in June 2009 (BNL 2005d, 2007a and 2009e). In addition, the *Land Use and Institutional Controls Mapping* database underwent a significant update since 2006, including peer reviews of the area fact sheets. The database continues to be enhanced as needed to improve its usability and effectiveness.

The second issue from the 2005 Five-Year Review was to complete surveying/mapping of the groundwater treatment systems off of BNL property and to record the license or access agreements with the Suffolk County Clerk's Office. The survey and mapping of the treatment systems was completed in June 2005 and forwarded to the property owners. All seven property license/access agreements have a requirement for recording except for LIPA, but there is a conveyance provision in that agreement. The only agreement that has been recorded to date is for the original Industrial Park system. Efforts have been and will continue to be made to record the remaining agreements with the County Clerk. It should be noted that the property for one of the access agreements changed owners in 2010 and BSA/DOE issued the executed access agreement with the new owner in March 2011.

6.0 Five-Year Review Process

6.1 Administrative Components

The activities scheduled for this Five-Year Review included regulator and community stakeholder notification, site inspections, interviews with stakeholders and regulatory officials, development of the Five-Year Review Report including review by DOE, EPA, NYSDEC, NYSDOH, and SCDHS, and a briefing on the results to the Community Advisory Council (CAC) and Brookhaven Executive Round Table (BER). The review was led by BSA's EPD Groundwater Protection Group. The Five-Year Review team consisted of:

- BSA staff – W. Dorsch, V. Racaniello, J. Burke, D. Paquette, R. Howe, R. Lee, S. Kumar, S. Johnson, T. Jernigan, and W. Medeiros
- DOE staff – T. Kneitel, S. Feinberg, J. Sattler, J. Carter, and G. Penny
- Regulatory staff – D. Pocze (EPA), C. Ng (NYSDEC), and A. Rapiejko (SCDHS)

The team included Hydrogeologists, Environmental Scientists, Engineers, Community Involvement Coordinators, and a Technical Editor.

6.2 Community Notification and Involvement

A Communications Plan for the Five-Year Review was prepared and on July 21, 2010, distributed to the project team including the regulatory agencies. The plan identifies specific outreach activities to be conducted, such as initial notification, interviews, report updates, and report issuance/notification.

An initial notification announcement was published in *Newsday* newspaper on July 22, 2010. It informed the public of the start of the review, as well as the purpose, schedule for completion, and how to contact DOE for more information. A copy of the announcements is available at http://www.bnl.gov/ltra/5-year_review.asp. The CAC and BER were briefed on the start of the Five-Year Review on September 9, 2010 and September 15, 2010, respectively. In addition, an announcement in the BNL weekly *Bulletin* and a BNL website update were made to inform the BNL employees and the community that the Five-Year Review was being conducted (http://www.bnl.gov/bnlweb/pubaf/bulletin/2010/bb072310.pdf and http://www.bnl.gov/ltra/).

Members of the CAC were polled during the September 9, 2010 meeting to obtain feedback on how informed they felt regarding the cleanup activities and progress, specific areas that the Review should focus on, and their confidence in BSA and DOE's management of the long-term cleanup at BNL. The results indicate that the CAC noted good progress with the cleanup, and the Laboratory has responded constructively to their comments. Some were interested in the potential for expediting the longer term cleanup goals (i.e., 50 and 70 years) for both soil and groundwater remediation. Others wanted the Laboratory to: continue evaluating emerging technologies; provide more focus on keeping the public informed using other media channels; request additional feedback; offer site visits/tours; and maintain funding for the long-term cleanup. Several members wanted to see a summary of how well the cleanup is going compared to the original goals. The CAC survey is included as **Attachment 1**.

Following regulator review/concurrence and EPA concurrence on the final protectiveness determination, the community will be notified that the Five-Year Review was completed and it will be made available to the public. A public notice will be issued in *Newsday* at that time. The notice will include a brief summary of the results, the protectiveness statements, post-ROD information, repository locations where the report is available for viewing, and the timeframe of the next Five-Year Review. These repositories are:

- BNL Research Library, Upton, NY
- EPA Region II Office, New York City, NY

- Stony Brook University, Melville Library, Stony Brook, NY

The CAC and BER will be briefed on any changes to the report's conclusions and recommendations as a result of regulator review. The Report will also be added to the BNL website.

6.3 Document Review

The Five-Year Review consisted of a review of relevant documents including the following:

- Records of Decision for OUs I, III, IV, V (two), VI, BGRR, g-2/BLIP, and HFBR
- *OU III ESDs* (BNL 2005a and 2009a)
- Annual *BNL Groundwater Status Reports* (e.g., BNL 2009f)
- Annual and five-year landfill reports (e.g., BNL 2001a and BNL 2002)
- Annual Peconic River Monitoring Reports (e.g., BNL 2009g)
- *Final Five-Year Review Report* (BNL 2006a)
- Closeout/Completion reports for soil (BNL 2005c, 2005e, 2005f, 1997)
- *Final Closeout Report for the Meadow Marsh Operable Unit I Area of Concern 8* (BNL 2004d)
- *Final Closeout Report for the Ash Pit Operable Unit I Area of Concern 2F* (BNL 2004e)
- *Final Closeout Report for the Brookhaven Graphite Research Reactor, Graphite Pile Removal, Area of Concern 9 (BNL 2010c)*
- *Final Closeout Report for the Brookhaven Graphite Research Reactor, Final Canal and Deep Soil Pockets Excavation and Removal* (BNL 2005j)
- *BNL High Flux Beam Reactor Characterization Summary Report, Rev 1* (BNL 2007f)
- *Final Completion Report for the Former Hazardous Waste Management Facility Perimeter Area Soil Remediation* (BNL 2010a)
- *Addendum to the Former Hazardous Waste Management Facility Perimeter Area Completion Report* (BNL 2010b)
- *High Flux Beam Reactor, Area of Concern 31, Final Completion Report for Waste Loading Area Soil Remediation* (BNL 2009d)
- *Final Closeout Report for Removal of the Building 801-811 Waste Transfer Lines (A/B Waste Lines with Co-Located Piping) Area of Concern 31*(BNL 2010d)
- *Central Steam Facility Storm Water Outfall Remediation Closeout Report* (BNL 2007c)
- *OU IV Five-Year Review Report* (BNL 2003a)
- *Environmental Monitoring Plan,* Annual Updates (BNL 2010e)
- O&M manuals for the groundwater treatment systems (BNL 2002-2009, available at www.bnl.gov/ltra/reports.asp)
- *BNL Land Use Controls Management Plan* (BNL 2009e)
- *EPA Five-Year Review Guidance* (EPA 2001)

As noted in **Section 4.1** above, the remedial action objectives for the projects are identified in the RODs and the OU III ESDs.

6.4 Data Review

This section provides a brief summary review of analytical data and trends for each OU, the HFBR, BGRR, g-2 and BLIP areas over the previous five years. Figures are provided which display historical trends for key groundwater monitoring wells by plume over the last several years. A detailed discussion of the status of the groundwater plumes and the progress of the 16 groundwater remediation systems is provided in the *2009 BNL Groundwater Status Report* (BNL 2010f—see **Attachment 2** for the CD version or http://webeims.b459.bnl.gov/gw_home/gw_home.asp). The Groundwater Status Reports are published on an annual basis and are a source of comprehensive information on the groundwater remediation systems and contaminant plumes.

Since the start of active groundwater remediation in 1997, approximately 6,433 pounds of VOCs have been removed, and over 16 billion gallons of treated groundwater have been returned to the aquifer. Additionally, the Chemical Holes Sr-90 treatment system and the BGRR/WCF treatment system have removed approximately 21 milliCuries (mCi) of Sr-90 while returning nearly 60 million gallons of treated water to the aquifer.

Figure 4-2 shows the location of the 16 groundwater treatment systems. **Table 6-1** provides a summary of the treatment system status through 2010.

Table 6-1: Groundwater Treatment System Status

Project	Target	Mode	Treatment Type	Expected System Shutdown	Highlights
OU I					
OU I South Boundary (RA V)	VOCs	Operational	P&T with AS	2015	Higher VOC concentration area of plume migrating slower than expected.
Current Landfill	VOCs tritium	Long-Term Monitoring & Maintenance	Landfill capping	NA	Groundwater continues slow improvement. VOCs and tritium stable or slightly decreasing.
Former Landfill	VOCs Sr-90 tritium	Long-Term Monitoring & Maintenance	Landfill capping	NA	No longer a continuing source of contaminants to groundwater.
Former HWMF	Sr-90	Long-Term Response Action	Monitoring	NA	Sr-90 data from 2009 characterization indicates concentrations will be below MCLs before reaching site boundary.
OU III					
Chemical/Animal Holes	Sr-90	Operational (EW-1 pulse pumping)	P&T with ion exchange (IE)	2014	System performing as expected. Began characterization of Sr-90 in western perimeter well.
Carbon Tetrachloride source control	VOCs (carbon tetra-chloride)	Standby	P&T with carbon	2004 (Complete)	Petition for closure signed in 2009. System decommissioned in 2010.
Building 96 source control	VOCs	Operational	Recirculation wells with AS for 3 of 4 wells. RTW-1 is P&T with AS.	2016	System pumping and treating high concentrations of VOCs. Source area soil remediation conducted in late 2010.
South Boundary	VOCs	Operational (EW-6, EW-7, EW-8 and EW-12 on standby)	P&T with AS	2017	Continued decline in monitoring well VOC concentrations at the site boundary with the exception of one well in the vicinity of EW-4 and EW-5.
Middle Road	VOCs	Operational (RW-4, RW-5, and RW-6 on standby)	P&T with AS	2025	Extraction wells RW-1 and RW-2 continue to show moderate VOC levels. Eastern extraction wells showing low VOC concentrations. *Continued...*
OU III (Cont.)					

Project	Target	Mode	Treatment Type	Expected System Shutdown	Highlights
Western South Boundary	VOCs	Operational (Pulse)	P&T with AS	2019	Freon-12 detected during 2008 persisting in monitoring well. Additional characterization planned.
Industrial Park	VOCs	Operational (UVB-1 and UVB-2 on standby)	In-well stripping	2012	VOC concentrations continued to decline. Placed UVB-2 on standby in 2010.
Industrial Park East	VOCs	Standby	P&T with carbon	2009 (Complete)	Monitoring the remaining low VOC concentrations.
North Street	VOCs	Operational	P&T with carbon	2013	Plume concentrations continue to decrease. Began pulse pumping NS-1 in 2010.
North Street East	VOCs	Operational (Pulse)	P&T with carbon	2013	Concentrations in plume core wells at very low levels in 2010. Temporary wells installed in 2011. Operate one to two more years, then prepare petition for shutdown.
Long Island Power Authority (LIPA) Right-of-Way/ Airport	VOCs	Operational (LIPA wells EW-1L, 2L, 3L on Standby/ Airport-Pulse)	P&T and recirculation wells with carbon	2014 (LIPA) 2019 (Airport)	Airport wells continued pulse pumping in 2010. Placed LIPA well EW-2 in standby.
HFBR Tritium	Tritium	Operational	Pump and recharge	2013	Leading edge of high-concentration slug being captured by EW-16. Concentrations in source area wells remained below MCL throughout 2009. Concentration increase in 2010 due to high water table.
BGRR/WCF	Sr-90	Operational	P&T with IE	2026	Continuing source areas observed at both the WCF and BGRR (Building 701). Four new extraction wells installed in 2011 to address WCF plume.
Chemical Holes system	Sr-90	Operational (Pulse)	P&T with IE	2014	Concentrations declining since installation of pumping wells EW-2 and EW-3 in 2007.
OU IV					
OU IV AS/SVE system	VOCs	Decommis-sioned	Air sparging/ soil vapor extraction	2003 (Complete)	VOC concentrations in monitoring wells remain low. System decommissioned in Dec. 2003.
Building 650 Sump Outfall	Sr-90	Long-Term Response Action	Monitored Natural Attenuation (MNA)	NA	Plume characterized in 2010. Higher concentration area of plume ~700' north of Brookhaven Avenue.
OU V					
STP	VOCs, tritium	Long-Term Response Action	MNA	NA	VOC plume has largely attenuated to below MCLs.

Continued...

Project	Target	Mode	Treatment Type	Expected System Shutdown	Highlights
OU VI					
Ethylene Dibromide (EDB)	EDB	Operational	P&T with carbon	2015	The EDB plume continues to migrate as predicted. The extraction wells are capturing the plume.

Notes:
AS = Air Stripping
AS/SVE = Air Sparging/Soil Vapor Extraction
EDB = ethylene dibromide
IE = Ion Exchange
LIPA = Long Island Power Authority
NA = Not Applicable
P&T = Pump and Treat
Recirculation = Double screened well with discharge of treated water back to the same well in a shallow recharge screen
In-Well = The air stripper in these wells is located in the well vault.

6.4.1 Operable Unit I

Soils: No cleanup activities were performed since 2005 for this OU. The BNL soil cleanup levels for principal radiological contaminants, based on the selected land use for each area, are provided in **Table 6-2**.

Table 6-2: BNL OU I Soil Cleanup Levels

Radionuclide	Soil Cleanup Level (pCi/g) Residential Land Use	Soil Cleanup Level (pCi/g) Industrial Land Use
Cesium-137	23	67
Strontium-90	15	15
Radium-226	5	5

Note: A post-cleanup dose assessment is required to determine compliance with the 15 mRem/year above background with 50 years of institutional control level.

As a follow-up to the 2005 *Closeout Report for the Former Hazardous Waste Management Facility* (Envirocon 2005), ORISE, at the request of DOE in 2007 conducted an in-process verification survey of the former HWMF. This survey was designed to identify whether the former HWMF contained any hot spots above the release criteria. The results concluded that the total dose to a future inhabitant from both the Cs-137 and Sr-90 contaminants would not increase significantly. This evaluation is documented in the report, *Data Evaluation and Dose Modeling for the Former Hazardous Waste Management Facility, Brookhaven National Laboratory, Upton, New York, Revision 1* (ORISE 2008).

The decontamination of the Merrimack Hole at the former HWMF was completed in July 2006.

Landfills: Soil-gas monitoring at the Current Landfill indicates that decomposition is still occurring. However, as with prior years, there is no indication that the vapors are migrating beyond the monitoring well network. Soil-gas monitoring at the Former Landfill Area indicates that there are only minimal detections of hydrogen sulfide, with no detectable levels of methane present. The soil-gas monitoring well networks are sufficient to monitor both landfill areas.

As part of the compliance monitoring for the Current Landfill, annual surface water and sediment sampling of the adjacent wooded wetland has been performed since 1999. Data from 1999 through 2007 indicated that risk to the adult eastern tiger salamanders from inorganic contaminants that may be in the sediment at this area was unlikely. The results of the May 2008 sediment and surface water sampling program indicate no elevated risk to adult tiger salamanders from sediments in the South or North Ponds. The average sediment concentrations for both ponds were lower than the maximum and/or background concentrations that would result in an elevated hazard quotient, as discussed in the *Final Focused Ecological Risk Assessment for OU I* (BNL 1999b). Ten years of data from both surface water and sediment sampling within the wooded wetlands indicate a stable pattern in the concentration of metals. Because of this stability, the sampling frequency of both surface waters and sediments within the wooded wetland complex was reduced to once every two years.

Groundwater: The landfill areas were capped between 1995 and 1997. Monitoring data presented in the *Environmental Monitoring Report – Current and Former Landfills* (BNL 2009h) indicate that, in general, contaminant concentrations have decreased following the capping of the landfills and landfill controls continue to be effective. Volatile organic compounds (VOCs) and metals continue to be detected downgradient of the Current Landfill. The most prevalent VOCs detected above standards are chloroethane and benzene, at maximum concentrations of 27 µg/L and 2 µg/L, respectively. **Figure 6-1** depicts VOC trends for individual wells. As with previous years, iron, manganese, and arsenic were detected downgradient from the Current Landfill at concentrations above applicable standards. Concentrations of these metals were similar to those detected in 2008. Maximum concentrations of iron, manganese, and arsenic in downgradient wells were 68,900 µg/L, 6,650 µg/L, and 23 µg/L, respectively.

VOCs were not detected above standards in Former Landfill Area monitoring wells. Leachate indicator parameters and metals concentrations were generally the same when comparing downgradient monitoring wells to upgradient monitoring wells.

Over the past five years, the OU I pump and treat system continued to maintain hydraulic control and treat contaminants originating from the Current Landfill and former HWMF, and prevented further contaminant migration across a portion of the site's southern boundary. As expected, the VOC mass removal has been steadily declining over the last several years, as indicated by low influent VOC concentrations. The overall extent and concentrations of the VOC plume have decreased significantly over the previous five years (**Figure 6-1**). The routine well network has been supplemented several times over the previous five years with temporary wells targeted to assess the remaining higher VOC concentration segment of the plume. This area extends from the site boundary to the north approximately 700 feet. Maximum total VOC concentrations range from approximately 70 to 100 µg/L. The plume has migrated to the deeper Upper Glacial aquifer in this area and is encountering the Upton Unit, which is slowing the migration rate. The Upton Unit is a lower permeability layer at the base of the Upper Glacial aquifer in this portion of the site. Existing and planned monitoring wells will provide the data needed to determine when the trailing edge of this higher concentration area has been captured and treated by the OU I system. From the start of operations in 1997 through 2009, the OU I South Boundary system has removed 353 pounds of VOCs from the aquifer.

Groundwater monitoring continues for an area of Sr-90 contamination that originated at the former HWMF and is now located approximately 2,200 feet to the south (approximately 1,000 feet north of the site boundary and OU I extraction wells). In 2010, 18 temporary wells were installed and sampled to characterize this area of Sr-90 that was initially detected in 2001. The highest Sr-90 concentration detected was 29 pCi/L, which is above the 8 pCi/L MCL but significantly lower than the peak concentration of 65 pCi/L observed in 2001. The rate of migration of Sr-90 in this area of this site is approximately 30 to 40 feet per year.

6.4.2 Operable Unit II

The remedial actions for the OU II AOCs are documented in the OU I, OU III and the g-2/BLIP/USTs RODs (see **Sections 6.4.1**, **6.4.3**, and **6.4.8**).

6.4.3 Operable Unit III

Soil: In 2008, a detailed soil characterization and soil vapor testing investigation was conducted to locate the continuing source of the Building 96 PCE groundwater plume. High PCE concentrations were identified in the unsaturated zone from just below land surface to a depth of approximately 15 feet within a surface area of approximately 25 by 25 feet. Maximum PCE concentrations detected in the soil were 1,800 milligrams per kilogram (mg/kg). A summary of the characterization data was provided in the *2008 BNL Groundwater Status Report* (BNL 2009f). A plastic liner was installed over the soil contamination area in November 2008 as a temporary measure to minimize infiltration from precipitation. To optimize the effectiveness of the Building 96 groundwater remedy, BNL recommended excavation of contaminated soils with off-site disposal. The regulatory approach for this action was to document the change in an Explanation of Significant Differences (ESD) to the OU III ROD. Following review and approval by the regulators, the *Final Operable Unit III Explanation of Significant Differences for Building 96 Remediation* (BNL 2009a) was issued. During 2010, approximately 350 cubic yards of contaminated soils were excavated and disposed of off site, and the excavation was backfilled with clean soil.

Groundwater: Over the past five years, the OU III groundwater remediation systems continued to maintain hydraulic control of contaminants originating from the central portion of the BNL site. Twelve of these systems are currently in active operation. The Carbon Tetrachloride system met the cleanup goal and was dismantled, and the Industrial Park East system is in standby mode and could be restarted if necessary. The extent of the high-concentration segments of the OU III VOC plumes have decreased as the result of active groundwater remediation and the effects of natural attenuation. Hydraulic control of the plume segments near the Middle Road, South Boundary, Industrial Park, Industrial Park East, and LIPA treatment systems can be seen on **Figure 5-1**. Complete breaks in the plumes, where contaminant concentrations have dropped below MCLs, are discernable near the South Boundary and the LIPA systems. The southernmost segment of the OU III plume has been hydraulically controlled by the Airport treatment system. As the plumes continue to decrease in size, a number of the extraction wells have been placed in either a pulse pumping mode or a standby mode (**Figure 4-3**). The HFBR Pump and Recharge system operated from May 1997 through September 2000, when it was placed in standby mode. As a ROD contingency action, the system was placed back into service in November 2007 (for details see BNL 2009f).

A review and evaluation of the performance data for the treatment systems is conducted monthly for most of the systems and quarterly for all of the systems, as well as annually for all systems. An evaluation of all the groundwater monitoring data collected for the year is documented in the annual *BNL Groundwater Status Report* (BNL 2010f).

The following is a brief status summary of OU III plume data through 2010.

Carbon Tetrachloride Treatment System

The Carbon Tetrachloride treatment system was successful in remediating the source area and resulting plume initially detected in 1998. Carbon Tetrachloride concentrations in the source area that ranged up to 179,000 μg/L in 1998 were reduced to levels below the MCL of 5 μg/L in 2009. **Figure 6-2** provides VOC trends for select monitoring wells in this plume. It began operating in October 1999, and was shut down and placed in standby mode in August 2004 after receiving regulatory approval. Groundwater monitoring continued through 2009, and a Petition for Closure of the system was submitted to the regulators in August 2009. Following the October 2009 regulatory approval for closure and decommissioning, the remediation system was removed, and the extraction wells and most monitoring wells were abandoned. While in operation from 1999 through 2004, the Carbon Tetrachloride system removed 349 pounds of VOCs from the aquifer.

Building 96 Treatment System

In 2004, VOC concentrations in three of the four Building 96 recirculation wells were below 30 µg/L total volatile organic compounds (TVOCs). As a result they were shut down and placed in standby mode in mid 2004. In addition, applications of the oxidizer potassium permanganate were applied in December 2004/January 2005 and April 2005 to degrade the persistent high PCE groundwater contamination in the shallow silt zone source area (**Figure 6-3** for VOC trends). Hexavalent chromium was detected in area monitoring wells in 2008 as a byproduct of the potassium permanganate injections. The extent of hexavalent chromium in groundwater was fully characterized in this area and continues to be monitored as described in the *BNL Groundwater Status Reports* (BNL 2008a, 2009f and 2010f). Concentrations of hexavalent chromium in the monitoring and extraction well are currently well below the 100 µg/L New York State SPDES discharge limit for hexavalent chromium. Based upon the progress that had been made in remediating the PCE plume, in 2005, BNL prepared the *OU III Building 96 Groundwater Treatment System Shutdown Petition (AOC 26B)* (BNL 2005g). However, based upon persistent detection of high levels of PCE, the system was turned back on in 2007.

During 2008, BNL collected soil samples to determine whether there was a continuing source of PCE in the vadose zone. A localized zone of soil contamination was detected with a maximum PCE detection of 1,800 mg/kg. As a follow-up and to help identify any other potential areas of soil contamination, a soil vapor survey was conducted. No other PCE contamination areas were identified from this survey. As described earlier, in late 2010 approximately 370 cubic yards of contaminated soils were excavated and disposed of off site. PCE concentrations in source area groundwater remained as high as 3,000 µg/L during the fourth quarter of 2009. With the excavation of the contaminated soils and the continued operation of the groundwater treatment system, the cleanup goals for this area are expected to be achieved by 2016. VOC trend graphs for select wells are shown on **Figure 6-3**. From the start of operations in 2001 through 2009, the Building 96 treatment system has removed 107 pounds of VOCs from the aquifer.

Middle Road Treatment System

The Middle Road treatment system continues to effectively capture and treat VOC contamination. From 2001 through 2009, the Middle Road system has removed 862 pounds of VOCs from the aquifer. The three easternmost of the six extraction wells (RW-4, RW-5 and RW-6) are currently in standby as VOC concentrations have decreased below the system capture goal of 50 µg/L over the past several years. Total VOC concentrations remain above 50 µg/L in the westernmost three extraction wells and surrounding monitoring wells. Monitoring wells upgradient of this area have shown decreasing trends over the past five years (**Figure 6-4**). Additional groundwater characterization is planned for an area immediately to the west of these extraction wells to determine whether an area of elevated VOC concentrations migrating from the north will be captured by the Middle Road wells as that area migrates south.

South Boundary Treatment System

The South Boundary treatment system continues to capture and treat VOCs at the southern site boundary. From the start of operations in 1997 through 2009, the South Boundary system has removed 2,715 pounds of VOCs from the aquifer. TVOCs to the west have decreased to below the system capture goal of 50 µg/L. The four easternmost extraction wells have been placed in standby mode over the past five years as a result of the decreasing VOCs. The three westernmost wells continue to operate although VOC concentrations in both these extraction wells and surrounding monitoring wells have shown marked declines. Total VOC concentrations in monitoring well 121-45, which is located approximately 750 feet north of the south boundary (**Figure 6-4**), have decreased from over 600 µg/L in 2006 to 170 µg/L in the fourth quarter of

2010. This data suggests that the Middle Road system to the north has hydraulically captured the VOC plume and the remnants of the plume are attenuating as they migrate toward the site boundary. Bypass monitoring well 121-43, located approximately 700 feet south of the boundary, showed increasing concentrations of VOCs in 2009. A temporary well is planned for the south boundary to determine whether these VOCs are trapped in the stagnation zone south of the system or the contamination is migrating under extraction well EW-4.

Western South Boundary Treatment System

Plume and extraction well data show that elevated VOC concentrations continue to be observed in the western portion of the OU III South Boundary area. Extraction well WSB-2, located in the eastern portion of this area, has been pumping in a pulsed mode since 2008 due to the decreased VOC concentrations observed both in this well and area monitoring wells. Groundwater characterization efforts in 2008 revealed an area of elevated TCA approximately midway between WSB-1 and East Princeton Avenue. An area of total TVOC concentrations (consisting of primarily TCA) greater than 50 µg/L currently extends from the Middle Road south to WSB-1 (approximately 2,000 feet). A new monitoring well (119-06) was installed at the Middle Road to monitor this area in 2008. Total VOC concentrations in this well have decreased from 170 µg/L in 2008 to <5 µg/L in 2010. This area is captured and treated by WSB-1 (**Figure 6-5**). From the start of operations in 2002 through 2009, the Western South Boundary system has removed 66 pounds of VOCs from the aquifer.

During the 2008 characterization, dichlorodifluoromethane (Freon) was detected at a concentration of 60 µg/L at a depth of 192 feet below land surface in a temporary well located approximately 800 feet south of East Princeton Avenue. A permanent well was installed at this location and has been monitored since May 2009. As of the fourth quarter 2010, Freon concentrations have decreased to 23 µg/L. Additional characterization is planned in 2011 to determine the extent of this Freon contamination.

Industrial Park Treatment System

The Industrial Park treatment system is effectively capturing and treating VOCs. From the start of operations in 2004 through 2009, the Industrial Park system has removed 1,045 pounds of VOCs from the aquifer. Influent extraction well TVOC concentrations are all below the 50 µg/L capture goal, and three of the seven extraction wells are now in standby mode (UVB-1, UVB-2, and UVB-7) as shown on **Figure 4-3.** There was only one monitoring well (000-262) that was still exceeding the capture goal as of the second quarter 2010, with TVOC concentrations over 200 µg/L. The decreasing trends over the past five years in plume monitoring wells are shown on **Figure 6-6**.

Industrial Park East Treatment System

The Industrial Park East treatment system remains in standby mode following the approved Petition for Shutdown in 2009. TVOC concentrations in the two extraction wells remained below 5 µg/L in 2010 following system shutdown. Monitoring continues for an area of VOC contamination that had migrated south of the treatment system prior to startup. The highest concentration of TVOCs observed in this area during the fourth quarter 2010 was 14 µg/L in well 000-494. From the start of operations in 2004 through 2009, the Industrial Park East system removed 38 pounds of VOCs from the aquifer.

North Street Treatment System

The North Street treatment system has been highly effective in remediating an off-site area of elevated VOCs since 2004. From the start of operations in 2004 through 2009, the North Street system removed 300 pounds of VOCs from the aquifer. Total VOC concentrations in extraction well NS-1 have dropped from 600 µg/L in 2004 to less than 10 µg/L as of the fourth quarter 2010 (**Figure 6-7**). Concentrations in monitoring wells upgradient of the treatment system were all less than 75 µg/L TVOCs in 2010.

North Street East Treatment System

The off-site segment of the OU I VOC plume is captured and treated by the North Street East System. From the start of operations in 2004 through 2009, the North Street East system has removed 30 pounds of VOCs from the aquifer. The extraction wells are situated in a line along the axis of the plume. The southernmost of the two wells, NSE-2, was in a pulse pumping mode from 2006 through 2009 and was placed on standby in 2010 due to TVOC concentrations remaining below 5 µg/L in both this well and the surrounding monitoring wells. VOC concentrations in the northern segment of this plume have also decreased since the treatment system began operation in 2004 (**Figure 6-1**). All of the monitoring wells in this area and extraction well NSE-1 were below the capture goal of 50 µg/L TVOCs by the end of 2010. However, concentrations in well 000-477 showed an increase in TVOCs from 18 µg/L in 2006 to 47 µg/L in 2009. Several temporary wells were installed in 2011 to evaluate VOC concentrations upgradient of 000-477 and assess whether a petition to shut down the system could be prepared for regulatory approval. One of these temporary wells reported a TVOC detection of 70 µg/L. Based on this data, NSE-1 will be required to operate for approximately one to two additional years in order to ensure that the remainder of the plume has been captured and treated.

LIPA/Airport Treatment System

The LIPA system was designed to provide capture and control of the OU III plume that has migrated past the Industrial Park system. Groundwater from these wells is sent to a treatment facility located at the Brookhaven Airport where it is treated along with water from the Airport extraction wells. Extraction well EW-4L is capturing and treating VOCs in the upper Magothy aquifer and continues to operate. Influent total VOC concentrations were >300 µg/L in 2004 and have declined to 20 µg/L in 2011. The nearest upgradient plume core monitoring well to EW-4L is 000-130. This well displayed peak TVOC concentrations of >5,000 µg/L in 1999 and has declined to <70 µg/L in the fourth quarter 2010. The VOC contamination in the deep Upper Glacial aquifer was captured and treated by three extraction wells (EW-1L, EW-2L, and EW-3L) that are all currently in standby mode due to the reduction in VOC concentrations in these wells and in area monitoring wells to well below the 50 µg/L TVOC capture goal for this system (**Figure 6-4**).

Two segments of the OU III plumes are captured and treated at the Brookhaven Airport (located approximately 9,000 feet south of the BNL site boundary). The western segment, originating from the Building 96 and Carbon Tetrachloride source areas on site, is captured by a network of three extraction wells: RW-1, RW-2, and RW-6. Extraction well RW-6 was added to the system in 2007 in response to perimeter monitoring well detections of increasing concentrations of carbon tetrachloride. The plume had a more westward flow component than originally anticipated in this area due to hydraulic influences from the Carmans River (approximately 4,000 feet to the west). Groundwater modeling predicted that an additional well, several hundred feet west of RW-1, would be necessary to capture the leading edge of this plume. TVOC concentrations in monitoring well 800-96 (the perimeter well triggering the need for RW-6) have declined from 132 µg/L in 2007 to 50 µg/L in 2009. VOC reductions in upgradient monitoring wells indicate that the trailing edge of the high-concentration area of carbon tetrachloride is approximately 500 feet north of RW-6 (**Figure 6-4**). From the start of operations in 2004 through 2009, the LIPA/Airport system has removed 280 pounds of VOCs from the aquifer.

VOC concentrations remain low (less than 20 µg/L TVOCs) in monitoring wells in the eastern portion of the Brookhaven Airport and thus the three extraction wells are operated in a pulse pumping mode. Wells in this area are monitored to detect the arrival of VOCs that had migrated south of the North Street treatment system capture zones prior to their operation. Monitoring well 800-92, located approximately 2,000 feet north of the Airport, has been showing steadily increasing TVOC concentrations from 4 µg/L in 2005 to 216 µg/L in late 2010.

HFBR Pump and Recharge System/Plume

Considerable progress has been observed in the attenuation of the HFBR tritium plume both at the source area and at the downgradient high-concentration slug. The OU III ROD contingency of exceeding 20,000 pCi/L at Weaver Drive was triggered with a detection of 21,000 pCi/L in November 2006. In 2007, new pump and recharge well EW-16 was installed to supplement the three existing extraction wells, and the system was restarted in November 2007 as per the ROD contingency. Groundwater modeling results predict that the pump and recharge system would have to operate until approximately 2013. This prediction is reasonable based on the tritium concentrations observed during 2010. Concentrations in well EW-16 peaked at just below 3,000 pCi/L in 2008 and had declined to about 1,600 pCi/L in the fourth quarter 2010. This decline in concentrations corresponds with the characterization data for the high-concentration slug. The highest concentration observed in this downgradient area in 2010 was 19,400 pCi/L in a temporary well along the Weaver Drive transect (**Figure 6-8**). Tritium concentrations in a temporary well just north of Weaver Drive were 113,000 pCi/L in 2007. There has been a steady decline in the peak tritium concentrations detected in this slug over the past several years.

Groundwater monitoring immediately downgradient from the HFBR continued to show a decline in tritium concentrations over the past five years. Although there were no detections of tritium above the 20,000 pCi/L MCL during 2009, in the source area monitoring wells in late 2010 there was a slight increase in tritium concentrations in several wells, with concentrations ranging up to 47,500 pCi/L. It is believed that this small concentration spike is in response to an historical high water table in early 2010 and the resulting flushing effect on residual tritium in the vadose zone beneath the HFBR. The historical peak tritium concentration was over 5 million pCi/L in 1999. It appears that the remaining source of tritium is significantly depleted and that concentrations will decrease to the point that they are continually below the MCLs in the source area within the next several years. A comparison of the extent and magnitude of the HFBR tritium plume over time is presented on **Figure 5-2**.

BGRR/WCF Treatment System

There are a total of five extraction wells pumping and treating Sr-90 from two source areas. Two of the extraction wells (SR-1 and SR-2) capture and treat Sr-90 immediately downgradient of the WCF. Based on the declining Sr-90 trend in source area monitoring well 065-175 (**Figure 6-9**), it appears that the source area soil cleanup was effective in removing the groundwater contamination source. This is corroborated by the Sr-90 influent concentration decline in SR-2 from a maximum of 98 pCi/L in 1998 to 55 pCi/L in the fourth quarter 2010. Well SR-2 is located approximately 110 feet downgradient of monitoring well 065-175 (or approximately three to four years travel time).

Modeling of the groundwater characterization data from the remedial investigation (RI) and pre-design phases of the work projected that the concentrations observed in the plume downgradient of SR-1 and SR-2 would naturally attenuate to levels that would meet the OU III ESD cleanup goal for Sr-90 of MCLs by 2070. Groundwater samples collected in the southern area of this plume during the 2007/2008 g-2 tritium plume investigation revealed a slug of Sr-90 with higher than expected concentrations ranging up to 518 pCi/L. Updated groundwater modeling based on this data showed that active remediation of this area would be required to achieve the OU III ESD cleanup goals for this plume. Subsequent characterization efforts in 2009/2010 have tracked this area migrating slowly to the south (approximate rate of 20 to 40 feet per year).

The second source area for Sr-90 contamination in this area of the site is the BGRR. This source is effectively captured and treated by extraction wells SR-3, SR-4, and SR-5. Sr-90 influent concentrations in SR-3 have shown a steady decline over the past several years from a high of 1,270 pCi/L in 2007 down to 71 pCi/L during the fourth quarter 2010. A temporary well located between the BGRR and SR-3 was installed and sampled in early 2010 and showed Sr-90 concentrations as high as 592 pCi/L. It appears that high concentrations of Sr-90 continue to migrate from the BGRR source area.

In 2009, a Sr-90 concentration of 82 pCi/L was observed in plume sentinel well 075-671 (located at the leading edge of the BGRR plume near Brookhaven Avenue). Based on this detection, additional characterization work was implemented in 2009/2010 to assess whether there were higher than anticipated Sr-90 concentrations downgradient of the extraction well network. Updated groundwater modeling was performed for this plume based on the newly obtained data and it was determined that the concentrations would not jeopardize achieving the OU III ESD Cleanup Goals.

Since the start operations in 2005 through 2009, the BGRR/WCF system has removed approximately 17 mCi of Sr-90 from the aquifer.

Chemical Holes Treatment System

Sr-90 migrating south from the former source area is captured and treated by extraction well EW-1. Pulse pumping was implemented for this well in 2008 due to the stable and low influent concentrations. The pulse pumping appears to be mobilizing Sr-90 to the aquifer based on the concentration fluctuations over the past several years. Source area wells upgradient of EW-1 continue to show high Sr-90 concentrations. The peak concentration in well 106-16 (**Figure 6-10**) was 2,540 pCi/L in 1999. It decreased to 69 pCi/L in 2006 but remained above 400 pCi/L in 2010. Eight temporary wells were installed in the Chemical Holes/Animal Pits former source area in 2008 to characterize Sr-90 concentrations. The highest concentration observed was 190 pCi/L. There appears to be at least periodic mobilization of Sr-90 at the source area based on the continued high Sr-90 concentrations in source area monitoring wells such as 106-16. The mechanism for this may be the flushing of the vadose zone by rising and falling of the water table and/or precipitation flushing remnant Sr-90 from the vadose zone.

Two additional extraction wells (EW-2 and EW-3) were installed south of EW-1 in 2007 to capture and treat an area of higher Sr-90 concentrations that had migrated south of EW-1 prior to startup. This action was specifically triggered by increasing concentrations in monitoring well 106-49 which peaked at 1,530 pCi/L in 2005. This downgradient area of elevated Sr-90 was characterized in 2005/2006 using temporary wells. Updated groundwater modeling predicted that this area of contamination would not attenuate to drinking water standards by 2040 (OU III ESD Cleanup Goal) if it were not actively treated to lower concentrations. Since addition of the two extraction wells, concentrations have shown a steady decline in well 106-49 to a low of 10 pCi/L in the fourth quarter of 2010. Since the start operations in 2003 through 2009, the Chemical Holes treatment system has removed almost 4 mCi of Sr-90 from the aquifer.

6.4.4 Operable Unit IV

Soil: Remediated radiologically contaminated soil at the Building 650 Sump Outfall is included under OU I.

Groundwater: The OU IV AS/SVE treatment system was dismantled in 2003, and post-closure groundwater monitoring continues to show a decline in VOC concentrations. Contaminant concentrations associated with this former source area are below applicable MCLs.

Groundwater monitoring continues to evaluate the natural attenuation of an area of Sr-90 contamination which originated at the Sump Outfall and is slowly migrating to the south. Monitoring of this area began back in 1997 and the higher concentration segment was reaching the southern extent of the monitoring well network (approximately 1,200 feet southeast of the Sump Outfall) by 2010. Sr-90 concentrations for key wells are shown on **Figure 6-11**. A characterization of this area was conducted in 2010 to update data on both the nature and extent of Sr-90 concentrations. The highest Sr-90 concentration detected in temporary wells from the characterization was 74 pCi/L at a location approximately 700 feet north of Brookhaven

Avenue. Based on Sr-90 well data observations, the migration rate of Sr-90 in this area appears to be in the 20 to 40 foot per year range, which corresponds with observations for other Sr-90 plumes at the site. The newly collected data was used to perform an updated attenuation simulation using the BNL groundwater model. The model predicts concentrations will attenuate to less than the 8 pCi/L MCL by 2034. This is a conservative estimate and the maximum southward extent of the leading edge of this area (defined by 8 pCi/L) will be approximately 200 feet south of Brookhaven Avenue.

6.4.5 Operable Unit V

Peconic River: Annual data for the 2006 – 2010 Peconic River sediment, surface water, and fish monitoring program are detailed in the annual Peconic River Monitoring Reports and have been routinely reviewed with the regulators. The 2006 to 2010 mercury concentration data for sediment, surface water and fish each indicate substantial improvements relative to pre-cleanup conditions and the sediment cleanup goals or other criteria (surface water and fish concentrations). Sediment is the only matrix with a ROD-specified cleanup goal: <2.0 mg/kg mercury. The EPA's mercury criterion[1] for fresh waters is 0.3 mg/kg mercury in fish tissue residue. Although this is not a ROD-required goal, Peconic River fish tissue mercury concentrations were measured and compared to the criterion as a reference, and as a benchmark for water quality improvement.

Peconic River Sediment: Mercury data for the 30 routine Peconic River sediment sampling stations, plus one water-column sampling location (PR-WC-06) and the Sediment Trap are summarized on **Table 6-3**. Sediment was collected from PR-WC-06 to determine the source(s) of elevated water-column total mercury concentrations.

Mercury was below the cleanup goal of 2.0 mg/kg at 24 of the 30 sediment monitoring stations. However, eight of the sediment sampling stations had at least one sample with mercury concentrations greater than or equal to the cleanup goal. In addition to the annual sampling, supplemental sampling was performed at these locations. For the sediment trap and sampling stations PR-SS-15 and PR-WC-06, the frequency and magnitude of mercury concentrations greater than 2.0 mg/kg merited remedy optimization via supplemental sediment removal. Sediment excavation and off-site disposal was conducted between November 2010 and January 2011 per the *Final Plan for the Optimization of the Peconic River Remedy* (BNL 2010g). Remedy optimization locations are shown on **Figure 6-12**.

Peconic River Water Column: Mercury concentrations in the Peconic River water samples were less than or equal to 200 nanograms per liter (ng/L; equivalent to parts of mercury per trillion parts of water) with the exception of three samples collected from two locations (PR-WC-06 and PR-WC-03). One sample point (PR-WC-06) had the two highest mercury concentrations: 1,360 and 876 ng/L (**Figure 6-13**). These two water column mercury concentrations were the basis for the extensive characterization of the PR-WC-06 area (**Table 6-3)** and its subsequent sediment removal in December 2010.

Mercury data for the water-column samples are plotted on **Figure 6-13**. Each station was sampled twice per year (water depth permitting), and therefore is represented by up to 10 sample points (circles). The Connetquot River, which is sampled as a reference station, had a maximum mercury concentration of 4.52 ng/L (plotted as a reference line). The triangles represent STP effluent samples collected from about 30 feet before the effluent enters the Peconic River. As shown on **Figure 6-13**, the mercury concentrations downstream of the STP (i.e., to the right of STP-EFF-UVG) are clearly elevated relative to the stations upstream of the STP (to the left of STP-EFF-UVG). A downward trend in mercury concentration between STP-EFF-UVG and PR-WC-01 (at Schultz Road) is evident. The two lowest STP mercury samples

[1] Final Water Quality Criterion for the Protection of Human Health: Methylmercury, Office of Science and Technology, Office of Water, U.S. Environmental Protection Agency, Washington, DC, 20460, EPA-823-R-01-001, January 2001. All mercury within a fish is assumed to be methylmercury.

plotted[2] were collected in 2010 after routine STP maintenance consisting of the removal and replacement of the top two feet of sand in the sand filter beds was completed in 2009[3]. Additional improvements in mercury concentrations are expected following the 2010-2011 sediment removal for the PR-WC-06, PR-SS-15 and Sediment Trap areas, and the planned rerouting (to be completed in 2014) of STP effluent to groundwater rather than to the Peconic River.

Between PR-WC-01 and PR-WCS-04 (between three to five miles downstream from the STP) mercury concentrations have ranged between approximately 5 and 24 ng/L. Downstream of PR-WCS-04 mercury concentrations are generally in the range of approximately 1 to 10 ng/L, which is slightly higher than the maximum mercury concentration (4.52 ng/L) at the Connetquot River station.

Peconic River Fish: As shown on **Figure 6-14**, fish tissue mercury concentrations have decreased substantially since completion of the 2004/2005 cleanup, and additional decreases are anticipated in response to the 2010 sediment removal summarized above. The annual average fish tissue mercury concentrations from 2006 through 2010 (0.28 mg/kg) are significantly lower than the 1997 and 2001 pre-cleanup concentration (0.58 mg/kg)[4]. Also, the average mercury concentrations for the 2006 through 2010 post-cleanup fish tissue samples are lower than the EPA mercury criterion of 0.3 mg/kg.

---

[2] The STP effluent data used in this report are limited to samples collected between the times of collection of samples upstream of the STP and samples that were collected downstream of the STP. These data were collected twice annually between 2007 and 2010.

[3] In order to minimize the mass of BNL STP sewage sludge, the sludge has routinely been digested by anaerobic microbes in the sludge digester, with the liquid effluent from the digestion process being mixed with the STP influent and treated within the STP system before being discharged to the Peconic River. This and historical elevated mercury concentrations in the STP influent could have been sources for mercury that were subsequently leached from the filter bed sand into the water passing through the filter beds. The treated effluent is discharged into the Peconic River. These two potential contamination sources were removed in 2007-2009 when the sludge from the digester was removed and dried for 18 months in Geo Tubes. The sludge was then homogenized within the top two feet of sand media from filter beds 1-4 and disposed of at permitted facilities off site. Between July and September 2009 approximately 4,934 tons (approximately 3,322 cubic yards) of mixed sludge and filter bed media were removed from the beds and disposed of at Allied Landfill (96 percent) in Niagara, NY, or at Energy Solutions (4 percent) in Clive, Utah, thus removing a source of contamination to the Peconic River.

[4] The 1997 and 2001 Peconic River fish data set is shown in Table 4-10 and described on page 33 in the *Final 2009 Peconic River Monitoring Report*. The 2006-2010 fish data sets are described in each of the respective annual Peconic River Monitoring Reports.

Table 6-3. 2006 - 2010 Summary for All Routine and Supplemental Sediment Mercury Monitoring Stations

Site ID[1]	Number of Samples	Mean Mercury (mg/kg)	Minimum Mercury (mg/kg)	Maximum Mercury (mg/kg)	Standard Deviation
PR-SS-38	9	1.493	0.35	3.1	0.812
PR-SS-37	5	0.536	0.092	1	0.361
PR-SS-35	5	0.260	0.12	0.5	0.156
PR-SS-33	10	0.913	0.05	4.7	1.394
PR-SS-31	5	0.094	0.038	0.16	0.053
PR-SS-30	5	0.152	0.063	0.3	0.091
PR-SS-29	5	0.288	0.13	0.55	0.166
PR-SS-26	5	0.342	0.13	0.87	0.301
PR-SS-24	5	0.170	0.11	0.31	0.080
PR-SS-23	5	0.204	0.043	0.46	0.167
PR-SS-21	5	0.318	0.051	0.78	0.285
PR-WC-06 - Supplemental	84	2.476	0.029	22.3	4.243
PR-SS-19	41	1.116	0.13	4.4	0.958
PR-SS-18	10	0.900	0.089	4.1	1.192
PR-SS-17	5	0.537	0.027	1.2	0.501
PR-SS-16	5	1.130	0.45	1.8	0.559
Sediment Trap[2] Supplemental	25	1.14	0.057	11.1	2.366
PR-SS-15	58	4.022	0.043	36.8	8.091
PR-SS-14	5	0.270	0.16	0.41	0.090
PR-SS-12	5	0.051	0.034	0.069	0.014
PR-SS-10	37	1.487	0.052	7.1	1.568
PR-SS-09	5	0.347	0.094	0.69	0.229
PR-SS-07	5	0.058	0.016	0.091	0.030
PR-SS-06	5	0.105	0.032	0.27	0.095
PR-SS-05	5	0.300	0.059	0.85	0.327
PR-SS-04	5	0.035	0.0066	0.062	0.024
PR-SS-03	5	0.292	0.072	0.81	0.309
PR-SS-02	5	0.145	0.057	0.3	0.092
PR-SS-01	5	0.082	0.023	0.18	0.064
PR-MR-01	5	0.176	0.038	0.47	0.172
PR-MR-02	5	0.065	0.055	0.073	0.009
PR-DP-01	5	0.103	0.005	0.239	0.101

[1] Site IDs are arranged from upstream to downstream
[2] The Sediment Trap data set includes characterization samples collected 01/04/2011

Groundwater: Active treatment of the low-level VOC plume that originated from the BNL Sewage Treatment Plant (STP) was not required by the ROD. However, the groundwater continues to be monitored. VOC concentrations remained below the MCLs for individual VOCs from 2008 through 2010. This VOC plume which originated at the STP has largely attenuated. Tritium has consistently remained well below the MCL of 20,000 pCi/L. The highest tritium value reported historically from this monitoring well network was 3,320 pCi/L in 1997 from a monitoring well (050-02) located on the eastern site boundary. There have been no tritium detections above 1,000 pCi/L in monitoring wells since 2008. See **Figure 6-15** for historical VOC trends.

Select OU V and STP monitoring wells were sampled for perchlorate during 2004, prompted by the detection of perchlorate in a SCDHS monitoring well located east of BNL. Perchlorate was detected in four of the OU V wells, but levels were below the New York State Department of Health Action Level of 18 µg/L in drinking water supply wells. BNL added routine perchlorate analyses for eight OU V wells in 2005. Based on the low levels of perchlorate detected, a recommendation was made in the *2009 BNL Groundwater Status Report* (BNL 2010f) to reduce the number of wells sampled to five and discontinue monitoring for perchlorate if levels in the wells remained below the Action Level for two consecutive years. There were no detections above the Action Level in either 2009 or 2010.

6.4.6 Operable Unit VI

Groundwater: Monitoring over the past five years continues to show a steady decline in 1,2-ethylene dibromide (EDB) concentrations as the plume migrates south and is captured and treated by the EDB treatment system. This system consists of two extraction wells (EW-1E and EW-2E). The trailing edge of the plume is approximately 1,300 feet south of the site boundary. The maximum historical detection of EDB in this plume was 7.6 µg/L in 2001 (well 000-283). During the fourth quarter 2010, the maximum EDB concentration in plume monitoring wells was 0.6 µg/L. The first detections of EDB were observed in the extraction wells in 2006 as the leading edge of the plume arrived in the area. The southward migration of the plume can be observed by comparing the EDB concentration trends for key wells on **Figure 6-16**.

6.4.7 BGRR

- Structures and Soil: Removal of the canal structure and subsurface contaminated deep soil pockets located outside the footprint of the reactor building was completed in 2005. The maximum residual Cs-137 and Sr-90 concentrations following cleanup were 5,907 pCi/g and 676 pCi/g, respectively. In most cases, any additional excavation of these areas would have resulted in a significant engineering and construction project because of shoring requirements and access limitations. Radiological surveys were completed to measure the extent of and document residual contamination. Soil samples were obtained to document the as-left conditions. The excavated areas have been backfilled, compacted and covered with a temporary asphalt cap to minimize water infiltration prior to the final cap installation currently underway. All associated waste from these actions was packaged, transported and disposed at authorized radioactive, hazardous, and clean waste disposal facilities.

  Removal and disposal of the graphite pile, control rods, boron shot, shield plugs, upper portion of air tight membrane, and the invar rods was completed in May 2010. Removal of the bioshield and installation of the final engineered cap is in progress. The completion and closeout reports document the final status of the various cleanup activities at the BGRR. For a complete list of these reports, see the reference list at the end of this report.

Groundwater: See OU III Groundwater **Section 6.4.3** for groundwater data review.

6.4.8 g-2/BLIP/USTs

Groundwater: Groundwater monitoring at the g-2 and BLIP source areas has shown that the stormwater controls have been effective in preventing additional leaching of radionuclides from the activated soil shielding. At the BLIP facility, all tritium concentrations have been less than the 20,000 pCi/L MCL since early 2006. However, tritium concentrations continue to routinely exceed 20,000 pCi/L in the g-2 source area monitoring wells. Although tritium concentrations downgradient of the g-2 source area are typically

<100,000 pCi/L, since the signing of the ROD in 2007 there have been three short-term spikes in tritium concentrations with a maximum concentration of 186,000 pCi/L during the first quarter of 2008. The periodic, short-term increases in tritium concentrations appear to be related to water-table fluctuations and the flushing of residual tritium from the deep portion of the vadose (unsaturated) zone below the source area. The overall reductions in tritium concentrations observed since 2003 suggest that the amount of residual tritium that is available to be flushed out of the deep vadose zone is decreasing.

The downgradient portion of the tritium plume (as defined by concentrations >20,000 pCi/L) is breaking up into discrete segments. Based upon the most recent sampling of the temporary wells during the first quarter 2010, the downgradient portion of the g-2 plume extends from southwest of the HFBR building to an area near the north side of the National Synchrotron Light Source, a distance of approximately 600 feet. The highest tritium concentration was 92,200 pCi/L in a temporary well installed near Temple Place. The observed tritium concentrations are consistent with model predictions of decay and dispersion effects on the plume segments with distance from the source area.

No groundwater monitoring is required for the former UST areas.

Structures and Soil: BNL has routinely inspected and maintained the caps and other stormwater controls at the g-2 and BLIP source areas. Since the signing of the ROD in 2007, only minor repairs have been required for the BLIP cap, whereas the entire g-2 cap was recoated in 2009. For the former UST areas, no additional remedial actions were required.

6.4.9 HFBR

Groundwater: See OU III Groundwater **Section 6.4.3** for groundwater data review.

Structures and Soil: The report, *BNL High Flux Beam Reactor Characterization Summary Report, Rev 1* (BNL 2007f) summarizes the historical characterizations of the facility, including the reactor itself, systems and components, ancillary support structures, and the surrounding soil. These characterizations have involved direct radiation surveys, samples for radioactivity, and calculations of activated materials over a period of several years. The data summarized in this report have helped provide the basis for many of the actions taken to prepare the HFBR for decommissioning including; dismantling ancillary buildings in the HFBR complex in 2006; the removal and disposal of the HFBR control rod blades and beam plugs in 2008 and 2009; confinement building stabilization; removal of fan house, above and below ground structures, and associated soil removal; and underground utilities, and associated soil removal. Completion and closeout reports document the final status of the various decommissioning activities at the HFBR (including BNL 2009b and 2010h). For a complete list of these reports, see the reference list at the end of this report.

Cleanup of the Waste Loading Area, and removal of Building 801-811 waste transfer lines (A/B waste lines with co-located piping) and associated soil were completed and documented in completion/closeout reports (BNL 2009d). Sampling and analysis were conducted in accordance with the dose-based cleanup goal (15 mRem/year above background with 50 years of institutional control) and methodology specified in the OU I ROD to verify that the remaining soils meet the cleanup goal. The results were presented in the completion/closeout reports. The average and maximum residual Cs-137 concentrations following cleanup were 7.4 pCi/g and 61.3 pCi/g, respectively for the Waste Loading Area. The average and maximum residual Cs-137 concentrations following cleanup for the A/B waste line soils were 0.15 pCi/g and 1.0 pCi/g, respectively.

6.4.10 Other Areas

Soils: See **Section 5.0** for a discussion of the soil characterization data and cleanup performed for the former HWMF Perimeter Areas. The average and maximum residual Cs-137 concentrations following cleanup for the Phase I perimeter soils were 4.4 pCi/g and 15.1 pCi/g, respectively. The Phase II average and maximum residual Cs-137 concentrations were 2.4 pCi/g and 16.7 pCi/g, respectively.

6.4.11 Groundwater Monitoring

The *2009 BNL Groundwater Status Report* (BNL 2010f) identifies changes to the well monitoring network at BNL (see Section 5.0 of http://www.bnl.gov/ltra/files/Annual_Reports/2009pdf/Main_Text.pdf). The changes include the installation of additional temporary and permanent monitoring wells, well abandonments, and modifications to monitoring frequency and analytical parameters.

6.5 Inspections

Representative site inspections took place between June 21 and November 18, 2010 for the landfills, soils, Peconic River, and groundwater. Representatives from BNL and DOE attended. The purpose of the inspections was to assess the protectiveness of the various sites, including operating treatment systems and controls. No significant issues were identified during the site inspections, but some follow-up recommendations were identified. These include recommending to no longer perform inspections of the former Building 208 and Building 464 cleanup areas since they are now covered by the construction site for new buildings. It is also recommended that inspections for Recharge Basins HS and HW are no longer needed since they are already regulated under the New York State SPDES permits and any work in or near these basins are covered under the existing Work Planning and Control process, the digging permit process, and the BNL *Natural Resource Management Plan.* The completed inspection checklists are included in **Attachment 3**. All of the groundwater systems are routinely inspected as part of the ongoing O&M. In addition, Tier 1 assessments that evaluate primarily safety and operational concerns are performed on all of the systems at least annually. The more significant recommendations are included in **Section 9.0, Table 9-1**.

Monthly routine surveillances were performed on the HFBR confinement dome as part of the long-term surveillance and maintenance program for this facility from June through December 2010. Beginning in 2011 these surveillances are performed quarterly. Structural integrity, leak detection and other physical characteristics are also inspected and maintenance activities performed as specified in the surveillance and maintenance manual. No significant issues have resulted to date from these inspections.

The scope of routine surveillance activities at the BGRR includes radiological and environmental monitoring, house and grounds keeping, testing, inspection, and preventive maintenance and repair of required systems and equipment, removal of liquid and solid waste, and verification of conditions throughout the BGRR complex. Surveillance activities within the BGRR are routine in nature and are scheduled at specific frequencies based upon their intended purpose.

The caps and other stormwater controls at the g-2 and BLIP source areas are inspected two times per year, and inspection reports are submitted to the regulatory agencies annually.

6.6 Interviews

Interviews conducted in July and August 2010 consisted of discussions with the EPA, NYSDEC, SCDHS, and DOE representatives. Questions from the list below were asked during the interview; however, each representative was not asked all of the questions on the list. Potential interview questions included:

- What is your overall impression of the cleanup at BNL?
- Are there any specific aspects of the cleanup that you feel should be of particular focus during the review?
- Do you feel well informed about BNL's cleanup activities and progress?
- Do you believe the public is sufficiently informed of the cleanup progress?
- Do you believe the remedies are functioning as expected by the RODs?
- Are you aware of any particular component of the cleanup decisions that pose a higher degree of difficulty in achieving?
- Are you aware of any recent or upcoming changes to federal or New York State laws, regulations, or cleanup standards that may impact protectiveness of human health and the environment at BNL?
- Do you believe there are current opportunities to optimize operations and maintenance, or sampling efforts at BNL that could result in cost savings or improved efficiency?
- What do you think are the biggest risks to achieving the soil and groundwater cleanup objectives at BNL?
- Do you feel that BNL and DOE are actively managing the long-term cleanup operations for the site and are properly maintaining appropriate institutional controls?
- Do you have any comments, suggestions, or recommendations regarding BNL/DOE's management of the cleanup?

The following individuals were specifically contacted for interviews concerning the BNL site:

- Mr. Douglas Pocze - EPA Region 2
- Mr. Chek Ng - NYSDEC
- Mr. David O'Hehir - NYSDEC
- Mr. Andy Rapiejko- SCDHS
- Mr. Martin Trent - SCDHS
- Mr. Bill Faulk - Brookhaven Executive Round Table
- Mr. Steven Feinberg and Ms. Terri Kneitel - DOE
- Mr. Gerald Granzen - DOE
- Mr. Steve Karpinski - NYSDOH
- Mr. Ernie Lewis - BNL Envoy Program

Most people interviewed thought the cleanup has progressed well over the last five years and more recently due to the addition of American Recovery and Reinvestment Act (ARRA) funding for the reactor projects. Communication with the regulators and the community is good. The EPA Project Manager is concerned with the long-term cleanups that go out for 50 years and achieving the cleanup goals if the property is transferred or sold at some point in the future. He said there are problems with this at other federal sites. He also thought that maintaining institutional controls such as deed restrictions in the long-term will be harder if there is a transfer of property. The NYSDEC representative believes one risk in achieving the soil and groundwater cleanup goals is that something will be missed, such as a plume. However, continued monitoring will help alleviate that risk. DOE representatives felt that the cleanup is going well, and some good cost savings have been realized. Addressing all sources is important to help ensure that the ROD cleanup goals are met. NYSDOH feels the remedies are functioning as expected but they must continue to be monitored to ensure the goals will be met. Suffolk County was very positive about the progress of the cleanup. They would like to see clarified when (what years) the 50 years of institutional controls for the different soil and reactor radionuclide cleanup projects starts and ends. The interview summaries are included under **Attachment 4**.

7.0 Technical Assessment

The following subsections assess both the soil and groundwater remedies by Operable Unit and address the three EPA designated questions. Information on the majority of the soil cleanup work was completed prior to the last Five-Year Review and can be found in that document (BNL 2006a). BNL performs a comprehensive assessment of each of the groundwater treatment systems' operation, performance, plume monitoring information and opportunities for optimization as part of the annual Groundwater Status Report. The 2009 Report (*2009 BNL Groundwater Status Report* [BNL 2010f]) and reports from prior years are available for review.

The only significant institutional control issues noted over the previous five years are as follow:

- A key institutional control for the groundwater treatment systems located off of the BNL property is to ensure that the property access agreements are in place and have not been violated. To date, all requirements of the access agreements have been met, including communicating the LUICs and restrictions to the property owners. To date, the use of the properties has conformed to these controls. However, the recording of the deeds for these properties with the Suffolk County Land Registrar Office to reflect the controls and restrictions (i.e., easements) related to operation of the treatment systems is still in progress. Under a New York State provision, property easements must be taxed. The recording of the deeds have been delayed since Brookhaven Science Associates is awaiting receipt of the completed taxpayer form from the property owners.
- In 2009, site preparation work began for the Interdisciplinary Science Building (ISB). The parking lot for this new facility will be located partially on one of the Landscape Soils remediation areas adjacent to Building 355. This Area of Concern (AOC) was remediated in 2000 and a post-remediation radiological dose assessment indicated that residential cleanup levels were met. As a precaution, BNL excavated the surface soils from this previously remediated area and relocated them to the former HWMF/Waste Loading Area (WLA) during the spring of 2010. They were used to fill in low spots that collect precipitation in those areas. The EPA and NYSDEC were notified of these plans via the transmittal of a Fact Sheet and discussion on an IAG weekly conference call in November 2009.
- In 2010, DOE implemented institutional controls on the LI Solar Farm project. The institutional controls include a BNL Radiological Controls Group check on and approval prior to any soils being removed from the area; all disturbed soils remaining within the area from which they were disturbed; and adding the area to the *BNL Land Use Controls Management Plan* and LUIC Website for tracking of administrative controls.

7.1 Operable Unit I

OU I Question A: Is the remedy functioning as intended by the decision documents?

OU I Remedial Action Performance

- Based on a review of the closeout reports completed for the soil/disposal pit cleanups and wetland restoration, site inspections, and regulatory interviews, the remedies were implemented in accordance with the OU I ROD and the soil cleanup levels were met. This achieved the objectives of preventing human exposure including direct external exposure, ingestion, inhalation, and dermal contact, as well as environmental exposure to contaminants. Reconstruction of the Upland Recharge/Meadow Marsh area wetlands was successfully implemented, and has minimized uptake of contaminants in the soil/sediment by ecological receptors, including the eastern tiger salamander. Reconstruction activities included the planting of aquatic vegetation plants within the pond, planting of native grasses adjacent to the pond, and the addition of rip-rap on the pond slopes to prevent erosion. Reconstruction of the former HWMF wetlands was performed in mid 2005. For the soil excavation remedies completed, such as the former HWMF, Building 811, and the former residual surface soils at the Chemical Holes, the work was performed in accordance with the ROD, applicable design documents, and Remedial Action Work Plans. The soil cleanup levels defined in the ROD have been met for these areas. The 2007 ORISE verification survey concluded that the total dose to a future inhabitant from the Cs-137 and Sr-90 contaminants at the former HWMF is acceptable and meets the cleanup criteria.

- The landfill areas were capped in accordance with the ROD and the NYS Part 360 requirements. The buried waste is contained, and groundwater monitoring results indicate that the caps have achieved the objective to minimize the further leaching of contaminants from the soil into the groundwater. Although groundwater monitoring results for the Current Landfill indicate that several VOCs (e.g., chloroethane and benzene) and metals (e.g., iron and sodium) continue to be detected at concentrations above MCLs in several downgradient wells, there has been an overall reduction in VOC concentrations since the landfill was capped in 1995. Furthermore, although low levels of tritium and Sr-90 continue to be detected in the Current Landfill monitoring wells, all concentrations have been below MCLs since 1998. At the Former Landfill, there has been an overall reduction in contaminant concentrations since it was capped in 1996. Currently all VOC and radionuclide (e.g., tritium and Sr-90) concentrations are below MCLs. Iron concentrations continue to exceed MCLs in one downgradient well. The soil cover placed on the ash pit prevents direct contact with the metals in surface soils and prevents the potential migration of the metals by wind.
- The OU I groundwater pump and treat system has been in operation since 1997, and is effectively remediating groundwater contamination originating from the former HWMF and the Current Landfill. The OU I groundwater treatment system was placed in a pulsed operating mode in September 2005 because TVOC concentrations in plume core wells had dropped below 50 µg/L (the capture goal of the system). The system was placed back into full-time operations in July 2007 following the detection of elevated TVOC levels in the deep portion of the Upper Glacial aquifer (well 107-40). The system will remain in full-time operation until the remainder of the high-concentration segment of the plume is captured and treated. Model results indicate that the cleanup goals can be achieved by extending the operation of the treatment system from the planned shutdown in 2011 until 2015. This is due to the slower than anticipated migration of VOC contamination in the deep (Upton Unit) section of the Upper Glacial aquifer near the southern portion of the site.

OU I System Operations/O&M

- BNL performs monthly surveillance of the caps and associated drainage structures at the Current and Former Landfill areas. Although evidence of burrowing by small animals is common at the Current Landfill, the burrows do not penetrate beyond the outer soil layer, and therefore do not affect the protectiveness of the cap. As they are found, the burrows are filled in and repaired. Grass areas are periodically mowed, and small trees are removed before they can damage the caps. Monthly inspections will continue to ensure that the caps are properly maintained and repaired.
- The OU I treatment system operated without any significant down time or maintenance issues over the past 13 years, and the system effluent has consistently met the discharge requirements. The O&M manual identifies required preventative maintenance tasks, and there do not appear to be any issues that would impact continued operations or the effectiveness of the remedy.

OU I Costs of System Operations/O&M

The average annual O&M cost for the OU I treatment system is approximately $100K. This does not include project engineering, project management or groundwater monitoring well sampling and analysis costs.

OU I Implementation of Institutional Controls and Other Measures

The land use and institutional controls that are in place and maintained for OU I include:

- Postings to communicate potential hazards and aid in controlling access at areas such as Building 650 Sump Outfall, Upland Recharge/Meadow Marsh pond, and former HWMF. Following a facility walk-through by BSA and DOE, the prior outdated postings at the former HWMF were removed and replaced with point of contact signage prior to entry. A separate radiological posting was added to the Waste Loading Area portion of the former HWMF. The need for point of contact signs at some of the other post soil cleanup areas is currently being evaluated.
- Prohibitions on excavation activities in designated residual contaminated soil areas, and disturbance and erosion of the landfill and ash pit caps. The cap and the surrounding area were undisturbed.
- Fencing around cleanup areas such as the Current Landfill, former HWMF, and Building 811 WCF to aid in controlling physical access. As noted in the System Operations/O&M section above, even though the gate to one the Landfills was broke, there did not appear to be any disturbance noted during the monthly inspections.
- Maintenance of landfill engineered caps to prevent continued groundwater contamination and covers over residual soil contamination to aid in preventing the direct exposure of such contamination to site workers, visitors, and wildlife.
- Several wetland areas that may contain protected habitats are adjacent to the former HWMF. NYSDEC regulations regulate all work within 100 feet of wetlands with confirmed protected species habitats. Any work activities within 100 feet of a wetland requires DOE and NYSDEC notification and approval.
- BNL limits activities within 850 feet of wetlands with confirmed protected species habitats.
- Restrictions/controls on the pumping and recharge of groundwater on the BNL site until cleanup levels are achieved. This will help maintain consistent groundwater flow directions.
- Groundwater monitoring to track contaminant plumes as well as reporting in the Annual Groundwater Status Report.

No activities were observed at OU I that would have violated these institutional controls.

OU I Monitoring Activities

The monitoring data obtained from the groundwater monitoring wells and the treatment system provides the basis to evaluate system performance and effectiveness. The monitoring wells for the OU I plume and treatment system are categorized as background, core, perimeter, or bypass wells. The landfill areas are monitored by upgradient and downgradient wells. Descriptions of the wells that are sampled and their monitoring frequencies are presented in the annual *BNL Environmental Monitoring Plan* (BNL 2010e). The monitoring data are reported in the annual *BNL Groundwater Status Report* (BNL 2010f) and the *BNL Environmental Monitoring Report – Current and Former Landfill Areas* (BNL 2009h).

OU I Early Indicators of Potential Issues

- The downgradient high-concentration VOC area is migrating slower than anticipated towards the extraction wells. Extending the operational duration of the extraction wells will ensure that this area is captured and treated. An area of Sr-90 concentrations in groundwater was initially observed and characterized in 2001 and has been monitored since that time. Updated characterization of this Sr-90 contamination in 2010 detected the current peak Sr-90 concentration of 29 pCi/L. Based on the updated data, groundwater modeling predicts that the Sr-90 will not migrate off site at concentrations greater than the 8 pCi/L MCL, that the Sr-90 will attenuate to below 8 pCi/L by 2022, and that any Sr-90 migrating beyond the site boundary would be less than the MCL. The model assumes that the OU I extraction wells will remain active until 2015, as discussed above.

- There do not appear to be any problems or issues at this time that could place protectiveness of the remedies at risk.

OU I Opportunities for Optimization

- Pulse pumping was implemented for the OU I treatment system between 2005 and 2007 as VOC concentrations decreased to below the capture goal. The wells were reinstated to full-time operation in 2007 to capture the arrival of the higher VOC concentration slug migrating south. It is recommended that pulse pumping resume in order to induce a water flushing effect in the capture zone and potentially manipulate the adsorption/desorption properties of the aquifer. This may help to increase the capture of residual contaminants from the small remaining area of higher concentrations.
- Install several new monitoring wells as recommended in the *2009 BNL Groundwater Status Report* to track the Sr-90 groundwater contamination. Install one new monitoring well upgradient of the two extraction wells to help track the migration of the higher concentration VOC slug near the extraction wells.

OU I Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

OU I Changes in Standards and items To Be Considered (TBCs)

- The standards or TBCs in the OU I ROD have not changed nor do they call into question the protectiveness of the remedy. Except for arsenic (discussed below), radiological soil cleanup levels and the MCLs for drinking water are unchanged since the signing of the ROD in 1999. **Attachment 5** provides the cleanup levels for the OU I primary contaminants of concern.
- As discussed in the last Five-Year Review, the drinking water standard for arsenic changed in 2001 from 50 µg/L to 10 µg/L. Arsenic was detected above the standard in several of the monitoring wells located downgradient of the Current Landfill. However, the remedy for the Current Landfill is not affected since the arsenic levels are low. Due to the low mobility characteristics of dissolved arsenic in the aquifer, concentrations above standards are not expected to migrate any significant distance from the landfill area. During 2009, the highest arsenic level in these wells was 23.2 µg/L. Monitoring for metals, including arsenic, will continue.

OU I Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within OU I or in the use of the site that would reduce the protectiveness of the remedies or require updates to the risk assessment. The exposure assumptions used in the original risk assessment are consistent with current land use.
- In 2006, a preliminary screening of the OU I groundwater VOC plume was performed to evaluate the potential for soil vapor intrusion. The Current Landfill is the only OU I area of VOC contamination that is close to an inhabited building. Although groundwater contamination immediately beneath the Current Landfill is shallow, and the levels of several VOCs exceed MCLs, the closest office building is approximately 1,000 feet upgradient of the landfill. Therefore, the subsurface vapor to indoor air pathway is incomplete, and no further evaluation is needed. The downgradient portion of the plume is deeper and has a clean layer of groundwater above. Therefore the contaminants are not present in the uppermost portion of the groundwater (i.e., water table) to present a soil-gas concern. The previous Five-Year Review presented the soil vapor intrusion screening for the plume.
- In the event that further construction is planned at BNL within the area of the OU I VOC groundwater plume, landfills, or former HWMF, BSA will re-evaluate any potential issues and, if necessary, undertake appropriate measures to address them. Any construction projects to be undertaken at the Lab are reviewed for environmental, security, safety and health concerns in the

conceptual design or early planning phase. BSA procedure, *EP-ES&H-500, Project Environmental, Security, Safety and Health Review,* includes an *ES&H 500A Evaluation Form* that requires any potential issues, such as potential soil vapor gas intrusion, be identified, documented, and mitigative actions taken, if necessary. In addition, the LUCMP and the groundwater plumes factsheet will be revised to reflect the potential for soil vapor intrusion should new buildings be proposed.

OU I Expected Progress in Meeting Remedial Action Objectives

- Projects completed to date within OU I continue to meet the remedial action objectives identified in the OU I ROD, based on post-excavation confirmatory soil sampling results, continued monitoring of the surface waters and sediment, groundwater monitoring downgradient of potential source areas, and visual inspections of remediated areas. Institutional controls continue to remain effective.
- The OU I groundwater restoration project is on schedule for meeting the ROD cleanup goal of reaching MCLs for VOCs in the Upper Glacial aquifer within 30 years (by 2030). As mentioned previously, the system will continue to be operated for four years beyond its originally planned 2011 shutdown, which will then be followed by a period of monitored natural attenuation.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

There is no additional information that calls into question the protectiveness of the remedies at OU I.

7.2 Operable Unit II

The AOCs in this OU are documented in the OU I and OU III RODs, except for BLIP, which was documented in a separate ROD. The following questions relate to remedial actions taken at the BLIP facility.

OU II Question A: Is the remedy functioning as intended by the decision documents?

- Silica grout was injected into the activated soil at the BLIP facility in 2000. This Removal Action was an additional protective measure to further reduce the permeability of the activated soil. Moreover, it would reduce the potential impact of rainwater leaching radionuclides into the groundwater, should the primary stormwater controls fail. The Removal Action also included stormwater drainage improvements and maintenance, installation and maintenance of the gunite cap, and continued groundwater monitoring.
- As reported in the *BLIP Closeout Report Removal Action AOC 16K* (BNL 2001d), the injection of the silica grout at BLIP can be characterized as successful; however, its deployment was not. The objectives of minimizing threats to human health, migration of contaminants to the groundwater, and migration from operations of the facility in the future appear to have been met. However, the displacement of contaminated soil pore water during the injection caused a short-term impact to the groundwater. As a result, the goal of improving the control of the activation area “without harm to the environment” was not achieved. As discussed in **Section 6.4** above, the concentrations of tritium in the groundwater have remained less than the 20,000 pCi/L MCL since early 2006.
- The stormwater diversions and cap inspection and repair are included under BNL’s Preventative Maintenance Program. The gunite cap, paved areas, and roof drains at BLIP are in good condition and are effectively controlling stormwater infiltration. Although direct inspection or maintenance of the silica grout is not possible, it is expected to be in good condition and would be effective in preventing significant leaching of tritium from the activation zone.

- Quarterly groundwater monitoring in the immediate vicinity of BLIP continues per the *BNL Environmental Monitoring Plan* (BNL 2010e), and the results are reported to the BLIP facility operator on a routine basis and in the annual Groundwater Status Report.

The final remedy for the BLIP facility was documented in the g-2/BLIP/UST ROD which was signed in 2007.

OU II Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

- The Removal Action objective to prevent further migration of radionuclides from the activated soil to the groundwater is still valid. There have been no changes to the exposure assumptions or the MCLs.
- There have been no physical changes to the BLIP area except as an added measure of protection, a new protective concrete cap over the Linac-to-BLIP spur was constructed in late 2004. The spur is where the beam line from Linac is kicked into the Linac-to-BLIP beam line. As part of an effort to investigate potential upgradient sources of tritium, soil samples obtained in 2003 along the BLIP spur identified low levels of sodium-22 activation. In accordance with BNL's Accelerator Safety Subject Area, if potential leachate concentrations can exceed five percent of the MCL, the beam loss area must be capped. As a result, the concrete cap was installed in November 2004.

OU II Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

There is no additional information that calls into question the protectiveness of the remedy at BLIP.

7.3 Operable Unit III

OU III Question A: Is the remedy functioning as intended by the decision documents?

OU III Remedial Action Performance

- The OU III groundwater plumes are tracked and monitored via a comprehensive network of temporary and permanent monitoring wells on and off of the BNL property. Plume and system monitoring data and system performance and recommendations for optimization are described in the annual *BNL Groundwater Status Reports.*
- The groundwater remediation program remains on track to reach the overall groundwater cleanup objectives as defined by the OU III ROD and modified by the OU III ESDs. These objectives are:
    - Meet MCLs for VOCs and tritium in the Upper Glacial aquifer by 2030.
    - Meet MCLs for Sr-90 at the former Chemical Holes plume and the BGRR/WCF plumes by 2040 and 2070, respectively.
    - Meet MCLs for VOCs in the Magothy aquifer by 2065.
- Remediation of the OU III plumes began in 1997. Fourteen of BNL's 16 groundwater treatment systems are included under OU III. Twelve of these systems are currently in active operation. One system met the cleanup goal and was dismantled (Carbon Tetrachloride), one system (Industrial Park East) is in standby mode and will be restarted if needed. The HFBR Pump and Recharge system operated from May 1997 through September 2000, when it was placed in standby mode. As a ROD contingency action, the system was modified with an additional extraction well and placed back into service in November 2007 (for details see BNL 2009f). Although the Building 96 treatment system was placed in standby mode by June 2005, one well (RTW-1) was placed back into full-time service in October 2005 due to a rebound in PCE concentrations in the groundwater. In order to improve the effectiveness of the remediation efforts, BNL injected potassium

permanganate (an oxidizer) for an *in situ* treatment of a low permeability zone with high levels of PCE, modified the operations of one of the treatment wells, and excavated approximately 370 cubic yards of PCE-contaminated soil from a 25' by 25' by 16' deep area.

- A detailed discussion of the progress of the OU III groundwater remediation is available in the *2009 BNL Groundwater Status Report* (BNL 2010f) (see **Attachment 2** for the CD or http://webeims.b459.bnl.gov/gw_home/gw_home.asp).
- DOE continues to offer free annual water testing to the four homeowners known to be using a private well for drinking water purposes in the OU III public water hookup area. The last time the homeowners accepted the annual test was in 2008. The test results indicate that the water quality complies with NYS drinking water standards, except for iron, which can cause taste, stain, and odor problems. Suffolk County recommended connecting to a public water supply whenever possible.
- Excavation and off-site disposal of PCE-contaminated soil at the Building 96 Source Area was completed in 2010. The designated soil cleanup levels were met. This action was taken to optimize the groundwater treatment system effectiveness. Groundwater modeling predicts that the system will have to operate from three to six additional years to achieve the VOC capture goal for the system. Also, as noted in **Section 5.0**, in January 2010 the resin treatment for well RTW-1 was bypassed and placed in standby mode due to reduced hexavalent chromium.
- The BGRR/WCF Sr-90 treatment system was modified in 2010/2011 with the addition of four new extraction wells designed to capture and treat the downgradient high-concentration slug of Sr-90 located in the vicinity of the HFBR.

OU III System Operations/O&M

The operation of each of the treatment systems is evaluated in a number of ways: monthly during preparation of the NYSDEC SPDES discharge monitoring reports, during preparation of the quarterly operation reports, and annually in the Groundwater Status Report. These evaluations include review of the extraction well and system influent data, treatment system midpoint data, if appropriate, and the effluent data. The systems' O&M manuals identify required preventative maintenance tasks (BNL 2002-2009). The systems are routinely inspected and can also be monitored via a remote system which allows for the control panel information to be viewed from the Groundwater Protection Group Office. There do not appear to be any issues that would impact continued operations or the effectiveness of the remedy. The BNL Preventive Maintenance Program helps to eliminate unnecessary system shutdowns due to routine wear and tear on equipment. Maintenance of remediation system recharge basins, such as periodic scraping to remove sediment buildup, is performed in accordance with the *Natural Resource Management Plan for Brookhaven National Laboratory* (BNL 2003b) to ensure protection of potential eastern tiger salamander habitats.

The VOC treatment systems experienced mostly minor downtime or other operational issues over the past eight years, and treatment system discharges have consistently met the NYSDEC SPDES discharge equivalency permit requirements (although there have been a few minor pH excursions due to the natural groundwater conditions, and one instance of exceedance of the PCE discharge limit for the Bldg. 96 RTW-1 extraction well in June 2009, which are documented in the SPDES Discharge Monitoring Reports). A summary of issues, successes and lessons learned from the operation of the various treatment systems follows.

- The Middle Road and South Boundary treated effluent is distributed between the OU III basin and the RA V basin. This is accomplished through the use of a wet well adjacent to the air strippers and allows for the management of the amount of water that is discharged to each basin. This balancing of discharges, in combination with coordinating BNL's management of the BNL water supply well pumpage, has been very successful in maintaining relatively steady groundwater flow directions on the BNL site and minimizing the potential shifting of plumes.
- Resin usage for the Sr-90 treatment systems has been lower than originally estimated resulting in lower operational costs. Several minor modifications to the system designs have increased their

reliability. These include removing the air stripper from the BGRR system and replacing it with carbon for treatment of low-level VOCs and bypassing the three holding tanks in both the BGRR and Chemical Holes treatment systems so that the systems operate solely utilizing the groundwater extraction pumps.

- The recirculation wells with the Industrial Park in-well air stripping system has been the most costly VOC treatment system. The technology has proven successful in removing VOC mass from the aquifer as the project is nearing its cleanup goals. However, the design of the system makes the maintenance very expensive relative to the other VOC pump and treat systems.
- The recirculation wells require more maintenance to keep them operational than conventional extraction wells and injection wells. This is due to the increased amount of equipment associated with them and the difficulties in cleaning the double screen design.
- Problems were experienced in a number of the extraction wells, with the steel drop pipes corroding and creating holes large enough to slow down or stop pumping from the wells. These have been replaced with schedule 120 PVC drop pipe or galvanized drop pipe.
- Lightning strikes in the vicinity of the treatment systems have caused numerous problems with the control systems. Systems are frequently disabled due to this issue. The programs for each system are backed up and spares of parts frequently impacted are stocked in order to mitigate this problem. This is also a sitewide problem for other BNL utilities.
- Flow meter failures have been a common problem. Both mechanical and digital meters have been used and there have been durability issues with each type. Changing some of the meters to a different manufacturer has increased durability.

OU III Costs of System Operations/O&M

- The O&M costs over the past five years for the OU III treatment systems are presented in **Table 4-1** in **Section 4.3**. The annual costs are equivalent to, if not lower than, the original estimates. The largest overall cost drivers for the systems are electricity and disposal or reuse of spent carbon and resins. It should be noted that the O&M costs in this document do not include costs for Field Engineering and Project Management or costs associated with sampling and analysis of the monitoring wells associated with each project.
- BNL has successfully minimized costs for several systems by shutting off extraction wells when influent concentration data and groundwater contamination levels at a given location are very low. The extraction wells remain in standby mode and continue to be monitored. If necessary, the wells can be restarted. A depiction of the current status of the individual extraction wells is provided on **Figure 4-3**.
- Due to the extensive use of activated carbon for the treatment of VOCs, a large-scale carbon services contract was awarded based on competitive bidding. The contractor performing this work contract regenerates the carbon in batches and returns the cleaned carbon back to that specific project the next time a carbon replacement is needed.
- Access agreements were negotiated with private property owners to allow the operation of treatment systems on their property. In consideration for access for the North Street East system, payments of $85K per year will be made to the property owners for as long as the treatment system is on their property. Additional payments are required for the OU VI system access agreement discussed below. Although access agreements are also in place for the other off-site treatment systems (Industrial Park, North Street East, Airport and LIPA), no lease fees are required because they are constructed on publicly owned property or along public right-of-ways.

OU III Implementation of Institutional Controls and Other Measures

Institutional controls are in place at BNL to ensure the effectiveness of all groundwater remedies. The OU III groundwater LUICs continue to be maintained and are effective in protecting human health and the environment. During the past five years, there have been no activities at any of the OU III areas that would have violated these institutional controls.

The land use and institutional controls that are in place and maintained for OU III include:

- Groundwater quality is monitored in the vicinity of each treatment system to evaluate the system's performance and to detect any change in conditions that might result in the system not meeting its stated objective or threatening a water supply source. The details of this monitoring are prescribed in the *BNL Environmental Monitoring Plan*.
- Extensive groundwater monitoring program to track contaminant plumes and reporting of the data.
- Monitoring of BNL potable supply system and SCDHS monitoring of Suffolk County Water Authority (SCWA) well fields closest to BNL.
- Remediation progress is reviewed annually as part of the Groundwater Status Report.
- Five-Year reviews are performed, as required by CERCLA, until cleanup goals are met and to help determine the effectiveness of the groundwater monitoring program.
- Controls are placed on the installation of new supply wells and recharge basins on BNL property.
- Public water service has been offered in plume areas south of BNL.
- Installation of new drinking water wells and other pumping wells where public water service exists is prohibited (Suffolk County Sanitary Code Article 4).
- BNL maintains an internal Water and Sanitary Planning Committee to coordinate operational activities on the BNL site that may impact the flow of contaminated groundwater. The committee also tracks and evaluates changes in groundwater management activities off of the BNL site (i.e. SCWA and drainage changes planned in the vicinity of BNL) to determine if they will affect BNL groundwater remedies.
- Property access agreements for treatment systems off of BNL property are in place, and have not been violated.
- A new property access agreement relating to the North Street treatment system was executed in March 2011 due to a change in property owners.
- The treatment systems installed off of the BNL site are fenced, with locked gates, locked buildings, and video surveillance with direct feedback to BNL police. No security violations have been identified by the police.

OU III Monitoring Activities

- Monitoring data obtained from the treatment systems, as well as the data from groundwater monitoring wells, provide the basis to evaluate the performance and effectiveness of the various systems. The data are reported in the annual *BNL Groundwater Status Report.*
- Changes to the groundwater monitoring program are recommended each year in the annual *BNL Groundwater Status Report* and implemented following regulatory approval. Changes to several of the OU III plume monitoring networks were recommended in the *2009 BNL Groundwater Status Report* (BNL 2010f). These modifications, which include the installation of additional permanent monitoring wells and temporary wells, increase BNL's confidence in tracking the contaminant plumes and assessing remediation progress.

OU III Early Indicators of Potential Issues

- In 2010, approximately 370 cubic yards of PCE-contaminated soil was excavated from the Bldg. 96 area and disposed of at approved off-site facilities. With the removal of the contaminated soil and continued use of the treatment system, PCE concentrations in groundwater are expected to drop below the MCL by the approved 2030 cleanup timeframe. Based on the complete removal of PCE in the source area the groundwater model predicts that the treatment system should achieve the capture goal of 50 μg/L by 2016. There are two potential issues that could lengthen this timeframe. The first is any residual PCE that may be beneath the excavation and continues to be mobilized by the fluctuating water table. The other issue is whether there are any additional sources of PCE that have not been identified. The second issue appears unlikely due to the extensive soil-gas survey that was done in addition to the soil boring characterization of the area. Early indications based on

groundwater monitoring results near the former source area are that PCE concentrations are rapidly and significantly decreasing.
- Persistent high Sr-90 concentrations in the BGRR Building 701 source area monitoring wells and extraction well SR-3 indicate the potential of a continuing source. The persistence of this source may require increased operational time for SR-3 unless the source shows signs of depleting or an engineering solution is identified to inhibit Sr-90 mobilization to groundwater.
- Persistent high concentrations of Sr-90 in the former Chemical Holes source area present a similar issue to that discussed above for the BGRR source area.
- Characterization is currently continuing to determine the extent of higher than expected VOC concentrations (approximately 600 μg/L TVOC) that are too deep to be captured by extraction well EW-4 at the southern site boundary. Characterization is also ongoing to determine the presence of higher concentration VOCs that may be located west of the capture zones of the Middle Road and South Boundary treatment systems.
- Extended operation of Western South Boundary extraction well WSB-1 is required to ensure the complete capture of a slug of TCA identified subsequent to remedy implementation. An area of elevated Freon concentrations was also indentified 4,500 feet north of the southern site boundary. Additional characterization is currently ongoing to determine its extent.
- There do not appear to be any problems or issues at this time that could place protectiveness of the remaining remedies at risk.

OU III Opportunities for Optimization

Optimization of several of the OU III groundwater treatment systems was recommended as part of the *2009 BNL Groundwater Status Report*. Several other optimization recommendations are planned for the 2010 status report. The status of each of the groundwater treatment systems is shown on **Figure 4-2** and the operational status of the extraction wells is provided on **Figure 4-3**. These changes are based on an evaluation of treatment system and monitoring well contaminant concentration trends. A summary of optimization activities and opportunities include:
- In 2010, BNL removed approximately 370 cubic yards of PCE-contaminated vadose zone soils from the former Building 96 area, thereby eliminating a continuing source of groundwater contamination. Extraction well RTW-1 was placed back into service and it is anticipated that active remediation will take another 3 to 6 years (by 2016).
- Because TVOC concentrations at the Industrial Park East system were below the 50 μg/L cleanup goal, the system was placed in standby mode in December 2009. There has been no rebound observed for VOC concentrations in the extraction or monitoring wells during 2010. BNL is working with LIPA to secure access for a sentinel monitoring well (recommended in the *2009 BNL Groundwater Status Report*) on the LIPA right-of-way.
- TVOC concentrations at the Industrial Park system area have been below the 50 μg/L cleanup goal since 2008. Extraction well UVB-2 was placed in standby mode in 2010 and three of the seven wells are now in standby mode. Only one monitoring well is currently showing concentrations above that capture goal. The system is scheduled for shutdown in 2012. In preparation for potential system shutdown, a recommendation was made in the *2009 BNL Groundwater Status Report* to install a temporary well to fill a data gap between UVB-3 and UVB-4.
- North Street East system extraction well NSE-2 was placed in pulse pumping mode in 2009 and then in standby mode in 2010 due to low VOC concentrations in the extraction well and in immediately upgradient monitoring wells. Although TVOC concentrations in NSE-1 ranged between 5 and 15 μg/L during the previous two years, the extraction well remained in operation in 2010 due to an observed VOC concentration increase in an upgradient monitoring well. This system was scheduled for shutdown in 2011; additional groundwater characterization is being performed to determine the extent of the higher VOC concentrations and whether to proceed with the petition for shutdown. A TVOC concentration of 60 μg/L was observed in one of the temporary wells installed in January 2011. Additional characterization is ongoing.

- Three of the six Middle Road treatment system extraction wells are currently in standby mode. Well RW-5 was placed back in operation in July 2009 due to a spike in VOC concentrations. This well was placed back in standby mode in 2010 following several consecutive quarterly sampling rounds showing concentrations having decreased back to levels below the 50 µg/L capture goal. TVOC concentrations have been below 2 µg/L since the third quarter of 2010. Several temporary wells were recommended as per the *2009 BNL Groundwater Status Report* to determine the location of a higher concentration slug of VOCs identified along Weaver Drive several years ago and determine whether it was in the capture zone of RW-1. A permanent well will be installed to fill a data gap adjacent to RW-1 in the deep Upper Glacial aquifer. Another will be installed approximately 500 feet north of RW-1 to provide an early indication of plume concentrations upgradient and assist in assessing when the trailing edge of the plume will be reaching the Middle Road. This work was being implemented in February 2011.
- The westernmost four of the seven South Boundary treatment system extraction wells are in standby mode due to VOC concentrations decreasing to below the 50 µg/L capture goal. A temporary well was recommended in the *2009 BNL Groundwater Status Report* just upgradient of South Boundary system well EW-4 to determine whether there may be deep contamination migrating underneath the capture zone of this well.
- Western South Boundary treatment system extraction well WSB-2 has been in pulse pumping mode since 2005 due to low VOC concentrations. WSB-1 remains in full-time operation due to a slug of high TCA concentrations currently located from the south boundary back to the Middle Road. This system was scheduled for shutdown in 2014; however, the operation of WSB-1 will be extended to 2019 to ensure the capture of the TCA slug. Characterization work is currently underway (as per a *2009 BNL Groundwater Status Report* recommendation) in 2011 to determine the extent of Freon contamination detected in the deep Upper Glacial aquifer at the Middle Road.
- The HFBR Pump and Recharge system was restarted in November 2007 as a contingency action. One additional extraction well (EW-16) was installed to facilitate the capture of the high-concentration slug. Fourth quarter 2010 characterization of the downgradient high-concentration area that triggered the contingency action resulted in all tritium concentrations remaining below the MCL of 20,000 pCi/L. Well EW-16 tritium concentrations have been steadily decreasing and below 2,000 pCi/L since August 2009. Groundwater modeling predicted that tritium concentrations would decrease to below the MCL between 2011 and 2013. It is recommended that the high-concentration area be characterized again during the third quarter of 2011 and, if concentrations in the wells remain below the MCL, place the pump and recharge wells back in standby mode and proceed with a reduced groundwater monitoring program.
- In late 2010/early 2011, BNL installed four additional extraction wells to treat high-concentration segments of the WCF Sr-90 plume located near the HFBR facility. The new wells will help reduce Sr-90 concentrations to a level required to meet the cleanup goals of less than 8 pCi/L by 2070.
- Due to the apparent continuing sources of Sr-90 contamination at both the BGRR Building 701 source and the Chemical Holes Sr-90 plume, BSA will evaluate the possibility of using techniques to stabilize the mobilization of Sr-90 in the aquifer at these locations which would allow for extraction wells at these locations to be shutdown. Pulse pumping BGRR extraction wells SR-4 and SR-5 will begin due to low influent Sr-90 concentrations over the previous two years.

OU III Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

OU III Changes in Standards and TBCs

The standards or TBCs identified in the OU III ROD have not changed nor do they call into question the protectiveness of the remedy. **Attachment 5** provides the cleanup levels for the OU III primary contaminants of concern. The PCB soil cleanup levels and MCLs for groundwater have remained the same since 1999.

OU III Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within OU III or in the use of the site that would reduce the protectiveness of the remedies or render the initial risk analysis invalid. Also, the exposure assumptions have not changed since the ROD was signed in 2000.
- In 2006, two additional homes were identified, which brought the total to eight homes that continue to use their well as their sole source of drinking water. DOE continues to offer free annual water testing to the eight homeowners who continue to use their well as their sole source of drinking water.
- No new sources of contamination have been identified within OU III. However, an unanticipated byproduct of the Building 96 potassium permanganate injections was the localized creation of hexavalent chromium resulting from the interaction of the potassium permanganate and naturally occurring trivalent chromium present in the aquifer materials. It is expected that over time the hexavalent chromium will revert back to trivalent chromium. Furthermore, an ion exchange filter system was added to extraction well RTW-1 to reduce hexavalent chromium concentrations in treated water prior to discharge. Details on the characterization and monitoring of hexavalent chromium in the Building 96 area are provided in the annual *BNL Groundwater Status Reports.*
- A preliminary initial screening of the OU III groundwater VOC plume was performed in 2006 to evaluate the potential for soil vapor intrusion. There are two OU III VOC source areas where soil contamination is present and contaminated groundwater is at or close to the water table. These include the former Building 96 area where the closest occupied building is Building 452, and the former Carbon Tetrachloride UST area where the closest building is the on-site Upton service station. In the Building 96 area, a soil vapor survey was conducted in 2008 prior to the excavation of the contaminated soils, and results confirmed the high PCE concentrations only at the source area. Soil vapor PCE results were observed to drop off to low levels along the perimeters of the study area. The nearest occupied building from the plume is Building 452, Utilities Maintenance. This building is approximately 300 feet northwest of the plume and does not have a basement. The low soil-gas levels from perimeter locations indicated that additional sampling closer to Building 452 was not needed. In addition, the Building 96 source area soils were excavated in 2010. For the former Carbon Tetrachloride UST area, the UST and nearby contaminated soils were removed, and the groundwater has been remediated. Due to the proximity of the nearby carbon tetrachloride groundwater plume to Building 600 and the proposed expansion, three air samples were obtained in the basement and main level to check for this compound. The results showed that carbon tetrachloride is well below the American Conference of Governmental Industrial Hygienists (ACGIH) time-weighted average (TWA) and 8-hour threshold limit value (TLV), therefore no further action is necessary at this time.
- **Attachment 6** presents the soil vapor intrusion screenings performed in 2006 and 2008 for five buildings either under construction or recently constructed. These are the Research Support Building, the New Warehouse, the Center for Functional Nanomaterials, the National Synchrotron Light Source II, and the Interdisciplinary Science Building. A clean layer of groundwater exists above these plumes, therefore the subsurface to indoor air pathway is incomplete and no further evaluation is needed at this time.
- In the event that further construction is planned at BNL within the area of the OU III VOC groundwater plumes, BNL will re-evaluate any potential exposure issues and, if necessary, undertake appropriate measures to address them. Any construction projects to be undertaken at BNL are reviewed for environmental, security, safety and health concerns in the conceptual design or early planning phase. BNL procedure, *EP-ES&H-500, Project Environmental, Security, Safety and Health Review,* includes an *ES&H 500A Evaluation Form* that requires any potential issues, such as potential soil vapor gas intrusion, be identified, documented, and mitigative actions taken, if necessary. In addition, the *BNL Land Use Controls Management Plan* and the LUIC groundwater

plume factsheets will be revised to reflect the potential for soil vapor intrusion should new buildings be proposed.

OU III Expected Progress in Meeting RAOs

- There are currently 12 groundwater remediation systems in operation under OU III. As noted in **Section 7.3**, all the systems are on track for meeting the ROD and ESD cleanup goal of reaching MCLs in the aquifer and preventing or minimizing plume growth. The *2009 BNL Groundwater Status Report* (BNL 2010f) evaluates each system's performance based on decision rules identified from the BNL groundwater Data Quality Objective (DQO) process (see *BNL Environmental Monitoring Plan* [BNL 2010e] for discussions of the DQO process).
- As noted, in the *Early Indicators of Potential Issues* section, there was a concern with whether the Building 96 groundwater treatment system would meet its cleanup objective in light of the continuing sources of PCE in the area. However, with the revised remedial approach of using potassium permanganate injections and the recent excavation of contaminated near surface soils, BNL believes that the objectives of reducing VOC levels in the Upper Glacial aquifer to below the MCLs by 2030 will be met. Furthermore, with the addition of two new extraction wells for the Chemical Holes Sr-90 plume in 2007, and four new extraction wells for the WCF Sr-90 plume in 2010/2011, BNL will be on track to meet the objectives of reducing Sr-90 concentrations to below MCLs by 2040 and 2070, respectively. BNL will also remain alert to any new Sr-90 remediation techniques and technologies, as well as any operational efficiency that might accomplish cleanup sooner with less waste generation.
- The property access agreements for the groundwater treatment systems off of BNL property need to be recorded with the County Clerk.
- There are no known issues with any of the institutional controls, which could jeopardize their future operation.

OU III Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information has come to light that calls into question the protectiveness of the OU III remedies. No new technologies have been identified at this time for the treatment of Sr-90-contaminated groundwater. No newly identified ecological risks have been found within OU III, nor impacts from natural disasters.

7.4 Operable Unit IV

OU IV Question A: Is the remedy functioning as intended by the decision documents?

Although the OU IV ROD states that a Five-Year Review of this remedial action is not necessary, the following items are provided as a summary:

- The OU IV remedial action objectives have been satisfied. The soil/groundwater treatment AS/SVE system met its cleanup objectives and the regulators approved its dismantlement in 2003. A fence was installed around the Building 650 Sump Outfall in 1995. The excavation of the radiologically contaminated soil in the Building 650 Sump, along with the discharge pipe and Sump Outfall, was included under the OU I ROD.
- The remediation has achieved the objectives of preventing or minimizing the leaching of contaminants from the soil into the groundwater, human exposure (including ingestion, inhalation, and dermal contact), and the uptake of contaminants present in the soil and groundwater by plants and animals.
- BNL continues to monitor for VOCs in groundwater at select wells downgradient of the former AS/SVE system, as well as monitoring for Sr-90 at the Building 650 Sump and Sump Outfall per

the *BNL Environmental Monitoring Plan.* The results are reported in the annual *BNL Groundwater Status Report* (BNL 2010f).
- The AS/SVE-remediated area is classified for unrestricted industrial use.

OU IV Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

- The standards or TBCs identified in the OU IV ROD have not changed, nor do they call into question the protectiveness of the remedy. The radiological soil cleanup levels and the MCLs for drinking water have remained the same since 1999. **Attachment 5** provides the cleanup levels for the OU IV primary contaminants of concern.
- The remedial action objectives have been met and have not changed.
- The groundwater within OU IV is not contaminated with VOCs above MCLs, therefore, the subsurface vapor to indoor air pathway is incomplete, and no further evaluation is needed.

OU IV Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information calls into question the protectiveness of the remedy at OU IV.

7.5 Operable Unit V

OU V Question A: Is the remedy functioning as intended by the decision documents?

OU V Remedial Action Performance

- Groundwater contaminated with low levels of VOCs and tritium continues to be monitored on a routine basis. The extent of the VOC plume is well defined and is updated annually. All tritium concentrations remain less than the 20,000 pCi/L MCL, and concentrations of individual VOC compounds have decreased to levels near or below MCLs.
- The Peconic River remedy is functioning as intended:
  - The 2004/2005 Peconic River cleanup of mercury in the sediment has led to substantially reduced mercury concentrations in fish. Reduced mercury concentrations mitigate potential health impacts for human and wildlife consumers of fish.
  - Routine monitoring has functioned as intended by identifying three small areas including the sediment trap with elevated mercury concentrations in the sediment that merited removal. Cleanup of these areas was completed in late 2010/early 2011.
  - In addition to the ROD-related environmental cleanups of the BNL STP soils and the Peconic River on-site and off-site sediment, BSA/DOE have also completed remediation of the STP digester sludge and sand filter beds in 2009. Mercury concentrations in the STP effluent have been substantially lower since completion of the removal and shipment of the waste. The average of the two 2010 STP effluent Peconic River water-column monitoring program samples (72.1 ng/L) was substantially lower than the average mercury concentration for the six 2006 – 2009 samples (105.6 ng/L).
- Planned future action likely to further improve Peconic River water quality:
  - In 2014 DOE plans to start recharging the treated STP effluent directly to groundwater rather than continuing to discharge it to the Peconic River. This activity, together with the completed sludge digester and sand filter bed remediation, and the completed Peconic River sediment removal, are anticipated to even further reduce mercury concentrations in the Peconic River.

- Monitoring of the ecological receptors continues to be performed in accordance with the OU V Peconic River ROD and further detailed in the *Operable Unit I Soils and Operable Unit V Long-Term Monitoring and Maintenance Plan* (BNL 2006b).

OU V System Operations/O&M

As required by the OU V Peconic River ROD, a long-term monitoring program was implemented to ensure protection of human health and the environment. This monitoring includes mercury, PCBs and cesium-137 in sediment; total mercury and methylmercury in the water column; and mercury, PCBs and cesium-137 in fish on and off of BNL property, as appropriate. The sediment, surface water and fish monitoring results for each year since completion of the 2004/2005 cleanup (i.e., 2006-2010) are available in the annual *Peconic River Monitoring Reports* (BNL 2007g, 2008b, 2009g, 2010i, and 2011 [pending]).

OU V Costs of System Operations/O&M (Not applicable for this project.)

OU V Implementation of Institutional Controls and Other Measures

Institutional controls are in place at BNL to ensure the effectiveness of all groundwater remedies. The OU V land use and institutional controls continue to be maintained and effective in protecting human health and the environment. During the past five years, there have been no activities at any of the OU V areas that would have violated these institutional controls.

The land use and institutional controls that are in place and maintained for OU V include:

- The New York State general advisory on the consumption of freshwater fish caught from New York freshwaters applies to the Peconic River. The advisory is to eat no more than one meal (1/2 pound) of fish per week.
- The DOE does not envision any sale or transfer of property in the Peconic River area. If it were to occur, the sale or transfer would meet the requirements of Section 120 (h) of CERCLA to ensure that future users are not exposed to unacceptable levels of contamination.
- Excavation activities in designated residual contaminated soil areas are prohibited.
- Groundwater monitoring to track contaminant plumes as well as reporting in the Annual Groundwater Status Report.
- Five-year reviews will be performed, as required by CERCLA, until cleanup goals are met, to determine the effectiveness of the groundwater monitoring program and sediment remediation.
- Controls have been placed on the installation of new supply wells and recharge basins on BNL property.
- NYSDEC regulations regulate all work within 100 feet of wetlands with confirmed protected species habitats. Any work activities within 100 feet of a wetland requires DOE and NYSDEC notification and approval.
- BNL limits activities within 850 feet of wetlands with confirmed protected species habitats.
- Installation of new drinking water wells and other pumping wells where public water service exists is prohibited (Suffolk County Sanitary Code Article 4).

OU V Monitoring Activities

- Following completion of the Peconic River cleanup in 2005, ROD-required post-cleanup routine sediment, surface water and fish monitoring was initiated in 2006 as indicated in the *Operable Unit I Soils and Operable Unit V Long-Term Monitoring and Maintenance Plan* (BNL 2006b). The sediment, surface water and fish monitoring results for 2006-2010 are available in the annual *Peconic River Monitoring Reports* (BNL 2007g, 2008b, 2009g, 2010i and 2011 [pending]), respectively.
- Water-column samples from monitoring station PR-WC-06 had elevated mercury concentrations in 2006 and 2008. To determine the sources of the elevated mercury concentrations, BNL conducted detailed supplemental sediment sampling in 2008 and 2009 that identified sediment exceeding the

mercury cleanup goal in the PR-WC-06 area. BNL shared the data with the regulators, supplemental sediment samples verified the exceedances, and the area was then remediated in January 2011. All PR-WC-06 area confirmation samples met the ROD cleanup goals.
- In 2006, routine sediment samples from PR-SS-15 detected mercury concentrations greater than the ROD goal of 2.0 mg/kg. BNL shared the data with the regulators, supplemental samples verified the exceedances, and the area was remediated in January 2011. All PR-SS-15 area confirmation samples met the ROD cleanup goals.
- The ROD[5] required that the Sediment Trap be removed to facilitate upstream and downstream fish migration. Sediment characterization beneath and upstream of the former Sediment Trap identified mercury concentrations greater than the ROD cleanup goal. The contaminated sediment was removed and confirmation samples were collected as part of the remediation of the PR-WC-06 and PR-SS-15 areas between December 2010 and January 2011. All Sediment Trap area confirmation samples met the ROD cleanup goals.
- The remediation of both the PR-SS-15 area and the PR-WC-06 area, and removal of the Sediment Trap were completed in December 2010 and January 2011.

OU V Early Indicators of Potential Issues
- The re-growth of invasive species (e.g., *phragmites*) is a significant concern for the long-term success of the Peconic River revegetation. Monitoring, followed by appropriate controls for the invasive species *phragmites*, is needed on a timely basis. BNL met the NYSDEC Permit Equivalency requirements for invasive species control in 2007[6] and met the EPA requirements for invasive species control in 2008.
- As required by the NYSDEC Equivalency Permit, the stone and fabric from the haul access roads have been removed. However, revegetation of the former temporary haul paths will hinder access to the river for future sediment, water and fish sampling tasks. The former temporary haul path that runs along the west bank of the Peconic River between East Boundary Path in an east to southeast direction toward North Street should remain accessible to the BNL monitoring team. This will require periodic trimming of brush (approximately every three to five years) as natural re-vegetation proceeds.

OU V Opportunities for Monitoring Optimization
- The *2009 BNL Groundwater Status Report* recommended that if individual VOC concentrations in groundwater remained below MCLs during 2010, a petition would be prepared and submitted to the regulatory agencies to conclude the monitoring program. Also as per this report, sampling for perchlorate will be discontinued if there are no detections above the action level in 2011 (detections have been less than the action level since 2008).
- One year prior to this 2010 Five-Year Review, DOE recognized an opportunity to optimize the Peconic River remedy and proposed a supplemental sediment removal in two small areas: PR-WC-06 (0.217 acres) and PR-SS-15 (0.121 acres). In addition, the Sediment Trap and adjacent contaminated sediment were also removed. The supplemental sediment removal began in November 2010 and was completed in January 2011. Wetland re-planting will be completed in the summer of 2011, or as soon as river water levels allow.
- The Peconic River ROD states that after the first five years of monitoring are completed (2006 - 2010) and the data reviewed with EPA, NYSDEC and SCDHS, appropriate modifications will be made as necessary for subsequent sampling.[7] These modifications discussed below are based on the approximately 2,380 confirmation samples collected during the 2004 to 2005 20-acre cleanup,

---

[5] Page iii, last paragraph of Final Operable Unit V Record of Decision for Area of Concern 30 (Peconic River), November 3, 2004.
[6] 2007 Peconic River Monitoring Report, Attachment B.
[7] Final Operable Unit V Record of Decision for Area of Concern 30 (Peconic River), page 38, paragraph 2.

approximately 1,700 sediment, surface water and fish post-cleanup monitoring samples collected between 2006 and 2010, and the 37 sediment confirmation samples collected in December 2010 and January 2011 at the PR-WC-06, Sediment Trap, and PR-SS-15 areas. The recommendations are summarized in **Table 7-1**.

- All monitoring data has been documented in the 2006 through 2010 *Peconic River Monitoring Reports*. These data have been reviewed by and with the DOE, EPA, NYSDEC, NYSDOH, and the SCDHS. DOE recognizes that modifications to the monitoring represent additional opportunities to optimize the post-cleanup monitoring aspect of the remedy. Modifications to sediment, water column and fish monitoring are discussed below.

Table 7-1. Recommendations for Peconic River Optimization

	2011 Requirements	2012-2014	Comments
Surface Water	22 samples 2x/yr - Hg, MeHg, TSS	15 samples 2x/yr	Sample WCS-06 under S&M Program starting in 2012
	8 samples 4x/yr - water quality	Discontinue	Chlorophyll-a, N, P, TOC, TKN, TSS. Data historically provided in Appendix to Annual Peconic Report.
	4 samples 4x/yr - PR-SS-10	Discontinue	
Sediment	30 samples annually	3 samples annually	3 samples include WC-06, SS-15 and former sediment trap cleanup areas.
Fish	6 locations annually	4 locations every other year, 2013	Discontinue Manor Road and Area C in 2012
	Age determination on all fish	Age determination on all fish	
Vegetation	NYSDEC - Monitor for 2 full growing seasons for plant survival and invasive species control (4/2011 - 9/2012) EPA - 3 to 5 years for invasive species control	No change	

Sediment Monitoring Modifications

- The 2006 through 2010 sediment summary data (**Table 6-3**) indicate that 24 of the 30 routine sediment monitoring stations never exceeded the ROD cleanup goal that all mercury samples in the remediated areas would be less than 2.0 mg/kg[8]. **BSA/DOE recommend that sediment monitoring at these 24 stations is no longer necessary and can be discontinued in 2012 without jeopardizing the Peconic River risk assessment objectives** (See **Table 7-2** for those 24 stations recommended for discontinued sampling).
- **Table 7-3** summarizes the remaining six routine monitoring stations that have had at least one sediment sample exceed the 2.0 mg/kg mercury goal, and the post-cleanup data for the three areas (PR-WC-06, Sediment Trap, PR-SS-15) for which sediment was removed in 2010 and 2011. Whenever a routine sediment monitoring result equals or exceeds 2.0 mg/kg, BNL/DOE follows the data quality objectives detailed in the *Environmental Monitoring Plan*[9]. All data have been reported in the respective annual reports and reviewed with the regulators.
    - Sediment monitoring stations PR-SS-33 and PR-SS-18 each had one out of ten total samples contain greater than 2.0 mg/kg mercury. PR-SS-38 had three of nine samples

[8] Final Operable Unit V Record of Decision for Area of Concern 30 (Peconic River), page 28, paragraph 4.
[9] Brookhaven National Laboratory, Environmental Monitoring Plan, 2010 Update, January 1, 2010, BNL 52676-2010, page 8.2-4, third paragraph from bottom.

equal to or greater than 2.0 mg/kg., but all were less than or equal to 3.1 mg/kg. PR-SS-19 had a similar range of concentrations greater than or equal to 2.0 mg/kg and a similar mean and individual concentrations to PR-SS-18, PR-SS-33 and PR-SS-38. The average mercury concentration for each of these stations is between 0.90 and 1.49 mg/kg.

  - Review of these data with DOE, EPA, NYSDEC, NYSDOH, and the SCDHS led to agreement that no additional action would be required for PR-SS-18, PR-SS-19, PR-SS-33 and PR-SS-38 because of their low frequencies of exceeding the ROD goal and their low individual and mean mercury concentrations. **BSA/DOE recommend that future sediment monitoring at these four stations can be discontinued without jeopardizing the Peconic River risk assessment objectives** (**Table 7-3**).

- Of the remaining two routine monitoring locations (PR-SS-10 and PR-SS-15), PR-SS-10 (relative to PR-SS-18, PR-SS-19, PR-SS-33 and PR-SS-38) has one markedly elevated mercury concentration (7.1 mg/kg), the first sample collected at PR-SS-10 in 2006. Otherwise the mercury concentrations are similar to PR-SS-18, PR-SS-19, PR-SS-33, and PR-SS-38 (**Table 7-3**).
- Eleven of the 12 highest mercury concentrations in the PR-SS-10 area are less than or close to the maximum mercury concentrations at PR-SS-18, PR-SS-19, PR-SS-33, and PR-SS-38 (**Table 7-3**).
- The mean mercury concentration for all PR-SS-10 area samples was 1.49 mg/kg, which equals the mean mercury concentration for PR-SS-38.
- None of the nine additional samples collected within five feet of the original 7.1 mg/kg mercury detection at PR-SS-10 had a mercury concentration approaching the concentration of the original sample. **Figure 7-1** shows the mercury concentrations of all sediment samples collected within five feet of PR-SS-10 between 2006 and 2010. **BSA/DOE recommend that PR-SS-10 sediment monitoring be discontinued and replaced by quarterly water-column sampling for total mercury, methylmercury and total suspended solids (TSS) in 2011 to evaluate potential downstream transport of mercury and methylmercury from PR-SS-10.** These data will be shared with and reviewed with and by the regulators.
- The remaining routine sediment monitoring location at PR-SS-15, as well as supplemental sampling locations at PR-WC-06 and the Sediment Trap areas, were each remediated between December 2010 and January 2011. Post-cleanup monitoring at these three sites will consist of collecting annual sediment mercury samples at the locations of the 2006-2010 samples. For each of these three areas the respective sample locations and former maximum mercury concentrations are:
  - PR-WC-06 area (PR-WC-06-D1-L50, 22.3 mg/kg);
  - PR-SS-15 area (PR-SS-15-U1-L65-O, 36.8 mg/kg);
  - Sediment Trap area (ST1-80-U20, 11.1 mg/kg).

Table 7-2. Areas Recommended for Discontinued Mercury Sediment Sampling (Stations <2.0 mg/kg)

Site ID	Number of Samples	Mean Mercury (mg/kg)	Minimum Mercury (mg/kg)	Maximum Mercury (mg/kg)	Standard Deviation
PR-SS-37	5	0.536	0.092	1	0.361
PR-SS-35	5	0.260	0.12	0.5	0.156
PR-SS-31	5	0.094	0.038	0.16	0.053
PR-SS-30	5	0.152	0.063	0.3	0.091
PR-SS-29	5	0.288	0.13	0.55	0.166
PR-SS-26	5	0.342	0.13	0.87	0.301
PR-SS-24	5	0.170	0.11	0.31	0.080
PR-SS-23	5	0.204	0.043	0.46	0.167
PR-SS-21	5	0.318	0.051	0.78	0.285
PR-SS-17	5	0.537	0.027	1.2	0.501
PR-SS-16	5	1.130	0.45	1.8	0.559
PR-SS-14	5	0.270	0.16	0.41	0.090
PR-SS-12	5	0.051	0.034	0.069	0.014
PR-SS-09	5	0.347	0.094	0.69	0.229
PR-SS-07	5	0.058	0.016	0.091	0.030
PR-SS-06	5	0.105	0.032	0.27	0.095
PR-SS-05	5	0.300	0.059	0.85	0.327
PR-SS-04	5	0.035	0.0066	0.062	0.024
PR-SS-03	5	0.292	0.072	0.81	0.309
PR-SS-02	5	0.145	0.057	0.3	0.092
PR-SS-01	5	0.082	0.023	0.18	0.064
PR-MR-01	5	0.176	0.038	0.47	0.172
PR-MR-02	5	0.065	0.055	0.073	0.009
PR-DP-01	5	0.103	0.005	0.239	0.101

Table 7-3. Recommendations for Sediment Monitoring Stations With Mercury Concentrations > 2.0 mg/kg

Site ID	No. of Samples	No. > 2.0 mg/kg	Values > 2.0 mg/kg	Mean Mercury (mg/kg)	Minimum Mercury (mg/kg)	Maximum Mercury (mg/kg)	Standard Deviation (mg/kg)	Recommendation
PR-SS-18	10	1	4.1	0.90	0.089	4.1	1.192	Discontinue PR-SS-18 sediment sampling
PR-SS-33	10	1	4.7	0.91	0.05	4.7	1.394	Discontinue PR-SS-33 sampling
PR-SS-38	9	3	2, 2.1, 3.1	1.49	0.35	3.1	0.812	Discontinue SS-38 sampling
PR-SS-19	41	6	2, 2, 2.1 3.2, 3.4, 4.4	1.12	0.13	4.4	0.958	Discontinue PR-SS-19 sediment sampling
PR-SS-10	37	12	2, 2.1, 2.2, 2.4, 2.6, 2.7, 2.8, 3.2, 3.5, 4.3, 4.6, 7.1	1.49	0.052	7.1	1.568	Discontinue PR-SS-10 sediment sampling. Continue supplemental water column sampling in 2011 for mercury, methylmercury, TSS (four times annually).
PR-WC-06	84	21	21 samples 2.7 to 22.3	2.48	0.029	22.3	4.243	Sediment removed in 2010. Discontinue supplemental water column sampling. Collect future annual sediment samples in the PR-WC-06 area as described below.
Post-remedy Excavation PR-WC-06	19	0	Not Applicable	0.34	0.044	1.2	0.324	Initiate annual sediment mercury sampling at pre-remedy sediment removal location with previous maximum pre-cleanup sediment mercury concentration in the PR-WC-06 area (PR-WC-06-D1-L50, 22.3 mg/kg).
Sediment Trap Area	25	5	2, 2.2, 2.2, 5, 11.1	1.14	0.057	11.1	2.366	Trap and sediment removed in 2011. Collect future annual sediment samples in the PR-WC-06 area as described below.
Post-remedy Excavation Sediment Trap Area	5	0	Not Applicable	0.17	0.11	0.26	0.055	Initiate annual sediment mercury sampling at pre-remedy sediment removal station with maximum pre-cleanup mercury concentration in the sediment trap area (ST1-80-U20., 11.1 mg/kg).
PR-SS-15	58	17	17 samples 2.1 to 36.8	4.02	0.043	36.8	8.091	Sediment removed in 2011. Discontinue supplemental water column sampling. Collect future annual sediment samples as described below.
Post-remedy Excavation PR-SS-15	11	0	Not Applicable	0.13	0.029	0.67	0.191	Replace annual sediment mercury sampling at station PR-SS-15 with the sediment sampling station with the maximum mercury concentration in the PR-SS-15 area (PR-SS-15-U1-L65-O, 36.8 mg/kg).

These data will be reported in the annual *BNL Site Environmental Report* and will be evaluated with and by DOE, EPA, NYSDEC, NYSDOH, and the SCDHS. The need to continue to collect and/or to modify annual sediment samples at PR-WC-06, Sediment Trap, and PR-SS-15 will be evaluated annually with the regulators and as part of the 2015 Five-Year Review.

Surface Water Monitoring Optimization

- As shown on **Figure 6-13**, the 2006-2010 Peconic River water column total mercury concentrations are substantially higher between station STP-EFF-UVG and PR-WC-02 than at the stations located upstream and downstream of this section of the river. Future decreases in Peconic River total mercury concentrations are expected as a result of the recent remediation of the sludge digester, sand filter beds, and the PR-WC-06, Sediment Trap and PR-SS-15 areas.
- Between PR-WC-01 and PR-WCS-04 (between three to five miles downstream from the STP) the concentrations range between approximately 5 and 24 ng/L. Total mercury concentrations in the downstream section of the river between PR-WCS-04 and PR-WCS-07 are generally in the range of approximately 1 to 10 ng/L.
- **BNL recommends that routine water-column monitoring for total mercury, methylmercury and TSS continue two times per year at the 15 stations between PR-WC-15 (upstream of STP-EFF-UVG) and PR-WC-02.** This will include the anticipated reductions in surface water total mercury concentrations associated with the sediment removal and the scheduled and NYSDEC-approved initiation of discharge of the STP effluent directly to ground outside the area of recharge to the Peconic River.
- **BNL recommends that routine water-column monitoring at stations between and including PR-WC-02 and PR-WCS-07 be discontinued in 2012, with the exception of PR-WCS-06 (Donahue's Pond). PR-WCS-06 will continue to be sampled as part of the routine environmental surveillance program. BNL also recommends that analysis for water quality parameters be discontinued in 2012.** Sufficient water quality data has been collected over the previous five years to assist in the analysis of methylmercury data. These results will be published each year in the annual *Site Environmental Report.*

Fish Monitoring Optimization

Figure 6-14 shows a substantial reduction in post-cleanup (2006-2010) fish tissue mercury concentrations relative to pre-cleanup (1997 and 2001) concentrations. The figure also shows that the average mercury concentration for all fish caught between 2006 and 2010 (0.28 mg/kg) is lower than the EPA mercury criterion (0.3 mg/kg). **BNL recommends that fish monitoring be modified in the following ways:**

- Frequency will be modified from one round annually to one round every other spring. Thus, between 2011 and 2016 fish will be collected in the spring of 2011, 2013 and 2015. Harvesting fish biennially will allow the fish population to grow in both number and individual size.
- Monitoring of fish from the Manor Road area should be discontinued after the 2011 collection, due to the typically low fish catch in that area. Every two years fish monitoring would occur in Area A[10] (downstream of the STP), Area D, Schultz Road, and Donahue's Pond, when water depths are favorable. Supplemental sampling in Area C would be discontinued unless the yield was low in the two adjacent collection areas (Area A and Area D).
- Continuing fish age determination via scale and otolith interpretation through 2015.

---

[10] Note that BSA/DOE expect to initiate discharge of treated STP effluent to the water table rather than to the Peconic River, in 2014. This may cause water levels in Area A (and possibly also Area D) to be too low for fish migration except during the spring. Fish collection locations may require revision following groundwater discharge of the STP effluent.

OU V Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

OU V Changes in Standards and TBCs

The standards or TBCs identified in the OU V ROD have not changed nor do they call into question the protectiveness of the remedy. The mercury sediment cleanup level and the MCLs for drinking water have remained the same since 1999. **Attachment 5** provides the cleanup levels for the OU V primary contaminants of concern.

OU V Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within OU V or in the use of the STP, the Peconic River, or the groundwater that would reduce the protectiveness of the remedies or render the initial risk analysis invalid. The exposure assumptions used in the original risk assessment are consistent with current land use.
- The plan to divert STP effluent from the Peconic River to a nearby groundwater recharge basin in 2014 will eliminate continued discharges of low levels of metals (such as mercury) to the river. The elimination of discharges to the Peconic River will cause the river bed to be completely dry from the STP outfall to the eastern firebreak road. This change in river flow may require revision of the some of the established surface water and/or fish sampling stations on the BNL site.
- DOE continues to offer free annual water testing to the one homeowner known to be using a private well for drinking water purposes in the OU V public water hookup area. The last time the homeowner accepted the annual test was in January 2009. To date, all test results indicate that the water quality complies with NYS drinking water standards.
- No new contaminants or sources of contamination have been identified within OU V, and no unanticipated toxic byproducts have been detected.
- A preliminary initial screening of the OU V groundwater VOC plume was performed to evaluate the potential for soil vapor intrusion. The plume is deeper and has a clean layer of groundwater above. Therefore the contaminants are not present in the uppermost portion of the groundwater (i.e., water table) to present a soil-gas concern.

OU V Expected Progress in Meeting RAOs

- Excavation of the radiologically and metal-contaminated sediments at the STP and in the Peconic River on and off of BNL property met the appropriate cleanup levels and remedial action objectives in the OU V STP and OU V Peconic River RODs. A monitoring program is being implemented to demonstrate the effectiveness of the Peconic River cleanup to mitigate potential ecological effects.
- As mentioned above, BNL implemented actions since completing the Peconic River cleanup that have supplemented the progress achieved as a direct result of the ROD-required Peconic River cleanup:
  - The removal of historical sludge from the sludge digester, mixing it with sand from the four active sand filter beds, and disposing the sand/sludge mixture at permitted off-site disposal facilities.
  - Current plans are to discontinue discharging the treated effluent into the river. BSA anticipates completing this project in 2014. This will discontinue the historical source of the majority of Peconic River contaminants and is expected to further support the protection of ROD cleanup goals and risk assessment objectives.
- Supplemental sediment removal of locations in the Peconic River was completed in January 2011 for the two small areas identified above and the sediment trap. Post-cleanup sediment monitoring is expected to demonstrate compliance with the Peconic River cleanup goals and risk assessment objectives identified in the Peconic River ROD.
- Groundwater monitoring results continue to indicate that MCLs will be met within 30 years.

OU V Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No newly identified ecological risks have been found within OU V nor impacts from natural disasters. No additional information has come to light that calls into question the protectiveness of the OU V remedies.

7.6 Operable Unit VI

OU VI Question A: Is the remedy functioning as intended by the decision documents?

OU VI Remedial Action Performance

- The OU VI EDB groundwater plume has been defined and continues to be monitored via a network of monitoring wells on and off of BNL property. The plume is currently positioned entirely south of the BNL site.
- The EDB groundwater treatment system was installed in accordance with the OU VI ROD, and began operating in August 2004. EDB is being captured by the extraction wells and the hydraulic capture performance of the system is being met as described in the Startup Report. The detection of EDB in the influent samples from the groundwater extraction wells for the past several years indicates that the plume is being captured by the extraction wells. An additional well is being added to increase monitoring of the eastern perimeter of the plume just north of the extraction wells as per the recommendation in the *2009 Groundwater Status Report*. The system is currently on schedule to meet the cleanup goal of reaching the MCL by 2030.
- DOE continues to offer free annual water testing to the three remaining known homeowners still using private wells for drinking water purposes in the OU VI public water hookup area. Two of the homeowners had their wells last sampled in 2009 and 2010. The results for all samples have showed compliance with the NYS drinking water standards. The remaining home is currently vacant.

OU VI System Operations/O&M

- The system O&M manual identifies required preventative maintenance tasks. There do not appear to be any issues that would impact continued operations or the effectiveness of the remedy. The BNL Preventive Maintenance Program helps to eliminate unnecessary system shutdowns due to routine wear and tear on equipment.
- An evaluation of the operation of the treatment system is performed monthly during preparation of the discharge monitoring reports, during preparation of the quarterly operation reports, and annually in the *BNL Groundwater Status Report*. These evaluations include review of the extraction well and system influent data, treatment system midpoint data, and the effluent data.

OU VI Costs of System Operations/O&M

- The system has been operational for five years and the average annual O&M cost is approximately $190K. The largest overall cost drivers for the system are annual property access payments and electricity.
- Since the OU VI ROD was signed in 2001, two access agreements were negotiated with private property owners to allow for treatment system operations on their property. In consideration for the agreements, total payments of $85K per year are made to the property owners as long as the treatment system is on their property. These costs are in addition to the payments required for the OU III systems discussed above.

OU VI Implementation of Institutional Controls and Other Measures

The OU VI groundwater land uses and institutional controls continue to be maintained and effective in protecting human health and the environment. Based on inspections, no activities were observed at OU VI that would have violated these institutional controls.

OU VI Monitoring Activities

- The monitoring data obtained from the EDB treatment system, as well as the data from the plume monitoring wells, provide the basis to evaluate the performance and effectiveness of the remediation system. The data is reported in the annual *BNL Groundwater Status Report*.
- Changes to the OU VI plume monitoring network are recommended in the annual *BNL Groundwater Status Report*. These modifications, such as additional monitoring wells and temporary wells, would increase BNL's confidence in the plume's distribution and remediation progress.

OU VI Opportunities for Optimization

An additional groundwater monitoring well is planned to enhance monitoring of the eastern edge of the plume to the north of the extraction wells. There are no other opportunities identified at this time.

OU VI Early Indicators of Potential Issues

There do not appear to be any problems or issues at this time that could place protectiveness of the remedy at risk.

OU VI Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

OU VI Changes in Standards and TBCs

- The regulatory standards or TBCs identified in the OU VI ROD have not changed nor do they call into question the protectiveness of the remedy. The EDB standard and the MCLs for drinking water have remained the same since 1999. **Attachment 5** provides the cleanup levels for the OU VI primary contaminants of concern. In December 2009, the SPDES equivalency permit level for EDB was changed by the NYSDEC from 5.0 µg/L to 0.03 µg/L to reflect an updated practical quantification limit based on EPA Method 504.1. The MCL for EDB is 0.05 µg/L. There have been no detections of EDB in the system effluent above SPDES Equivalency permit levels since the system began operations in 2004.

OU VI Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within OU VI or in the use of the site that would reduce the protectiveness of the remedies or render the initial risk analysis invalid. Also, the exposure assumptions have not changed since the ROD was signed in 2001.
- DOE continues to offer free annual water testing to the two homeowners in the OU VI plume area who are still using their private wells for drinking purposes. These homeowners had their wells last sampled in 2009 and 2010. The results for all samples were below the NYS drinking water standards.
- A preliminary initial screening of the OU VI groundwater VOC plume was performed to evaluate the potential for soil vapor intrusion. The portion of the plume that exceeds the MCL is located off of the BNL property, is deeper, and has a clean layer of groundwater above. Therefore the contaminants are not present in the uppermost portion of the groundwater to present a soil-gas concern.

OU VI Expected Progress in Meeting RAOs

- The annual *BNL Groundwater Status Report* evaluates the system's performance based on five major decisions identified from the BNL groundwater DQO process (see *BNL Environmental Monitoring Plan Triennial Update* [BNL 2003c] for the DQO process). As described in the *2004 BNL Groundwater Status Report* (BNL 2005h), EDB concentrations are expected to be lowered to below the 0.05 µg/L MCL by 2030, as required by the OU VI ROD.
- The two property access agreements for the groundwater treatment system need to be recorded with the County Clerk.

OU VI Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No newly identified ecological risks have been found within OU VI nor impacts from natural disasters. No additional information has come to light that calls into question the protectiveness of the OU VI remedy.

7.7 BGRR

BGRR Question A: Is the remedy functioning as intended by the decision documents?

BGRR Remedial Action Performance

- As described in the completion and closeout reports completed to date, site inspections, and regulatory interviews, the interim cleanup measures were implemented in accordance with the Action Memoranda and NEPA categorical exclusions and are consistent with the BGRR ROD. This has achieved the remedial action objectives of: protecting human health from the hazards posed by the radiological inventory at the BGRR, using the ALARA principle (i.e., limiting worker exposure), and implementing monitoring, maintenance, and institutional controls to manage potential hazards. Specific activities completed to help reduce the radiological inventory, to reduce the potential for exposure, and to prevent the future migration of radiological contamination into surrounding soil and groundwater include:
    - Removal of primary air cooling fans – Removed and properly disposed of contaminated equipment in the fan rooms and decontaminated or fixed surface contamination.
    - Removal of the Pile Fan Sump, pipes, and contaminated soil
    - Removal of above-ground ducts, pipes, and contaminated soil – Prevented low-level radioisotopes from being released to soil and potential migration into groundwater.
    - Removal of canal and water treatment house, piping, and accessible contaminated soils – Reduced the amount of contamination in the concrete structures of the canal and removed contaminated surface soil.
    - Removal of the exhaust cooling coils and filters
    - Removal of BGD primary liner
    - Sealing of the BGDs
- The April 2005 completion of the removal of the canal structure and subsurface contaminated soil located outside the footprint of the reactor building was performed in accordance with the Action Memorandum (BNL 2005i) and is consistent with the selected remedy in the BGRR ROD. A completion report was prepared and issued to the regulators in 2005.
- A temporary asphalt cap was installed over the soil areas in 2005 to minimize water infiltration prior to the final cap installation.
- Removal of the graphite pile in accordance with the ROD was completed in May 2010. A final closeout report was issued to the regulators in October 2010.

- The remaining work to be performed, including removal of the biological shield and installation of the final engineered cap for water infiltration management, is currently being implemented in accordance with the ROD Remedial Design/RA Work Plan.

BGRR System Operations/O&M

As required by the BGRR ROD, long-term S&M activities are conducted to ensure effectiveness of the remedy. Specific measures are being implemented for the BGRR project. They include the following:

- Routine environmental health and safety monitoring.
- Radiation detection monitoring.
- Secure access via locked doors.
- Periodic structural inspections of Building 701.
- Water intrusion monitoring.
- Preventive maintenance of Building 701 and the infiltration management system.
- Groundwater monitoring required as part of the OU III ROD and the ESD.

BGRR Costs of System Operations/O&M

The estimated cost of long-term S&M activities is approximately $450K annually (in FY10 dollars) for routine surveillance and groundwater monitoring. Additionally requirements include $12K every 10 years for infiltration barrier upkeep and $760K every 20 years to refurbish the Building 701 exterior facade and roof system. The S&M activities include radiation and environmental monitoring, the testing, inspection, and maintenance/repair of essential equipment, and verification of conditions throughout the facilities. Activities also include preventative and corrective maintenance on the temporary asphalt cap to ensure its integrity.

BGRR Implementation of Land Use and Institutional Controls and Other Measures

In addition to the administrative controls placed on the future land use at BNL, the following specific institutional controls are being implemented:

- Control measures for future excavation of residual subsurface contamination – No digging, drilling, ground-disturbing activities, or groundwater shall be extracted within the area designated on Figure 10-1 of the BGRR ROD unless the activity has undergone a BNL review process, which includes but is not limited to the restrictions in BNL's LUCMP. Any activity that occurs deeper than 15 feet will require EPA concurrence. Upon implementation of the BGRR remedy, a reassessment will be made to determine the area in which the digging, drilling, ground-disturbing and groundwater extraction restrictions will be applied during the post-remedy phase.
- Specific land use restrictions are established within the BNL LUCMP limiting future use and development of the BGRR complex to commercial or industrial uses only. Additionally, any future plans for excavation of the inaccessible contaminated soils will include the assessment of risk to human health and the environment based on the actual distribution, depth, and concentrations of the residual radioactive material encountered.
- Annual certification will be provided to NYSDEC verifying that the institutional controls and engineering controls put in place are unchanged from the previous certification, and that nothing has occurred that would impair the ability of the control to protect public health or the environment. The annual certification will be prepared and submitted by a professional engineer or environmental professional accepted by NYSDEC.
- Land use restrictions and reporting requirements will be passed on to any/all future landowners through an environmental easement on the deed to the property. In light of the fact that a deed does not exist for property owned by a federal entity, DOE will be responsible for implementing, enforcing, maintaining, and reporting on these controls. Although DOE may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the DOE or its successor agency shall retain ultimate responsibility for remedy

integrity. Upon transfer of the property to a nonfederal entity by the U.S. government, a deed will be established and an environmental easement will be added to the deed at that time.

BGRR Monitoring Activities

- Monitoring environmental health and safety, such as radiological dose monitoring, is a significant component of the remediation completed to date as well as for the remaining work. Work is planned to limit worker exposure throughout all phases of the remediation effort.
- Groundwater monitoring in the vicinity of the BGRR complex will continue throughout the institutional control period. Results of the OU III BGRR/WCF monitoring program will be used to help verify the effectiveness of the BGRR remedy.
- Water intrusion monitoring is routinely performed in accordance with a surveillance and maintenance procedure to ensure that water does not infiltrate into contaminated areas of the BGRR complex, which could potentially cause the migration of radiological contamination into surrounding soils and groundwater.

BGRR Opportunities for Optimization

- Robotic tools and remote handling technologies have been employed to implement the remedy while minimizing radiation exposure to the workers.
- For the graphite pile removal, a remote manipulator fitted with special tools was installed on top of the biological shield. It was used to remove the graphite blocks from the pile and load them into soft-sided containers called "supersacks." They were then placed inside metal containers for shipment to DOE's Nevada Test Site for disposal. All graphite handling took place inside a contamination control enclosure that was maintained at a slight negative pressure (with respect to the atmosphere) in order to eliminate the release of radioactive material to the environment.
- For biological shield removal that is currently in progress, remote-operated tools operating inside a contamination control enclosure are being used.

BGRR Early Indicators of Potential Issues

- A potential continuing source of Sr-90 contamination beneath the BGRR below ground ducts is a concern for the groundwater remediation system. See **Section 7.3** for additional discussion.
- Continued protection of workers during the remaining bioshield removal is an important consideration.

BGRR Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

BGRR Changes in Standards and TBCs

The standards or TBCs, including DOE Orders, identified in the BGRR ROD have not changed nor do they call into question the protectiveness of the remedy.

BGRR Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within the BGRR complex or in the use of the site that would reduce the protectiveness of the remedies nor render the initial risk analysis invalid. Also, the exposure assumptions have not changed since the ROD was signed in 2005.
- No new contaminants or sources of contamination have been identified within the BGRR, and no unanticipated toxic byproducts have been detected.

BGRR Expected Progress in Meeting RAOs

- A significant effort has already been completed with the removal and disposal of contaminated components, structures, water, and soil at the BGRR complex. Based on sampling results, continued monitoring and surveillance of the facility, groundwater monitoring downgradient of potential source areas, and visual inspections of remediated areas, those projects completed to date continue to meet the remedial action objectives identified in the ROD.

  - A portion of the radiological inventory at the BGRR has been either removed or stabilized as a result of the cleanup actions.
  - The ALARA principle was extensively used to help protect workers while implementing the removal actions.
  - The implementation of long-term monitoring, maintenance, and institutional controls has been initiated for the BGRR.

- The remaining remedial activities to be implemented for the bioshield removal, as well as installation of the temporary and final engineered caps, are also expected to meet the overall ROD remedial action objectives.
  - Once completed, the overall remedy will remove over 99 percent of the radioactive material inventory at the BGRR complex.
  - The Building 701 structure and the soon-to-be-installed engineered cap will protect the contaminated soil and components that will remain under the building footprint. It will form a significant barrier to future excavation and direct exposure, and serve as an effective barrier to prevent the migration of the remaining contaminants to groundwater.
  - Water infiltration management and institutional controls will be effective in protecting human health and the environment.
- As noted in **Section 7.3** above, BNL will carefully evaluate the performance and efficiency of the Sr-90 ion exchange treatment system implemented for remediation of the BGRR/WCF plumes to ensure that they are on track to meet their objectives as stated in the OU III ROD and ESD of meeting MCLs in the aquifer within 70 years. BNL will also remain alert to any new Sr-90 remediation techniques and technologies as well as any operational efficiencies that might accomplish cleanup sooner with less remediation waste. Continued evaluation of the potential continuing source of Sr-90 contamination from the BGRR below ground ducts will be performed.

BGRR Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No newly identified risks have been found within the BGRR complex, nor impacts from natural disasters or land use changes. No additional information has come to light that calls into question the protectiveness of the BGRR remedy.

7.8 g-2/BLIP/USTs

g-2/BLIP/USTs Question A: Is the remedy functioning as intended by the decision documents?

g-2/BLIP/USTs Remedial Action Performance

- Groundwater monitoring at the g-2 and BLIP source areas has shown that the stormwater controls have been effective in preventing additional leaching of radionuclides from the activated soil shielding. At the BLIP facility, all tritium concentrations have been less than the 20,000 pCi/L MCL since early 2006. However, tritium concentrations continue to routinely exceed 20,000 pCi/L in the g-2 source area monitoring wells. During 2009, a maximum concentration of 138,000 pCi/L was detected during the fourth quarter sampling round. As in past years, periodic, short-term increases in tritium concentrations appear to be related to water-table fluctuations and the flushing of residual tritium from the deep portion of the vadose (unsaturated) zone below the source area. The overall reductions in tritium concentrations observed since 2003 suggest that the amount of residual tritium that is available to be flushed out of the deep vadose zone is decreasing.

- The downgradient portion of the tritium plume (as defined by concentrations >20,000 pCi/L) is breaking up into discrete segments. Based upon the most recent sampling of the aquifer using temporary wells, the downgradient portion of the g-2 plume extends from southwest of the HFBR building to an area near the north side of the National Synchrotron Light Source, a distance of approximately 600 feet. The highest tritium concentration was 92,200 pCi/L in a temporary well installed near Temple Place road. The observed tritium concentrations are consistent with model predictions of decay and dispersion effects on the plume segments with distance from the source area.
- No groundwater monitoring is required for the former UST areas.

g-2/BLIP/USTs System Operations/O&M

As required by the 2007 ROD, long-term cap maintenance activities are conducted to ensure effectiveness of the remedy. The BNL LUCMP contains sitewide control measures and land-use restrictions to prevent exposure to environmental contamination and to protect the integrity of remedies specified within the g-2/BLIP/USTs ROD and other approved RODs. To accomplish this objective, specific measures are being implemented for the g-2/BLIP project. They include the following:

- Routine inspections and maintenance of the caps and other stormwater controls at the g-2 source area and BLIP facility.
- Groundwater monitoring required to verify that the source controls are in effect and to monitor the attenuation of the g-2 tritium plume.
- There are no actions associated with the former UST areas.

g-2/BLIP/USTs Costs of System Operations/O&M

The estimated annual costs for routine surveillance and groundwater monitoring are:

- Approximately $5,000 for routine inspections and maintenance of the caps and other stormwater controls at the g-2 source area and BLIP facility. However, in 2009 the g-2 cap was entirely resurfaced at a cost of approximately $50,000.
- Approximately $30,000 for monitoring the g-2 source area; approximately $20,000-$30,000 for the installation and sampling of temporary wells used to monitor the downgradient portion of the g-2 tritium plume; and approximately $5,000 for monitoring groundwater at the BLIP facility.
- There are no costs associated with the former UST areas.

g-2/BLIP/USTs Implementation of Land Use and Institutional Controls and Other Measures

- The *BNL Land Use Controls Management Plan* (LUCMP, BNL 2005d) provides an overview of land use and other controls that are deployed at BNL to prevent exposure to residual environmental contamination. The web-based *Land Use and Institutional Controls Mapping* tool contains map locations and fact sheets for the g-2 and BLIP facilities. The LUCMP is a living document and is periodically updated to stay current with evolving management techniques.
- There are no LUCMP issues associated with the former USTs.

g-2/BLIP/USTs Monitoring Activities

- Groundwater monitoring at the g-2 and BLIP source areas will continue throughout the institutional control period. Results of the g-2 and BLIP monitoring programs will be used to help verify the effectiveness of the remedy.
- Groundwater monitoring of the downgradient portion of the tritium plume will continue until the tritium concentrations decrease to below the 20,000 pCi/L MCL.
- No groundwater monitoring is required for the former UST areas.

g-2/BLIP/USTs Opportunities for Optimization

There are no opportunities for optimization identified at this time. Monitoring data indicate that the source area controls are effective and the g-2 tritium plume is attenuating in the aquifer as anticipated.

g-2/BLIP/USTs Early Indicators of Potential Issues

- There have been no changes in the physical conditions at the g-2 or BLIP facilities or in the use of the site that would reduce the protectiveness of the remedies nor render the initial risk analysis invalid. Also, the exposure assumptions have not changed since the ROD was signed in 2007.
- Contamination levels in the soil shielding at the g-2 and BLIP source areas should be consistent with those evaluated at the time of the 2007 ROD, and monitoring data suggest that the caps and other stormwater controls are effective. Because the g-2 facility has not operated since the completion of the project in April 2001, no additional buildup of radioactivity has occurred. Although the BLIP is an active facility, additional buildup of radioactivity is occurring in a zone of soil shielding that was injected with colloidal silica grout in 2002, which, in addition to the cap, offers additional protection from potential stormwater infiltration into the activated shielding.

g-2/BLIP/USTs Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

g-2/BLIP/USTs Changes in Standards and TBCs

The standards or TBCs identified in the ROD have not changed nor do they call into question the protectiveness of the remedy.

g-2/BLIP/USTs Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

There have been no changes in the physical conditions within the g-2 or BLIP facilities or use of the site that would reduce the protectiveness of the remedies nor render the initial risk analysis invalid. Also, the exposure assumptions have not changed since the ROD was signed in 2007. There are no risks associated with the former UST areas.

g-2/BLIP/USTs Expected Progress in Meeting RAOs

- Groundwater monitoring at the g-2 and BLIP source areas has shown that the stormwater controls have been effective in preventing additional leaching of radionuclides from the activated soil shielding. At the BLIP facility, all tritium concentrations in groundwater have been less than the 20,000 pCi/L MCL since early 2006. However, tritium concentrations continue to routinely exceed 20,000 pCi/L in the g-2 source area groundwater monitoring wells. The continued detection of tritium appears to be related to water-table fluctuations and the flushing of residual tritium from the deep portion of the vadose (unsaturated) zone below the source area. The overall reductions in tritium concentrations observed in the g-2 source area wells since 2003 suggest that the amount of residual tritium that is available to be flushed out of the deep vadose zone is decreasing by means of this flushing mechanism and natural radioactive decay.
- The downgradient portion of the tritium plume (as defined by concentrations >20,000 pCi/L) is breaking up into discrete segments. The currently observed tritium concentrations are consistent with model predictions of decay and dispersion effects on the plume segments with distance from the source area.
- There are no continued environmental concerns associated with the former UST areas.

g-2/BLIP/USTs Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No newly identified risks have been found at the g-2 or BLIP facilities, nor have there been any changes in land use. There are no continued environmental concerns associated with the former UST areas. No additional information has come to light that calls into question the protectiveness of the remedy defined in the ROD.

7.9 HFBR

HFBR Question A: Is the remedy functioning as intended by the decision documents?

HFBR Remedial Action Performance

As described in the completion and closeout reports completed to date, site inspections, and regulatory interviews, the interim cleanup measures were implemented in accordance with the Action Memoranda (BNL 2007d and 2008c) and *National Environmental Policy Act* (NEPA) categorical exclusions, and are consistent with the HFBR ROD. This has achieved the remedial action objectives of: protecting human health from the hazards posed by the radiological inventory at the HFBR, using the ALARA principle, and implementing monitoring, maintenance, and institutional controls to manage potential hazards.

HFBR System Operations/O&M

Long-term S&M activities are being conducted in accordance with the *Long-Term Surveillance and Maintenance Plan for the HFBR (BNL 2011*) to ensure effectiveness of the remedy. The BNL LUCMP contains sitewide control measures and land-use restrictions to prevent exposure to environmental contamination and to protect the integrity of remedies specified within the HFBR ROD and other approved RODs. To accomplish this objective, specific measures are being implemented for the HFBR project. They include the following:

- Routine environmental health and safety monitoring.
- Secure access via locked doors.
- Periodic structural inspections of Building 750.
- Water intrusion monitoring.
- Preventive maintenance of Building 750 and the infiltration management system.
- Groundwater monitoring required as part of the OU III ROD.

HFBR Costs of System Operations/O&M

The estimated cost of S&M activities required to ensure that Building 750 (HFBR) remains in a safe and stable condition during the safe storage phase is approximately $200K annually (in FY10 dollars). The S&M activities include radiation and environmental monitoring, the testing, inspection, and maintenance/repair of essential equipment, and verification of conditions throughout the facilities.

HFBR Implementation of Land Use and Institutional Controls and Other Measures

The HFBR remedy includes the continued implementation of LUICs in accordance with the LUCMP. These include:

- Measures for controlling future excavation and other actions that could otherwise disturb residual subsurface contamination.
- Land use restrictions and an acceptable method for evaluating potential impact that the remaining contaminants have on future development.
- Periodic certification to EPA and NYSDEC stating that the institutional and engineering controls put in place are unchanged from the previous certification, and that nothing has occurred that would impair the ability of the control to protect public health or the environment or constitute a violation or failure to comply with the site management plan. This annual certification will be prepared and submitted by a professional engineer or environmental professional acceptable to NYSDEC.

DOE is currently responsible for implementing the land use controls with regard to the property that is the subject of the HFBR ROD. If the property is transferred out of federal ownership, it is DOE's intention that all continuing land use restrictions, reporting requirements, and any other obligations relating to the property of DOE (or any other successor federal entity on behalf of the United States) will be satisfied through the United States' conveyance of a deed restriction/ environmental easement prior to any such transfer of any deed(s) to the property.

While it is DOE's intention that any such deed restriction/environmental easement would require that the transferee (and subsequent transferees) would be required to satisfy all of DOE's obligations relating to the property, DOE acknowledges that, notwithstanding this intention, it (or any other successor federal entity on behalf of the United States) remains ultimately responsible for satisfying DOE's remedial obligations set forth in this ROD relating to the property if any subsequent transferee fails to satisfy the remedial obligations in this regard.

Any activity that is inconsistent with the land use restrictions or actions that may interfere with the effectiveness of the institutional controls established for the HFBR complex will be addressed by DOE with EPA and NYSDEC, as outlined in the BNL LUCMP. LUICs will be maintained until the hazardous substances reach levels that allow unlimited use and unrestricted exposure.

HFBR Monitoring Activities

The *Long-Term Surveillance and Maintenance (S&M) Plan for the HFBR* was developed to manage the inventory of radioisotopes that will remain in the HFBR Confinement Building during the safe storage (decay) period and subsequent decontamination and dismantlement. The details of the S&M processes are contained in a supporting document – the *Long-Term S&M Manual*. The S&M Plan and Manual will be implemented to ensure that the inventory of stored radioisotopes and all residual contamination is maintained in a safe condition, and to preclude future human exposure pathways or migration from their locations within the HFBR.

HFBR Opportunities for Optimization

There are no apparent opportunities for optimization at this time

HFBR Early Indicators of Potential Issues

Continued protection of workers during the remaining activities (demolition of Building 802 and stack) is an important consideration. Controls developed and implemented for the completed remedial actions (demolition of Building 704 and removal of underground utilities) will be used to help mitigate potential risk.

HFBR Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

HFBR Changes in Standards and TBCs

The standards or TBCs, including DOE Orders, identified in the HFBR ROD have not changed nor do they call into question the protectiveness of the remedy.

HFBR Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within the HFBR complex or in the use of the site that would reduce the protectiveness of the remedies nor render the initial risk analysis invalid. Also, the exposure assumptions have not changed since the ROD was finalized in 2009.
- No new contaminants or sources of contamination have been identified within the HFBR, and no unanticipated toxic byproducts have been detected.
- In accordance with the HFBR ROD, DOE will determine the feasibility of reducing the 65-year safe storage (decay) period and completing the removal of large activated components earlier taking into consideration the following factors:
    - Advancements in cleanup technologies and transportation methods.

  - Availability of waste disposal facilities.
  - Changes in standards and regulations for worker, public, and environmental protection.
  - Worker safety impacts.
  - Environmental impacts.
  - Public health impacts.
  - Economic impacts.
  - Land use.
  - Existing stabilization and safety of the facility and hazardous materials.
  - Projected future stability and safety of the facility and hazardous materials.
- No advances in new technologies or other factors have been identified since the ROD was finalized in 2009 that would warrant a reduction in the 65-year safe storage (decay) period.
- Recognizing that there are uncertainties inherent in activation analyses, per the ROD, DOE conducted an additional investigation involving the following steps:
  - Performed radiation surveys (measurements of radiation levels) after the removal of the control rod blades from the reactor vessel. (Surveys before the removal of control rod blades with high dose rates would not yield reliable results).
  - Reevaluated the dose rate at 1 foot from the large activated components (reactor vessel, thermal shield, and biological shield) based on the radiation surveys.
  - Using the reevaluated dose rates, determined the decay period necessary for the dose rate at 1 foot to fall below 100 mRem/hour for the large activated components, including the limiting component.
  - Used the results of the additional investigation in this Five-Year Review in assessing the feasibility of shortening the decay period.
- The following conclusions from this evaluation were reached:
  - The predicted time for when the large limiting activated component (i.e., thermal shield) will decay to 100 mRem/hour is in 65 years from 2007 (the safe storage decay period was determined based on the radiological inventory and radiation levels in 2007), or in the year 2072.
  - This predicted time was calculated based on activation analysis, and the calculations were supported by measurements of actual dose rates.
  - Radiation levels from the small highly activated components (transition plate and anti-critical grid) were within the bounds of expected levels when measured in a reactor vessel internal survey in 2009.
  - When the control rod blades were removed from the reactor, radiation levels and curie contents were in close agreement with the predicted levels.
  - Based on this close agreement between actual and predicted radiation levels, the calculated dose rates for the large activated components are also expected to be reasonably accurate. Therefore, there is no justification to change the safe storage (decay) period of 65 years.

HFBR Expected Progress in Meeting RAOs

- A significant effort has already been completed with the removal and disposal of contaminated components, structures, water, and soil at the HFBR complex. Based on sampling results, continued monitoring and surveillance of the facility, groundwater monitoring downgradient of potential source areas, and visual inspections of remediated areas, those projects completed to date continue to meet the remedial action objectives identified in the ROD.
  - A portion of the radiological inventory at the HFBR complex has been either removed or stabilized as a result of the cleanup actions.
  - The ALARA principle was extensively used to help protect workers while implementing the removal actions.
  - The implementation of long-term monitoring, maintenance, and institutional controls has been initiated for the HFBR.

- The remaining remedial actions to be implemented for Building 802 (Fan House) removal and stack demolition are also expected to meet the overall ROD remedial action objectives.

HFBR Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No newly identified risks have been found within the HFBR complex, nor impacts from natural disasters or land use changes. No additional information has come to light that calls into question the protectiveness of the HFBR remedy.

7.10 Other Areas

In 2005, additional radiological contamination was identified in surface soil in a number of discrete locations within wooded areas adjacent to the northeastern, northwestern, and southeastern corners of the former HWMF. The contamination is believed to be a result of historical operations associated with the transfer and management of wastes to and within the former HWMF and historical stormwater runoff from contaminated soils within the facility.

The cleanup of the former HWMF Perimeter Area has occurred in various stages and was performed as a non-time-critical removal action authorized by the Final Action Memorandum, *Removal Action for Contaminated Soil from the Former Hazardous Waste Management Facility Perimeter Area* (BNL 2009c) using the same cleanup goals and methodology required for radiologically contaminated soils in the OU I ROD. In late 2009, an extensive cleanup was completed through an ARRA-funded Environmental Management project, considered as Phase I of the cleanup, and was documented in the April 2010 *Final Completion Report for the Former Hazardous Waste Management Facility Perimeter Area Soil Remediation* (BNL 2010a). In 2010, cleanup of an 11-acre section of the Long Island Solar Farm (LISF) Project area, located to the southeast of the former HWMF and adjacent to the previously remediated former HWMF Perimeter Area was completed. This area is designated as Phase II and documented in the December 2010 *Addendum to the Former Hazardous Waste Management Facility Perimeter Area Completion Report* (BNL 2010b).

Institutional controls for the Phase 1 and Phase II areas are being implemented. For the Phase II area that was granted to the LISF in December 2010 via an easement from DOE, institutional controls include that no soil be removed from that area. The cleanup of Phase II allowed for industrial reuse as the solar farm.

Additional discrete areas of soil contamination within the former HWMF Perimeter Area that were not addressed in the Phase I and II investigations will be investigated and remediated, as necessary, in future remedial efforts, referred to as Phase III.

7.11 Technical Assessment Summary

Currently, nine RODs have been signed at BNL. The first was signed in 1996 and the last was signed in 2009. With the exception of the BGRR engineered cap and bioshield removal, and the HFBR stack and Building 802 demolition, all selected remedies for the nine RODs have been implemented. This includes the excavation and off-site disposal of contaminated soil, sediment, tanks, and the installation and operation of all planned groundwater treatment systems. All closeout reports were prepared and submitted to the regulators.

Remedies have been implemented in accordance with the RODs and the ESDs, according to the data presented in the closeout reports and the annual *BNL Groundwater Status Reports*, site inspections, and regulatory interviews. Soil cleanup levels were met and groundwater pump and treat systems have been functioning as intended by the RODs. The cleanup performed continues to meet the remedial action objectives identified in each ROD.

For soil excavation/disposal remedies, work was performed in accordance with the ROD, applicable design documents, and Remedial Action Work Plans. Soil cleanup levels were met for these areas. The remaining work at the BGRR and HFBR will be implemented in accordance with the RODs.

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedies. Soil and groundwater applicable or relevant and appropriate requirements in the RODs and ESDs have either been met or are expected to be met. There is no other information that calls into question the protectiveness of the remedies.

8.0 Issues

Issues are identified in **Section 9**, **Table 9-1**.

9.0 Recommendations and Follow-up Actions

The following table summarizes key recommendations developed in the Technical Assessment section of this document. These recommendations are subject to regulatory review and implementation will be based on the availability of funding.

Table 9-1: Recommendations and Follow-up Actions

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Capture of remaining VOCs in OU I Plume	Implement pulse pumping of extraction wells. Continue pumping until 2015 to meet VOC capture goal.	BNL	DOE, EPA, NYSDEC, SCDHS	July 2011	N	N
Sr-90 in OU I Groundwater	Enhance monitoring well network to track Sr-90.	BNL	DOE, EPA, NYSDEC, SCDHS	June 2011	N	N
OU III Building 96 Source Removal Effectiveness	Continue treatment system operations. Monitor plume and determine if continuing source remains.	BNL	DOE, EPA, NYSDEC, SCDHS	September 2012	N	N
Monitoring of downgradient OU III Industrial Park East Plume	Install additional downgradient monitoring well.	BNL	DOE, EPA, NYSDEC, SCDHS	August 2011	N	N
OU III Industrial Park Treatment System Shutdown	Install additional temporary well between UVB-3 and UVB-4 in support of anticipated system shutdown.	BNL	DOE, EPA, NYSDEC, SCDHS	August 2011	N	N
OU III North Street Treatment System Shutdown	Increase system operation through 2013 due to continued high VOCs	BNL	DOE, EPA, NYSDEC, SCDHS	October 2012	N	N
OU III North Street East Treatment System Shutdown	Characterize contamination upgradient of NSE-1 and monitor for achievement of capture goal. Extend system operation through 2013 to achieve system capture goal.	BNL	DOE, EPA, NYSDEC, SCDHS	September 2011	N	N
OU III Middle Road Treatment System	Assess contamination to west of RW-1 and need for additional extraction well.	BNL	DOE, EPA, NYSDEC, SCDHS	September 2012	N	N
OU III South Boundary deep VOC contamination	Install additional extraction well(s) to capture and treat deeper contamination. Extend system operation until 2017.	BNL	DOE, EPA, NYSDEC, SCDHS	September 2012	N	N
OU III Western South Boundary TCA/Freon contamination	Extend operation of extraction well WSB-1 to 2019 to capture high TCA concentrations. Characterize extent of Freon contamination and develop path forward.	BNL	DOE, EPA, NYSDEC, SCDHS	November 2012	N	N

Continued...

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
OU III HFBR contingency pumping termination	Determine shutdown of pump and recharge system based on characterization of high-concentration slug.	BNL	DOE, EPA, NYSDEC, SCDHS	March 2012	N	N
OU IV Sump Outfall Sr-90	Install additional monitoring wells as per *2009 Groundwater Status Report* Recommendations.	BNL	DOE, EPA, NYSDEC, SCDHS	October 2011	N	N
OU V Groundwater	Petition regulatory agencies to conclude groundwater monitoring program pending 2011 perchlorate results.	BNL	DOE, EPA, NYSDEC, SCDHS	December 2011	N	N
Potential continuing Sr-90 source at BGRR	Monitor to determine existence and assess feasibility of in-situ source stabilization. Monitor the effectiveness of new extraction wells.	BNL	DOE, EPA, NYSDEC, SCDHS	July 2012	N	N
Potential continuing Sr-90 source at Chemical Holes	Monitor to determine existence and assess feasibility of in-situ source stabilization and/or removal.	BNL	DOE, EPA, NYSDEC, SCDHS	July 2012	N	N
Peconic River Monitoring Program	Modify monitoring program following remedy optimization.	BNL	DOE, EPA, NYSDEC, SCDHS	September 2011	N	N
OU VI EDB	Add new monitoring well to bound the east side of the plume	BNL	DOE, EPA, NYSDEC, SCDHS	September 2011	N	N
BGRR Decommissioning	Complete remaining remedial actions and submit closeout report(s) to the regulators	BNL	DOE, EPA, NYSDEC, SCDHS	October 2012	N	N
HFBR	Complete remaining remedial actions and submit closeout report(s) to the regulators	BNL	DOE, EPA, NYSDEC, SCDHS	October 2011	N	N
HFBR	Explore the feasibility of reducing the 65-year safe storage (decay) period and completing the removal of large activated components earlier.	BNL	DOE, EPA, NYSDEC, SCDHS	Recurring	N	N
OUs III & VI - Deeds not reflecting operating treatment systems	Complete survey/mapping of treatment systems off of BNL property and record updated deeds with County	BNL	DOE, EPA, NYSDEC, SCDHS	June 2005 (survey/mapping completed 6/30/05)	N	Y
Former HWMF Perimeter Soils	Phase III Assess soil contamination Additional cleanup if necessary	BNL	DOE, EPA, NYSDEC, SCDHS	September 2012 September 2014	N	N

Notes
Recommendations are subject to regulatory review, and implementation will be based on the availability of funding
BGRR = Brookhaven Graphite Research Reactor
DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
HFBR = High Flux Beam Reactor
NYSDEC = New York State Department of Environmental Conservation
SCDHS = Suffolk County Department of Health Services
VOCs = volatile organic compounds

10.0 Protectiveness Statements

Individual Protectiveness Statements

Protectiveness statement for the individual OUs, the BGRR, HFBR, and g-2/BLIP/USTs are presented below.

Operable Unit I: The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

- All soil cleanup actions are complete and the groundwater treatment system is operational. The attainment of groundwater cleanup goals is expected to require 30 years or less to achieve (by 2030). In the interim, exposure pathways that could result in unacceptable risks are being controlled. Institutional controls are preventing exposure to, or the ingestion of, contaminated groundwater and soil.
- Long-term protectiveness of the remedy will be verified by monitoring the movement and remediation of the plume. Current monitoring data indicate that the remedies are effective and they are functioning as required to achieve the groundwater cleanup goals.

Operable Unit II: Remedial actions for the AOCs in this OU are documented in the OU I and OU III RODs, except for BLIP and the g-2 tritium plume, which is documented in another ROD. Since there is no ROD or remedial action for this OU, a protectiveness statement cannot be prepared. A protectiveness statement for the g-2/BLIP/UST AOCs is identified below.

Operable Unit III: The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- All soil cleanup actions are complete and all groundwater treatment systems are operational or in standby mode. The attainment of groundwater cleanup goals is expected to require:
  - 30 years or less to achieve MCLs for VOCs and tritium in the Upper Glacial aquifer (by 2030).
  - 40 years and 70 years or less to achieve MCLs for Sr-90 at the former Chemical Holes plume and the BGRR/WCF plumes, respectively (by 2040 and 2070, respectively).
  - 65 years or less to achieve MCLs for VOCs in the Magothy aquifer (by 2065).
- Exposure pathways that could result in unacceptable risks are being controlled. Site-specific institutional controls are preventing exposure to contaminated groundwater and soil.

Long-term protectiveness of the remedies will be verified by continuing to monitor the movement and remediation of the plumes. Current monitoring data indicate that the remedies are functioning as required to achieve the groundwater cleanup goals.

Operable Unit IV: The remedy is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled.

- The groundwater cleanup goals have been met for the VOCs/SVOCs present at the 1977 oil/solvent spill site, and the treatment system has been dismantled. Institutional controls are preventing exposure to contaminated soil and groundwater. All threats at the site have been addressed through the installation of fencing and warning signs, and the implementation of institutional controls.
- Additional groundwater characterization performed in 2010 (and updated groundwater modeling) verified that the remaining Sr-90 contamination in groundwater will remain in the central portion of the site and attenuate to below MCLs by 2034.

Operable Unit V: The remedy currently protects human health and the environment because the contaminated soil at the STP filter beds and contaminated sediment in the Peconic River has been excavated to meet the appropriate cleanup levels. Revegetation of remediated areas has been completed. The monitoring program has demonstrated the effectiveness of the Peconic River cleanup to mitigate potential ecological effects.

- The soil cleanup goals for the STP filter beds/berms have been met.
- All potential threats have been addressed through excavation of contaminated sediment, and the implementation of specific institutional controls for fish, soil/sediment, and groundwater.

Long-term protectiveness of the remedy has been achieved following five years of sediment, surface water, fish, and revegetation monitoring and supplemental removal of sediment in several targeted areas of the river. A long-term monitoring plan is in place. In addition to periodic reporting of the analytical results, the monitoring data is evaluated and summarized in the annual *Site Environmental Report* that is submitted to and reviewed with and by the DOE, EPA, NYSDEC, and SCDHS.

Operable Unit VI: The remedy is expected to be protective of human health and the environment upon attainment of the groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- The EDB groundwater treatment system is operational. The attainment of groundwater cleanup goals is expected to require 30 years or less to achieve MCLs for EDB in the Upper Glacial aquifer (by 2030).
- Exposure pathways that could result in unacceptable risks (e.g., off-site potable water supply) are being controlled and site-specific institutional controls are preventing exposure to, or the ingestion of, contaminated groundwater.

BGRR: The completed remedy is expected to be protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

- The remedy is expected to be protective upon completion of the bioshield removal and installation of the final engineered cap. In the interim, exposure pathways that could result in unacceptable risks are being controlled. Institutional controls are preventing exposure to contaminated structures, soil, and groundwater.
- All threats at the site are being addressed through removal or stabilization of the radiological inventory, excavation of contaminated soil, infiltration management, installation of signs, building access controls, and the implementation of specific institutional controls for the structures, soil and groundwater.
- Long-term protectiveness of the remedy will be verified by continuing to perform health and safety monitoring, periodic structural inspections of Building 701, water intrusion monitoring, preventive maintenance of the infiltration management system, and groundwater monitoring required as part of the OU III ROD and the ESD.

g-2/BLIP/USTs: The remedy defined in the ROD is expected to be protective of human health and the environment, and institutional controls are in place that are designed to prevent exposure to contaminated structures, soil, and groundwater. Long-term protectiveness of the remedy will be verified by continuing inspections and maintenance of the g-2 and BLIP facility stormwater controls, and groundwater monitoring required by the ROD.

HFBR: The completed remedy is expected to be protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

- The remedy is expected to be protective upon completion of the near-term actions (demolition of the fan house and stack, and remediation of associated soils), and the segmentation, removal, and disposal of the remaining HFBR structures, systems, and components (including the reactor vessel, internals, thermal shield and biological shield) following a safe storage decay period (not to exceed 65 years). In the interim, exposure pathways that could result in unacceptable risks are being controlled. Institutional controls are preventing exposure to contaminated structures, soil, and groundwater.

- All threats at the site are being addressed through removal or stabilization of the radiological inventory, excavation of contaminated soil, infiltration management, installation of signs, building access controls, and the implementation of specific institutional controls for the structures, soil and groundwater.
- Long-term protectiveness of the remedy will be verified by continuing to perform health and safety monitoring, periodic structural inspections of the reactor confinement building, water intrusion monitoring, preventive maintenance of the infiltration management system, and groundwater monitoring required as part of the OU III ROD.

Other Area: The remedy is expected to be protective upon attainment of soil cleanup goals once the assessment and potential remediation of the former HWMF perimeter soils Phase III is complete. In the interim, exposure pathways that could result in unacceptable risks are being controlled. Institutional controls are preventing exposure to, or the ingestion of, contaminated soil.

Comprehensive Protectiveness Statement

A comprehensive sitewide protectiveness determination covering all the OUs and BGRR must be reserved at this time because:

- BGRR remedy implementation is not yet complete. Dismantling of the BGRR bioshield and installation of the engineered cap are currently in progress.
- HFBR remedy implementation is also underway. Removal of Building 802 (Fan House) and planning for stack demolition are currently in progress.

11.0 Next Review

The third sitewide Five-Year Review for BNL will be submitted within five years of issuance of this final report. This will include all OUs, including the g-2 Tritium Plume, the BLIP, and USTs ROD (AOCs 16T, 16K, and 12), the BGRR and HFBR RODs. A comprehensive sitewide protectiveness determination will be included at that time.

D.A.R.G.E. — 29 Mar 2011

For John Sattler, Brookhaven Federal Project Director
Office of Environmental Management
U.S. Department of Energy

Date

M. Holland — 3/30/11

Michael Holland, Site Manager
Brookhaven Site Office
U.S. Department of Energy

Date

This page intentionally left blank.

12.0 References

BNL. 1996. *Brookhaven National Laboratory Operable Unit IV Record of Decision*. Upton, NY.

BNL. 1997. *Animal/Chemical Pits and Glass Holes Remedial Action Closure Report.* October 1997. Upton, NY.

BNL. 1999a. *Record of Decision, Operable Unit I and Radiologically Contaminated Soils (Including Areas of Concern 6, 8, 10, 16, 17, and 18)*. Upton, NY.

BNL. 1999b. *Final Focused Ecological Risk Assessment for OU I.* Upton, NY.

BNL. 2000a. *Brookhaven National Laboratory Operable Unit III Record of Decision*. Upton, NY.

BNL. 2000b. *Brookhaven National Laboratory Operable Unit VI Record of Decision*, Upton, NY.

BNL. 2001a. *Current Landfill Area Five-Year Evaluation Final Report*. Upton, NY.

BNL. 2001b. *Brookhaven National Laboratory Operable Unit V Record of Decision for AOC 4 (Sewage Treatment Plant), AOC 21 (Sewer Lines), AOC 23 (Eastern Off-site Tritium Plume)*. Upton, NY.

BNL. 2001c. *Final Closeout Report for Area of Concern 16 Landscape Soils.* Upton, NY.

BNL. 2001d. *BLIP Closeout Report Removal Action AOC 16K*. Upton, NY.

BNL. 2002. *Former Landfill Area Five-Year Evaluation Report.* Upton, NY.

BNL. 2002-2009. Operation and Maintenance Manuals for Groundwater Treatment Systems. Available on-line at http://www.bnl.gov/ltra/reports.asp

BNL. 2003b. *Natural Resource Management Plan for Brookhaven National Laboratory.* Upton, NY.

BNL. 2003c. *BNL Environmental Monitoring Plan Triennial Update.* Upton, NY.

BNL. 2004a. *Brookhaven National Laboratory Final Operable Unit V Record of Decision for Area of Concern 30 (Peconic River)*. Upton, NY.

BNL 2004b. *Final Completion Report Remedial Action AOC 4 STP, Sludge Drying Beds and Sand Filter Beds/Berms, AOC 21 Abandoned Former Sewer Lines*. Upton, NY.

BNL. 2004c. *Peconic River Removal Action for Sediment on BNL Property* (Action Memorandum). Upton, NY.

BNL. 2004d. *Final Closeout Report for the Meadow Marsh Operable Unit I Area of Concern 8*. Upton, NY.

BNL. 2004e. *Final Closeout Report for the Ash Pit Operable Unit I Area of Concern 2F.* Upton, NY.

BNL. 2004f. *Remedial Investigation and Soil Remediation Evaluation and Cost Estimate for the Central Steam Facility Storm Water Outfall.* Upton, NY.

BNL. 2005a. *Operable Unit III Explanation of Significant Differences*. February 28, 2005. Upton, NY.

BNL. 2005b. *Brookhaven National Laboratory, Final Record of Decision for Area of Concern 9, Brookhaven Graphite Research Reactor.* Upton, NY.

BNL. 2005c. *Final Closeout Report for Peconic River Remediation Phases 1 and 2.* Upton, NY.

BNL. 2005d. *BNL Land Use Controls Management Plan.* Upton, NY.

BNL. 2005e. *OU III Building 96 PCB Soil (AOC 26B) Excavation Closeout Report*. Upton, NY.

BNL 2005f. *BNL Animal/Chemical Pits and Glass Holes Remedial Action Closure Report Addendum.* Upton, NY.

BNL. 2005g. *OU III Building 96 Groundwater Treatment System Shutdown Petition (AOC 26B)*. Upton, NY.

BNL. 2005h. *2004 BNL Groundwater Status Report*. Upton, NY.

BNL. 2005j. *Final Closeout Report for the Brookhaven Graphite Research Reactor, Final Canal and Deep Soil Pockets Excavation and Removal.*

BNL. 2006a. *Final Five-Year Review Report for Brookhaven National Laboratory Superfund Site.* Upton, NY.

BNL. 2006b. *Operable Unit I Soils and Operable Unit V Long-Term Monitoring and Maintenance Plan*. Upton, NY.

BNL. 2007a. *BNL Land Use Controls Management Plan.* Upton, NY.

BNL. 2007b. *Brookhaven National Laboratory Record of Decision for Area of Concern 16T g-2 Tritium Source Area and Groundwater Plume, Area of Concern 16T Brookhaven Linac Isotope Producer, and Area of Concern 12 Former Underground Storage Tanks.* April 6, 2007. Upton, NY.

BNL. 2007c. *Central Steam Facility Storm Water Outfall Remediation Closeout Report.*

BNL. 2007d. *Brookhaven National Laboratory, Action Memorandum, High Flux Beam Reactor, Removal Action for Waste Loading Area.* Upton, NY.

BNL. 2007e. *Investigation and Characterization of the Brookhaven Avenue Cs-137 Contamination*.

BNL. 2007f. *BNL High Flux Beam Reactor Characterization Summary Report, Rev 1.*

BNL. 2007g. *Final 2006 Peconic River Monitoring Report.* Upton, NY.

BNL. 2008a. *2007 BNL Groundwater Status Report*. Upton, NY.

BNL. 2008b. *Final 2007 Peconic River Monitoring Report.* Upton, NY.

BNL. 2008c. *Brookhaven National Laboratory, Action Memorandum, High Flux Beam Reactor, Removal Action for Control Rod Blades and Beam Plugs.* Upton, NY.

BNL. 2009a. *Final Operable Unit III Explanation of Significant Differences for Building 96 Remediation.* Upton, NY.

BNL. 2009b. *Brookhaven National Laboratory, Final Record of Decision for Area of Concern 31, High Flux Beam Reactor.* Upton, NY.

BNL. 2009c. *Final Action Memorandum, Removal of Contaminated Soil from the Former Hazardous Waste Management Facility Perimeter Area.* Upton, NY.

BNL. 2009d. *Brookhaven National Laboratory, High Flux Beam Reactor, Area of Concern 31, Final Completion Report for Waste Loading Area Soil Remediation.* Upton, NY.

BNL. 2009e. *BNL Land Use Controls Management Plan.* Upton, NY.

BNL. 2009f. *2008 BNL Groundwater Status Report*. Upton, NY.

BNL. 2009g. *Final 2008 Peconic River Monitoring Report.* Upton, NY.

BNL. 2009h. *Environmental Monitoring Report – Current and Former Landfills.* Upton, NY.

BNL. 2010a. *Final Completion Report for the Former Hazardous Waste Management Facility Perimeter Area Soil Remediation, April 2010.* Upton, NY.

BNL 2010b. *Addendum to the Former Hazardous Waste Management Facility Perimeter Area Completion Report. December 2010.* Upton, NY.

BNL. 2010c. *Final Closeout Report for the Brookhaven Graphite Research Reactor, Graphite Pile Removal, Area of Concern 9.*

BNL. 2010d. *Final Closeout Report for Removal of the Building 801-811 Waste Transfer Lines (A/B Waste Lines with Co-Located Piping) Area of Concern 31.* Upton, NY.

BNL. 2010e. *BNL Environmental Monitoring Plan Annual Update*. Upton, NY.

BNL. 2010f. *2009 BNL Groundwater Status Report*. Upton, NY.

BNL. 2010g. *Final Plan for the Optimization of the Peconic River Remedy.* Upton, NY.

BNL. 2010h. *Brookhaven National Laboratory, High Flux Beam Reactor Decommissioning Project, Area of Concern 31, Final Completion Report for Removal of Control Rod Blades and Beam Plugs.* Upton, NY.

BNL. 2010i. *Final 2009 Peconic River Monitoring Report.* Upton, NY.

BNL 2011. *Long-Term Surveillance and Maintenance Plan for the HFBR.*

DOE. 2003. Order 450.1. *Environmental Protection Program*. U.S. Department of Energy, Washington DC. 1-15-03.

Envirocon. 2004. *Completion Report for Peconic River Remediation on BNL Property*.

Envirocon. 2005. *Closeout Report for the Former Hazardous Waste Management Facility.*

EPA. 2001. *EPA Five-Year Guidance.* Environmental Protection Agency, Washington, DC.

New York State. 1992. NYS 6 NYCRR Part 360, Regulations. *Solid Waste Management Facilities*. 1992, Revision in progress.

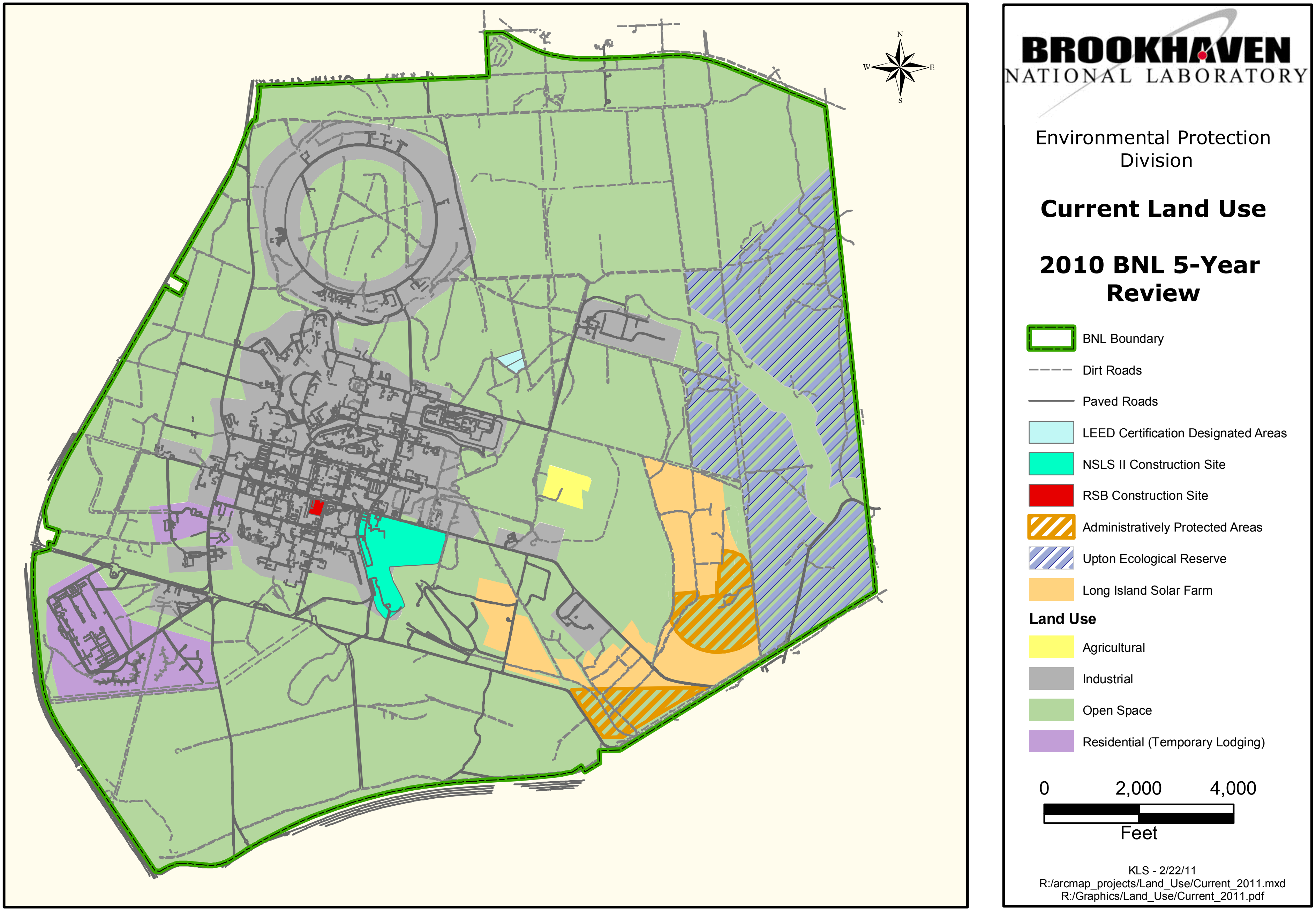
ORISE 2008. *Data Evaluation and Dose Modeling for the Former Hazardous Waste Management Facility, Brookhaven National Laboratory, Upton, New York, Revision 1.*

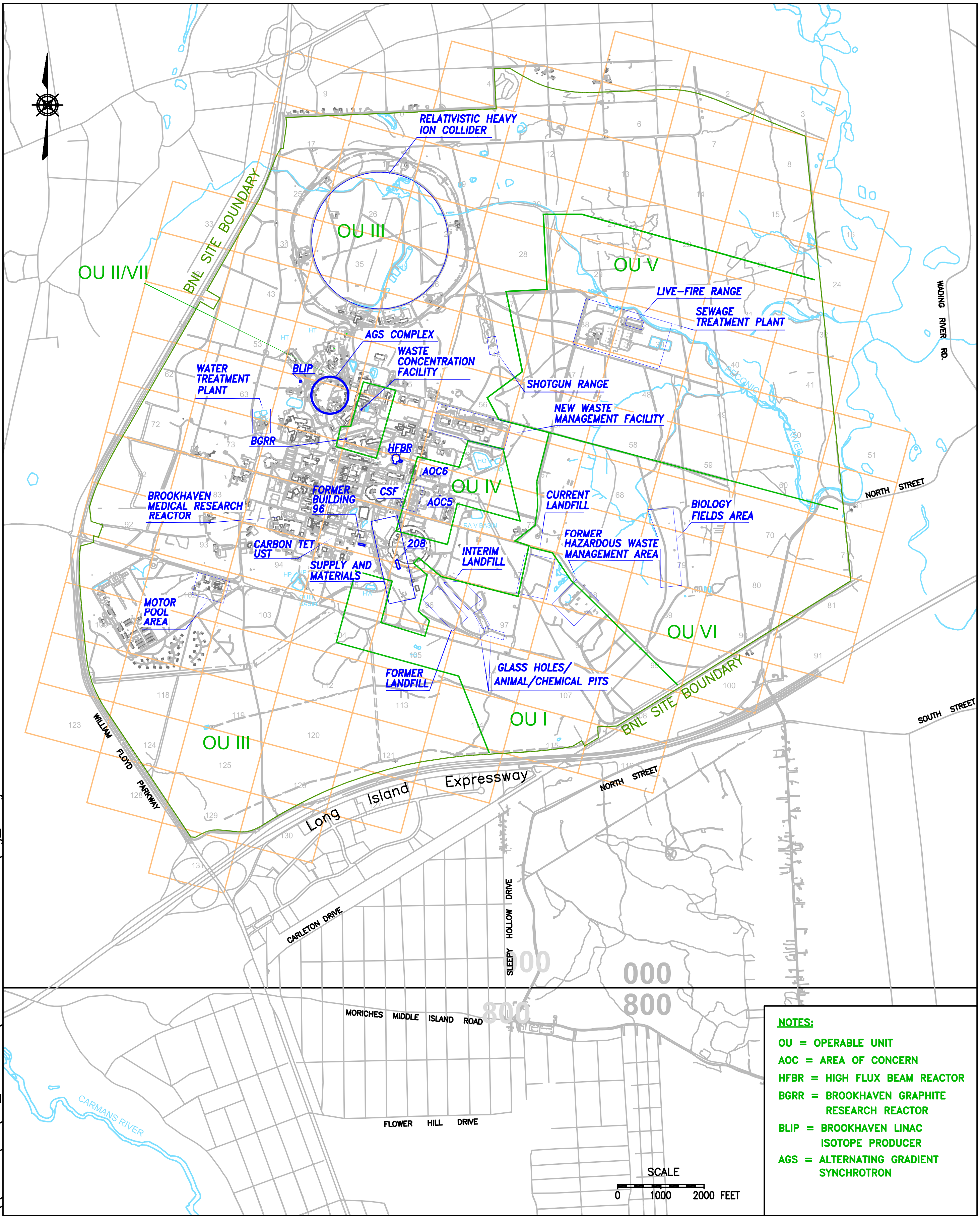
SCDHS. *Article 4 of the Suffolk County Sanitary Code* (private water system standards).

Figures

(Figures 3-1 through 7-1)

FIGURE 3-1


BROOKHAVEN
NATIONAL LABORATORY
Environmental Protection Division
Current Land Use
2010 BNL 5-Year Review
BNL Boundary
Dirt Roads
Paved Roads
LEED Certification Designated Areas
NSLS II Construction Site
RSB Construction Site
Administratively Protected Areas
Upton Ecological Reserve
Long Island Solar Farm
Land Use
Agricultural
Industrial
Open Space
Residential (Temporary Lodging)
0
2,000
4,000
Feet
KLS - 2/22/11
R:/arcmap_projects/Land_Use/Current_2011.mxd
R:/Graphics/Land_Use/Current_2011.pdf



BROOKHAVEN NATIONAL LABORATORY

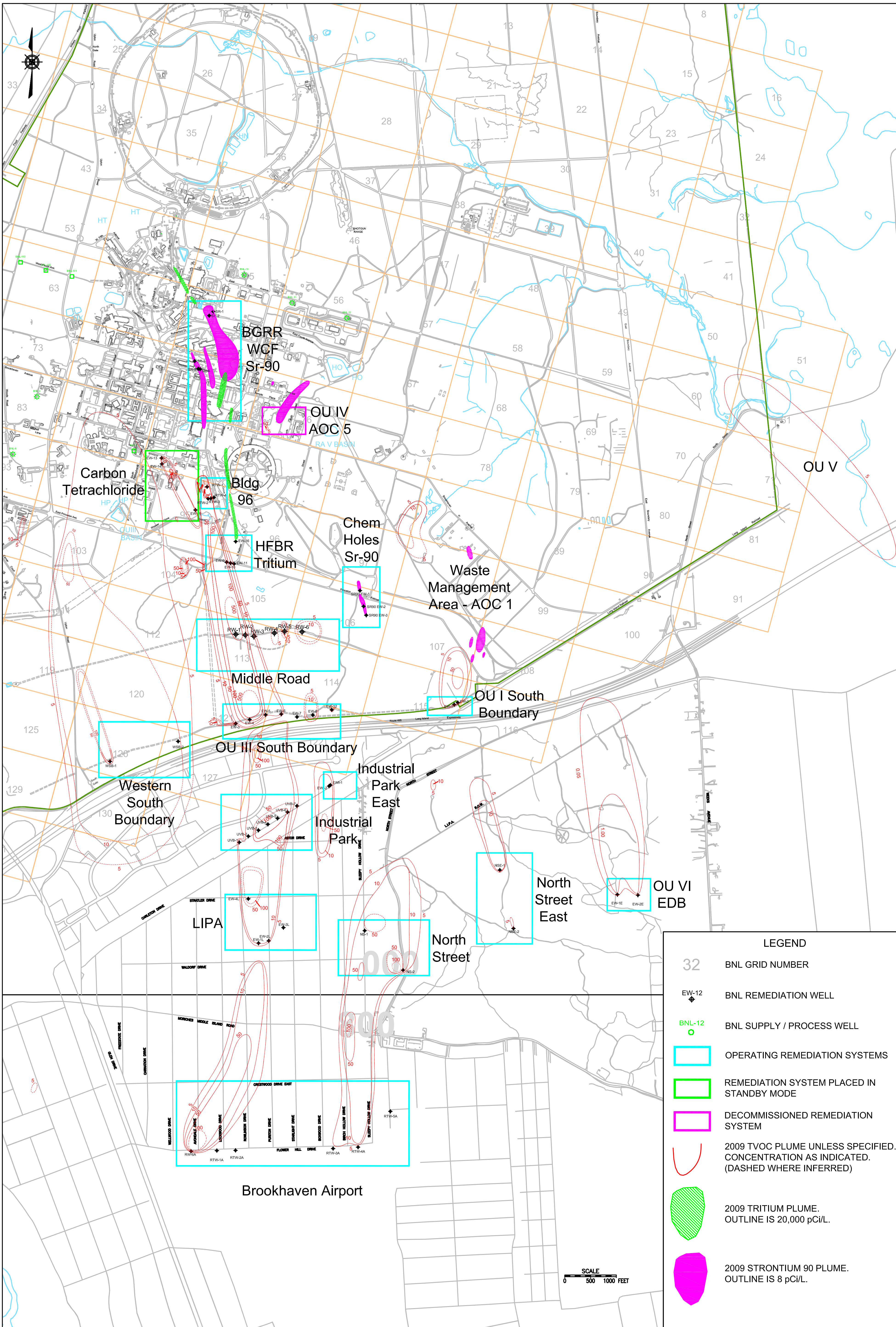
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU LOCATIONS

2010 BNL FIVE-YEAR REVIEW

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
AJZ	–	02/22/11	–
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
FIGURE NO.: 4–1			



\\OERNT\GIS\GW_PROJECTS\Five Year Review – 2010\Fig_4-2.dwg

BROOKHAVEN NATIONAL LABORATORY

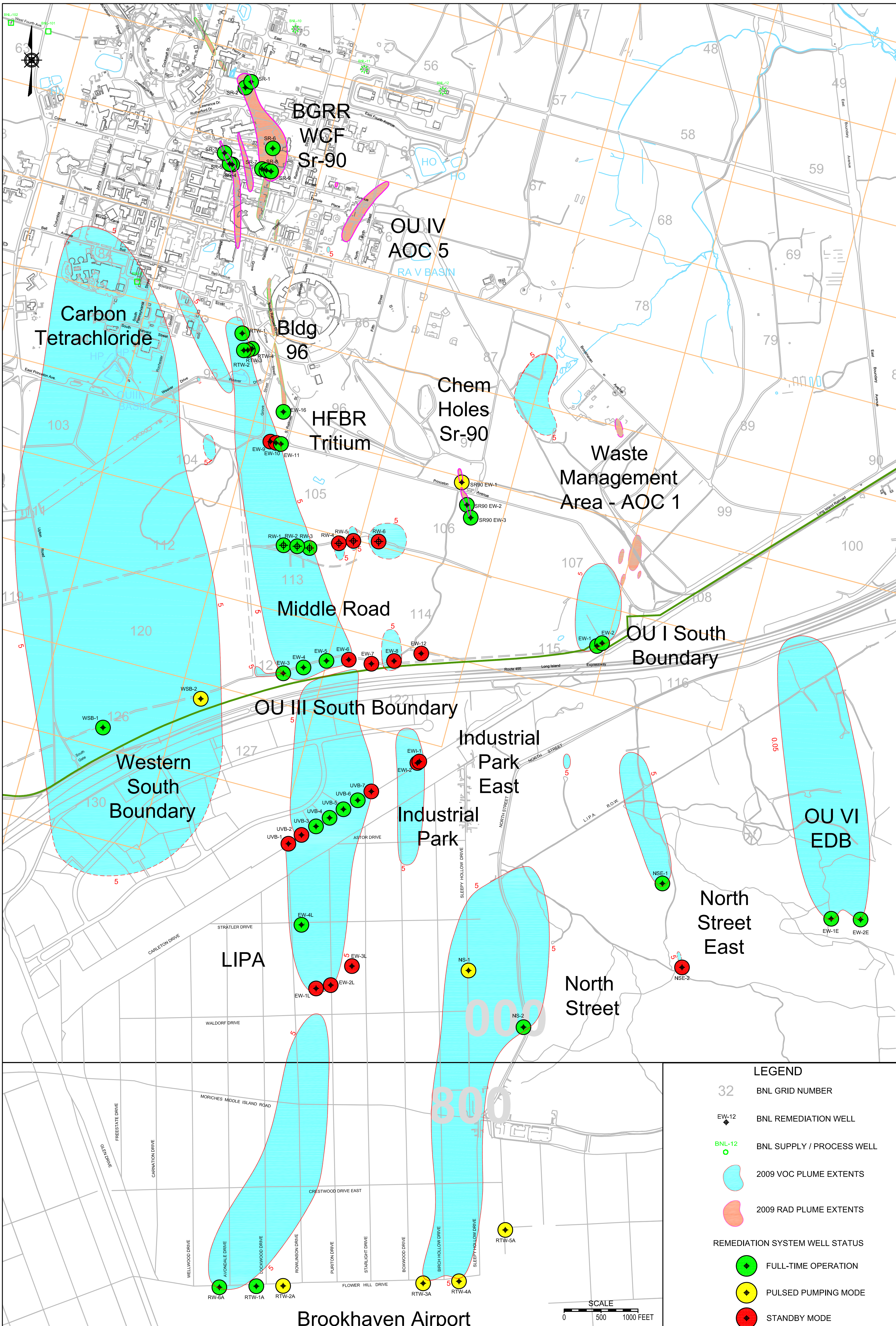
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

GROUNDWATER REMEDIATION SYSTEMS

2010 BNL FIVE-YEAR REVIEW

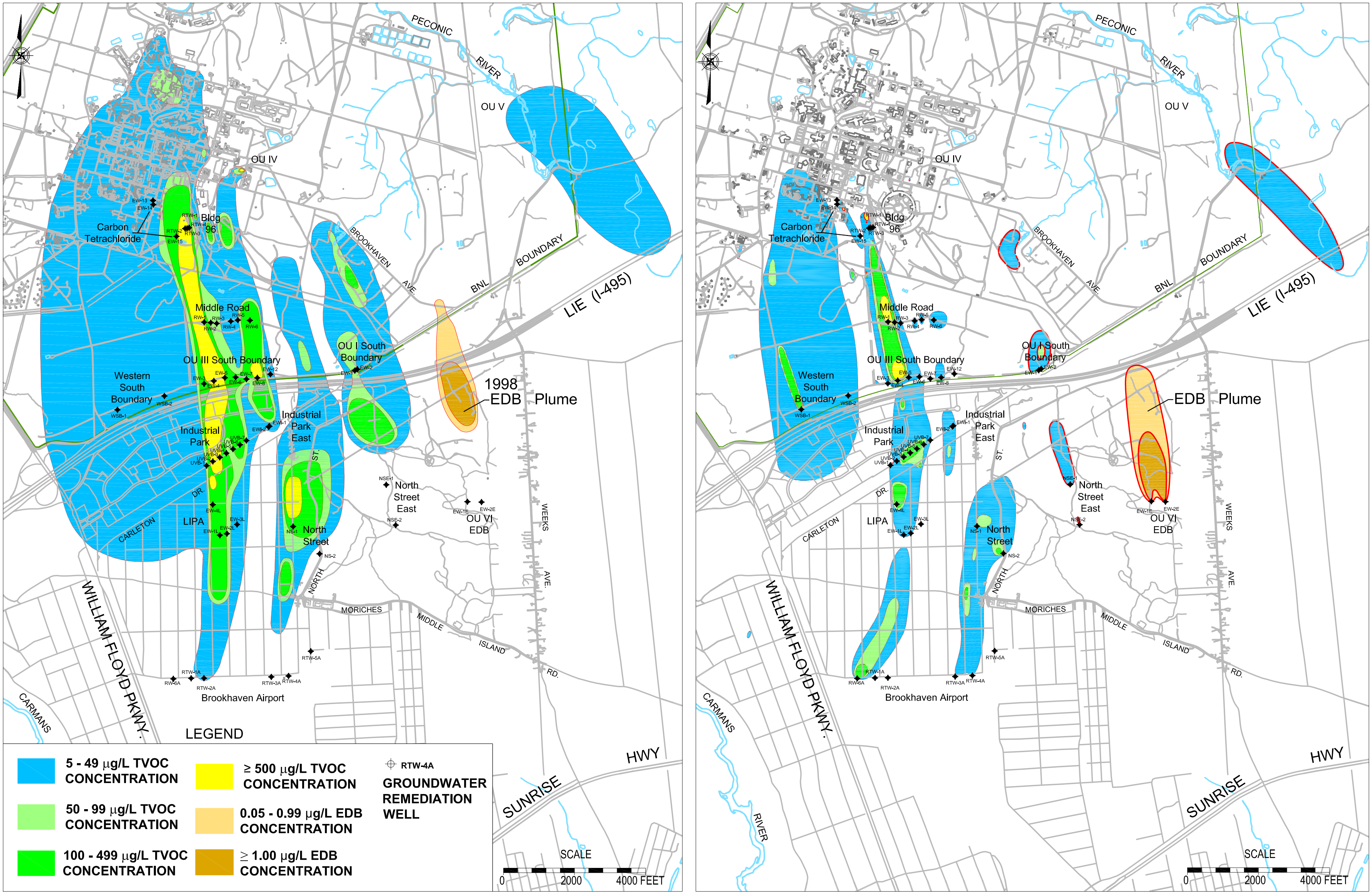
DWN: AJZ	VS: HS.: –	DATE: 02/22/11	PROJECT NO.: –
CHKD: –	APPD: –	REV.: –	NOTES: –
FIGURE NO.: 4-2			



\\OERNT\GIS\GW_PROJECTS\FIVE YEAR REVIEW – 2010\FIVE YEAR FIG 03 021111.DWG

BROOKHAVEN NATIONAL LABORATORY ENVIRONMENTAL PROTECTION DIVISION	TITLE: OPERATIONAL STATUS OF GROUNDWATER REMEDIATION SYSTEM WELLS 2010 BNL FIVE-YEAR REVIEW	DWN: AJZ	VS: HS.: –	DATE: 02/22/11	PROJECT NO.: –
		CHKD: –	APPD: –	REV.: –	NOTES: –
		FIGURE NO.: 4–3			

\\OERNT\GIS\GW_PROJECTS\FIVE YEAR REVIEW - 2010\FIVE YEAR FIG 04 020811.DWG



BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

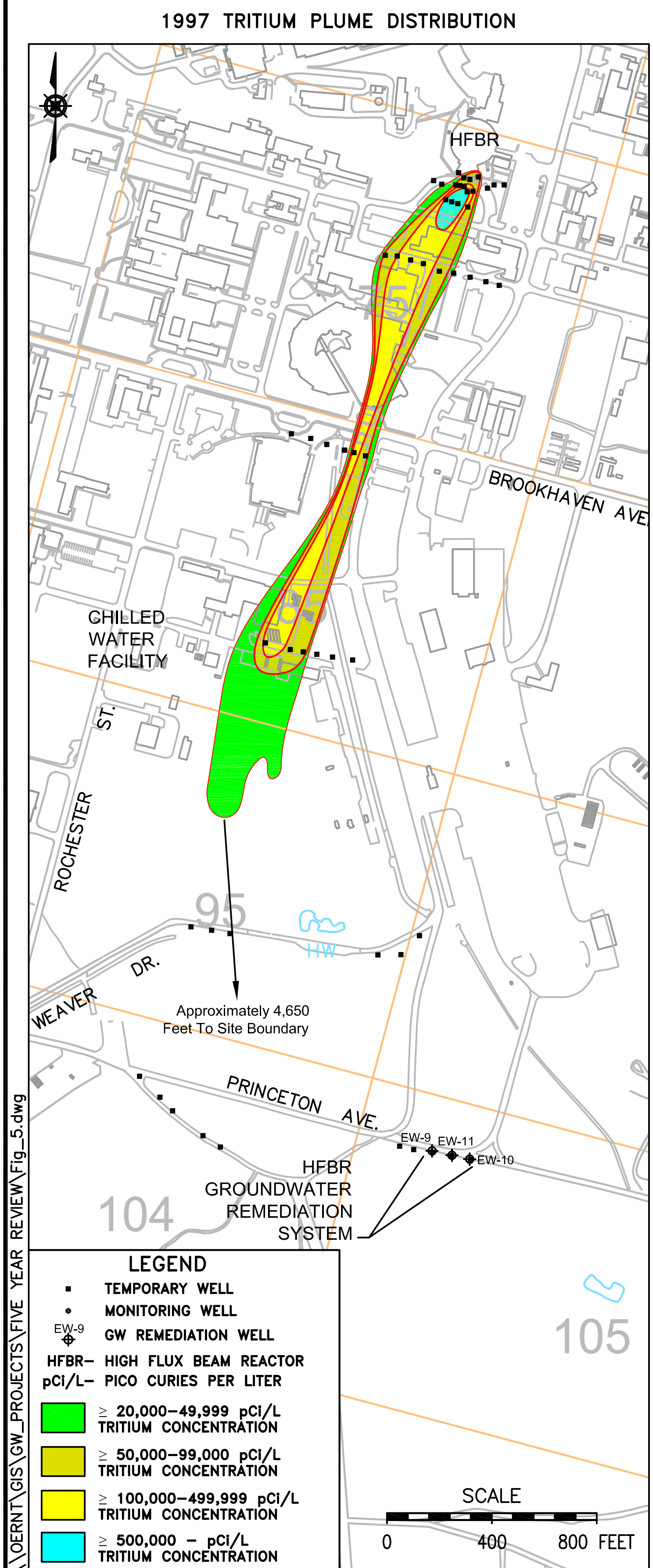
TITLE:

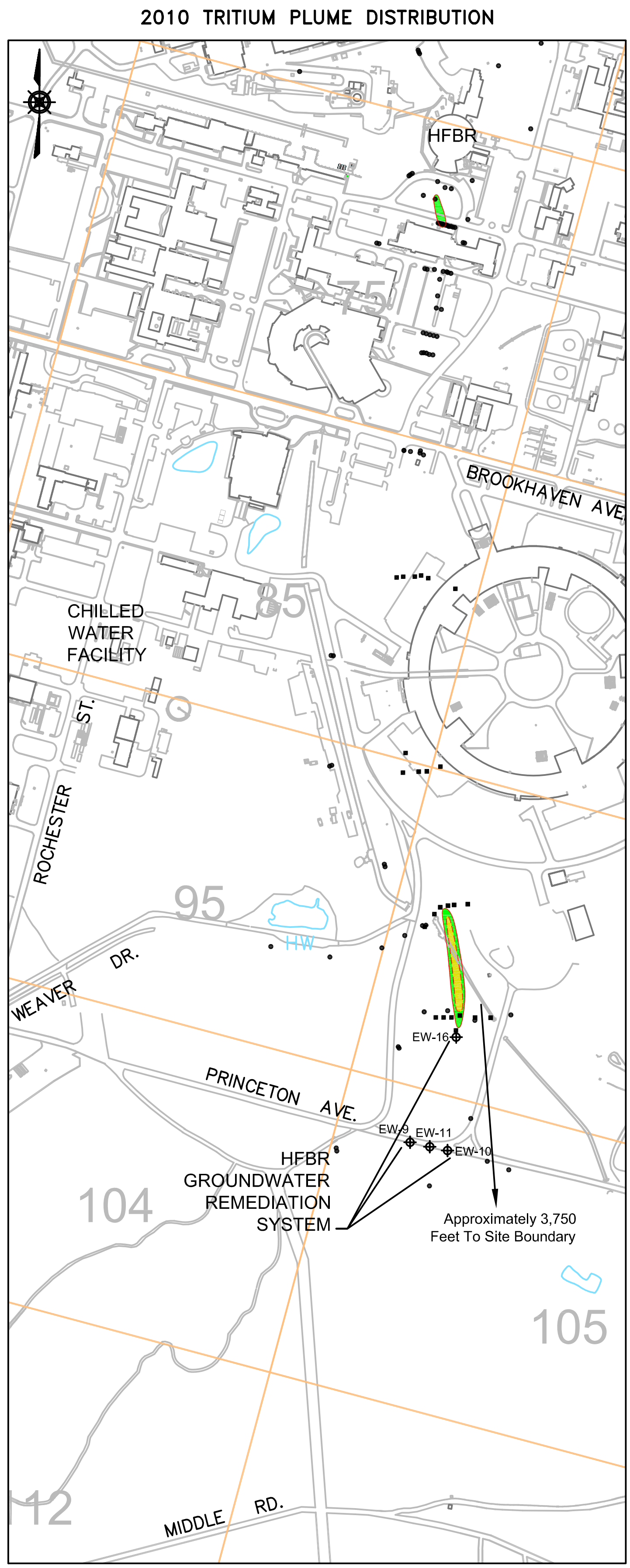
TVOC/EDB PLUME COMPARISON 1997/1998 - 2009

2010 BNL FIVE-YEAR REVIEW

DWN:	VT:HZ.:	DATE:	PROJECT NO.:
AJZ	-	02/22/11	-
CHKD:	APPD:	REV.:	NOTES:
-	-	-	-

FIGURE NO.: 5-1





BROOKHAVEN NATIONAL LABORATORY

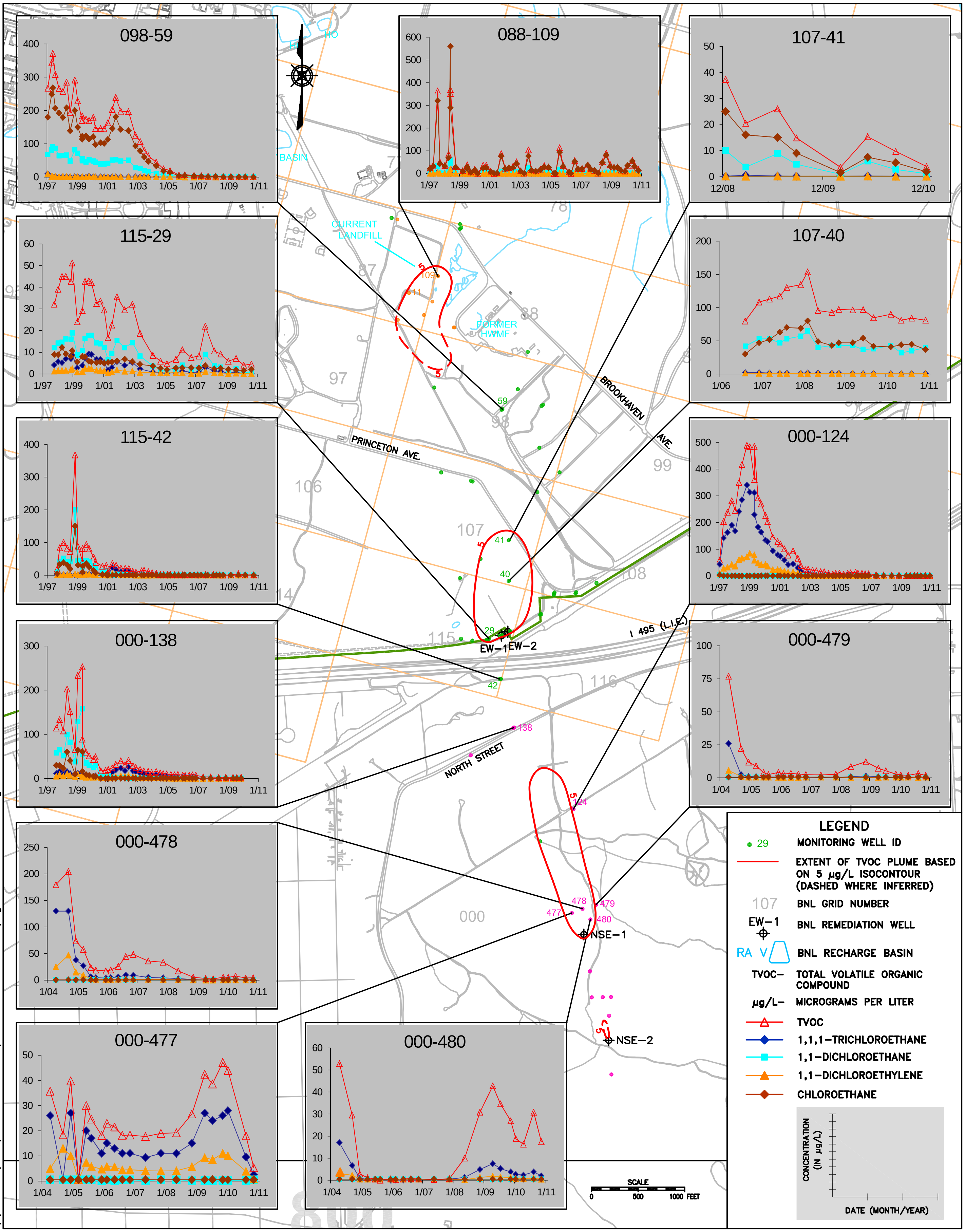
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU III HFBR AOC 29
TRITIUM PLUME COMPARISON
1997 – 2010

2010 BNL FIVE-YEAR REVIEW

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
AJZ	–	02/22/11	–
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
FIGURE NO.: 5–2			



\\OERNT\GIS\GW_PROJECTS\FIVE YEAR REVIEW\Fig_6-1 022311.dwg

BROOKHAVEN NATIONAL LABORATORY

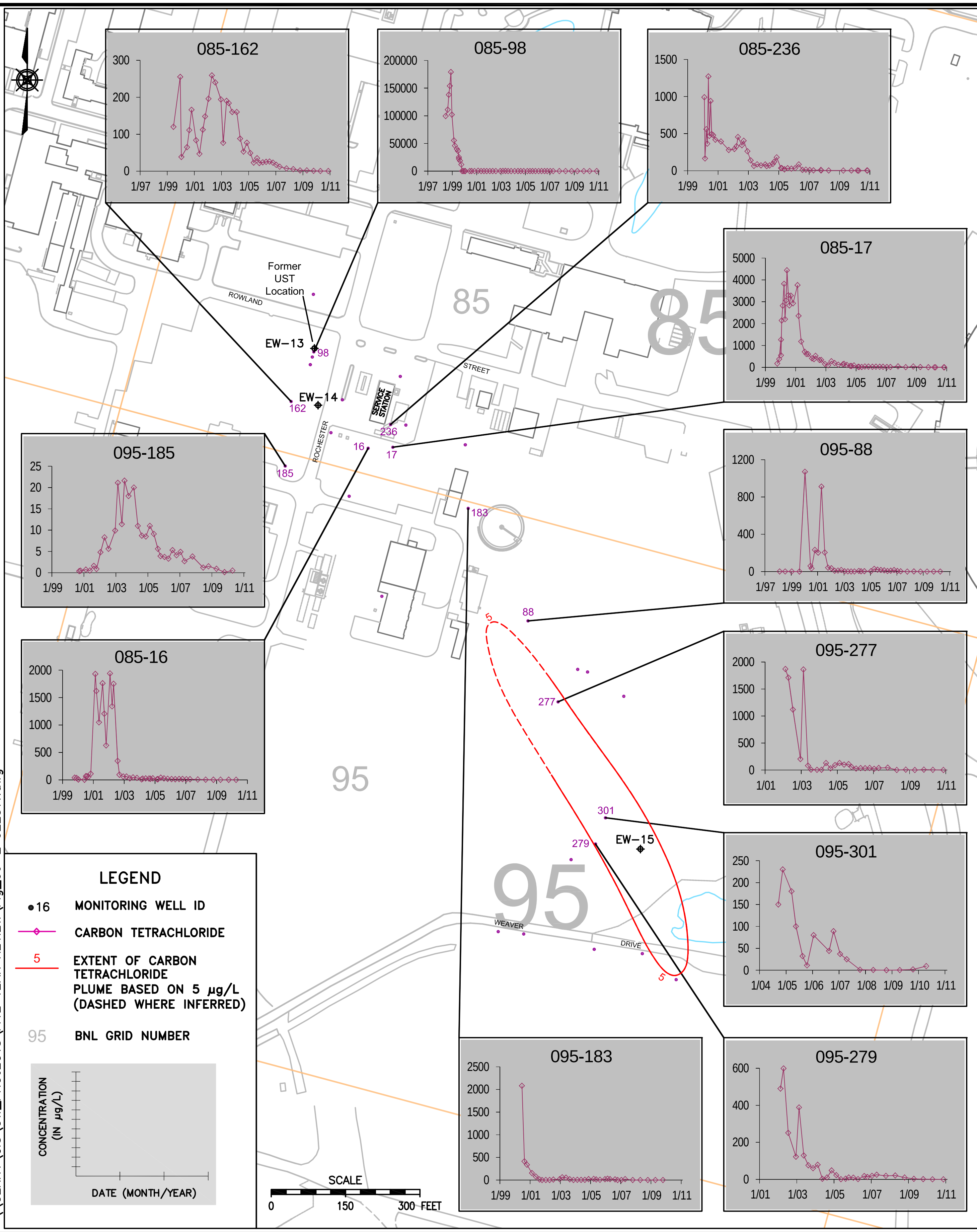
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU I CURRENT LANDFILL/ SOUTH BOUNDARY/ NORTH STREET EAST HISTORICAL VOC TRENDS

2010 BNL FIVE-YEAR REVIEW

DWN: AJZ	VT: HZ.: –	DATE: 02/23/11	PROJECT NO.: –
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
FIGURE NO.: 6-1			



\\OERNT\GIS\GW_PROJECTS\FIVE YEAR REVIEW\Fig_06-2 022311.dwg

BROOKHAVEN NATIONAL LABORATORY

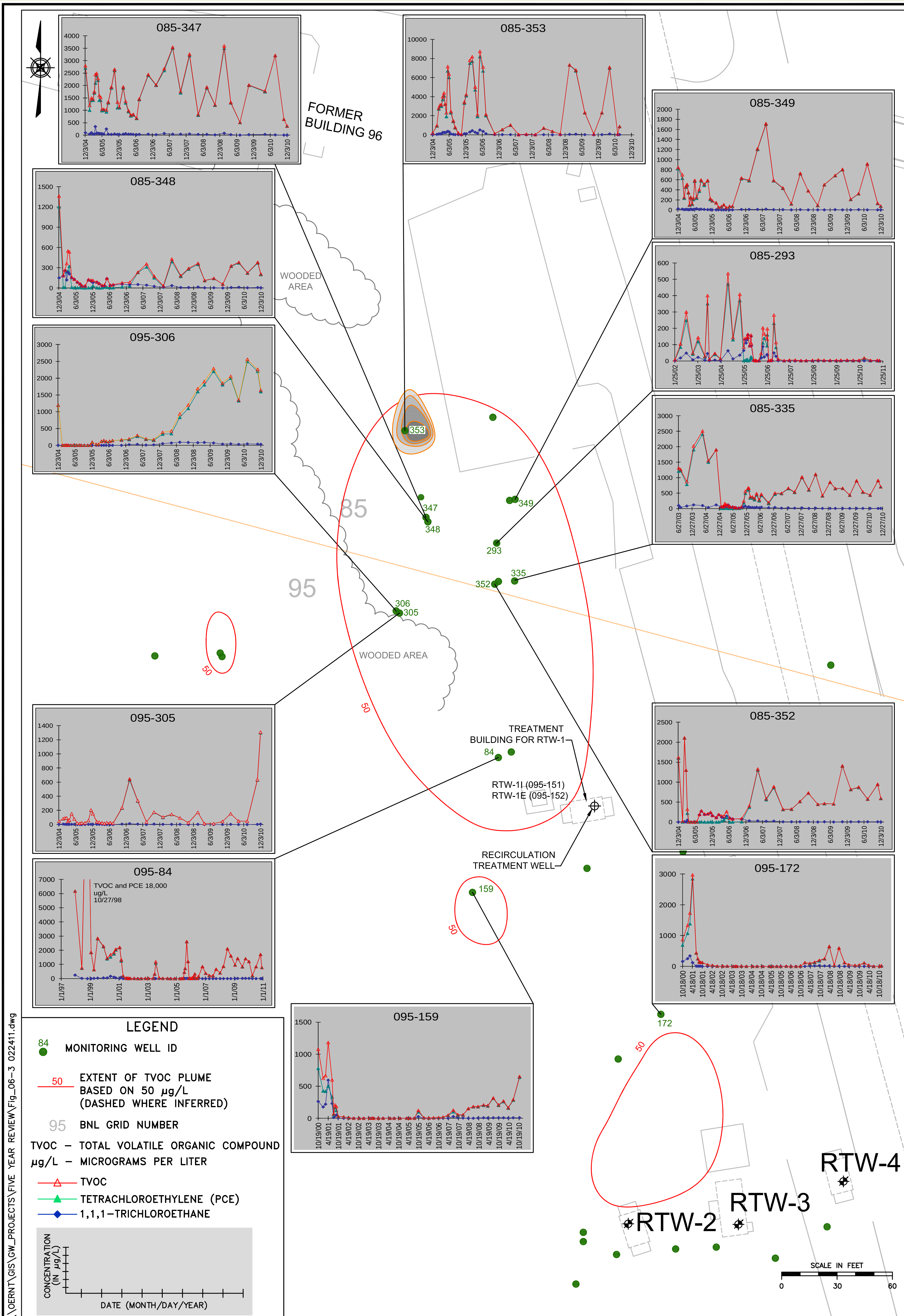
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

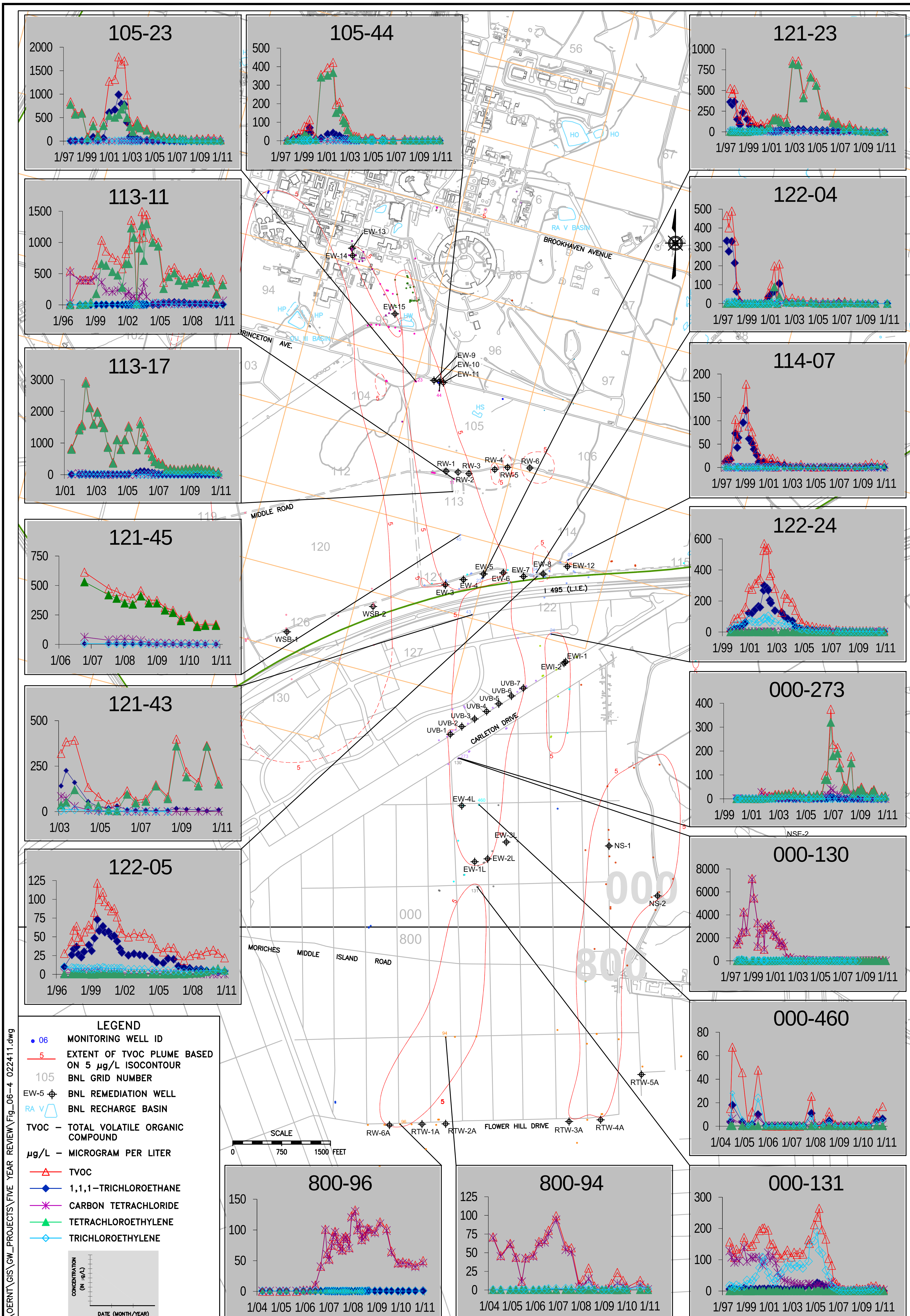
OU III CARBON TETRACHLORIDE HISTORICAL TRENDS

2010 BNL FIVE-YEAR REVIEW

DWN: AJZ	VT: HZ.: –	DATE: 02/23/11	PROJECT NO.: –
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
FIGURE NO.: 6-2			



BROOKHAVEN NATIONAL LABORATORY ENVIRONMENTAL PROTECTION DIVISION	TITLE: OU III BUILDING 96 AREA HISTORICAL VOC TRENDS 2010 BNL FIVE–YEAR REVIEW	DWN: AJZ	VS: HS.: –	DATE: 02/24/11	PROJECT NO.: –
		CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
		FIGURE NO.: 6–3			



BROOKHAVEN NATIONAL LABORATORY

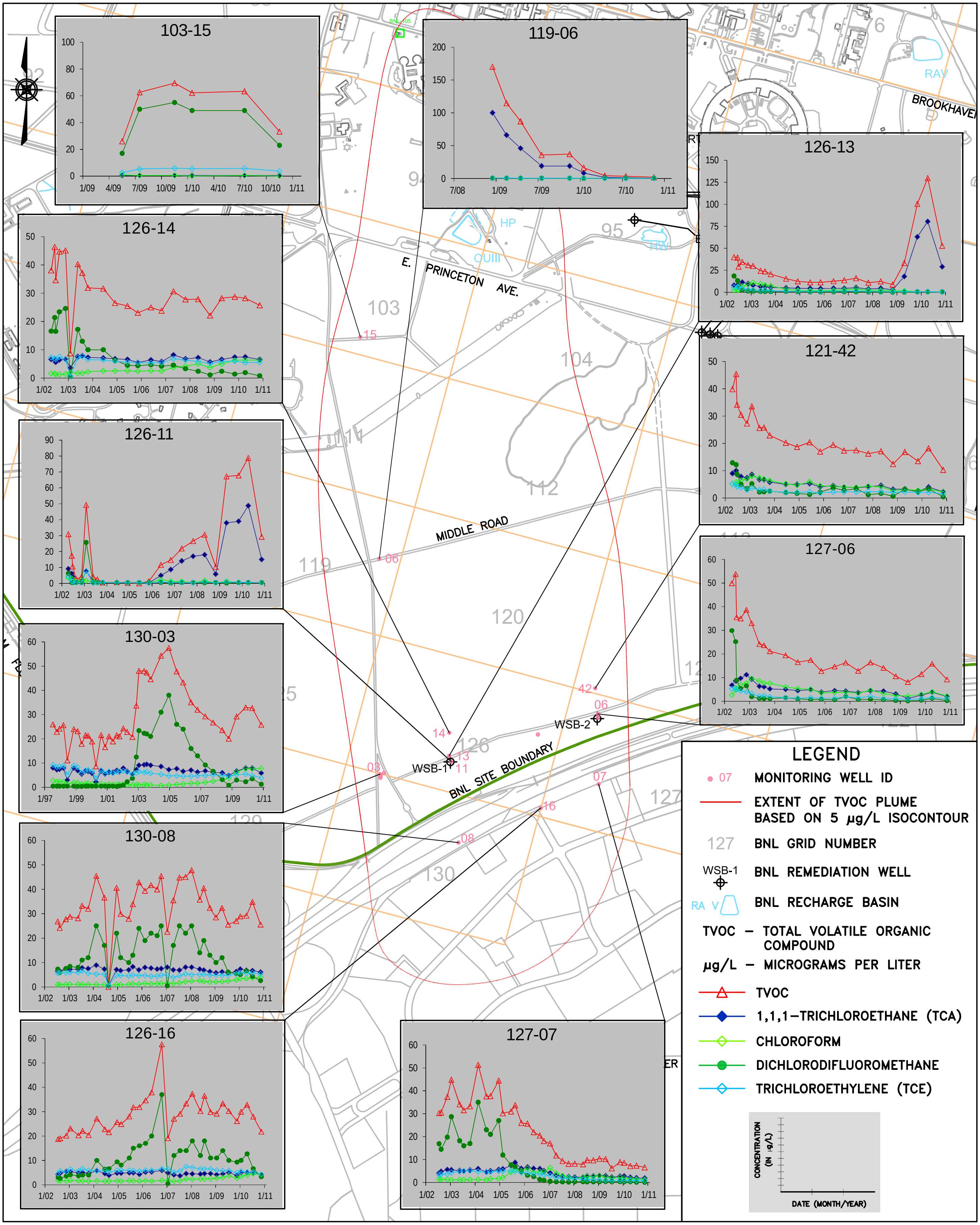
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU III AND OU IV PLUME(S) HISTORICAL VOC TRENDS

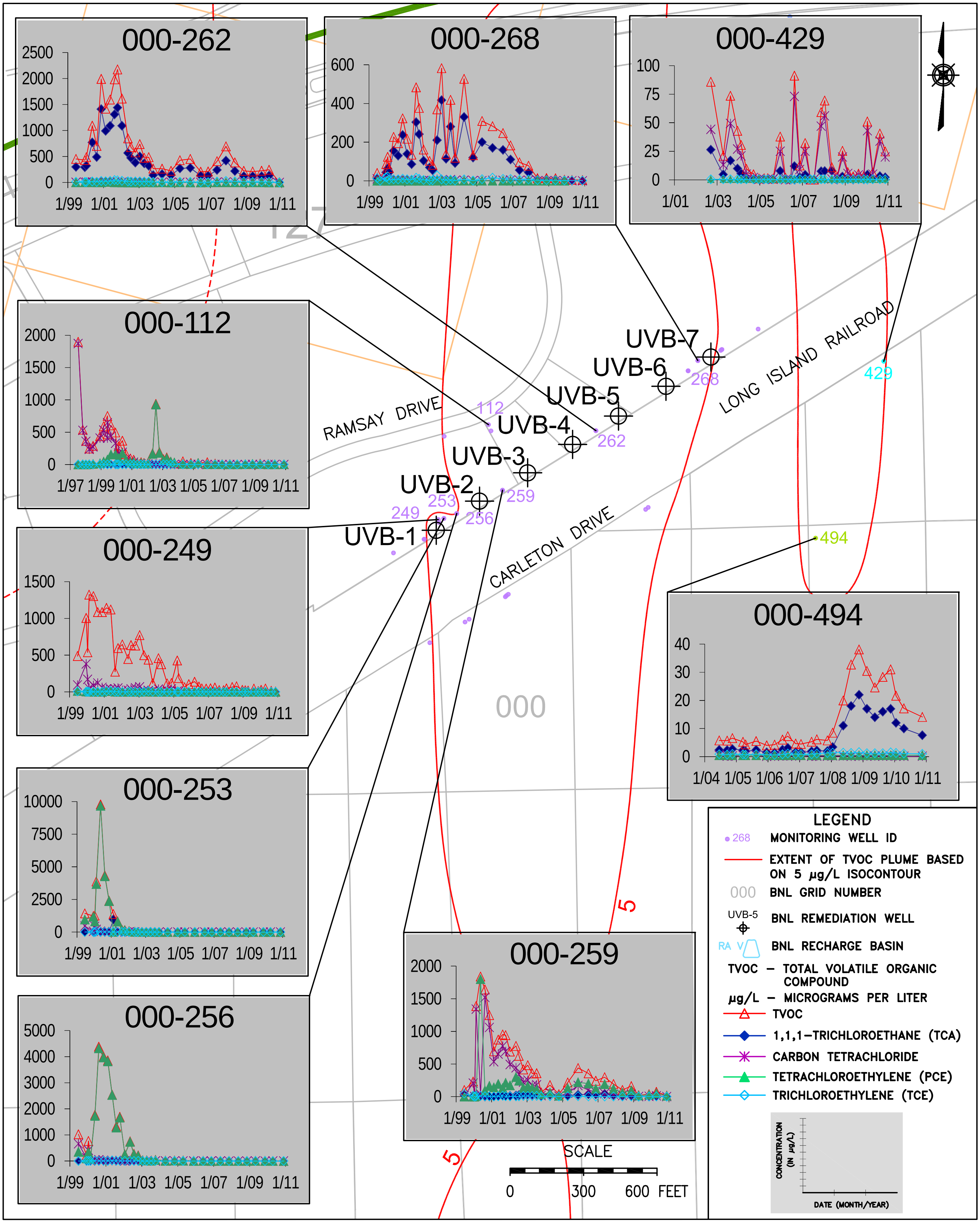
2010 BNL FIVE-YEAR REVIEW

DWN: AJZ	VT: HZ.: –	DATE: 02/24/11	PROJECT NO.: –
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
FIGURE NO.: 6–4			



\\OERNT\GIS\GW_PROJECTS\FIVE YEAR REVIEW\Fig_06-5 022411.dwg

BROOKHAVEN NATIONAL LABORATORY ENVIRONMENTAL PROTECTION DIVISION	TITLE: OU III WESTERN SOUTH BOUNDARY HISTORICAL VOC TRENDS 2010 BNL FIVE-YEAR REVIEW	DWN: AJZ	VT: HZ.: –	DATE: 02/24/11	PROJECT NO.: –
		CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
		FIGURE NO.: 6–5			



\\OERNT\GIS\GW_PROJECTS\Five Year Review\Fig_06-6 022411.dwg

BROOKHAVEN NATIONAL LABORATORY

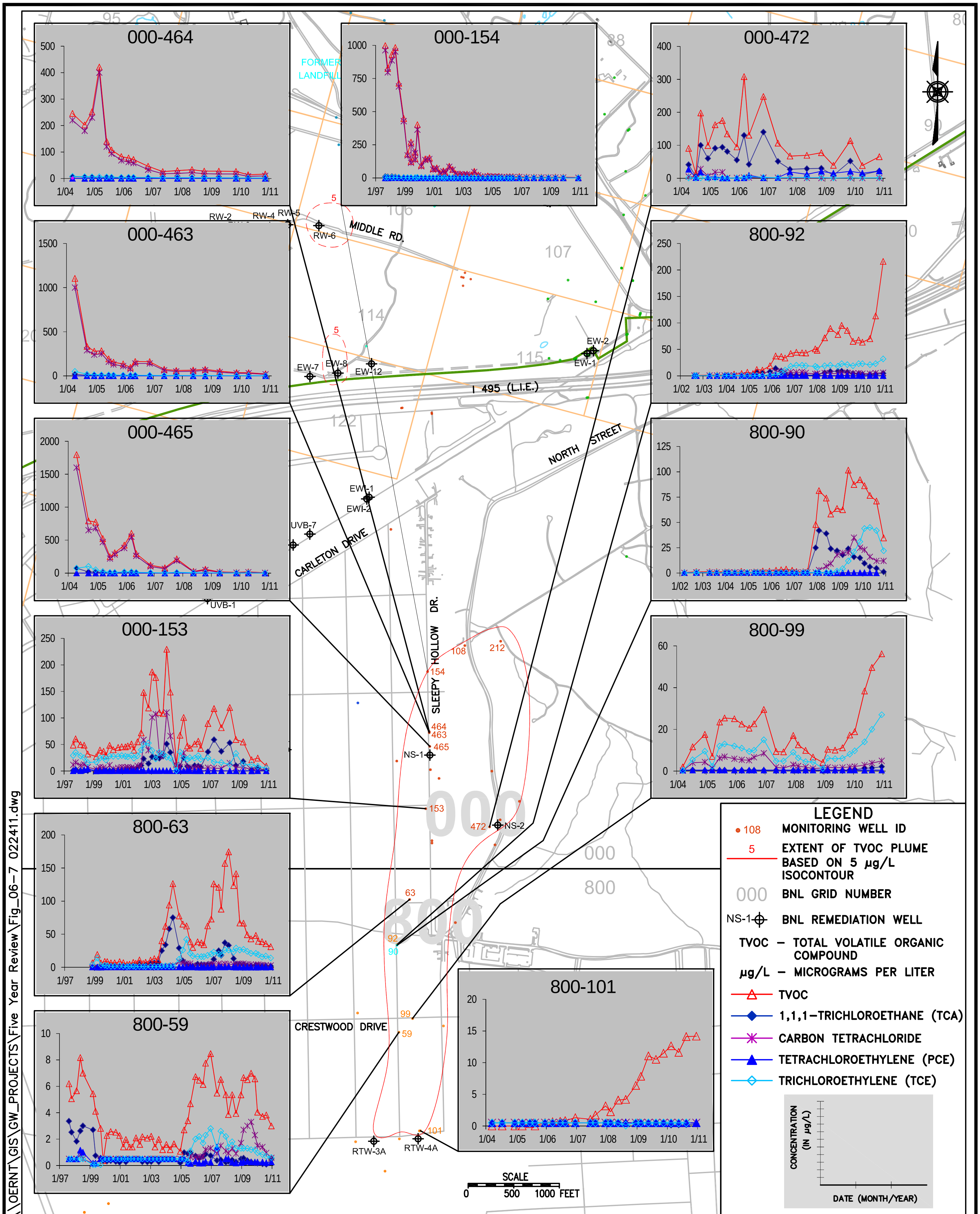
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU III INDUSTRIAL PARK HISTORICAL VOC TRENDS

2010 BNL FIVE-YEAR REVIEW

DWN: LR	VT: HZ.: –	DATE: 02/24/11	PROJECT NO.: –
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
FIGURE NO.: 6–6			



BROOKHAVEN NATIONAL LABORATORY

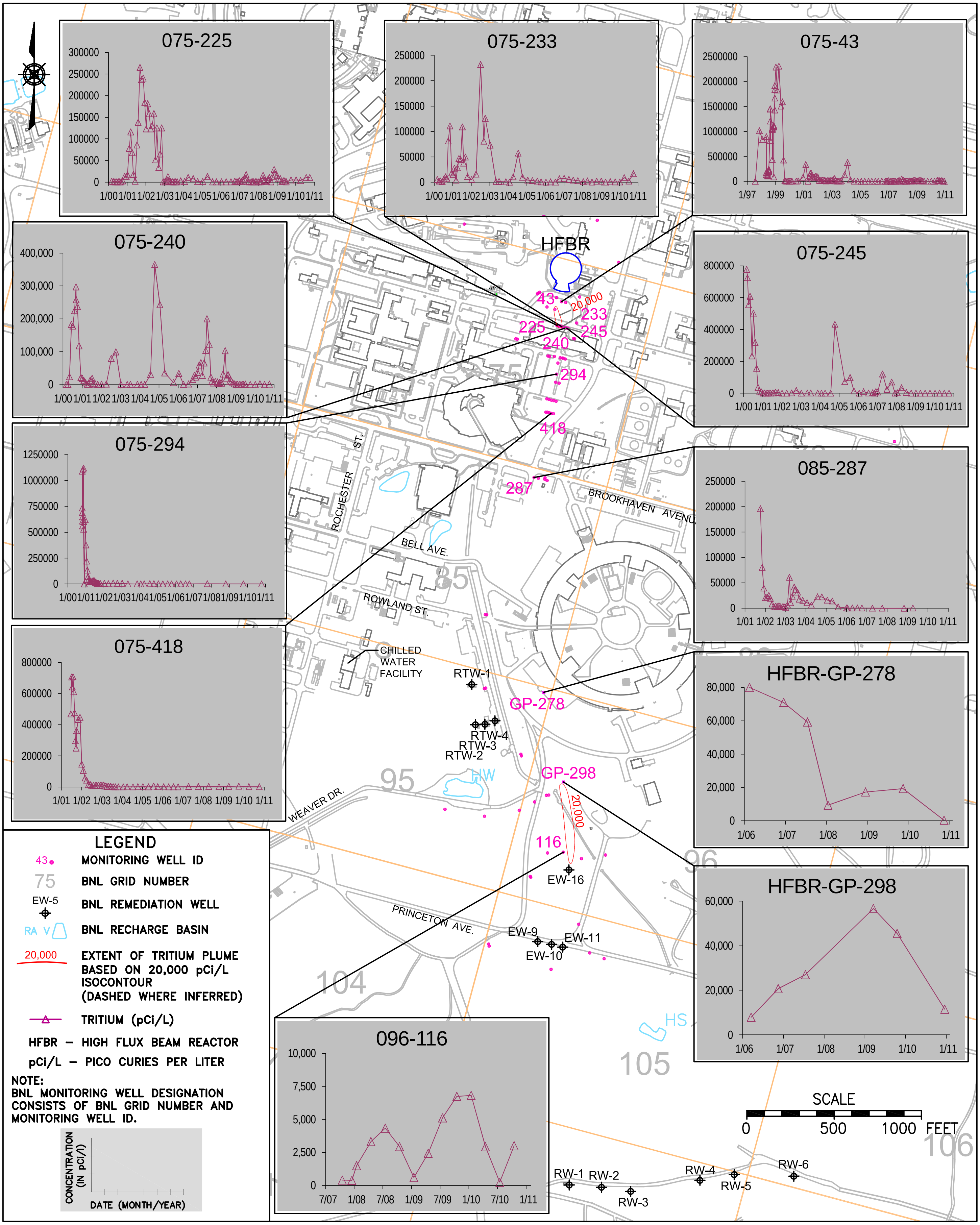
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

NORTH STREET (OU I/IV FORMER LANDFILL, CHEMICAL/ANIMAL HOLES) HISTORICAL VOC TRENDS

2010 BNL FIVE-YEAR REVIEW

DWN: AJZ	VT: HZ.: –	DATE: 02/24/11	PROJECT NO.: –
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
FIGURE NO.:		6–7	



\\OERNT\GIS\GW_PROJECTS\Five Year Review – 2010\Fig_6–8 022211.DWG

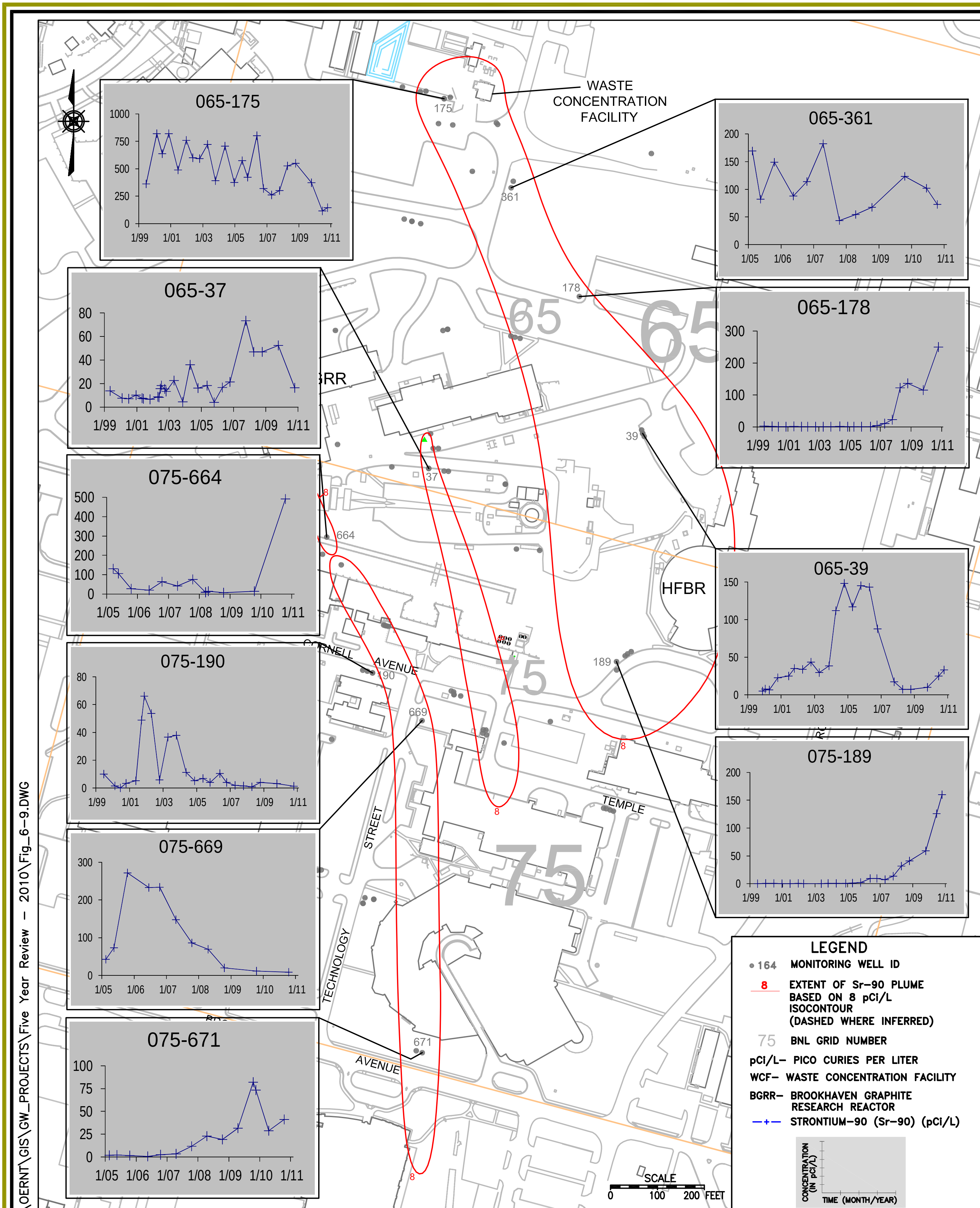
BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU III HFBR AOC 29
HISTORICAL TRITIUM TRENDS
2010 BNL FIVE–YEAR REVIEW

DWN: DH	VT: HZ.: –	DATE: 02/22/11	PROJECT NO.: –
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
FIGURE NO.: 6–8			



\\OERNT\GIS\GW_PROJECTS\Five Year Review - 2010\Fig_6-9.DWG

BROOKHAVEN NATIONAL LABORATORY

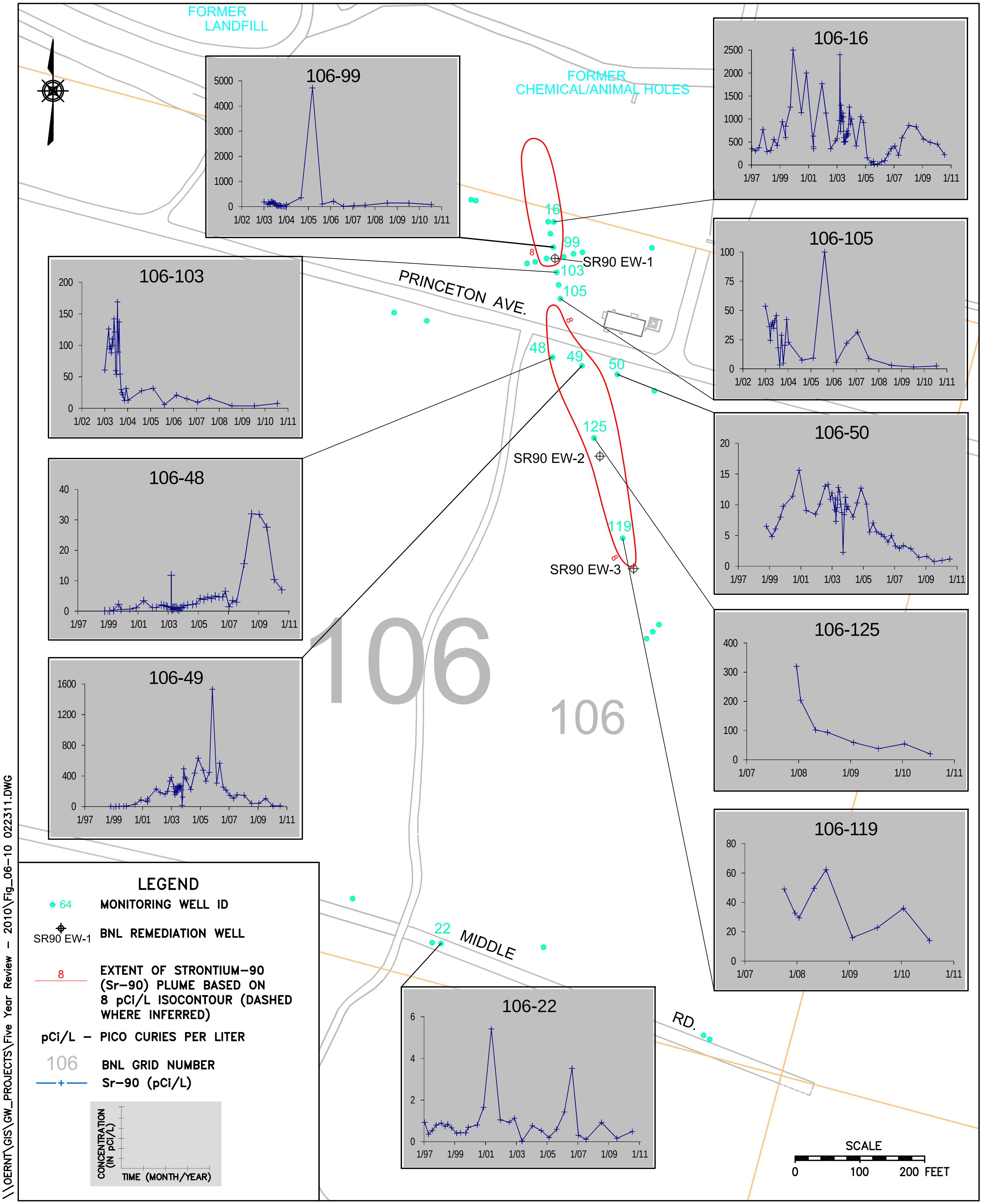
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU III BGRR/WCF
HISTORICAL Sr-90 TRENDS

2010 BNL FIVE-YEAR REVIEW

DWN: AJZ	VT: HZ.: –	DATE: 02/22/11	PROJECT NO.: –
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
FIGURE NO.: 6-9			



BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

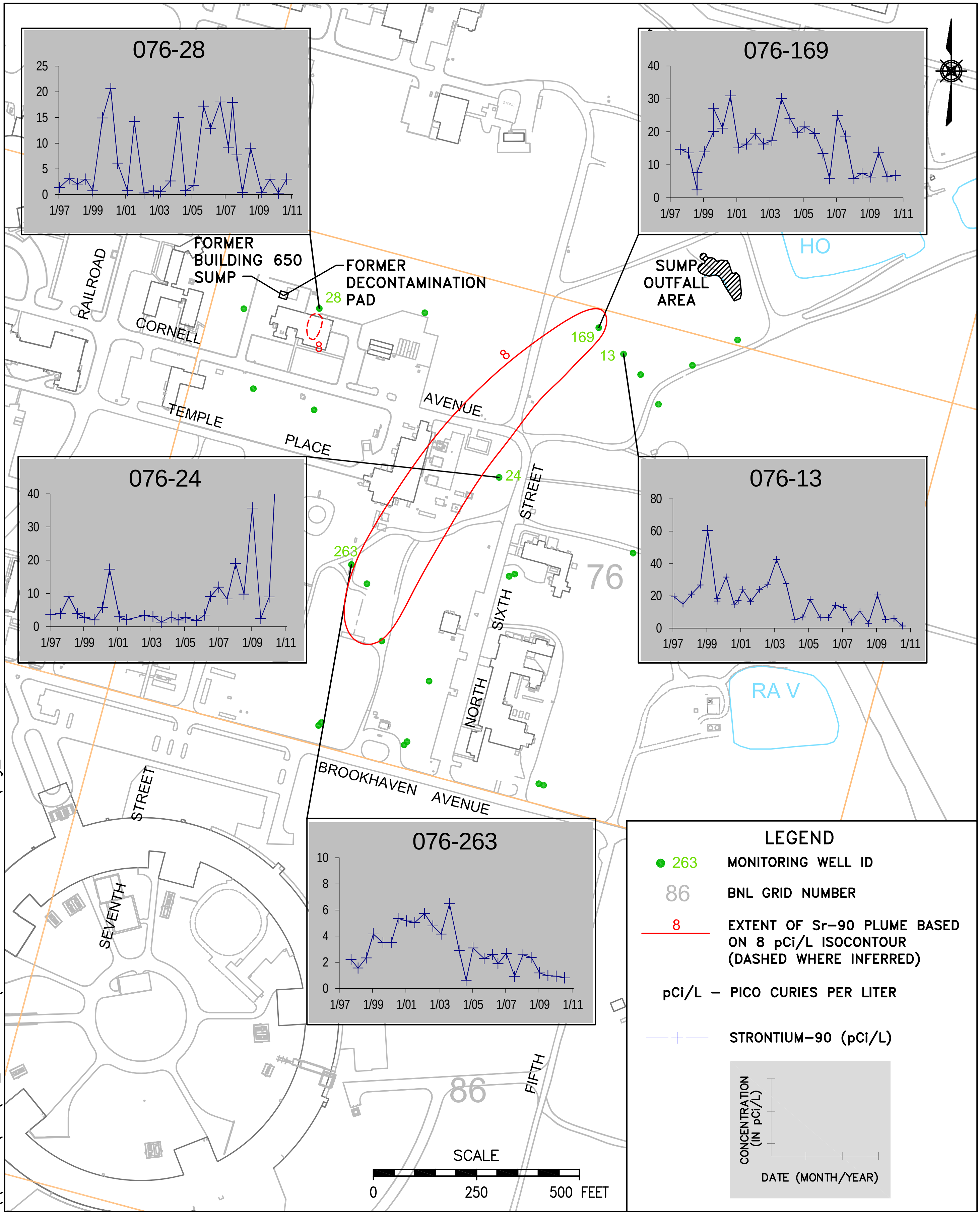
TITLE:

OU III CHEMICAL/ANIMAL HOLES HISTORICAL Sr–90 TRENDS

2010 BNL FIVE-YEAR REVIEW

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
DH	–	02/23/11	–
CHKD:	APPD:	REV.:	NOTES:
JEB	WRD	–	–

FIGURE NO.: 6–10



\\OERNT\GIS\GW_PROJECTS\Five Year Review – 2010\Fig_06-11 022311.DWG

BROOKHAVEN NATIONAL LABORATORY

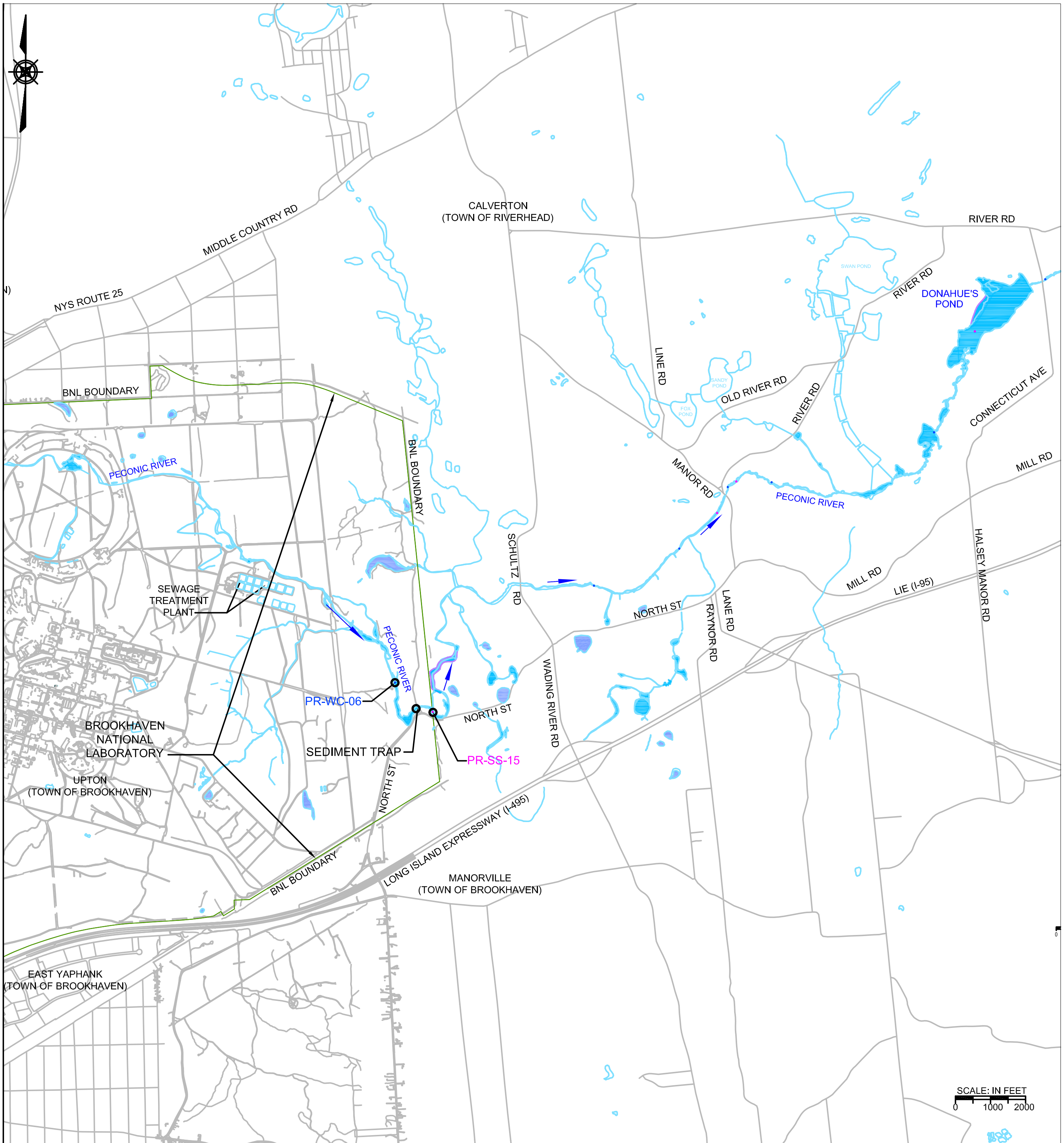
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU IV AOC 6 HISTORICAL Sr-90 TRENDS

2010 BNL FIVE-YEAR REVIEW

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
DH	–	02/23/11	–
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
FIGURE NO.: 6-11			



\\OERNT\GIS\GW_PROJECTS\FIVE YEAR REVIEW\Fig_06-12 030211.dwg

LEGEND

- PECONIC RIVER
- ISOLATED POND
- MARSH AREAS
- PR-WC-06 — SURFACE WATER SAMPLING STATION ID
- PR-SS-15 — SEDIMENT SAMPLING STATION ID
- PECONIC RIVER FLOW DIRECTION

BROOKHAVEN NATIONAL LABORATORY
ENVIRONMENTAL PROTECTION DIVISION

TITLE:
PECONIC RIVER SEDIMENT TRAP AND SUPPLEMENTAL REMOVAL LOCATIONS

2010 BNL FIVE-YEAR REVIEW

DWN:	VT:HZ.:	DATE:	PROJECT NO.:
AJZ	–	03/02/11	–
CHKD:	APPD:	REV.:	NOTES:
WM	–	–	–
FIGURE NO.:	6–12		

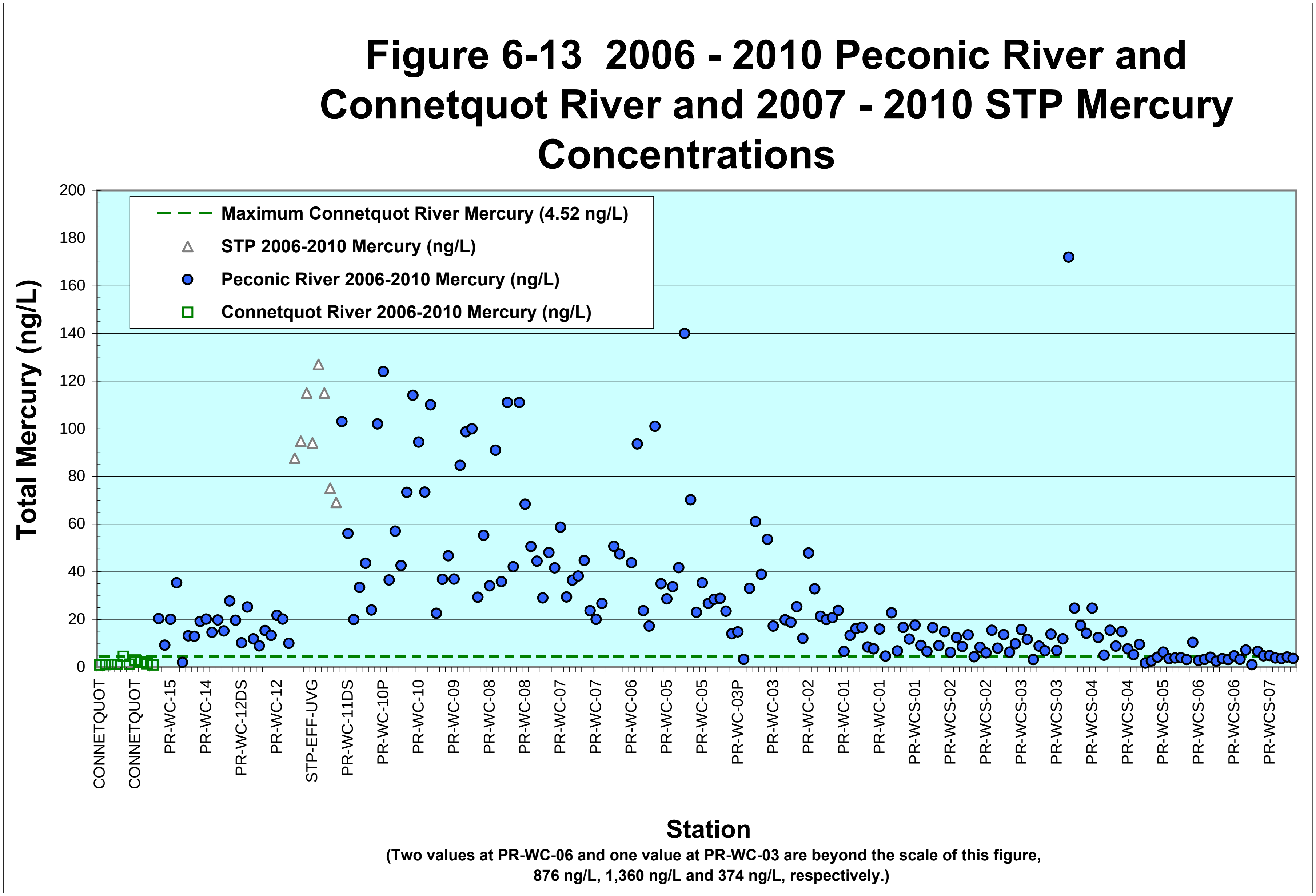


Figure 6-13 2006 - 2010 Peconic River and Connetquot River and 2007 - 2010 STP Mercury Concentrations
Total Mercury (ng/L)
200
180
160
140
120
100
80
60
40
20
0
Maximum Connetquot River Mercury (4.52 ng/L)
STP 2006-2010 Mercury (ng/L)
Peconic River 2006-2010 Mercury (ng/L)
Connetquot River 2006-2010 Mercury (ng/L)
CONNETQUOT
CONNETQUOT
PR-WC-15
PR-WC-14
PR-WC-12DS
PR-WC-12
STP-EFF-UVG
PR-WC-11DS
PR-WC-10P
PR-WC-10
PR-WC-09
PR-WC-08
PR-WC-08
PR-WC-07
PR-WC-07
PR-WC-06
PR-WC-05
PR-WC-05
PR-WC-03P
PR-WC-03
PR-WC-02
PR-WC-01
PR-WC-01
PR-WCS-01
PR-WCS-02
PR-WCS-02
PR-WCS-03
PR-WCS-03
PR-WCS-04
PR-WCS-04
PR-WCS-05
PR-WCS-06
PR-WCS-06
PR-WCS-07
Station
(Two values at PR-WC-06 and one value at PR-WC-03 are beyond the scale of this figure,
876 ng/L, 1,360 ng/L and 374 ng/L, respectively.)

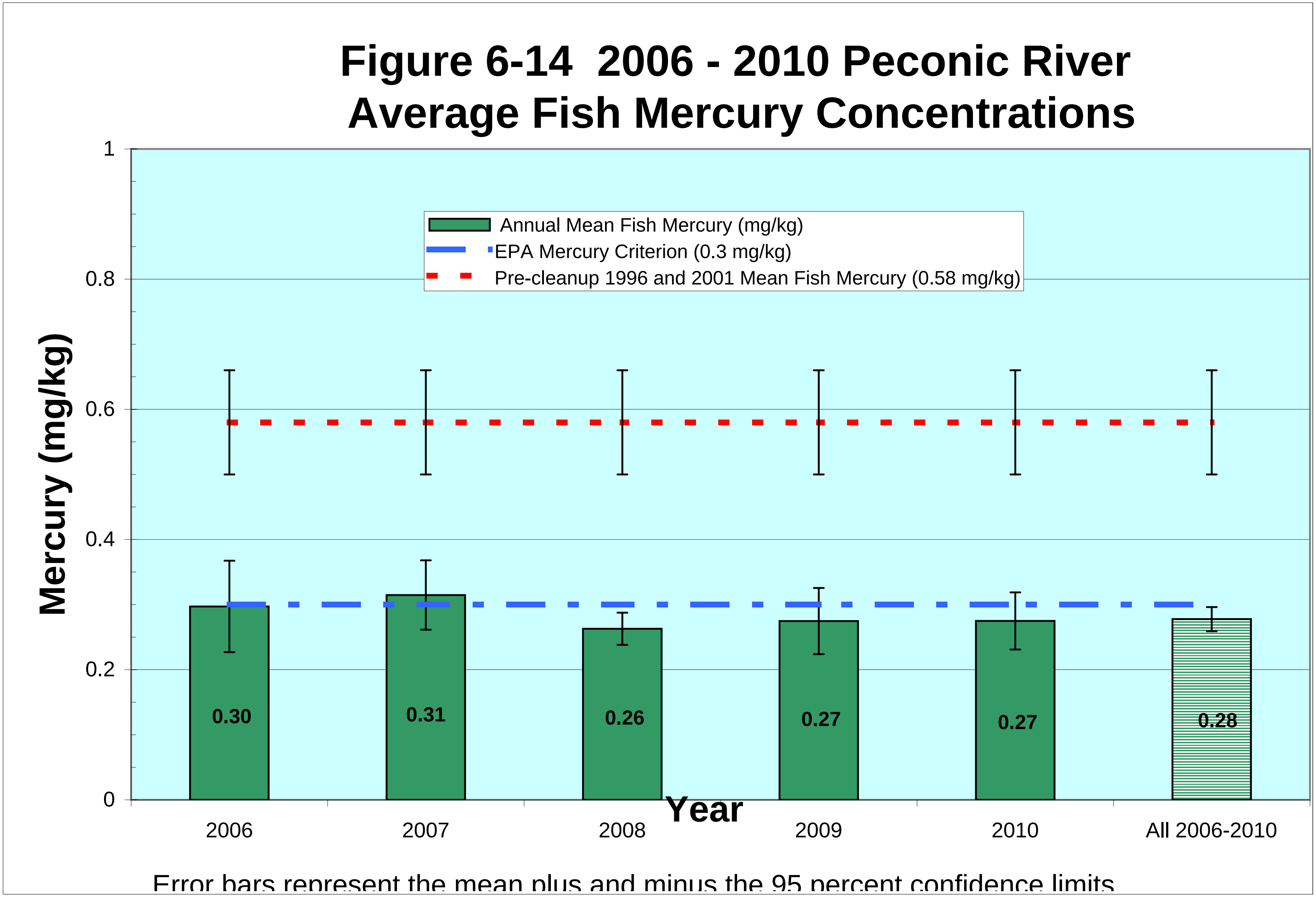
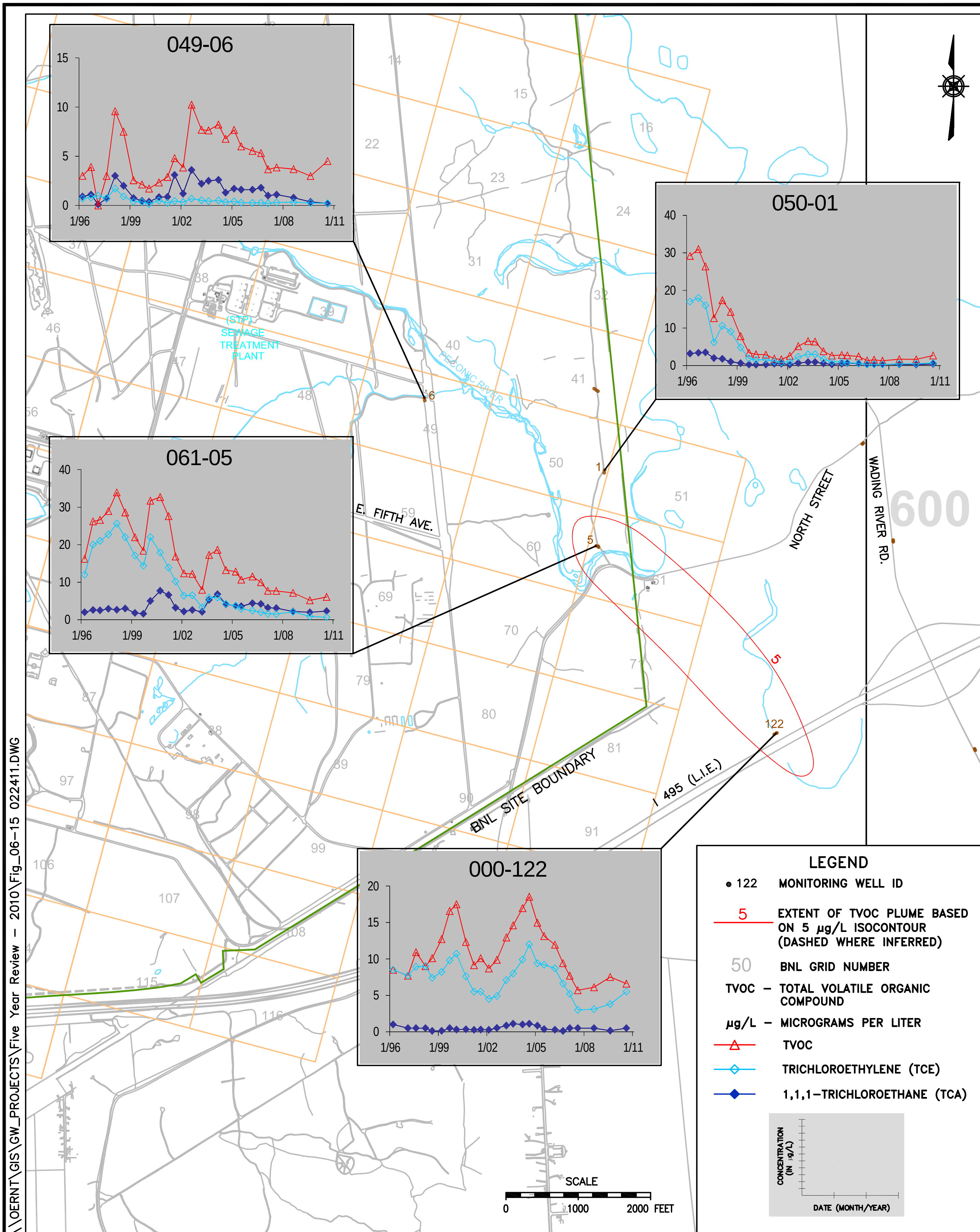


Figure 6-14 2006 - 2010 Peconic River
Average Fish Mercury Concentrations
Annual Mean Fish Mercury (mg/kg)
EPA Mercury Criterion (0.3 mg/kg)
Pre-cleanup 1996 and 2001 Mean Fish Mercury (0.58 mg/kg)
Mercury (mg/kg)
1
0.8
0.6
0.4
0.2
0
0.30
0.31
0.26
0.27
0.27
0.28
2006
2007
2008
2009
2010
All 2006-2010
Year
Error bars represent the mean plus and minus the 95 percent confidence limits



BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

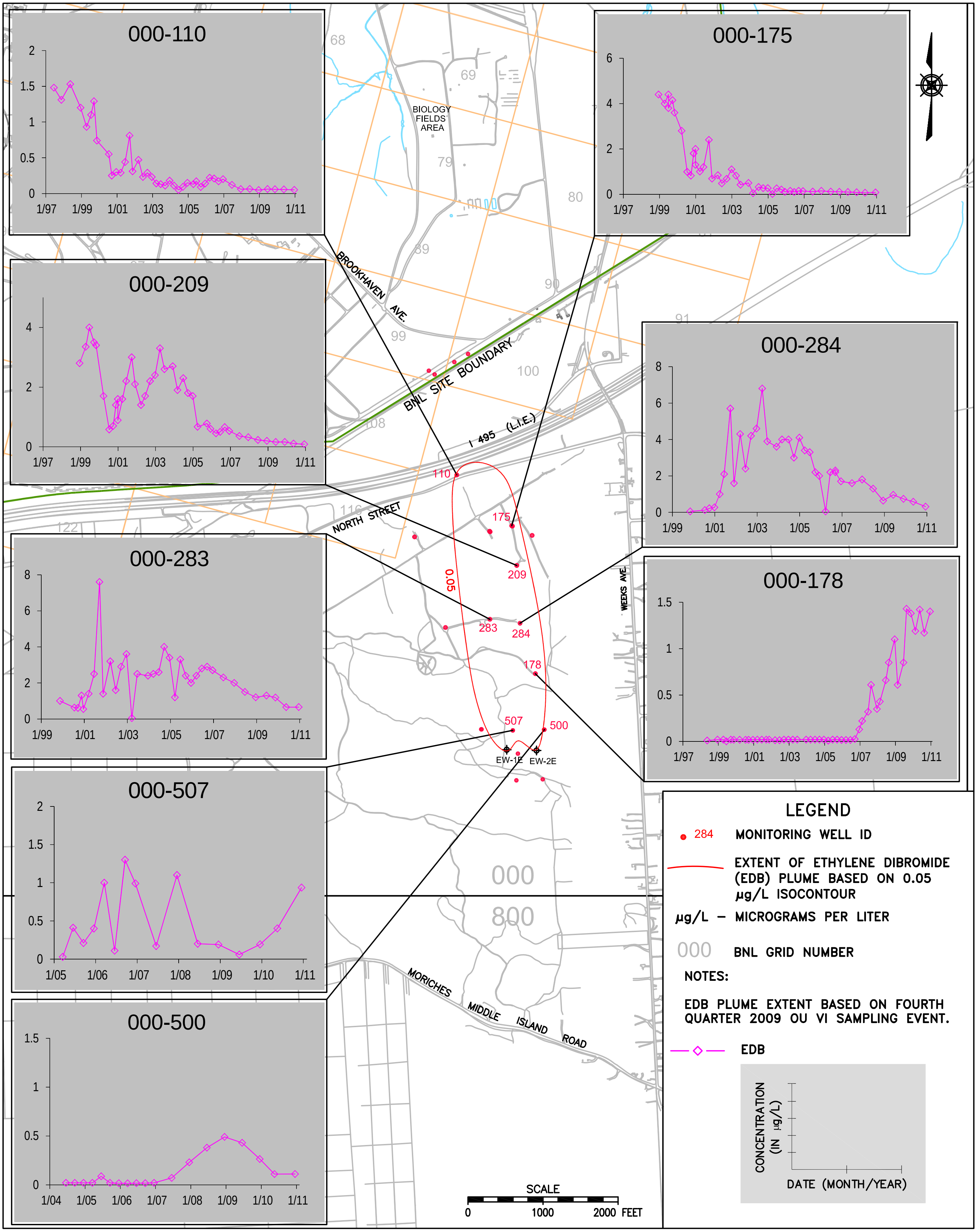
TITLE:

OU V SEWAGE TREATMENT PLANT HISTORICAL VOC TRENDS

2010 BNL FIVE–YEAR REVIEW

DWN: AJZ	VT: HZ.: –	DATE: 02/24/11	PROJECT NO.: –
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
FIGURE NO.: 6–15			

\\OERNT\GIS\GW_PROJECTS\Five Year Review – 2010\Fig_06-16 022311.DWG



BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

TITLE:

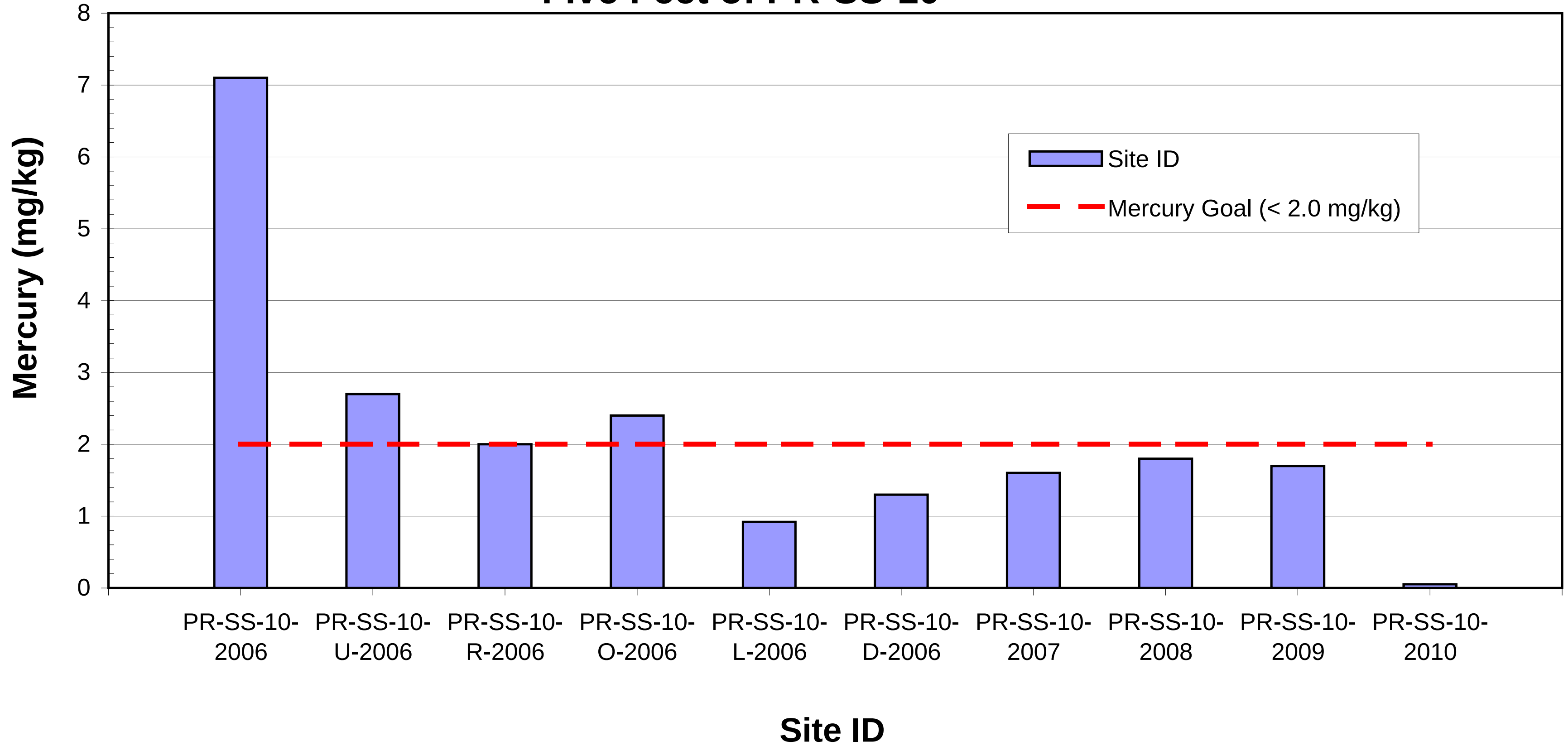
OU VI HISTORICAL EDB TRENDS

2010 BNL FIVE–YEAR REVIEW

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
AJZ	–	02/23/11	–
CHKD: JEB	APPD: WRD	REV.: –	NOTES: –

FIGURE NO.: 6–16

Figure 7-1 2006 - 2010 Sediment Mercury Data at or Within Five Feet of PR-SS-10



Attachment 1

Poll from September 9, 2010 BNL Community Advisory Council Meeting

Five-Year CERCLA Review

Community Advisory Council Input
September 9, 2010

September Meeting Survey

The Community Advisory Council members present at the September 9, 2010 meeting provided comments on the following questions. The comments are to serve as their input into the 2010 Five-Year Review. Additionally, some CAC members also provided written comments.

1. What is your overall impression of BNL's cleanup and do you feel well informed about the cleanup activities and progress?

Member Sprintzen: He is astounded at the care and attention of cleanup at the Peconic River. The Laboratory's effort to attend to and success at it is impressive.

Member Talbot commented on the responsiveness to questions and concerns of a diverse audience.

Member Shea: The quality of charts and graphs in presentations are helpful to us in understanding what's going on.

Member Sprintzen: The progress over the last 12 years has been a remarkable success and is rare. He said there has been a transformation of culture and the contribution of knowledgeable people shows that the Lab is very responsive to the concerns of the community. The Lab has responded constructively to our comments.

Member Henagan: He would add that the Lab is open and pro-active. He commended the Laboratory on being a good neighbor.

Member Chaudhry: The work the Lab is doing on cleanup and keeping the CAC informed is good, but he would like to see the sampling at some point to see the accuracy of the information.

Member Blumer: I am impressed with the speed and responsiveness of the Lab. She sees change due to the CAC's efforts.

Member Biss: Usually the follow-up is good, but sometimes it is missed. She asked what happened to the information on the HFBR. She suggested the Lab occasionally write a letter to the general public with updated information on different topics. Perhaps the Lab could submit articles to the newspapers to get information out to the public.

Member Esposito: Overall things have been very good, she feels well informed. Her organization was looking for cleanup of existing contamination, preventing future contamination, and changing the culture at the Lab. She feels all three have been accomplished. Culture change is the most important. She said always keep transparency and an engaged stakeholder, such as the CAC. She said you need to have checks and balances. Be vigilant.

Member Shea: I would like to follow up on the idea of keeping the public informed. She said broad communication with full disclosure builds confidence.

Member Sprintzen: It is very helpful to have Reed, as the facilitator, here to find common ground and articulate what is said.

Member Guthy agreed and said the CAC and the Lab have come so far.

2. Are there any specific aspects of the cleanup that you feel should be of particular focus during the review? (e.g. Records of Decision, cleanup goals, community input, etc.)

Member Esposito: The timelines should be expedited. Particularly the 50 and70 year timelines for both groundwater and soil remediation, when and where it can be expedited; it should be.

Member Talbot: Skip Medeiros said some places need to be remediated and they are using a new approach. It's important to pursue emerging technologies.

3. Do you feel confident in BNL and DOE's management of the long-term cleanup operations of the site?

Reed said this topic has been covered thoroughly already and asked if anyone had further comment.

4. Do you have any comments, suggestions, or recommendations regarding BNL/DOE's management and communications of the cleanup?

Member Esposito: Keep an educated stakeholder entity so you don't become complacent.

Member Heil: Continue to seek monetary support from Washington D.C. It is important to continue to fund the cleanup effort.

Member Talbot: There has been a nice transition of different Lab Directors. He said site level management is moving forward consistently.

Member Chaudhry: Some community members feel that BNL has spread contamination. He would like more detailed involvement so he would be in a better place to spread accurate information to the public. Perhaps more site visits to see the actual work being done.

Member Henagan: It is important to educate the public. Summer Sundays are great, but some avenues are being missed. Perhaps half hour science shows on TV to keep the public informed and push science education from BNL.

Member Blumer: She will send her responses through the mail. She said her experience has been that many things happen that are not coordinated. She was given a chart, but still couldn't figure out how decisions are made. She is an ecologist and feels that some of the decisions lack a certain amount of concern or knowledge of the environment.

Written Reponses

The following are written responses were received from CAC members on the following four questions:

1. What is your overall impression of BNL's cleanup and do you feel well informed about the cleanup activities and progress?

2. Are there any specific aspects of the cleanup that you feel should be of particular focus during the review: (e.g. Records of Decision, cleanup goals, community input, etc.)

3. Do you feel confident in BNL and DOE's management of the long-term cleanup operations for the site?

4. Do you have any comments, suggestions, or recommendations regarding BNL / DOE's management and communications of the cleanup?

Chris Birben
Colonial Woods / Whispering Pines

Positive, impressive, successful. Responsiveness to concerns and inquiries.

Timelines – is there anywhere that the goals / time frames of the cleanup that is still ongoing can be expedited.

Yes, how can BNL and DOE continue the funding to help with the long-term management of the clean up.

The onus is one me to absorb and digest information shared and presented to the CAC, as a representative of my organization I would have appreciated more time than two or three business days to solicit individual responses of my civic community for opinion responses. For example, the prior Five-Year survey possibly could have tracked back to those individuals. Also, the knowledgeable facilitator for the CAC meetings has been invaluable.

Rita Biss
Lake Panamoka Civic Association

The cleanup appears to be going quite well and information provided especially at the CAC meetings is good. One problem is that some seem to tall through the cracks, nothing is heard about the problem for several years.

One idea to cover the lack of information would be to have an annual summary of either the entire cleanup or completed work or a statement, e.g. the work has been performed and why. e.g. time required for radiation levels to be lowered by time.

A summary of problems, with or without solutions should be presented in the yearly summary.

Local newspapers would probably accept and publish a statement or article from BNL about progress and/or problems and/or new ideas in work at BNL. The summer schedule of summer tours was good. A short published article several times a year would keep the local community informed about BNL.

Iqbal Chaudhary
Science & Technology

I think BNL has done a very good job at clean up of various pollutants that resulted from its operation over the years past. With a slower start or insufficient attention in the beginning BNL became much more attentive and responsive to addressing the problem more systematically and more scientifically in accord with acceptable industrial practices. The progress has been accelerated with the availability of additional funding from the current administration. BNL has been doing as excellent job at keeping the CAC well informed on the progress and success of its cleanup operations.

Community input should be the most important aspect of the focus during the review. Whereas the majority of Long Island residents are now reasonably satisfied with the efforts and accomplishments of the Lab there still are people who harbor concerns at the long term impact of the pollutants that might have been left untreated or ignored so far.

Yes, I have no qualms with the ability and competence of the BNL in managing the long term cleanup operations and in fact I can vouch for it from my person perspective as a member of the CAC.

I find that BNL's communications on the clean up are very competent and efficient. Perhaps more opportunities for the CAC to conduct group site visits would enhance acceptance by the community of the results achieved and reported.

Adrienne Esposito
Citizens Campaign for the Environment

Yes, the CAC is well informed about the cleanup and progress. BNL cleanups are very comprehensive.

Yes, some of the times for remediation. Many clean up plans that are planned for between 50 – 70 years – I feel this is too long. Review of emerging technology for the various cleanups.

Yes, as long as there is a vibrant, educated CAC and community input process. Every system needs accountability. Transparency of the process is key to the success of effectively managing the long-term cleanup.

Don't get lazy or complacent. Provide informative, technical presentations to CAC and don't hold back.

Don Garber
Affiliated Brookhaven Civic Organizations

I think the cleanup is proceeding extremely well. Partly do to the infusion of extra stimulus funds but mainly due to excellent organization and commitment by the cleanup groups. The Lab management directors from Marburger to Chaudhari to Aronson have shown exemplary commitment to keep the CAC and others informed on the cleanup progress.

While the ROD and the Goals are largely behind us, future meetings should focus on how well the cleanup is progressing. Earlier meetings were a good balance as the CAC needed to be informed of the problems then have its input solicited.

I feel quite confident in the present BNL and DOE management. I hope that the present Lab management continues with adequate funding to meet our joint objectives.

I think the dialog is working well. I must point out that the Lab's providing the CAC with Reed Hodgin as a moderator has been quite pivotal to the smooth working of the CAC and therefore to the constructive dialog between the Lab and the community stakeholders.

Helga Guthy
Wading River Civic Association

We have been well informed. BNL has been very responsive to our concerns. The effort of the Lab to bring in people and cover subjects we have asked about has been extremely informative.

Nothing specific that I know of, just do the thorough jobs have done in the past.

Yes, everyone has gone to extremes to furnish information and done clean up of all contamination, throughout BNL, that the CAC has been concerned about.

Continue to include community concerns, and to clean up and inform us of what is happening at BNL in the future.

James Heil
Town of Brookhaven, Senior Representative

The cleanup appears to be well managed and on schedule. The CC is well informed on the progress of the cleanup.

Unanticipated events or procedures learned that could be used under similar circumstances at other Labs should be focused on as well as advances in technologies.

Yes, I feel confident in BNL and DOE's management.

I don't have any additional comments, suggestions, or recommendations.

Pat Henagan
Ridge Civic Association

I feel very informed on the cleanup. The Lab has been very forth coming on "blemishes" that it finds in the process.

Rate of progress towards the goals should be focused on.

Yes, with the current management. I do hope that future management teams continue this level of performance.

BNL has done an excellent job of keeping the CAC informed. It is disappointing that the Lab doesn't do more public communication via available media channels. Besides the newspapers, BNL PR dept should look at the possibility of either public access channels or News12 to do a weekly program.

Beth Motschenbacher
Long Island Pine Barrens Society

We have been asking for a very long time for a summary of how each clean-up component worked out relative to expectations, time, and expense. We don't think we know this at all.

Cleanup goals relative to projected and actual expenses should be focused on.

If BNL continues open communication and modifying its practices based on lessons learned from past mistakes then the prognosis for long-term cleanup looks good.

The Lab seems to be communicating well on current operations and advising the CAC of the rare problems that have cropped up. We think communications between the Lab and the community have steadily improved.

Arnie Peskin
Brookhaven Retired Employees Association

I have a positive feeling about both the cleanup and the Lab's attempt to keep the CAC informed.

In addition to the three mentioned above, perhaps a review of Lab programs to keep the community informed (community dialogue, not just community input).

I do, but recognize this can change each time there is a change in BNL or DOE management. Who is the custodian of the "institutional memory" of commitments?

I have no other comments or suggestions, other than what I have mentioned above.

David Sprintzen
Long Island Progressive Coalition

I think that BNL has done an exceptional job on informing and responding to community input and has addressed the cleanup with responsibility, attention to detail, and concerns for health and safety.

Goals and community input – in accord with technical information concerning environmental and health and safety concerns.

So long as current management and goals remain, the answer is yes.

It is important for BNL/ DOE to provide complete and timely information of problems and strategies to the members of the CAC.

Tom Talbot
Longwood Alliance

BNL provided numerous opportunities for CAC members to request and receive information, additionally, field trips and topic specific presentation were set up and well attended.

Goal management is the most effective means of evaluating many of the issues addressed in the cleanup. Oversight should also include emerging technologies that may benefit the cleanup

Yes, and hopefully financial constraints will not be an issue, or cause the Lab to forgo their true missions in order to fund the cleanup operations.

It is a good model of how to deal with a complex set of issues and to communicate with a diverse audience. It appears that BNL management/staff have successfully implemented a culture change which will endure.

No Name

BNL's cleanup has been vigorous, transparent, and targets stakeholder groups for input. Considerable progress has been made across-the-board.

An ongoing tally of the degree to which cleanup goals have been met would be most useful (particularly if made available online).

BNL has demonstrated its sincerity to best environmental practices and has gained the confidence of the many stakeholder groups involved in the CAC.

More on-site tours of cleanups and other items of environmental interest. And outreach to students (high school and colleges).

Attachment 2

2009 BNL Groundwater Status Report, BNL 2009 (CD Version)

(To be included in public availability version)

Attachment 3

Inspection Checklists

BNL Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Brookhaven National Laboratory	**Date(s) of inspection:** 3/30/10 through 7/12/10
Location and Region: Upton, NY, EPA Region 2	**EPA ID:** NY7890008975
Agency, office, or company leading the five-year review: Brookhaven Science Associates (BSA) for the U.S. Department of Energy (DOE)	**Weather/temperature:** NA
Remedy Includes: (Check all that apply) ☒Landfill cover/containment ☒ Monitored natural attenuation ☒ Access controls ☒ Groundwater containment ☒ Institutional controls ☐ Vertical barrier walls ☒ Groundwater pump and treatment ☐ Surface water collection and treatment ☐ Other___________________________	
Attachments: ☒ Inspection team roster attached ☐ Site map attached	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** _ Bill Dorsch, LTRA Manager_ Interviewed ☒ at site ☒ at office ☐ by phone Phone no. _344-5186 Problems, suggestions; ☐ Report attached _Work with on a daily basis and discuss issues weekly. ___	
2. **O&M staff** Vinnie Racaniello, Eric Kramer, Adrian Steinhauff, Project Manager and Field Engineers Interviewed ☒ at site ☒ at office ☐ by phone Phone no. 344-5436, 8226, 2363______________ Problems, suggestions; ☐ Report attached Work with on a daily basis and discuss issues weekly.____	
3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply. Agency ___EPA, DEC, SCDHS, DOE _________________________ Contact ____________ ____________ ________ ____________ Name Title Date Phone no. Problems; suggestions; ☒ Report attached See interview records. ______________________________ Agency ______________________________ Contact ____________ ____________ ________ ____________ Name Title Date Phone no. Problems; suggestions; ☐ Report attached ______________________________ ______________________________	
4. **Other interviews** (optional) ☐ Report attached.	

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual ☒ Readily available ☒ Up to date ☐ N/A
☒ As-built drawings ☒ Readily available ☒ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☐ N/A

Remarks: All O&M Manuals have been updated and are available on the website. The as-built drawings are available through Facility & Operations database.

2. **Site-Specific Health and Safety Plan** ☒ Readily available ☒ Up to date ☐ N/A

☒ Contingency plan/emergency response plan ☒ Readily available ☒ Up to date ☐ N/A

Remarks: Each project has a H&S Plan and Work Permit specific to that job. The operating groundwater treatment systems have a contingency/emergency plan in their O&M Manuals.

3. **O&M and OSHA Training Records** ☒ Readily available ☐ Up to date N/A

Remarks _Worker training records are available on the BNL training website database. __

4. **Permits and Service Agreements**

☒ Air discharge permit ☒ Readily available ☒ Up to date ☐ N/A
☒ Effluent discharge ☒ Readily available ☒ Up to date ☐ N/A
☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☐ N/A
☒ Other permits: Peconic ☒ Readily available ☒ Up to date ☐ N/A

Remarks: DEC air and SPDES equivalency permits in place for all treatment systems, as appropriate. Peconic River On-site and Off-site Supplemental Sediment Removal permit is in place. ____

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: Passive gas venting only. ________________________________

6. **Groundwater Monitoring Records** ☒ Readily available ☒ Up to date ☐ N/A

Remarks: Groundwater monitoring data is made available via the Quarterly System Operations Reports, as well as the Annual Groundwater Status Report. _________________

7. **Discharge Compliance Records**

☒ Air ☒ Readily available ☒ Up to date ☐ N/A
☒ Water (effluent) ☒ Readily available ☒ Up to date ☐ N/A

Remarks: Discharge Monitoring Reports (DMRs) for the treatment systems with SPDES equivalency permits are issued monthly to the DEC. Air compliance records are documented in the Annual Groundwater Status Reports. ____________________________________

8. **Daily Access/Security Logs** ☒ Readily available ☐ Up to date ☐ N/A

Remarks_Daily operating data sheets for the groundwater systems are available at the treatment building and the Project files.

9. **Comments** ____

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☒ Contractor for Federal Facility
☐ Other: Responsibility for managing BNL's Long Term Response Actions lies with the Environmental Protection Division's (EPD) Groundwater Protection Group (GPG). ___

2. **O&M Cost Records**

☒ Readily available ☒ Up to date
☒ Funding mechanism/agreement in place
Original O&M cost estimate____________________ ☐ Breakdown attached

Total annual cost by year for review period if available

	From (Date)	To (Date)	Total cost	
From	10/04	9/05	Avg. Annual of $246K	☒ Breakdown attached
From	10/05	9/06	Avg. Annual of $228K	☒ Breakdown attached
From	10/06	9/07	Avg. Annual of $211K	☒ Breakdown attached
From	10/07	9/08	Avg. Annual of $203K	☒ Breakdown attached
From	10/08	9/09	Avg. Annual of $204K	☒ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: No unusually high O&M costs identified. FY05 was the first full year of operation for the five treatment systems beyond the BNL property. The annual costs for each system from FY2005 through FY2009 is identified in the Five-Year Review.

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A	
A. Fencing	
1.	**Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A Remarks: See Current Landfill inspection forms for needed repair to gate. _
B. Other Access Restrictions	
1.	**Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks: Identification signs are in place for all of the on-site and off-site groundwater treatment systems. DOE notification signs are in place for all treatment facilities located beyond BNL's property boundary. There are BNL security personnel at the site 24 hours per day. For the systems located beyond the BNL boundaries, security cameras are present that communicate with BNL's security personnel. Restricted use signs are posted at former soil cleanup areas including the Former Hazardous Waste Management Facility, former Meadow Marsh, Landfills, Ash Pit, former Chemical Holes, Bldg. 96, Bldg. 650 Sump Outfall, and Bldg. 811. ______________________________
C. Institutional Controls (ICs)	
1.	**Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A Type of monitoring (*e.g.*, self-reporting, drive by): Routine walkdown inspections of landfills, former soil cleanup areas, and groundwater treatment systems. ____ Frequency: Varies from almost daily for treatment systems, monthly for landfills, semi-annual former soil cleanup araes. ____ Responsible party/agency: BSA under contract with DOE. ____ Contact: William Dorsch — BSA GPG Manager — 3/21/05 — (631) 344-5186 Gail Penny — DOE Project Manager — 3/21/05 — (631) 344-4363 Name — Title — Date — Phone no. Reporting is up-to-date ☒ Yes ☐ No ☐ N/A Reports are verified by the lead agency ☒ Yes ☐No ☐ N/A Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A Violations have been reported ☐ Yes ☒ No ☐ N/A Other problems or suggestions: ☐Report attached Remarks: There are seven access agreements in place among BSA/DOE and various property owners to allow for operation of BNL's groundwater remediation systems for plumes that have migrated beyond the BNL property. Each agreement has terms and conditions that must be adhered to. A license agreement is also in place among BSA/BHSO/Suffolk County for the supplemental sediment cleanup for the Peconic River in 2010/2011.___________________________________
2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks: The Land Use Controls Management Plan and institutional controls website and fact sheets continue to be updated, as needed to reflect the most recent IC's for each project. ___

D. General		
1.	**Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident Remarks_There has been some vandalism in the past at some of the treatment systems located beyond the BNL property. However, additional precautions have been implemented such as security cameras, motion detectors, and fencing to help minimize the potential risk. ____________	
2.	**Land use changes on site** ☒ N/A Remarks: None____	
3.	**Land use changes off site** ☒ N/A Remarks: None____	
	VI. GENERAL SITE CONDITIONS	
A. Roads	☒ Applicable ☐ N/A	
1.	**Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks____	
B. Other Site Conditions		
	Remarks: ____	

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A
A. Project OU I AOC 2F Ash Pit 6/24/10
1. **Soil Excavation Complete** ☒ Yes ☐ No Remarks ______
2. **S&M Documents** ☒ S&M Plan ☒ Readily available ☐ Up to date ☐ N/A ☒ Completion/Closeout Report ☒ Readily available ☒ Up to date ☐ N/A ☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A Remarks: Final Closeout Report for the Ash Pit OU I AOC 2F, dated 2/5/04. Section 4.0 of the Closeout Report identifies LTRA requirements (i.e., annual inspection). _
3. **Settlement** (Low spots) ☒ Location shown on site map ☒ Settlement not evident Areal extent ______ Depth______ Remarks: None
4. **Erosion** ☒ Location shown on site map ☒ Erosion not evident Areal extent______ Depth______ Remarks: None.
5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Trees surround the pit area. Excellent native grass growth.
6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Location shown on site map Areal extent______ ☐ Ponding ☐ Location shown on site map Areal extent______ ☐ Seeps ☐ Location shown on site map Areal extent______ ☐ Soft subgrade ☐ Location shown on site map Areal extent______ Remarks: None.
7. **Monitoring Wells** (within the excavated area) ☒ Properly secured/locked ☒ Functioning ☐ Routinely sampled ☒ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks______
8. **Other Site Conditions**
Remarks: Inspection attendees include W. Dorsch, R. Howe, K. Conkling, D. Hanley. ____

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A

A. Project OU I AOC 8 Meadow Marsh 6/28/10

1. **Soil Excavation Complete** ☒ Yes ☐ No
Remarks ______

2. **S&M Documents**
☒ S&M Plan ☒ Readily available ☐ Up to date ☐ N/A
☒ Completion/Closeout Report ☒ Readily available ☒ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A
Remarks: Final Closeout Report for the Meadow Marsh OU I AOC 8, dated 2/6/04. Section 4.0 of the Closeout Report identifies LTRA requirements (i.e., ecological monitoring and inspection for Tiger Salamanders). Institutional controls are also identified in the Report.

3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident
Areal extent______ Depth______
Remarks______

4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent______ Depth______
Remarks______

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☒ No signs of stress
G Trees/Shrubs (indicate size and locations on a diagram)
Remarks: Native grasses planted adjacent to the pond.

6. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent______
☒ Ponding ☐ Location shown on site map Areal extent______
☐ Seeps ☐ Location shown on site map Areal extent______
☐ Soft subgrade ☐ Location shown on site map Areal extent______
Remarks: The remediated area is a pond for the Tiger Salamanders.

7. **Monitoring Wells** (within the excavated area)
☒ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks______

8. **Other Site Conditions**
Remarks: Inspection attendees include R. Howe, D. Hanley.

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A

A. Project OU I AOC 6 Bldg. 650 Sump Outfall 6/29/10

1. **Soil Excavation Complete** ☒ Yes ☐ No
Remarks ______

2. **S&M Documents**
☒ S&M Plan ☒ Readily available ☐ Up to date ☐ N/A
☒ Completion/Closeout Report ☒ Readily available ☐ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A
Remarks: Draft Final Closeout Report for AOC 6 Bldg. 650 Sump and Sump Outfall, dated 1/02.

3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident
Areal extent______ Depth______
Remarks: The entire area is graded and a drainage swale exists that routes surface runoff to the ponded sump. The pond has been staying wet year round.

4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent______ Depth______
Remarks: ______

5. **Vegetative Cover** ☒ Grass ☐ Cover properly established ☒ No signs of stress
☒ Trees/Shrubs (indicate size and locations on a diagram)
Remarks: Some trees surround the sump. Good native grass cover.

6. **Wet Areas/Water Damage** G Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent______
☒ Ponding ☐ Location shown on site map Areal extent______
☐ Seeps ☐ Location shown on site map Areal extent______
☐ Soft subgrade ☐ Location shown on site map Areal extent______
Remarks: Pond is Tiger Salamander habitat

7. **Monitoring Wells** (within the excavated area)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks:

8. **Other Site Conditions**

Remarks: Inspection attendees include W. Dorsch, V. Racaniello, R. Howe. Replace institutional control sign at pond. Fence partially surrounds the former sump outfall (no restrictions for entering area).

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A
A. Project OU I AOC 16S Landscape Soil Areas 6/22/10
1. **Soil Excavation Complete** ☒ Yes ☐ No Remarks ____
2. **S&M Documents** ☒ S&M Plan ☒ Readily available ☐ Up to date ☐ N/A ☒ Completion/Closeout Report ☒ Readily available ☒ Up to date ☐ N/A ☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A Remarks: Final Closeout Report for AOC 16 Landscape Soils, dated 4/10/01.
3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent____ Depth____ Remarks____
4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident Areal extent____ Depth____ Remarks____
5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress G Trees/Shrubs (indicate size and locations on a diagram) Remarks____
6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Location shown on site map Areal extent____ ☐ Ponding ☐ Location shown on site map Areal extent____ ☐ Seeps ☐ Location shown on site map Areal extent____ ☐ Soft subgrade ☐ Location shown on site map Areal extent____ Remarks____
7. **Monitoring Wells** (within the excavated area) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks____
8. **Other Site Conditions**
Remarks: Inspection attendees include W. Dorsch, R. Howe, K. Conkling, D. Hanley. Due to the construction of the Interdisciplinary Science Building (ISB), landscape soil from the Bldg. 355 area was excavated in March 2010 and transferred to the former HWMF to be used as fill (per attached ISB Letter to Regs 11/10/09). Three confirmatory soil samples identified remaining Cs-137 concentrations below 0.5 pCi/g. Recommendations: Update the Landscape Soil LUIC Factsheet to include that the Bldg. 355 soils were removed and confirmatory samples obtained. The area is now the location of the ISB construction site. No further inspections are necessary.

Landscape Soil From Bldg. 355

	
3/4/10 – Building 355 excavated landscape soil area at ISB construction site	3/2/10 – Excavated landscape soil transferred to former hazardous waste management facility for use as fill

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A

A. Project OU I AOC 1 Hazardous Waste Management Facility (HWMF) 6/28/10__________

1. **Soil Excavation Complete** ☒ Yes ☐ No

Remarks:

2. **S&M Documents**

☒ S&M Plan ☒ Readily available ☐ Up to date ☐ N/A
☒ Completion/Closeout Report ☒ Readily available ☒ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A

Remarks: The OU I Soils and OU V Long-Term Monitoring and Maintenance Plan, dated May 2006. The Final Closeout Report for the Former Hazardous Waste Management Facility, dated 9/29/05.

3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident

Areal extent_______________ Depth_____________

Remarks:

4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident

Areal extent_______________ Depth_____________

Remarks: __

5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☐ No signs of stress

☒ Trees/Shrubs (indicate size and locations on a diagram)

Remarks: Some trees remain.

6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident

☒ Wet areas ☐ Location shown on site map Areal extent_small__________
☐ Ponding ☐ Location shown on site map Areal extent_______________
☐ Seeps ☐ Location shown on site map Areal extent_______________
☐ Soft subgrade ☐ Location shown on site map Areal extent_______________

Remarks: Two small slightly wet areas in yard. Not significant since vegetation is well established. Backfill was added to these lower areas from the Bldg. 355 landscape soils (see Landscape Soil inspection). The wetland area immediately to the northwest of the FHWMF was slightly wet. ______

7. **Monitoring Wells** (within the excavated area)

☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A

Remarks:

8. **Other Site Conditions**

Remarks: Inspection attendees include R. Howe, D. Hanley.
BNL RadCon completed the annual survey of the fixed contamination on several of the concrete foundations 6/15/10. No loose contamination detected. An Environmental Restoration Project (ERP) Radioactive Material Storage Area is located just outside the main gate and the postings extend slightly into the FHWMF. ERP to remove materials from the Waste Loading Area and fence and piping debris just outside the FHWMF yard. Following completion of ERP reactor waste shipping, perform Exit Readiness Evaluation for transfer of ownership to BNL Environmental Protection Division. Recommendation: Update LUIC Factsheet to reflect the identification in 2009 of the fixed contamination on five of the concrete foundations. They are rountine inspected and monitored by BNL and there should be no disturbance op these areas without BNL RadCon notification.

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A

A. Project OU V AOC 30 Peconic River 7/12/10

1. **Soil Excavation Complete** ☒ Yes ☐ No

Remarks: The original 2004/2005 is complete, however, procurement is underway to perform supplemental sediment remediation of three small areas in 2010. ___________________

2. **S&M Documents**

☒ S&M Plan ☒ Readily available ☐ Up to date ☐ N/A
☒ Completion/Closeout Report ☒ Readily available ☒ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A

Remarks: The OU I Soils and OU V Long-Term Monitoring and Maintenance Plan, dated May 2006. Surface water, sediment, and fish monitoring requirements are identified in this Plan.

Final Closeout Report for Peconic River Remediation Phases 1 and 2, 8/25/05.

3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident
Areal extent______________ Depth____________
Remarks: __________

4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent______________ Depth____________
Remarks____
____

5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress
☒ Trees/Shrubs (indicate size and locations on a diagram)
Remarks:

6. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
☒ Wet areas ☐ Location shown on site map Areal extent______________
☒ Ponding ☐ Location shown on site map Areal extent______________
☒ Seeps ☐ Location shown on site map Areal extent______________
☒ Soft subgrade ☐ Location shown on site map Areal extent______________
Remarks: This is all indicitative of the River and wetland environment.

7. **Monitoring Wells** (within the excavated area)
☒ Properly secured/locked ☒ Functioning ☐ Routinely sampled ☒ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks: Most wells are in good condition.

8. **Other Site Conditions**

Remarks: Inspection attendees include T. Green, R. Howe, W. Dorsch, D. Hanley.

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A
A. Project OU I AOC 10 Building 811 UST and Soils 6/29/10
1. **Soil Excavation Complete** ☒ Yes ☐ No Remarks: Excavation complete in 2005.
2. **S&M Documents** ☒ S&M Plan ☒ Readily available ☐ Up to date ☐ N/A ☒ Completion/Closeout Report ☒ Readily available ☒ Up to date ☐ N/A ☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A Remarks: Final Closeout Report for AOC 10 Waste Concentration Facility, 9/05. The OU I Soils and OU V Long-Term Monitoring and Maintenance Plan, dated May 2006.
3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent______________ Depth____________ Remarks: Excavation and restoration is complete.
4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident Areal extent______________ Depth____________ Remarks: __________________
5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Native grasses established. ____________
6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Location shown on site map Areal extent______________ ☐ Ponding ☐ Location shown on site map Areal extent______________ ☐ Seeps ☐ Location shown on site map Areal extent______________ ☐ Soft subgrade ☐ Location shown on site map Areal extent______________ Remarks______________________________
7. **Monitoring Wells** (within the excavated area) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☒ Needs Maintenance ☐ N/A Remarks: All of the BNL monitoring wells are secured and locked. Cracked well casing for flush mount monitoring well 065-161 awaiting repairs once AB waste line remediation project is complete.
8. **Other Site Conditions**
Remarks: Inspection attendees include W. Dorsch, V. Racaniello, R. Howe.

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A
A. Project OU III AOC 26B Building 96 7/7/10________________________
1. **Soil Excavation Complete** ☒ Yes ☐ No Remarks: PCB soil excavation complete in 2005. Planning is underway for the excavation of a localized area of high concentrations of PCE in soil that is scheduled to be excavated in August 2010.
2. **S&M Documents** ☒ S&M Plan ☒ Readily available ☐ Up to date ☐ N/A ☒ Completion/Closeout Report ☒ Readily available ☒ Up to date ☐ N/A ☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A Remarks: OU III Building 96 PCB Soil (AOC 26B) Excavation Closeout Report, 3/05. The OU I Soils and OU V Long-Term Monitoring and Maintenance Plan, dated May 2006.
3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent______________ Depth____________ Remarks: Excavation of PCB soils is complete. ____
4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident Areal extent______________ Depth____________ Remarks: BNL Facility and Operations cleaned-out vegetation to adjacent culvert that is covered with asphalt, since it is impeding flow to Recharge Basin HS.________________________
5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Native grasses established. ____________
6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Location shown on site map Areal extent______________ ☐ Ponding ☐ Location shown on site map Areal extent______________ ☐ Seeps ☐ Location shown on site map Areal extent______________ ☐ Soft subgrade ☐ Location shown on site map Areal extent______________ Remarks____ ____
7. **Monitoring Wells** (within the excavated area) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☒ Needs Maintenance ☐ N/A Remarks: All of the BNL monitoring wells are secured and locked. Cracked well casing for flush mount monitoring well 065-161 awaiting repairs once AB waste line remediation project is complete.
8. **Other Site Conditions**
Remarks: Plastic cover over PCE-contaminated soils in good condition. Inspection attendees include R. Howe.

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A
A. Project OU I AOC 2B,C Chemical/Animal/Glass Holes 6/21/10________________________
1. **Soil Excavation Complete** ☒ Yes ☐ No Remarks: Soil excavation complete in 2005.
2. **S&M Documents** ☒ S&M Plan ☒ Readily available ☐ Up to date ☐ N/A ☒ Completion/Closeout Report ☒ Readily available ☒ Up to date ☐ N/A ☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A Remarks: Animal/Chemical Pits and Glass Holes Remedial Action Closure Report Addendum, 9/05. The OU I Soils and OU V Long-Term Monitoring and Maintenance Plan, dated May 2006.
3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent______________ Depth____________ Remarks: None. ____
4. **Erosion** ☐ Location shown on site map ☐ Erosion not evident Areal extent______________ Depth_<1 foot___________ Remarks: BNL Facility and Operations to repair the one erosional area and seed.__________
5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Native grasses established. ____________
6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Location shown on site map Areal extent______________ ☐ Ponding ☐ Location shown on site map Areal extent______________ ☐ Seeps ☐ Location shown on site map Areal extent______________ ☐ Soft subgrade ☐ Location shown on site map Areal extent______________ Remarks____ ____
7. **Monitoring Wells** (within the excavated area) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks: None.
8. **Other Site Conditions**
Remarks: Rehung the LUIC sign near the former Glass Holes area which was found on the ground nearby. Recommendations: Modify the LUIC Factsheet to state that the former Glass Holes area is currently being used for site composting operations. A fabric liner was installed on the existing grade to ensure there is no disruption/penetration into the soil. Inspection attendees include R. Howe, J. Burke, W. Dorsch, R. Lee, E. Kramer, D. Hanley, T. Kneitel.

Location (AOC): Sewage Treatment Plant
Date of Inspection: 7/12/10___________________________________
Name of Inspector(s): R. Howe, W. Dorsch, T. Green, D. Hanley
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 2x/yr) ☐ Heavy Rainfall ☐ Reported Incident

A. Inspection Checklist

Component	Observed Condition: Excell.	Fair	Poor	Not Applic.	Further Action Req'd: Yes (describe)	No
1. Landfill Cap/SoilCover:						
Vegetation (e.g. grass)	X					X
Soil (Cap/Cover/Fill)	X					X
Other: ________________________						
2. Drainage Structures:						
Standing Water				X		X
Toe Drain				X		X
Drainage Channels				X		X
French Drains/Outfalls				X		X
Subsurface Drainage	X					X
Pipes/Outfalls				X		X
Manholes				X		X
Berms				X		X
Roof Drains	X					X
Recharge Areas						
Other: ________________________						
3. Monitoring System:						
Soil Gas Wells				X		X
Groundwater Wells	X					X
Gas Vents				X		X
Other: _____________________						
4. Site Access:						
Asphalt Access Road				X		X
Crushed-concrete Access Road		X				X
Fence	X					X
Gates/locks	X					X
Radiological Postings				X		X
Other:						

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence:

B. Description of Other Observations

Observed Conditions/Recommendations: No issues at STP. No unauthorized work visible at the abandoned sewer line area. No erosion of soil cover. Cover installed on sand trap located between the sand filters and the plant outfall. LUIC Fact Sheet Changes: Delete section of sewer pipe on figure that is south of East Fifth Ave. Under Remedial Action, add, Sludge was removed from manholes and a sewer line was capped and replaced with a new line. Under Admin. Controls, add control to prevent excavation or damage to the buried sewer line.

Location (AOC): Old Firehouse
Date of Inspection: 6/30/10
Name of Inspector(s): R. Howe, W. Dorsch, D. Paquette, K. Conkling, D. Hanely
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 1x/yr) ☐ Heavy Rainfall ☐ Reported Incident

A. Inspection Checklist

	Component	Observed Condition: Excell.	Fair	Poor	Not Applic.	Further Action Req'd: Yes (describe)	No
1.	**Landfill Cap/Soil Cover**						
	Vegetation (e.g. grass)	X					X
	Soil (Cap/Cover/Fill)				X		X
	Other: ________________________						
2.	**Drainage Structures:**						
	Standing Water				X		X
	Toe Drain				X		X
	Drainage Channels				X		X
	French Drains/Outfalls				X		X
	Subsurface Drainage				X		X
	Pipes/Outfalls				X		X
	Manholes				X		X
	Berms				X		X
	Roof Drains				X		X
	Recharge Areas				X		X
	Other: _______________						
3.	**Monitoring System:**						
	Soil Gas Wells				X		X
	Groundwater Wells	X					X
	Gas Vents				X		X
	Other: __________				X		X
4.	**Site Access:**						
	Asphalt Access Road	X					X
	Crushed-concrete Access Road				X		X
	Fence				X		X
	Gates/locks				X		X
	Radiological Postings				X		X
	Other: ________________________						

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence:

B. Description of Other Observations

Observed Conditions/Recommendations: The area currently consists grass and trees adjacent to the east side of the NSLS. LUIC Factsheet Changes, Replace existing factsheet photo.

Location (AOC): Old Incinerator Facility
Date of Inspection: 6/24/10________________________________
Name of Inspector(s): R. Howe, W. Dorsch, K. Conkling, D. Hanley
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 2x/yr) ☐ Heavy Rainfall ☐ Reported Incident

A. Inspection Checklist

Component	Observed Condition: Excell.	Fair	Poor	Not Applic.	Further Action Req'd: Yes (describe)	No
1. Landfill Cap/Soil Covers:						
Vegetation (e.g. grass)	X					X
Soil (Cap/Cover/Fill)	X					X
Other: ____________________						
2. Drainage Structures:						
Standing Water	X					X
Toe Drain				X		X
Drainage Channels				X		X
French Drains/Outfalls				X		X
Subsurface Drainage				X		X
Pipes/Outfalls				X		X
Manholes				X		X
Berms				X		X
Roof Drains				X		X
Recharge Areas						
Other: ____________________						
3. Monitoring System:						
Soil Gas Wells				X		X
Groundwater Wells	X					X
Gas Vents				X		X
Other: ____________________						
4. Site Access:						
Asphalt Access Road				X		X
Crushed-concrete Access Road				X		X
Fence				X		X
Gates/locks				X		X
Radiological Postings				X		X
Other: ____________________				X		X

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence: __________

B. Description of Other Observations

Observed Conditions/Recommendations: No soil erosional areas identified. Soil cover in good condition. LUIC Factsheet Changes: Add a Current Conditions Section that says the area consists of a grassy filed covered with at least 12" of topsoil. Delete reference and link to the OU I ROD and the Ash Pit Closeout Report. Change For Additional Information contact Bob Lee.

Location (AOC): Bubble Chamber
Date of Inspection: 6/30/10
Name of Inspector(s): R. Howe, W. Dorsch, D. Paquette, K. Conkling, D. Hanley, M. VanEssendelft, Frank Craner
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 1x/yr) ☐ Heavy Rainfall ☐ Reported Incident

A. Inspection Checklist

	Component	Observed Condition: Excell.	Fair	Poor	Not Applic.	Further Action Req'd: Yes (describe)	No
1.	**Landfill Cap/Soil Covers:**						
	Vegetation (e.g. grass)		X				X
	Soil (Cap/Cover/Fill)				X		X
	Other: ______						
2.	**Drainage Structures:**						
	Standing Water				X		X
	Toe Drain				X		X
	Drainage Channels				X		X
	French Drains/Outfalls				X		X
	Subsurface Drainage				X		X
	Pipes/Outfalls				X		X
	Manholes				X		X
	Berms				X		X
	Roof Drains				X		X
	Recharge Areas				X		X
	Other: ______						
3.	**Monitoring System:**						
	Soil Gas Wells				X		X
	Groundwater Wells		X				X
	Gas Vents				X		X
	Other: ______				X		X
4.	**Site Access:**						
	Asphalt Access Road		X				X
	Crushed-concrete Access Road				X		X
	Fence	X					X
	Gates/locks	X					X
	Radiological Postings	X				For AGS Rad Storage	X
	Other: ______						

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence: M. VanEssendelft from Collider Accelerator Dept (CA-D) and Frank Craner from ES attended the inspection and said there has been no unauthorized access to the posted/fenced rad storage area. In addition, any digging proposed for the area would be reviewed by the Groundwater Protection Group via the digging permit process.

B. Description of Other Observations

Observed Conditions/Recommendations: A portion of the area currently consists of a Collider Accelerator Dept. (CA-D) Bldg. 960 Waste Yard for outdoor storage of rad materials. It is fenced, locked, with rad postings, and paved. The remainder of the area to the north is open and consists of grass, pavement, and concrete slabs (no postings). LUIC Factsheet Changes: Add a Current Conditions Section that states the conditions described above.

Location (AOC): Low Mass Criticality Facility
Date of Inspection: 7/7/10______________________________________
Name of Inspector(s): R. Howe, W. Dorsch, D. Paquette, K. Conkling, D. Hanley
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 1x/yr) ☐ Heavy Rainfall ☐ Reported Incident

A. Inspection Checklist

	Component	**Observed Condition**				**Further Action Req'd**	
		Excell.	**Fair**	**Poor**	**Not Applic.**	**Yes (describe)**	**No**
1.	**Landfill Cap/Soil Covers:**						
	Vegetation (e.g. grass)	X					X
	Soil (Cap/Cover/Fill)				X		X
	Other: ______________						
2.	**Drainage Structures:**						
	Standing Water		X			Little water in basin	X
	Toe Drain				X		X
	Drainage Channels				X		X
	French Drains/Outfalls				X		X
	Subsurface Drainage	X					X
	Pipes/Outfalls	X					X
	Manholes				X		X
	Berms	X					X
	Roof Drains		X			Phragmites in basin	X
	Recharge Areas				X		X
	Other: ______________						
3.	**Monitoring System:**						
	Soil Gas Wells				X		X
	Groundwater Wells	X					X
	Gas Vents				X		X
	Other: __________				X		X
4.	**Site Access:**						
	Asphalt Access Road				X		X
	Crushed-concrete Access Road		X				X
	Fence				X		X
	Gates/locks				X		X
	Radiological Postings				X		X
	Other: ______________						

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence:

____

____

B. Description of Other Observations

Observed Conditions/Recommendations: No IC issues. LUIC Factsheet: Add a Current Conditions section.

Location (AOC): AGS Storage Yards (1 and 2)
Date of Inspection: 6/30/10______________________________________
Name of Inspector(s): R. Howe, W. Dorsch, D. Paquette, K. Comkling, D. Hanley, M. VanEssendelft (CA-D), Frank Craner (ES)
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 1x/yr) ☐ Heavy Rainfall ☐ Reported Incident

A. Inspection Checklist

Component	Observed Condition: Excell.	Fair	Poor	Not Applic.	Further Action Req'd: Yes (describe)	No
1. Landfill Cap/Soil Covers:						
Vegetation (e.g. grass)				X		X
Soil (Cap/Cover/Fill)				X		X
Other: __________						
2. Drainage Structures:						
Standing Water				X		X
Toe Drain				X		X
Drainage Channels				X		X
French Drains/Outfalls				X		X
Subsurface Drainage				X		X
Pipes/Outfalls				X		X
Manholes				X		X
Berms				X		X
Roof Drains				X		X
Recharge Areas				X		X
Other: __________						
3. Monitoring System:						
Soil Gas Wells				X		X
Groundwater Wells	X					X
Gas Vents				X		X
Other: __________						
4. Site Access:						
Asphalt Access Road				X		X
Crushed-concrete Access Road				X		X
Fence				X		X
Gates/locks	X					X
Radiological Postings	X					X
Other: __________						

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence: M. VanEssendelft from Collider Accelerator Dept (CA-D) attended the inspection and said there has been no unauthorized access to the posted/fenced rad storage areas.

B. Description of Other Observations

Observed Conditions/Recommendations: The Bldg. 912 Steel Yard (Yard 1A) is a Radioactive Material Area (RMA). It is fenced, rad posted with a chain, and a contact sign. The Bldg. 912 Lead Yard (Yard 1B), is also identified as a RMA, and is rad posted, and secured with a fence and gate. LUIC Factsheet Changes: Storage Yard 1: Under Current Conditions, first sentence, change to, Yard 1A (Bldg. 912 Steel Yard) and Yard 1B (Bldg. 912 Lead Yard) are currently being used for storage by CA-D and are fenced and posted for radiological control purposes (i.e., Radioactive Material Area). Under Access and Engineered Controls, change to Radioactive Material Area. Highlight Yard 1B on the LUIC map. LUIC Factsheet Storage Yard 2 (AOC 18) Changes: Under Remedial Action, delete last sentence. Under LUIC Classification, first bullet, change to say, The site is currently used for industrial purposes.

Location (AOC): Bldg. 830 USTs and Pipe Leak
Date of Inspection: 6/30/10____
Name of Inspector(s): R. Howe, W. Dorsch, D. Paquette, K. Conkling, D. Hanley
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 1x/yr) ☐ Heavy Rainfall ☐ Reported Incident

A. Inspection Checklist

	Component	Observed Condition: Excell.	Fair	Poor	Not Applic.	Further Action Req'd: Yes (describe)	No
1.	**Landfill Cap/Soil Covers:**						
	Vegetation (e.g. grass)		X				X
	Soil (Cap/Cover/Fill)				X		X
	Other: ________________________						
2.	**Drainage Structures:**						
	Standing Water				X		X
	Toe Drain				X		X
	Drainage Channels				X		X
	French Drains/Outfalls				X		X
	Subsurface Drainage				X		X
	Pipes/Outfalls				X		X
	Manholes				X		X
	Berms				X		X
	Roof Drains				X		X
	Recharge Areas				X		X
	Other: _______________						
3.	**Monitoring System:**						
	Soil Gas Wells				X		X
	Groundwater Wells		X				X
	Gas Vents				X		X
	Other: __________						
4.	**Site Access:**						
	Asphalt Access Road		X				X
	Crushed-concrete Access Road				X		X
	Fence		X				X
	Gates/locks		X			Open, not locked	X
	Radiological Postings	X				For Rad Storage Areas	X
	Other: ________________________						

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence: There doesn't appear to be, and any digging proposed for the area would be reviewed by the Groundwater Protection Group/LTRA via the digging permit process.

B. Description of Other Observations

Observed Conditions/Recommendations: The area currently consists of Bldg. 830 (occupied) by Energy, Environment and National Security Directorate (EENS) Environmental Sciences Dept., NSLS II Project Offices located in the mod trailer to the north , and outdoor connex storage, waste collection area, and rad waste storage areas. The yard is fenced but the gate is open/no lock. The remainder of the area is open and consists of grass and pavement/parking area.

Location (AOC): Building 208 Vapor Degreaser (AOC 26) and Warehouse Area
Date of Inspection: 11/19/09________________________________
Name of Inspector(s): R. Howe, W. Dorsch, V. Racaniello
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 1x/yr) ☐ Heavy Rainfall ☐ Reported Incident

A. Inspection Checklist

	Component	Observed Condition: Excell.	Fair	Poor	Not Applic.	Further Action Req'd: Yes (describe)	No
1.	**Landfill Cap/Soil Covers:**						
	Vegetation (e.g. grass)				X	NSLS II construction underway	X
	Soil (Cap/Cover/Fill)				X		X
	Other: ________________________						
2.	**Drainage Structures:**						
	Standing Water				X		X
	Toe Drain				X		X
	Drainage Channels				X		X
	French Drains/Outfalls				X		X
	Subsurface Drainage				X		X
	Pipes/Outfalls				X		X
	Manholes				X		X
	Berms				X		X
	Roof Drains				X		X
	Recharge Areas				X		X
	Other: _______________						
3.	**Monitoring System:**						
	Soil Gas Wells				X		X
	Groundwater Wells				X		X
	Gas Vents				X		X
	Other: __________						
4.	**Site Access:**						
	Asphalt Access Road				X		X
	Crushed-concrete Access Road				X		X
	Fence				X		X
	Gates/locks	X				Constr. Zone Fenced	X
	Radiological Postings				X		X
	Other: ~~NSLS II Construction signs~~	X					X

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence:
____

B. Description of Other Observations

Observed Conditions/Recommendations: The former Building 208, foundations, and the former warehouse area have been demolished and the construction of the NSLS II facility is in progress. Since this area will continue to be under the NSLS II building, there is no need to continue to perform annual LUIC inspections at this location. LUIC Factsheet Changes: Add a Current Conditions section referencing the NSLS II construction. Under Land Use Classification, first bullet, change to say that the area is used for industrial use. Update the third bullet to reference that the foundations were removed. Delete the engineered control for soil screening. Add link for the Closeout Report and reference the Factsheet for the Former Warehouse Area (Post NSLS II Construction). Also add this area to the OU I Soils and OU V Plan.

Location (AOC): Building 464 Mercury Contaminated Soils
Date of Inspection: 11/19/09
Name of Inspector(s): R. Howe, W. Dorsch, V. Racaniello
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 1x/yr) ☐ Heavy Rainfall ☐ Reported Incident

A. Inspection Checklist

Component	Observed Condition: Excell.	Fair	Poor	Not Applic.	Further Action Req'd: Yes (describe)	No
1. Landfill Cap/Soil Covers:						
Vegetation (e.g. grass)			X		ISB under construction	X
Soil (Cap/Cover/Fill)				X		X
Other: ________						
2. Drainage Structures:						
Standing Water				X		X
Toe Drain				X		X
Drainage Channels				X		X
French Drains/Outfalls				X		X
Subsurface Drainage				X		X
Pipes/Outfalls				X		X
Manholes				X		X
Berms				X		X
Roof Drains				X		X
Recharge Areas				X		X
3. Monitoring System:						
Soil Gas Wells				X		X
Groundwater Wells				X		X
Gas Vents				X		X
Other: ________						
4. Site Access:						
Asphalt Access Road				X		X
Crushed-concrete Access Road				X		X
Fence				X		X
Gates/locks				X		X
Radiological Postings				X		X
Other: ________						

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence:

____

B. Description of Other Observations

Observed Conditions/Recommendations: Construction preparation work is underway on the Interdisciplinary Science Building (ISB) which will be located at the former mercury cleanup area. This area is immediately north of Bldg. 464. This work was coordinated via the digging permit process and there are no impacts on the institutional controls for this area. The area will continue to be used for industrial purposes. The OU III ROD does not specify institutional controls for this area. Since this area will be underneath the ISB, there is no need to continue performing annual LUIC inspections at this location. The remaining institutional controls will continue to apply. LUIC Factsheet: Add Current Conditions section, stating that the area is currently under construction for the ISB. An extension to the east portion of Bldg. 464 was completed in the fall of 2009. Under Land Use, add a bullet that says the area will continue as industrial use while the ISB is in use. Under Other, add that annual inspections of this area are no longer needed since it is located under the ISB. Also add Bldg. 464 area to the OU I and V Plan.

Location (AOC): Recharge Basins HS and HW (AOCs 24E, 24F)
Date of Inspection: 11/19/09___________________________________
Name of Inspector(s): R. Howe, W. Dorsch, V. Racaniello
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 2x/yr) ☐ Heavy Rainfall ☐ Reported Incident

A. Inspection Checklist

Component	Excell.	Fair	Poor	Not Applic.	Further Action Req'd: Yes (describe)	No
1. Landfill Cap/Soil Covers:						
Vegetation (e.g. grass)				X		X
Soil (Cap/Cover/Fill)				X		X
Other: ________________________						
2. Drainage Structures:						
Standing Water		X				X
Toe Drain				X		X
Drainage Channels				X		X
French Drains/Outfalls				X		X
Subsurface Drainage				X		X
Pipes/Outfalls				X		X
Manholes				X		X
Berms				X		X
Roof Drains	X					X
Recharge Areas				X		X
Other: _______________						
3. Monitoring System:						
Soil Gas Wells				X		X
Groundwater Wells				X		X
Gas Vents				X		X
Other: __________						
4. Site Access:						
Asphalt Access Road				X		X
Crushed-concrete Access Road				X		X
Fence				X		X
Gates/locks				x		X
Radiological Postings				X		X
Other:						

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence:
____

B. Description of Other Observations

Observed Conditions/Recommendations: The basins continue to be use for recharge of stormwater. Since these basins are regulated under the New York State SPDES permits and any work in or near these basins are covered under the existing Work Planning and Control process, the digging permit process, and the BNL Natural Resource Management Plan, further LUIC inspections are not needed. LUIC Factsheet Changes: Add 24F to Factsheet title. For History, add bullet for Recharge Basin HW (AOC 24F) receives stormwater runoff from NSLS II area. For Admin Controls, last bullet, change details can be obtained from the SPDES permits and the NRMP. Under References, add link for the Natural Resource Management Plan. Revise The OU I Soils and OU V Plan to reflect no further need for LUIC inspections.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 9/23/10

A. System OU III LIPA/Airport. Inspection attendees include V. Racaniello, E. Murphy, P. Pizzo, A. Steinhauff

1. **Construction Complete/System Operating** ☒ Yes ☐ No

Remarks: Construction is complete, system operating a new extraction well was added in 2007 to address contamination detected further to the west then originally anticipated.

B. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☒Good condition ☒ All required wells properly operating Needs Maintenance ☐ N/A
Remarks: All wells are operating however LIPA wells 1, 2 and 3 are in standby.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks____

3. **Spare Parts and Equipment**
☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks____

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ☒ Carbon adsorbers
☐ Filters____
☐ Additive (*e.g.*, chelation agent, flocculent):
☐ Others____
☒ Good condition ☐ Needs Maintenance
☒ Sampling ports properly marked and functional
☒ Sampling/maintenance log displayed and up to date
☒ Equipment properly identified
☐ Quantity of groundwater treated annually________________________
☐ Quantity of surface water treated annually________________________
Remarks_ ____

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks:

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
Remarks:

4. **Discharge Structure and Appurtenances**
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks: Injection and recirculation wells require routine maintenance to prevent clogging.

5.	**Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks: ______________________________
6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks______________________________
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: VOC concentrations at Airport are low but stable in western extraction wells. Three of the four LIPA wells are currently in standby due to low VOC concentrations.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 9/23/10

A. System OU III North Street/North Street East. Inspection attendees include V. Racaniello, E. Murphy, P. Pizzo, A. Steinhauff

1. **Construction Complete/System Operating** ☒ Yes ☐ No

Remarks: Construction is complete, systems both operating. Well NSE-2 is in standby and well NS-1 is pulse pumping

B. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**

☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A

Remarks: Well NS-1 and NSE-1 are pulse pumping. Well NSE-2 is in standby.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**

☒ Good condition ☐ Needs Maintenance

Remarks______________________________________

3. **Spare Parts and Equipment**

☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks______________________________________

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)

☐ Metals removal ☐ Oil/water separation ☐ Bioremediation

☐ Air stripping ☒ Carbon adsorbers

☐ Filters______________________________________

☐ Additive (*e.g.*, chelation agent, flocculent):

☐ Others______________________________________

☒ Good condition ☐ Needs Maintenance

☒ Sampling ports properly marked and functional

☒ Sampling/maintenance log displayed and up to date

☒ Equipment properly identified

☐ Quantity of groundwater treated annually____________________

☐ Quantity of surface water treated annually____________________

Remarks______________________________________

2. **Electrical Enclosures and Panels** (properly rated and functional)

☐ N/A ☒ Good condition ☐ Needs Maintenance

Remarks:

3. **Tanks, Vaults, Storage Vessels**

☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance

Remarks______________________________________

4. **Discharge Structure and Appurtenances**

☐ N/A ☒ Good condition ☐ Needs Maintenance

Remarks: Injection wells need routine maintenance due to fouling (every 6 to 12 months).

5.	**Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks: ____________________
6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks____________________
D. Monitoring Data	
3.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
4.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 9/23/10

A. System OU VI AOC 28 EDB. Inspection attendees include V. Racaniello, E. Murphy, P. Pizzo, A. Steinhauff

1. **Construction Complete/System Operating** ☒ Yes ☐ No

B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks:

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ☒ Carbon adsorbers
☐ Filters
☐ Additive (*e.g.*, chelation agent, flocculent):
☐ Others
☒ Good condition ☐ Needs Maintenance
☒ Sampling ports properly marked and functional
☒ Sampling/maintenance log displayed and up to date
☒ Equipment properly identified
☐ Quantity of groundwater treated annually
☐ Quantity of surface water treated annually
Remarks

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks:

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
Remarks

4. **Discharge Structure and Appurtenances**
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks: Injection wells require periodic maintenance

5.	**Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks: Soffit on east side of building needs repair.
6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks____ ____
D. Monitoring Data	
5.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
6.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 9/23/10
A. System OU III Industrial Park East. Inspection attendees include V. Racaniello, E. Murphy, P. Pizzo, A. Steinhauff
1. **Construction Complete/System Operating** ☒ Yes ☐ No Remarks: Construction is complete, system was approved for shutdown in 2010 and shutdown. System currently in standby.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☐ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ☒ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks: System is operational but in standby mode.
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☒ Good condition ☐ Needs Maintenance Remarks____
3. **Spare Parts and Equipment** ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____
C. Treatment System ☒ Applicable ☐ N/A
1. **Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☐ Air stripping ☒ Carbon adsorbers ☐ Filters____ ☐ Additive (*e.g.*, chelation agent, flocculent): ☐ Others____ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date ☒ Equipment properly identified ☐ Quantity of groundwater treated annually________________ ☐ Quantity of surface water treated annually________________ Remarks____
2. **Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3. **Tanks, Vaults, Storage Vessels** ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks____
4. **Discharge Structure and Appurtenances** ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: When operating the injection wells require periodic maintenance

5.	**Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: As per Petition for Shutdown installation of one additional Magothy monitoring well is planned to the south of the extraction wells near the LIPA Right Of Way.
D. Monitoring Data	
7.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
8.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: Cleanup goals have been met at this location for the Upper Glacial Aquifer.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 9/23/10	
A. System OU III Industrial Park. Inspection attendees include V. Racaniello, E. Murphy, P. Pizzo, A. Steinhauff	
1.	**Construction Complete/System Operating** ☒ Yes ☐ No Remarks: Wells 1,2 and 7 are in standby due to low VOC concentrations
B. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☐ N/A	
1.	**Pumps, Wellhead Plumbing, and Electrical** ☒ Good condition ☒ All required wells properly operating ☒ Needs Maintenance ☐ N/A Remarks: Treatment wells UVB-1, UVB-2 and UVB-7 are shutdown due to low VOC concentrations in these wells.
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☒ Good condition ☐ Needs Maintenance Remarks____________________
3.	**Spare Parts and Equipment** ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____________________
C. Treatment System ☒ Applicable ☐ N/A	
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☒ Air stripping ☒ Carbon adsorbers (vapor phase) ☐ Filters____________________ ☐ Additive (*e.g.*, chelation agent, flocculent): ☐ Others____________________ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date ☒ Equipment properly identified ☐ Quantity of groundwater treated annually____________ ☐ Quantity of surface water treated annually____________ Remarks____________________
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks____________________
4.	**Discharge Structure and Appurtenances** ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: These wells are recirculation wells with two screens and require frequent cleaning to keep them operational

5.	**Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks: ________________
6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks____
D. Monitoring Data	
9.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
10.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: System is approaching cleanup goals for system operation.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 11/18/10	
A. System OU III AOC 29 HFBR Tritium Pump and Recharge. Inspection attendees include V. Racaniello, E. Kramer, Adrian Steinhauff, John Burke, John Young, Bill Dorsch.	
1.	**Construction Complete/System Operating** ☒ Yes ☐ No Remarks: An extraction well was added and the system began operating again in 2007 as a slug of higher concentrations was detected in this area.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☐ N/A	
1.	**Pumps, Wellhead Plumbing, and Electrical** ☒ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks: Well EW-16 and EW-11 are operating. Wells Ew-9 and EW-10 are in standby
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☒ Good condition ☐ Needs Maintenance Remarks
3.	**Spare Parts and Equipment** ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System ☒ Applicable ☐ N/A	
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☐ Air stripping ☒ Carbon adsorbers ☐ Filters________________________________ ☐ Additive (*e.g.*, chelation agent, flocculent): ☐ Others________________________________ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date ☒ Equipment properly identified ☐ Quantity of groundwater treated annually________________ ☐ Quantity of surface water treated annually________________ Remarks: Treatment is for VOCs
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks________________________________ ________________________________
4.	**Discharge Structure and Appurtenances** ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Recharge basin is in excellent condition
5.	**Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:

6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks
D. Monitoring Data	
11.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
12.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 11/18/10
A. System OU I South Boundary (Bldg. 598) Inspection attendees include V. Racaniello, , E. Kramer, Bill Dorsch, Adrian Steinhauff, John Young
1. **Construction Complete/System Operating** ☒ Yes ☐ No Remarks: System approaching Remedial Action Objectives.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ☐ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks:
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☒ Good condition ☐ Needs Maintenance Remarks
3. **Spare Parts and Equipment** ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____
C. Treatment System ☒ Applicable ☐ N/A
1. **Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☒ Air stripping ☐ Carbon adsorbers ☐ Filters____ ☐ Additive (*e.g.*, chelation agent, flocculent)_sodium polyphosphate is not used________ ☐ Others____ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date ☒ Equipment properly identified ☐ Quantity of groundwater treated annually________________________ ☐ Quantity of surface water treated annually________________________ Remarks____ ____
2. **Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks____ ____
3. **Tanks, Vaults, Storage Vessels** ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
4. **Discharge Structure and Appurtenances** ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Recharge Basin is in excellent condition
5. **Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:

6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☐ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks
D. Monitoring Data	
13.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
14.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks: Treatment system has met cleanup goals except for one small “Hot Spot” upgradient of the extraction wells.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 10/27/10
A. System OU III South Boundary (Bldg.517 and Bldg 518) Inspection attendees include V. Racaniello,, E. Kramer, Bill Dorsch, Adrian Steinhauff, John Young
1. **Construction Complete/System Operating** ☒ Yes ☐ No Remarks: Wells EW-6,7,8 and 12 are in standby due to low VOC concentrations.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks:
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☒ Good condition ☐ Needs Maintenance Remarks
3. **Spare Parts and Equipment** ☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____
C. Treatment System ☒ Applicable ☐ N/A
1. **Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☒ Air stripping ☐ Carbon adsorbers ☐ Filters____ ☐ Additive (*e.g.*, chelation agent, flocculent)_sodium polyphosphate is not used________ ☐ Others____ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date ☒ Equipment properly identified ☐ Quantity of groundwater treated annually________________________ ☐ Quantity of surface water treated annually________________________ Remarks____ ____
2. **Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks____ ____
3. **Tanks, Vaults, Storage Vessels** ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
4. **Discharge Structure and Appurtenances** ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Recharge Basins are in excellent condition but require occasional maintenance
5. **Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:

6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☐ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks
D. Monitoring Data	
15.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
16.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks: Three of seven extraction wells are currently operating. The four eastern wells have met the cleanup goals.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 11/18/10
A. System OU III Middle Road (Bldg.516 and 519) Inspection attendees include V. Racaniello, , E. Kramer, Bill Dorsch, Adrian Steinhauff, John Young
1. **Construction Complete/System Operating** ☒ Yes ☐ No Remarks: The three eastern extraction wells RW-4, RW-5 and RW-6 are in standby and have met the Remedial Action Objectives for this project.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ☐ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks:
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☒ Good condition ☐ Needs Maintenance Remarks
3. **Spare Parts and Equipment** ☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____
C. Treatment System ☒ Applicable ☐ N/A
1. **Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☒ Air stripping ☐ Carbon adsorbers ☐ Filters____ ☐ Additive (*e.g.*, chelation agent, flocculent)_sodium polyphosphate is not used________ ☐ Others____ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date ☒ Equipment properly identified ☐ Quantity of groundwater treated annually________________________ ☐ Quantity of surface water treated annually________________________ Remarks____ ____
2. **Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks____ ____
3. **Tanks, Vaults, Storage Vessels** ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
4. **Discharge Structure and Appurtenances** ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Recharge Basins are is in excellent condition but require occasional maintance
5. **Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:

6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☐ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks
D. Monitoring Data	
17.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
18.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks: The three eastern extraction wells have met cleanup goals and are in standby. There is currently an investigation on the eastern edge of the plume concerning VOCs that may be deeper or further to the east of the three eastern extraction wells. The results may require followup actions from additional monitoring wells up to an additional extraction well on the eastern edge of the plume.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 10/27/10

A. System OU III Western South Boundary (Bldg. 539) Inspection attendees include V. Racaniello, E. Kramer, Bill Dorsch, Adrian Steinhauff, John Young

1. **Construction Complete/System Operating** ☒ Yes ☐ No

Remarks: Well WSB-2 is being pulse pumped

B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☐ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks:

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks____

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☒ Air stripping ☐ Carbon adsorbers
☐ Filters____
☐ Additive (*e.g.*, chelation agent, flocculent)_sodium polyphosphate is not used________
☐ Others____
☒ Good condition ☐ Needs Maintenance
☒ Sampling ports properly marked and functional
☒ Sampling/maintenance log displayed and up to date
☒ Equipment properly identified
☐ Quantity of groundwater treated annually________________________
☐ Quantity of surface water treated annually________________________
Remarks____
____

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks____
____

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance

4. **Discharge Structure and Appurtenances**
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks: Recharge Basin is in good condition

5. **Treatment Building(s)**
☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair
☐ Chemicals and equipment properly stored
Remarks: Need insulation on tower influent piping.

6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☐ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks
D. Monitoring Data	
19.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
20.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks: A groundwater investigation in 2008/2009 showed higher then expected upgradient concentrations of TCA and Freon this has extended the expected duration of this systems operation. Further upgradient investigation of the Freon is ongoing.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 10/27/10
A. System OU III Building 96 (Bldg. TR-854, TR-866, TR-867, TR_868) Inspection attendees include V. Racaniello, , E. Kramer, Bill Dorsch, Adrian Steinhauff, John Young
1. **Construction Complete/System Operating** ☒ Yes ☐ No Remarks:
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ☐ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks:
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☒ Good condition ☐ Needs Maintenance Remarks
3. **Spare Parts and Equipment** ☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks____
C. Treatment System ☒ Applicable ☐ N/A
1. **Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☒ Air stripping ☐ Carbon adsorbers ☐ Filters____ ☐ Additive (*e.g.*, chelation agent, flocculent)_sodium polyphosphate is not used________ ☐ Others____ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date ☒ Equipment properly identified ☐ Quantity of groundwater treated annually________________________ ☐ Quantity of surface water treated annually________________________ Remarks: Well RTW-1 was changed from a recirculation well to a pumping well in 2007 and a Hexavalent chromium treatment system installed in the RTW-1 treatment building. The Hexavalent Chromium treatment is no longer required as concentrations have dropped to below required concentrations.
2. **Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks____
3. **Tanks, Vaults, Storage Vessels** ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
4. **Discharge Structure and Appurtenances** ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Recharge Basin is in excellent condition
5. **Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☒ Needs repair ☐ Chemicals and equipment properly stored Remarks: Building 868 has a minor roof leak that needs repair.

6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☐ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks	
D. Monitoring Data		
21.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality	
22.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks: A hot spot of soil contamination was identified in 2008 that was acting as a continuing source for groundwater contamination. From August to October 2010 approximately 370 yards of contaminated soil was excavated and disposed of. It is expected that the treatment system will need to operate for three to six additional years to reach the cleanup goals (2013 – 2016).	

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 10/27/10

A. System OU III Sr-90 Chemical Holes (Bldg. 670) Inspection attendees include V. Racaniello, E. Kramer, C. Shuster, A. Steinhauff, Bill Dorsch

1. **Construction Complete/System Operating** ☒ Yes ☒ No

Remarks: System was modified in 2007 and two additional extraction wells were added.

B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☒ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks: Extraction well 1 is being pulse pumped.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks____

3. **Spare Parts and Equipment**
☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks____

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ☐ Carbon adsorbers
☒ Filters: ion exchange__________________________
☐ Additive (*e.g.*, chelation agent, flocculent)__________________________
☐ Others__________________________
☒ Good condition ☐ Needs Maintenance
☒ Sampling ports properly marked and functional
☒ Sampling/maintenance log displayed and up to date
☒ Equipment properly identified
☐ Quantity of groundwater treated annually________________
☐ Quantity of surface water treated annually________________
Remarks: Resin ;has been successful at removing the SR90 from the groundwater and has performed better then expected.

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks____

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☒ Good condition ☒ Proper secondary containment ☐ Needs Maintenance
Remarks: ________________________

4. **Discharge Structure and Appurtenances**
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks: Drywells have never required maintenance.

5. **Treatment Building(s)**
☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair
☐ Chemicals and equipment properly stored
Remarks:

6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks______________________________	
D. Monitoring Data		
23.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality	
24.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: Concentrations in the two downgradient extraction wells have declined. Well 1 has had stable concentrations for several years now.	

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 11/18/10
A. System OU III Sr-90 BGRR/WCF (Bldg. 855) Inspection attendees include V. Racaniello, E. Kramer, A. Steinhauff, Bill Dorsch, John Young
1. **Construction Complete/System Operating** ☒ Yes ☐ No Remarks: Currently adding four new extraction wells to the system.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ☒ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks________________________________
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☒ Good condition ☐ Needs Maintenance Remarks: ________________
3. **Spare Parts and Equipment** ☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks________________________________
C. Treatment System ☒ Applicable ☐ N/A
1. **Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☐ Air stripping ☒ Carbon adsorbers ☒ Filters: ion exchange ___ ☐ Additive (*e.g.*, chelation agent, flocculent)________________ ☐ Others________________ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date ☒ Equipment properly identified ☐ Quantity of groundwater treated annually________________ ☐ Quantity of surface water treated annually________________ Remarks: Resin has performed better then expecting in removing Sr-90 from groundwater.
2. **Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks________________________________
3. **Tanks, Vaults, Storage Vessels** ☐ N/A ☒ Good condition ☒ Proper secondary containment ☐ Needs Maintenance Remarks________________________________
4. **Discharge Structure and Appurtenances** ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Drywells have never required maintenance

5.	**Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks______________________________
6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☒ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks______________________________
D. Monitoring Data	
25.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
26.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks: Plume is contained upgradient of the existing five wells. Four new wells are being added to address downgradient portions of these plumes. The monitoring data indicates that there may be a continuing source of Sr-90 upgradient of extraction well 3, which is located immediately downgradient of the BGRR.

E. Monitored Natural Attenuation
1. **Monitoring Wells** (natural attenuation remedy) ☒Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒All required wells located ☐ Needs Maintenance ☐ N/A Remarks: A portion of each groundwater remedy relies on some natural attenuation.________________
IX. OTHER REMEDIES
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.
X. OVERALL OBSERVATIONS
A. Implementation of the Remedy
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). With the exception of remaining soil excavation at OU I and the BGRR pile and bioshield removal, all soil, sediment, and groundwater remedies for the seven RODs at the site have been implemented and are functioned as designed. This includes the excavation and off-site disposal of contaminated soils, sediments, tanks, as well as the installation and operations initiated for all groundwater treatment systems. All of the remedies are being implemented in accordance with the RODs and the ESD. The remedies are expected to be protective upon attainment of soil cleanup goals once excavation is complete, and groundwater cleanup goals. ____
B. Adequacy of O&M
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. The VOC treatment systems operated without any significant down time or issues over the last eight years and have consistently met the state equivalency discharge requirements (although there have been a few pH excursions due to the natural groundwater conditions). The systems have been physically inspected typically on a daily basis. However, the frequency of physical inspections will generally be reduced starting in 2005 due to the significant operating history, the increase in the number of systems off of BNL property, and the availability of wireless system monitoring/alarms. ____
C. Early Indicators of Potential Remedy Problems
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. • See above. See Five Year Review Section 7.0. ____

D.	Opportunities for Optimization
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Opportunities are routinely identified. See Five Year Review Section 7.0________________ ____

Attachment 4

Interview Records

INTERVIEW RECORD

Site Name: Brookhaven National Laboratory	**EPA ID No.:**
Subject: 2011 Five-Year Review	**Time:** 2:00 **Date:** 7/27/10
Type: X Telephone ☐ Visit ☐ Other **Location of Visit:**	☐ Incoming ☐ Outgoing

Contact Made By:

Name: S. Johnson	**Title:**	**Organization:** CEGPA

Individual Contacted:

Name: Doug Pocze	**Title:** Remedial Project Manager	**Organization:** EPA II
Telephone No.: 212-637-4432 **Fax No.:** **E-Mail Address:** pocze.doug@epa.gov	**Street Address:** 290 Broadway **City, State, Zip:** NY, NY 10007-1866	

Summary of Conversation

Mr. Pocze said that he was very pleased with BNL and DOE especially considering the number of sites included in the cleanup. He said that the annual groundwater summary was helpful and served as "one-stop shopping" for information on the groundwater treatment systems. The IAG calls have been a big help and make it easy to keep track of the projects. The working relationship is non-adversarial.

He said it was hard to say if there are any specific aspects of the cleanup that should be focused on. He thought there was a good split among the projects. The big ticket projects are the ARRA-funded projects and groundwater, and the Peconic River to a lesser extent.

Mr. Pocze said he felt well informed about the cleanup projects. He said EPA is very interested in green initiatives and mentioned that DOE had been very helpful in getting him information on the recycling of materials such as concrete from the Fan House removal.

He feels that the public is sufficiently informed through the Community Advisory Council, the Roundtable, and public notices. He noted that the Lab also holds ceremonies and invites the community in to participate.

He said that he believes the remedies are functioning as expected. Some do need tweaking such as the Peconic River. He feels comfortable with them.

The particular component of the cleanup that concerns him is the long-term cleanups that go out for 50 years. There is concern about the achieving the cleanup goals if the property is transferred or sold at some point in the future. He said there are problems with this at other federal sites.

INTERVIEW RECORD

Site Name: Brookhaven National Laboratory	**EPA ID No.:**
Subject: 2011 Five-Year Review	**Time:** 2:00 **Date:** 7/27/10
Type: X Telephone ☐ Visit ☐ Other **Location of Visit:**	☐ Incoming ☐ Outgoing

Contact Made By:

Name: S. Johnson	**Title:**	**Organization:** CEGPA

Individual Contacted:

Name: Doug Pocze	**Title:** Remedial Project Manager	**Organization:** EPA II
Telephone No.: 212-637-4432 **Fax No.:** **E-Mail Address:** pocze.doug@epa.gov	**Street Address:** 290 Broadway **City, State, Zip:** NY, NY 10007-1866	

Summary of Conversation

Mr. Pocze noted that vapor intrusion seems to be an issue in some areas. He said it doesn't seem to be a problem at BNL because the contamination is deeper in the aquifer. It could become a problem if things change; it's a big issue for the Department of Health.

Mr. Pocze said that DOE does a good job and are usually ahead of EPA. He mentioned that use of rail versus shipping by truck was one way that is cost saving and more efficient. He mentioned that EPA is working with the USGS on a Long Island groundwater study and said that sharing well data could be an opportunity to optimize operations.

He felt that BNL and DOE are maintaining institutional controls but that will be harder if there is a transfer of property; it will be more difficult in the long-term. He mentioned the Land Use plan as a good document to have. He said that deed restrictions get lost over time, that people have a tendency to forget, and that institutional knowledge is lost. He said there is soil at RHIC that will need to be addressed (removed) in the future and he is concerned the information will be lost. He said that the HFBR will be a good example to follow as the years go by. Mr. Pocze commented that he is pleased that the Laboratory has a regulatory affairs person that he can contact first with any questions regarding the cleanup. This saves him time as he can then be directed to the correct person to answer his questions. This is especially helpful during staff transition; he still has one person to go to.

INTERVIEW RECORD

Site Name: Brookhaven National Laboratory			**EPA ID No.:**	
Subject: 2011 Five-Year Review			**Time:** 4:00	**Date:** 7/27/10
Type: X Telephone ☐ Visit ☐ Other **Location of Visit:**			☐ Incoming	☐ Outgoing
Contact Made By:				
Name: S. Johnson	**Title:**		**Organization:** CEGPA	
Individual Contacted:				
Name: Chek Beng Ng, P.E.	**Title: Remedial Project Manager**		**Organization:** NYSDEC	
Telephone No.: 518-402-9620 **Fax No.:** **E-Mail Address:** cbng@gw.dec.state.ny.us		**Street Address:** 625 Broadway, 11th Floor **City, State, Zip:** Albany, NY 12233-7015		

Summary of Conversation

Mr. Ng stated that his overall impression of the cleanup at BNL is pretty good. BNL is trying to do what it can to clean up the OUs as quickly as possible. He mentioned the removal of the HFBR control rod blades as an example. He said that the cleanup in general is progressing well and thought there maybe some RAD contamination that could be paid more attention, particularly the FHWMF perimeter soils. He said that shouldn't be forgotten.

He said there is nothing to indicate that the remedies are not functioning as expected. Mr. Ng thinks that the future decommissioning and dismantlement of the HFBR vessel and the confinement building may pose a higher degree of difficulty.

Mr. Ng thinks that the biggest risk in achieving the soil and groundwater cleanup objectives would be to completely miss something. So far, DOE and the Lab have done a good job installing temporary wells where needed and the groundwater status report every year is good, but that has to continue or there is a risk of missing a groundwater plume that could migrate off-site.

Mr. Ng believes that BNL and DOE are actively managing the long-term cleanup and properly maintaining the institutional controls. He mentioned the Land Use and Institutional Controls Mapping website which he has used and noted that the institutional controls have been agreed on by the IAG. He feels the spirit of the RODs is being followed.

He believes that management of the cleanup has gone smoothly; his management is happy with the progress and said they are impressed with the early HFBR control rod blade removal and with the removal of the BGRR graphite pile. He hopes the momentum will continue.

INTERVIEW RECORD

Site Name: Brookhaven National Laboratory	**EPA ID No.:**
Subject: 2011 Five-Year Review	**Time:** 10:20 **Date:** 7/27/10
Type: X Telephone ☐ Visit ☐ Other **Location of Visit:**	☐ Incoming ☐ Outgoing

Contact Made By:

Name: S. Johnson	**Title:**	**Organization:** CEGPA

Individual Contacted:

Name: David O'Hehir	**Title:** Environmental Radiation Specialist	**Organization:** NYSDEC

Telephone No.: 518-402-8579 **Fax No.:** **E-Mail Address:** djohehir@gw.dec.state.ny.us	**Street Address:** 625 Broadway, 9th Floor **City, State, Zip:** Albany, NY 12233-7255

Summary of Conversation

Mr. O'Hehir stated that he had been with the project for just about a year. He thinks it is going well. DOE has been very responsive to the IAG, meeting their concerns. He noted several times that the American Reinvestment and Recovery Act (ARRA) funding has stepped up the cleanup.

There were no particular areas that he felt should be focused on, but did mention the Peconic River since hot spots are continuously being found during sampling.

He has gone back to examine the RODs when reviewing Work Plans for the various projects. He has asked for the rationale behind some of the decisions and thinks some things could have been done differently, but thinks that overall they are functioning as written.

One particular difficulty may be achieving the cleanup goals in the Peconic River as the water levels change. There are higher water levels in the river during the summer when previously the river was dry during the same period.

Overall, Mr. O'Hehir thinks that DOE has done a good job with the groundwater project. Additional wells have been added when needed, there's been great progress. He expressed some concern that the resources continue to be available to stay on top of the project.

He feels that BNL and DOE are actively managing the long-term cleanup operations and properly maintaining appropriate institutional controls. The ARRA funding helped to move the cleanup forward so that it will be done by 2011 instead of 2020. The goal for the BGRR and HFBR projects will be met a head of time. DOE has to keep on top of the groundwater projects. He did not have any suggestions or recommendations regarding management of the cleanup.

INTERVIEW RECORD

Site Name: Brookhaven National Laboratory	**EPA ID No.:**
Subject: 2011 Five-Year Review	**Time:** 10:13 **Date:** 7/28/10
Type: X Telephone ☐ Visit ☐ Other **Location of Visit:**	☐ Incoming ☐ Outgoing

Contact Made By:

Name: S. Johnson	**Title:**	**Organization:** CEGPA

Individual Contacted:

Name: Martin Trent	**Title:** Chief, Office of Ecology	**Organization:** SCDHS

Telephone No.: 631-852-5750 **Fax No.:** **E-Mail Address:** martin.trent@suffolkcountyny.gov	**Street Address:** 360 Yaphank Ave., Ste. 3B **City, State, Zip:** Yaphank, NY 11980

Summary of Conversation

Mr. Trent's overall impression of the cleanup is that the Lab is earnestly trying to do a good job. He thinks that the ARRA funding has been very helpful. He said that his focus has been on groundwater and the Peconic River. The Lab has made them priorities and should continue to make them the priority. He feels well informed and said that he gets plenty of material on the cleanup.

He believes that the remedies are functioning as expected and said that he was involved with the selection of many of them. He thinks that DOE and the Lab are doing a good job and that the Lab has adjusted the remedies and been flexible when they needed to be.

Mr. Trent said that he really isn't involved in the operational or maintenance aspects of the cleanup so he did not know of opportunities for cost saving or efficiency. He did think that one of the risks to the cleanup was the long-term remedies and the required long-term follow-up. He thought the economy could have some impact there and hoped that the DOE and Lab would continue to demonstrate their current level of commitment in the future.

He believes that the long-term cleanup operations and institutional controls are being actively managed. He said he has been working with the Lab since 1979. Since the early years, the level of openness and willingness to work with the County has changed markedly. He urges the Lab and DOE to investigate potential problems. He feels that a good job is being done with the legacy issues but there may be things that aren't known yet. He urges the Lab and DOE to remain vigilant.

INTERVIEW RECORD

Site Name: Brookhaven National Laboratory		**EPA ID No.:**
Subject: 2011 Five-Year Review		**Time:** 12:00 **Date:** 8/2/10
Type: X Telephone ☐ Visit ☐ Other **Location of Visit:**		☐ Incoming ☐ Outgoing
Contact Made By:		
Name: S. Johnson	**Title:**	**Organization:** CEGPA
Individual Contacted:		
Name: Bill Faulk	**Title:** Aide to SC Leg. Ed Romaine and BER Chair	**Organization:** BER
Telephone No.: 631-852-3200 **Fax No.:** **E-Mail Address:** bill.faulk@suffolkcountyny.gov	**Street Address:** 423 Griffing Avenue **City, State, Zip:** Riverhead, NY 11901	

Summary of Conversation

Mr. Faulk stated that he had a positive impression of the cleanup at BNL. He said that he feels well informed about the clean-up, however, while the Community Advisory Council (CAC) and the Brookhaven Executive Roundtable (BER) are well informed, he does not think the general public is as well informed as they could be. He wasn't sure what the solution would be as he realizes that the local media doesn't always respond to press releases.

Mr. Faulk feels that to the best of his knowledge the remedies are functioning as expected. He thought that existing regulations had an impact on the soil and groundwater cleanup objectives and feels that BNL and DOE are actively managing the long-term cleanup operations. He had no comments or suggestions regarding the cleanup.

INTERVIEW RECORD

Site Name: Brookhaven National Laboratory		**EPA ID No.:**
Subject: 2011 Five-Year Review		**Time:** 10:00 **Date:** 8/2/10
Type: ☐ Telephone X Visit ☐ Other **Location of Visit:** DOE Site Office, Bldg. 464		☐ Incoming ☐ Outgoing
Contact Made By:		
Name: S. Johnson	**Title:**	**Organization:** CEGPA
Individual Contacted:		
Names: Steven Feinberg and Terri Kneitel	**Titles:** Federal Project Director and Project Engineer	**Organization:** DOE
Telephone No.: 631-344-2112 **Fax No.:** **E-Mail Addresses:** sfeinberg@bnl.gov and tkneitel@bnl.gov		**Street Address:** Bell Avenue **City, State, Zip:** Upton, NY 11973

Summary of Conversation

Joint interview with Steven Feinberg, DOE Federal Project Director and Terri Kneitel, DOE Project Engineer. DOE Headquarters Career Development Program Intern Lisa Phillips was also present.

Mr. Feinberg and Ms. Kneitel both feel the cleanup is going well. When asked about specific aspects of the cleanup to focus on during the review Mr. Feinberg mentioned the expansiveness of the cleanup and Ms. Kneitel noted that additional source contamination has been found in some areas, such as Building 96, after the initial cleanup. She expressed concern about meeting the ROD goals if additional sources are found and feels this could also be a risk to achieving cleanup objectives.

Both Mr. Feinberg and Ms. Kneitel believe that the remedies are functioning as expected. Ms. Kneitel feels that a good job is being done in identifying and implementing cost savings by the Groundwater Protection Group. She noted that performance of wells is looked at annually. Mr. Feinberg mentioned the savings on the filter material for the SR-90 treatment system.

Ms. Kneitel was not aware of any upcoming changes to federal laws, however, the transition within DOE for long term surveillance and monitoring, from the Office of Environmental Management (EM) to the Office of Science (SC) in the next fiscal year (at the end of FY11) was mentioned. Ms. Kneitel noted that it will take vigilance to ensure the cleanup goals are obtained in the long-term.

On management of the cleanup, Mr. Feinberg commented that getting information and updates to interested parties continues to be important.

INTERVIEW RECORD

Site Name: Brookhaven National Laboratory	**EPA ID No.:**
Subject: 2011 Five-Year Review	**Time:** 10:05 **Date:** 8/3/10
Type: ☐ Telephone X Visit ☐ Other **Location of Visit:** BNL RSB, Comm. Relations Offices	☐ Incoming ☐ Outgoing

Contact Made By:

Name: S. Johnson	**Title:**	**Organization:** CEGPA

Individual Contacted:

Name: Gerald Granzen	**Title:** Sr. Environmental Engineer	**Organization:** DOE

Telephone No.: 631-344-4089 **Fax No.:** **E-Mail Address:** ggranzen@bnl.gov	**Street Address:** Bell Avenue **City, State, Zip:** Upton, NY 11973

Summary of Conversation

Mr. Granzen stated that his impression of the BNL cleanup is generally positive, that it's very extensive, and very expensive. The specific aspects of the cleanup that he feels should be of particular focus are the soil and groundwater cleanups and any "loose ends."

Mr. Granzen said that he feels well informed about the cleanup and that the Lab does a good job informing the public. He believes that with some adjustments, as necessary (and the Groundwater Protection Group is good about making them), the RODs are functioning as expected. He feels that the SR-90 plume is difficult to deal with and also mentioned the residual contaminated soils along Brookhaven Avenue. He feels that increased communications between the BNL Environmental Protection Group and Regulators who oversee the Interagency Agreement (IAG) is needed. Mr. Granzen was not aware of any recent or upcoming changes to any laws or regulations.

When asked about opportunities to optimize operations and cost savings, Mr. Granzen noted that as the cleanups are winding down, oversight and management seem to be a bit top heavy. He thought the need might be less for the monitoring phase of the cleanup. He feels the biggest risks to achieving the soil and groundwater cleanup objectives are uncharacterized soil and the shifting or mixing of groundwater plumes.

Mr. Granzen feels that BNL (and DOE) are actively managing the cleanup. He had no comments or suggestions other than to say that the DOE shift from EM to Office of Science (SC) should be done with care and there needs to be adequate funding to ensure the long-term cleanup objectives are completed.

INTERVIEW RECORD

Site Name: Brookhaven National Laboratory	**EPA ID No.:**
Subject: 2011 Five-Year Review	**Time:** 10:04 **Date:** 8/4/10
Type: X Telephone ☐ Visit ☐ Other **Location of Visit:**	☐ Incoming ☐ Outgoing

Contact Made By:

Name: S. Johnson	**Title:**	**Organization:** CEGPA

Individual Contacted:

Name: Steve Karpinski	**Title:** Public Health Specialist, Bureau of Environmental Exposure Investigations	**Organization:** NYSDOH
Telephone No.: 518-402-7880 **Fax No.:** **E-Mail Address:** sxk23@health.state.ny.us	**Street Address:** 547 River Street **City, State, Zip:** Troy, NY 12180-2216	

Summary of Conversation

Mr. Karpinski stated that he has only been with the project for approximately two years, but his overall impression of the cleanup is good. He is impressed with the level of detail and quality and comprehensiveness of the information that is given to him. He did not have any specific aspects of the cleanup that he felt should be focused on during the review and he feels well informed about cleanup activities and progress.

Mr. Karpinski hasn't had too much of an opportunity to go back to review the Records of Decision (RODs), but based on his interactions with the other regulators, he feels that the remedies are functioning as expected. He feels that the biggest risk to achieving the cleanup objectives is ensuring that cleanup activities continue to function as intended. He noted that nothing will be accomplished in the short-term, but maintaining the momentum of the remedial activities is important so that the objectives are obtained in as short a time as possible.

Mr. Karpinski does feel that BNL and DOE are actively managing the long-term cleanup operations. He has been impressed with the level of detail and flow of information; he did not have any additional recommendations or comments about the management of the cleanup.

INTERVIEW RECORD

Site Name: Brookhaven National Laboratory	**EPA ID No.:**
Subject: 2011 Five-Year Review	**Time:** 1:54 **Date:** 8/6/10
Type: X Telephone ☐ Visit ☐ Other **Location of Visit:**	☐ Incoming ☐ Outgoing

Contact Made By:

Name: S. Johnson	**Title:**	**Organization:** CEGPA

Individual Contacted:

Name: Ernie Lewis	**Title:** Experimental Scientific Associate, BNL	**Organization:** Member, BNL Envoy Program

Telephone No.: 631-344-7406 **Fax No.:** **E-Mail Address:** elewis@bnl.gov	**Street Address:** **City, State, Zip:** Upton, NY 11973

Summary of Conversation

Mr. Lewis said it is his impression that quite a lot of cleanup has been done at BNL. He said he does not consider himself to be well informed about the cleanup (by his own choice) but information has been available. It is his impression that the cleanup is being actively managed; he had no suggestions or comments to add.

INTERVIEW RECORD

Site Name: Brookhaven National Laboratory		**EPA ID No.:**
Subject: 2011 Five-Year Review		**Time:** **Date:** 8/11/10
Type: ☐ Telephone ☒ Visit Other **Location of Visit:** SCDHS in Yaphank		☐ Incoming ☐ Outgoing
Contact Made By:		
Name: Robert Howe	**Title:**	**Organization:** GPG
Individual Contacted:		
Name: Andrew Rapiejko	**Title:**	**Organization:** SCDHS
Telephone No.: 631-852-5810 **Fax No.:** **E-Mail Address:** andrew.rapiejko@suffolkcountyny.gov	**Street Address:** 360 Yaphank Ave., Ste. 3B **City, State, Zip:** Yaphank, NY 11980	

Summary of Conversation

Mr. Rapiejko commented during the Annual Groundwater Status Report briefing that he would like to see clarified when (what years) the 50 years of Institutional Controls for the different soil and reactor radionuclide cleanup projects starts and ends. Without the actual years it is very confusing.

Attachment 5

Operable Unit Cleanup Levels Matrix

Attachment 5
Operable Unit Cleanup Levels Matrix

Operable Unit	Contaminants of Concern	Cleanup Levels			Note any Changes to Cleanup Levels	Remedial Action Objectives
		Soil		Groundwater		
		Residential	Industrial			
I	Cesium-137	23 pCi/g	67 pCi/g			Prevent or minimize: 1. Leaching of contaminants from soil into groundwater, 2. Human exposure from surface and subsurface soil, 3. Uptake to ecological receptors. Rad soil cleanup levels are based on 15 mRem/year above background. ALARA goal is 10 mRem/year above background.
	Strontium-90	15 pCi/g	15 pCi/g	8 pCi/L		
	Radium-226	5 pCi/g	5 pCi/g			
	Lead	400 mg/kg				
	Mercury	1.84 mg/kg				
	1,2-Dichloroethane			5 µg/L		
	Chloroethane			5 µg/L		
II	Cesium-137	23 pCi/g	67 pCi/g			Documented in the OU I and III RODs.
	Tritium			20,000 pCi/L		
	Sodium-22			400 pCi/L		
III	1,1,1-Trichloroethane			5 µg/L		1. Meet MCLs for VOCs and tritium in Upper Glacial aquifer within 30 years, 2. Meet MCLs for VOCs in Magothy aquifer within 65 years, 3. Meet MCLs for Sr-90 in Upper Glacial aquifer within 40 years and 70 years at Chemical Holes and BGRR/WCF plumes, respectively.
	Tetrachloroethylene			5 µg/L		
	Carbon tetrachloride			5 µg/L		
	Tritium			20,000 pCi/L		
	Strontium-90			8 pCi/L		
	PCBs	1 mg/kg - Surface NYSDEC TAGM	10 mg/kg - Subsurf. NYSDEC TAGM			
IV	Ethylbenzene			5 µg/L		Restore groundwater quality to MCLs or background, and prevent or minimize: 1. Leaching of contaminants from soil into groundwater, 2. Human exposure from surface and subsurface soil, 3, Uptake of contaminants in soil by plants and animals.
	Toluene			5 µg/L		
	Strontium-90			8 pCi/L		
V	Mercury	2 mg/kg				Protect public health and the sole source aquifer, monitor the groundwater, and prevent
	Cesium-137	23 pCi/g				

Attachment 5
Operable Unit Cleanup Levels Matrix

Operable Unit	Contaminants of Concern	Cleanup Levels			Note any Changes to Cleanup Levels	Remedial Action Objectives
	Trichloroethene			5 µg/L		or minimize: 1. Migration of contaminants present in surface soil via surface runoff, 2. Human and environmental exposure from surface and subsurface soil. 3. Reduce site-related contaminants (e.g., mercury) in sediment to levels that are protective of human health, 4. Reduce or mitigate, to the extent practicable, existing and potential adverse ecological effects of contaminants in the Peconic River, 5. Prevent or reduce the migration of contaminants off the BNL property.
VI	Ethylene dibromide			0.05 µg/L		1. Meet MCLs for EDB in the Upper Glacial aquifer within 30 years, 2. Prevent or minimize further migration of EDB in groundwater vertically and horizontally.
BGRR	Strontium-90	ALARA (1)	ALARA	8 pCi/L		1. Ensure protection of human health and the environment from the potential hazards posed by the radiological inventory that resides in the BGRR complex, 2. Use ALARA while implementing the remedial action, 3. Implement long-term monitoring, maintenance, and institutional controls to manage potential hazards.
	Cesium-137	ALARA	ALARA			

(1) ALARA - as low as reasonably achievable.

Attachment 6

Soil Vapor Intrusion Screenings

Environmental & Waste Management Services Division

Building 51
P.O. Box 5000
Upton, NY 11973-5000
Phone 631 344-5588
Fax 631 344-7776
howe@bnl.gov

BROOKHAVEN
NATIONAL LABORATORY

managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

date: *August 21, 2008*

to: *File*

from: *R. Howe* R Howe

subject: SOIL GAS VAPOR EVALUATION FOR NEW WAREHOUSE

This memo documents the potential for soil gas vapor buildup in the new Warehouse (Bldg. 98) that was recently constructed. As identified in the attached preliminary initial screening for this building, the closest groundwater contaminant plume is approximately 200 feet to the west and this facility has no basement. Therefore, the subsurface to indoor air pathway is incomplete, and no further evaluation is needed at this time.

Attachment

Copy: J. Burke
M. Davis
W. Dorsch
G. Penny
V. Racaniello
File: GWER 59.08

FOR New Warehouse - Bldg. 98 8/21/08
Soil Vapor Evaluation

IV. TIER 1 - Primary Screening

Primary Screening is designed to help quickly screen out sites at which the vapor intrusion pathway does not ordinarily need further consideration, and point out the sites that do typically need further consideration. This evaluation involves determining whether any potential exists at a specific site for vapor intrusion to result in unacceptable indoor inhalation risks and, if so, whether immediate action may be warranted. Recommended criteria for making these determinations are presented in Questions 1 through 3, which focus on identifying:

a) if chemicals of sufficient volatility and toxicity are present or reasonably suspected to be present (Question 1);
b) if inhabited buildings are located (or will be constructed under future development scenarios – except for Environmental Indicator determinations, see section IV.C below) above or in close proximity to subsurface contamination (Question 2); and
c) if current conditions warrant immediate action (Question 3).

This primary screening process is illustrated in a flow diagram included in Appendix C.

A. Primary Screening – Question #1

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface (e.g., in unsaturated soils, soil gas, or the uppermost portions of the ground water and/or capillary fringe – see Table 1)? (We recommend this consideration involve DQOs (see Appendix A) used in acquiring the site data as well as an appropriately scaled Conceptual Site Model (CSM) for vapor intrusion (see Appendix B).)

_____ If **YES** - check here, check off the relevant chemicals on Table 1, and continue with Question 2. The chemicals identified here (and any degradation products) are evaluated as constituents of potential concern in subsequent questions.

__✓__ If **NO** - check here, provide the rationale and references below, and then go to the Summary Page to document that the subsurface vapor to indoor air pathway is incomplete (i.e., no further consideration of this pathway is needed); or

_____ If sufficient data are not available, go to the Summary Page and document the need for more information. After collecting the necessary data, Question 1 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

1. What is the goal of this question?

This question is designed to help quickly screen out sites at which the vapor intrusion pathway generally does not need further consideration. This evaluation involves determining whether or not any potential exists at a specific site for the vapor intrusion

pathway to result in unacceptable indoor air inhalation risks. Table 1 lists chemicals that may be found at hazardous waste sites and indicates whether, in our judgment, they are sufficiently volatile (Henry's Law Constant > 10^{-5} atm m^3/mol) to result in potentially significant vapor intrusion and sufficiently toxic (either an incremental lifetime cancer risk greater than 10^{-6} or a non-cancer hazard index greater than 1, or in some cases both) to result in potentially unacceptable indoor air inhalation risks. The approach used to develop Table 1 is documented in Appendix D and can be used, where appropriate, to evaluate volatile chemicals not included in the Table. We recommend that if any of the chemicals listed in Table 1 that are sufficiently volatile and toxic are present at a site, those chemicals become constituents of potential concern for the vapor intrusion pathway and are evaluated in subsequent questions in this guidance. If the chemicals listed in Table 1 are not present at a site, and no other volatile chemicals are present, we suggest that the vapor intrusion pathway be considered incomplete and no further consideration of this pathway is needed.

2. *What should you keep in mind?*

In evaluating the available site data, we recommend the DQOs used in collecting the data be reviewed to ensure those objectives are consistent with the DQOs for the vapor intrusion pathway (see Appendix A). We recommend the detection limits associated with the available groundwater data be reviewed to ensure they are not too high to detect volatile contaminants of potential concern. Also, we suggest that the adequacy of the definition of the nature and extent of contamination in groundwater and/or the vadose zone be assessed to ensure that all contaminants of concern and areas of contamination have been identified. Additionally, we recommend groundwater concentrations be measured or reasonably estimated using samples collected from wells screened at, or across the top of the water table. We recommend users read Appendices B (Conceptual Site Model for the Vapor Intrusion Pathway) and E (Relevant Methods and Techniques) to obtain a greater understanding of the important considerations in evaluating data for use in screening assessments of the vapor intrusion pathway.

3. *Rationale and References:*

The carbon tetrachloride plume is the closest VOC contamination to Bldg. 98. The closest monitoring well is ~400 feet away and the carbon tetrachloride concentrations are less than the Table 2 criteria (i.e. MCL). Therefore the chemicals are not of sufficient volatility. (see attached analytical data + figure)

B. **Primary Screening – Question #2**

Q2: **Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located *near* (see discussion below) subsurface contaminants found in Table 1?**

_____ If **YES** – check here, identify buildings and/or areas of concern below, and document on the Summary Page whether the potential for impacts from the vapor intrusion pathway applies to currently inhabited buildings or areas of concern under reasonably anticipated future development scenarios, or both. (Note that for EI considerations, we recommend only current risks be evaluated.) Then proceed with Question 3.

__✓__ If **NO** – check here, describe the rationale below, and then go to the Summary Page to document that there is no potential for the vapor intrusion pathway to impact either currently inhabited buildings or areas of concern under future development scenarios (i.e., no further evaluation of this pathway is needed). (Note that for EI considerations, only current risks are evaluated.); or

_____ If sufficient data are not available – check here and document the need for more information on the Summary Page. After collecting the necessary data, Question 2 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

1. What is the goal of this question?

The goal of this question is to help determine whether inhabited buildings currently are located (or may be reasonably expected to be located under future development scenarios) above or in close proximity to subsurface contamination that potentially could result in unacceptable indoor air inhalation risks. If inhabited buildings and/or future development are not located "near" the area of concern, we suggest that the vapor intrusion pathway be considered incomplete and no further consideration of the pathway should be needed.

For the purposes of this question, **"inhabited buildings"** are structures with enclosed air space that are designed for human occupancy. Table 1, discussed above in Question 1, lists the **"subsurface contaminants demonstrating sufficient volatility and toxicity"** to potentially pose an inhalation risk. We recommend that an inhabited building generally be considered **"near"** subsurface contaminants if it is located within approximately 100 ft laterally or vertically of known or interpolated soil gas or groundwater contaminants listed in Table 1 (or others not included in table 1 – see Question 1) and the contamination occurs in the unsaturated zone and/or the uppermost saturated zone. If the source of contamination is groundwater, we recommend migration of the contaminant plume be considered when evaluating the potential for future risks. The distance suggested above (100 feet) may not be appropriate for all sites (or contaminants) and,

consequently, we recommend that professional judgment be used when evaluating the potential for vertical and horizontal vapor migration.

2. How did we develop the suggested distance?

The recommended distance is designed to allow for the assessment to focus on buildings (or areas with the potential to be developed for human habitation) most likely to have a complete vapor intrusion pathway. Vapor concentrations generally decrease with increasing distance from a subsurface vapor source, and eventually at some distance the concentrations become negligible. The distance at which concentrations are negligible is a function of the mobility, toxicity and persistence of the chemical, as well as the geometry of the source, subsurface materials, and characteristics of the buildings of concern. Available information suggests that 100 feet laterally and vertically is a reasonable criterion when considering vapor migration fundamentals, typical sampling density, and uncertainty in defining the actual contaminant spatial distribution. The recommended lateral distance is supported by empirical data from Colorado sites where the vapor intrusion pathway has been evaluated. At these sites, no significant indoor air concentrations have been found in residences at a distance greater than one house lot (approximately 100 feet) from the interpolated edge of ground water plumes. Considering the nature of diffusive vapor transport and the typical anisotropy in soil permeability, in our judgment a similar criterion of 100 feet for vertical transport is generally conservative. These recommended distances will be re-evaluated and, if necessary, adjusted by EPA as additional empirical data are compiled.

3. What should you keep in mind when evaluating this criterion?

It is important to consider whether **significant preferential pathways** could allow vapors to migrate more than 100 feet laterally. For the purposes of this guidance, a "significant" preferential pathway is a naturally occurring or anthropogenic subsurface pathway that is expected to have a high gas permeability and be of sufficient volume and proximity to a building so that it may be reasonably anticipated to influence vapor intrusion into the building. Examples include fractures, macropores, utility conduits, and subsurface drains that intersect vapor sources or vapor migration pathways. Note that naturally occurring fractures and macropores may serve as preferential pathways for either vertical or horizontal vapor migration, whereas anthropogenic features such as utility conduits are relatively shallow features and would likely serve only as a preferential pathway for horizontal migration. In either case, we recommend that buildings with significant preferential pathways be evaluated even if they are further than 100 ft from the contamination.

We also recommend that the potential for mobile "vapor clouds" (gas plumes) emanating from near-surface sources of contamination into the subsurface be considered when evaluating site data. Examples of such mobile "vapor clouds" include: 1) those originating in landfills where methane may serve as a carrier gas; and 2) those originating in commercial/industrial settings (such as dry cleaning facilities) where vapor can be released within an enclosed space and the density of the chemicals' vapor may result in

significant advective transport of the vapors downward through cracks/openings in floors and into the vadose zone. In these cases, diffusive transport of vapors is usually overridden by advective transport, and the vapors may be transported in the vadose zone several hundred feet from the source of contamination.

Finally, this guidance is intended to be applied to existing groundwater plumes as they are currently defined (e.g., MCLs, State Standards, or Risk-Based Concentrations). However, it is very important to recognize that some non-potable aquifers may have plumes that have been defined by threshold concentrations significantly higher than drinking-water concentrations. In these cases, contamination that is not technically considered part of the plume may still pose significant risks via the vapor intrusion pathway and, consequently, the plume definition may need to be expanded. Similarly, we recommend evaluating the technologies used to obtain soil gas and indoor air concentrations to determine if appropriate methods were used to ensure adequate data quality at the time analyses were conducted.

4. ***Identify Inhabited Buildings (or Areas With Potential for Future Residential Development) Within Distances of Possible Concern:***

The new Warehouse (Bldg 98) is located > 200 feet from the portion of the carbon tetrachloride plume exceeding the standard (i.e. MCL). The warehouse is used for storage and the office trailers are used by workers only during the day. The building does not have a basement.

C. Primary Screening Stage— Question #3

Q3: Does evidence suggest immediate action may be warranted to mitigate current risks?

_____ If **YES** – check here and proceed with appropriate actions to verify or eliminate imminent risks. Some examples of actions may include but are not limited to indoor air quality monitoring, engineered containment or ventilation systems, or relocation of people. The action(s) should be appropriate for the site-specific situation.

__✓__ If **NO** – check here and continue with Question 4.

1. What is the goal of this question?

This question is intended to help determine whether immediate action may be warranted for those buildings identified in Question 2 as located within the areas of concern. For the purposes of this guidance, "immediate action" means such action is necessary to verify or abate imminent and substantial threats to human health.

2. What are the qualitative criteria generally considered sufficient to indicate a need for immediate actions?

Odors reported by occupants, particularly if described as "chemical," or "solvent," or "gasoline." The presence of odors does not necessarily correspond to adverse health and/or safety impacts and the odors could be the result of indoor vapor sources; however, we believe it is generally prudent to investigate any reports of odors as the odor threshold for some chemicals exceeds their respective acceptable target breathing zone concentrations.

Physiological effects reported by occupants (dizziness, nausea, vomiting, confusion, etc.) may, or may not be due to subsurface vapor intrusion or even other indoor vapor sources, but, should generally be evaluated.

Wet basements, in areas **where chemicals of sufficient volatility and toxicity** (see Table 1) **are known to be present in groundwater and the water table is shallow enough that the basements are prone to groundwater intrusion or flooding.** This has been proven to be especially important where there is evidence of light, non-aqueous phase liquids (LNAPLs) floating on the water table directly below the building, and/or any direct evidence of contamination (liquid chemical or dissolved in water) inside the building.

Short-term safety concerns are known, or are reasonably suspected to exist, including: a) measured or likely explosive or acutely toxic concentrations of vapors in the building or connected utility conduits, sumps, or other subsurface drains directly connected to the

building and b) measured or likely vapor concentrations that may be flammable/combustible, corrosive, or chemically reactive.

3. *Rationale and Reference(s):*

None. No basement in Bldg. 98

VII. VAPOR INTRUSION PATHWAY SUMMARY PAGE

Facility Name: Warehouse (Bldg. 98)
Facility Address: Rochester St. and S. Harvard St. - BNL.

Primary Screening Summary

☐ *Q1: Constituents of concern Identified?*

_______ *Yes*
___✓___ *No* (If NO, skip to the conclusion section below and check NO to indicate the pathway is *incomplete.)*

☐ *Q2: Currently inhabited buildings near subsurface contamination?*

_______ *Yes*
___✓___ *No*

Areas of future concern near subsurface contamination?

_______ *Yes*
___✓___ *No* (If NO, skip to the conclusion section below and check NO to indicate the pathway is *incomplete.)*

☐ *Q3: Immediate Actions Warranted?*

_______ *Yes*
___✓___ *No*

Secondary Screening Summary

☐ *Vapor source identified:*

_____ *Groundwater*
_____ *Soil*
_____ *Insufficient data*

☐ *Indoor air data available?*

_____ *Yes*
_____ *No*

☐ *Indoor air concentrations exceed target levels?*

_____ *Yes*
_____ *No*

☐ *Subsurface data evaluation: (Circle appropriate answers below)*

Medium	Q4 Levels Exceeded?	Q5 Levels Exceeded?	Data Indicates Pathway is Complete?
Groundwater	YES / NO / NA / INS	YES / NO / NA / INS	YES / NO / INS
Soil Gas	YES / NO / NA / INS	YES / NO / NA / INS	YES / NO / INS

NA = not applicable
INS = insufficient data available to make a determination

Site-Specific Summary

☐ *Have the nature and extent of subsurface contamination, potential preferential pathways and overlying building characteristics been adequately characterized to identify the most-likely-to-be-impacted buildings?*

_____ *Yes*

_____ *No*

_____ *N/A*

EPA recommends that if a model was used, it be an appropriate and applicable model that represents the conceptual site model. If other means were used, document how you determined the potentially most impacted areas to sample. EPA recommends that predictive modeling can be used to support Current Human Exposures Under Control EI determinations without confirmatory sampling to support this determination. Current Human Exposures Under Control EI determinations are intended to reflect a reasonable conclusion by EPA or the State that current human exposures are under control with regard to the vapor intrusion pathway and current land use conditions. Therefore, if conducting evaluation for an EI determination, document that the **Pathway is Incomplete** and/or does not pose an unacceptable risk to human health for EI determinations.

☐ *Are you making an EI determination based on modeling and does the model prediction indicate that determination is expected to be adequately protective to support Current Human Exposures Under Control EI determinations?*

_____ *Yes*

_____ *No*

_____ *N/A*

☐ *Do subslab vapor concentrations exceed target levels?*

_____ *Yes*

_____ *No*

_____ *N/A*

☐ *Do indoor air concentrations exceed target levels?*

_____ *Yes*

_____ *No*

Conclusion

Is there a Complete Pathway for subsurface vapor intrusion to indoor air?

Below, check the appropriate conclusion for the Subsurface Vapor to Indoor Air Pathway evaluation and attach supporting documentation as well as a map of the facility.

__✓__ NO - the "Subsurface Vapor Intrusion to Indoor Air Pathway" has been verified to be incomplete for the __Warehouse (Bldg. 98)__ facility, EPA ID #______________, located at __BNL__. This determination is based on a review of site information, as suggested in this guidance, check as appropriate:

- __✓__ for current and reasonably expected conditions, or
- _____ based on performance monitoring evaluations for engineered exposure controls. This determination may be re-evaluated, where appropriate, when the Agency/State becomes aware of any significant changes at the facility.

_____ YES –The "Subsurface Vapor to Indoor Air Pathway" is Complete. Engineered controls, avoidance actions, or removal actions taken include: ____________

____

____

_____ UNKNOWN - More information is needed to make a determination.

Locations where References may be found:

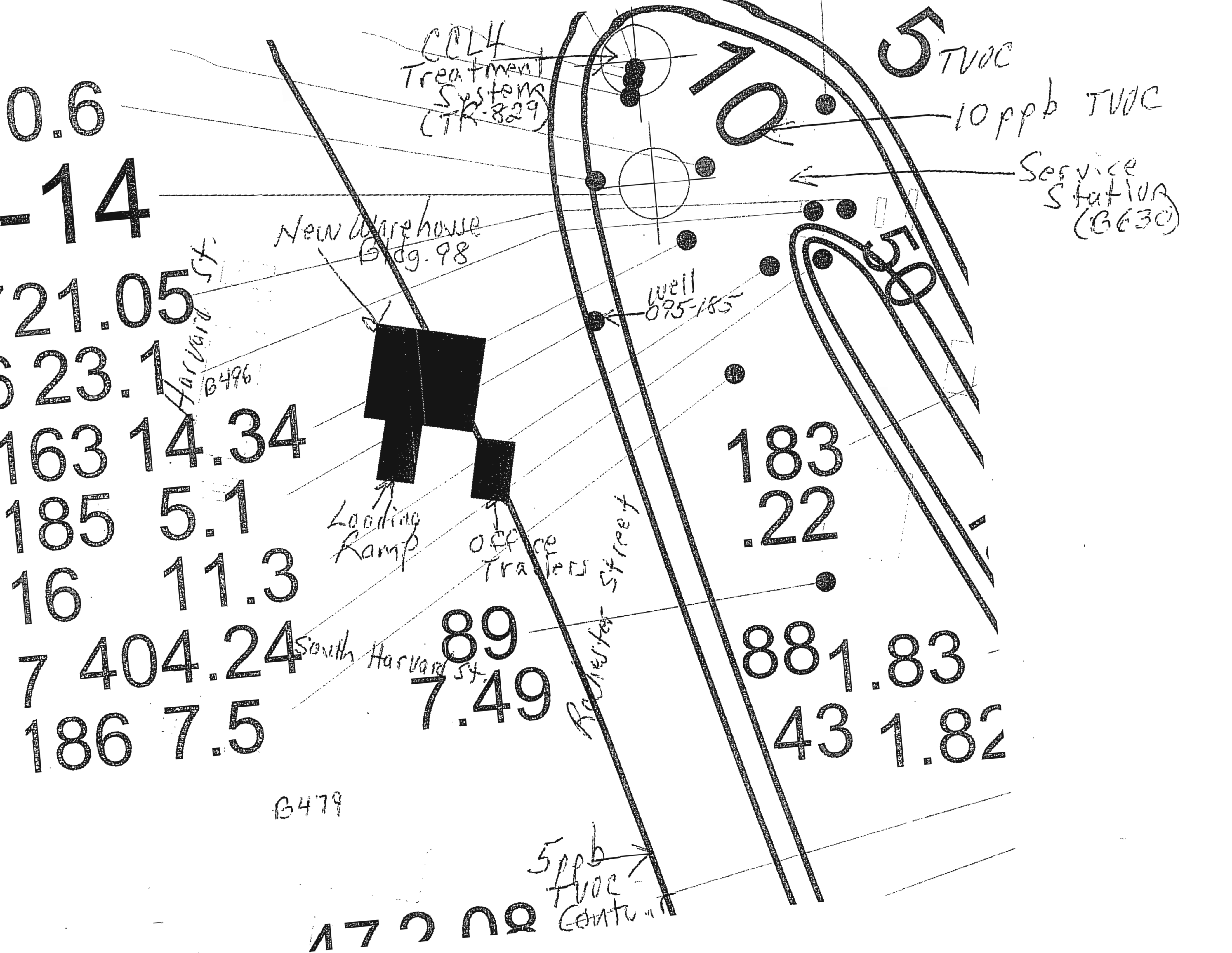
See attached

Contact telephone and e-mail numbers:

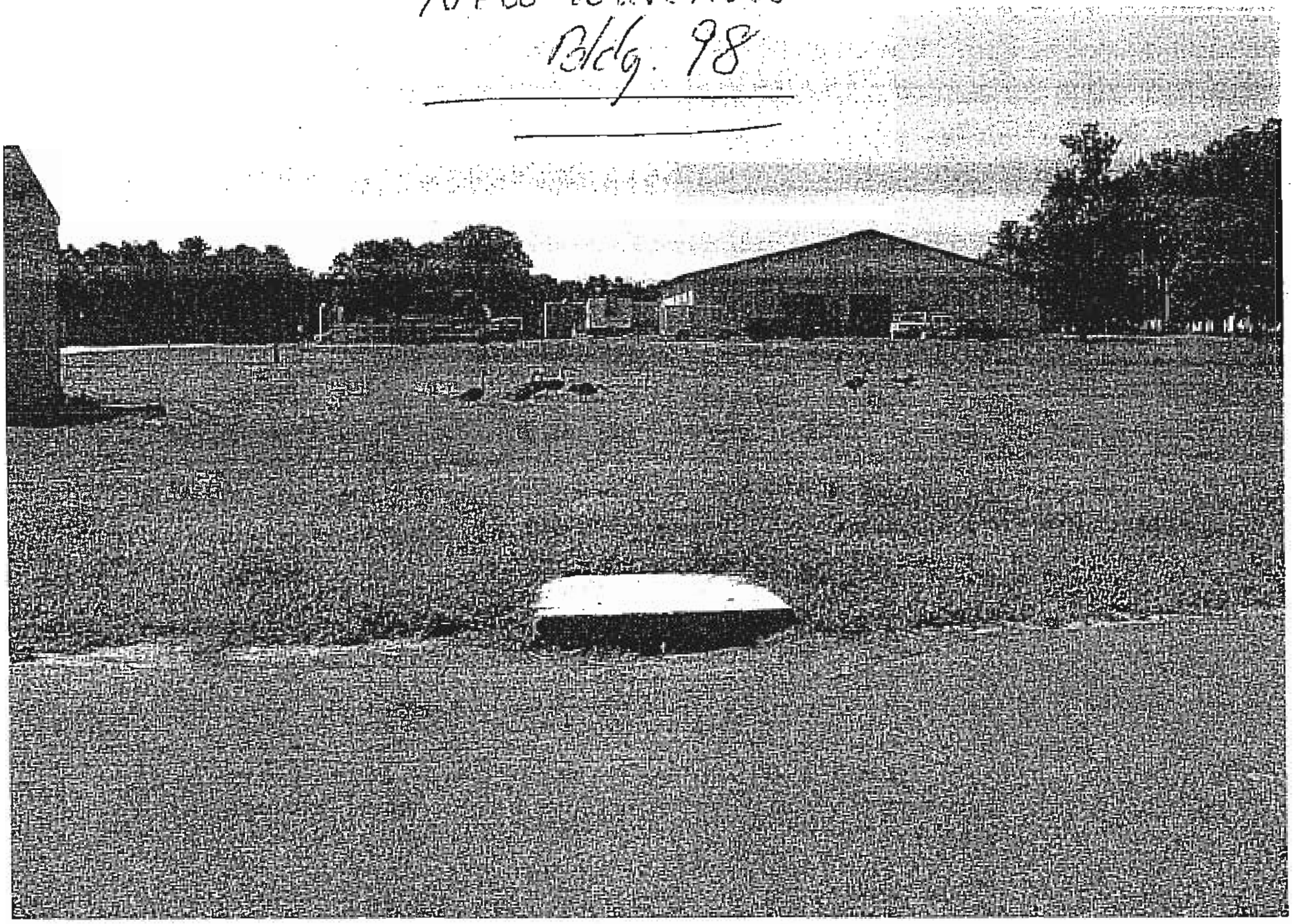
(name) Bob Howe [signature] 8/21/08

(phone #) 344-5588

(e-mail) howe@bnl.gov


5 TVOC
10 ppb TVOC
CCL4 Treatment System (CTR-829)
Service Station (G630)
10
50
New Warehouse Bldg. 98
Harvard St.
B496
Well 095-185
Loading Ramp
Office Trailers
Rochester Street
South Harvard St.
B479
5 ppb TVOC Contour
0.6
-14
21.05
23.1
163 14.34
185 5.1
16 11.3
7 404.24
186 7.5
89
7.49
183
.22
88 1.83
43 1.82

New Warehouse
Bldg. 98



New Warehouse (Bldg. 98) Nearby Monitoring Well Data (8/21/08)

Site ID: 095-185

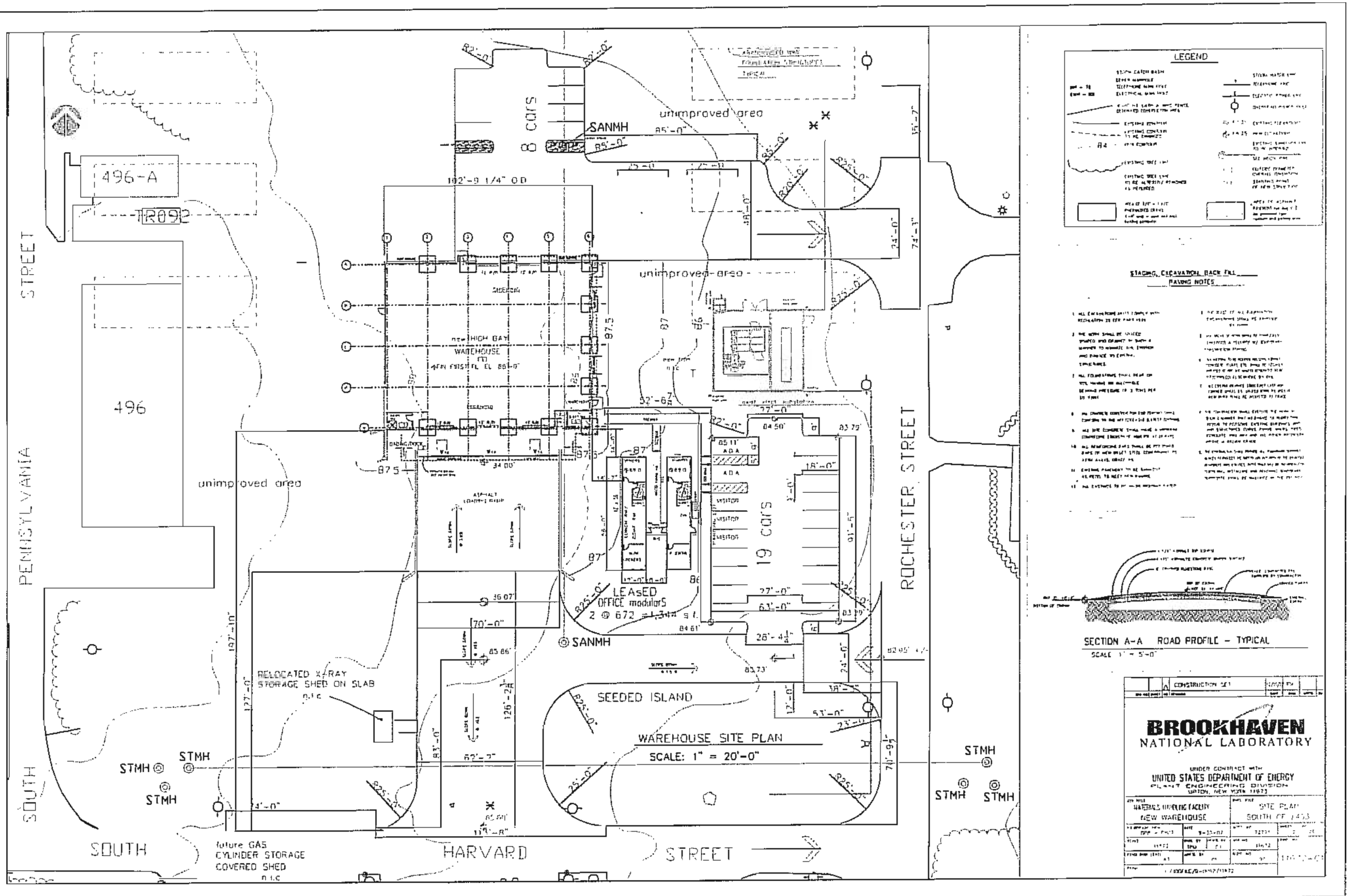
Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
524.2 TVOC	1/30/2006	4.42	--	--	UG/L	47	
Carbon tetrachloride	1/30/2006	3.7	0.5	--	UG/L	47	
Chloroform	1/30/2006	0.72	0.5	--	UG/L	47	
524.2 TVOC	4/28/2006	3.94	--	--	UG/L	47	
Carbon tetrachloride	4/28/2006	3.3	0.5	--	UG/L	47	
Chloroform	4/28/2006	0.64	0.5	--	UG/L	47	
524.2 TVOC	7/26/2006	6.13	--	--	UG/L	47	
Carbon tetrachloride	7/26/2006	5.3	0.5	--	UG/L	47	
Chloroform	7/26/2006	0.83	0.5	--	UG/L	47	
524.2 TVOC	10/16/2006	4.78	--	--	UG/L	47.5	
Carbon tetrachloride	10/16/2006	4.1	0.5	--	UG/L	47.5	
Chloroform	10/16/2006	0.68	0.5	--	UG/L	47.5	
524.2 TVOC	1/12/2007	6.1	--	--	UG/L	47	
Carbon tetrachloride	1/12/2007	4.9	0.5	--	UG/L	47	
Chloroform	1/12/2007	1.2	0.5	--	UG/L	47	
524.2 TVOC	4/11/2007	3.38	--	--	UG/L	47	
Carbon tetrachloride	4/11/2007	2.7	0.5	--	UG/L	47	
Chloroform	4/11/2007	0.68	0.5	--	UG/L	47	
524.2 TVOC	10/12/2007	5.1	--	--	UG/L	45	
Carbon tetrachloride	10/12/2007	3.8	0.5	--	UG/L	45	
Chloroform	10/12/2007	1.3	0.5	--	UG/L	45	
524.2 TVOC	6/17/2008	1.79	--	--	UG/L	47	
Carbon tetrachloride	6/17/2008	1.2	0.5	--	UG/L	47	
Chloroform	6/17/2008	0.59	0.5	--	UG/L	47	

Site ID: 095-89

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
1,1,1-Trichloroethane	1/27/2006	2.8	0.5	--	UG/L	160	
1,1-Dichloroethane	1/27/2006	0.49	0.5	--	UG/L	160	J
1,1-Dichloroethylene	1/27/2006	1.4	0.5	--	UG/L	160	
524.2 TVOC	1/27/2006	7.569	--	--	UG/L	160	
Carbon tetrachloride	1/27/2006	0.29	0.5	--	UG/L	160	J
Chloroform	1/27/2006	2	0.5	--	UG/L	160	
Trichloroethylene	1/27/2006	0.5	0.5	--	UG/L	160	
Trichlorofluoromethane	1/27/2006	0.089	0.5	--	UG/L	160	J
1,1,1-Trichloroethane	4/27/2006	3.1	0.5	--	UG/L	160	
1,1-Dichloroethane	4/27/2006	0.48	0.5	--	UG/L	160	J
1,1-Dichloroethylene	4/27/2006	1.5	0.5	--	UG/L	160	
524.2 TVOC	4/27/2006	8.02	--	--	UG/L	160	
Carbon tetrachloride	4/27/2006	0.24	0.5	--	UG/L	160	J
Chloroform	4/27/2006	2.2	0.5	--	UG/L	160	
Trichloroethylene	4/27/2006	0.5	0.5	--	UG/L	160	
1,1,1-Trichloroethane	8/8/2006	2.8	0.5	--	UG/L	160	
1,1-Dichloroethane	8/8/2006	0.43	0.5	--	UG/L	160	J
1,1-Dichloroethylene	8/8/2006	1.2	0.5	--	UG/L	160	
524.2 TVOC	8/8/2006	7.83	--	--	UG/L	160	
Carbon tetrachloride	8/8/2006	0.37	0.5	--	UG/L	160	J
Chloroform	8/8/2006	2.6	0.5	--	UG/L	160	
Trichloroethylene	8/8/2006	0.43	0.5	--	UG/L	160	J
1,1,1-Trichloroethane	10/17/2006	2.6	0.5	--	UG/L	160	

New Warehouse (Bldg. 98) Nearby Monitoring Well Data (8/21/08)

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
1,1-Dichloroethane	10/17/2006	0.38	0.5	--	UG/L	160	J
1,1-Dichloroethylene	10/17/2006	1.2	0.5	--	UG/L	160	
524.2 TVOC	10/17/2006	7.87	--	--	UG/L	160	
Carbon tetrachloride	10/17/2006	0.57	0.5	--	UG/L	160	
Chloroform	10/17/2006	2.7	0.5	--	UG/L	160	
Trichloroethylene	10/17/2006	0.42	0.5	--	UG/L	160	J
1,1,1-Trichloroethane	1/12/2007	1.8	0.5	--	UG/L	160	
1,1-Dichloroethylene	1/12/2007	0.97	0.5	--	UG/L	160	
524.2 TVOC	1/12/2007	5.58	--	--	UG/L	160	
Carbon tetrachloride	1/12/2007	0.71	0.5	--	UG/L	160	
Chloroform	1/12/2007	2.1	0.5	--	UG/L	160	
1,1,1-Trichloroethane	4/11/2007	1.8	0.5	--	UG/L	160	
1,1-Dichloroethane	4/11/2007	0.35	0.5	--	UG/L	160	J
1,1-Dichloroethylene	4/11/2007	0.88	0.5	--	UG/L	160	
524.2 TVOC	4/11/2007	5.85	--	--	UG/L	160	
Carbon tetrachloride	4/11/2007	0.3	0.5	--	UG/L	160	J
Chloroform	4/11/2007	2.2	0.5	--	UG/L	160	
Trichloroethylene	4/11/2007	0.32	0.5	--	UG/L	160	J
1,1,1-Trichloroethane	10/12/2007	1.9	0.5	--	UG/L	160	
1,1-Dichloroethane	10/12/2007	0.48	0.5	--	UG/L	160	J
1,1-Dichloroethylene	10/12/2007	0.93	0.5	--	UG/L	160	
524.2 TVOC	10/12/2007	7.49	--	--	UG/L	160	
Carbon tetrachloride	10/12/2007	0.72	0.5	--	UG/L	160	
Chloroform	10/12/2007	3.1	0.5	--	UG/L	160	
Trichloroethylene	10/12/2007	0.36	0.5	--	UG/L	160	J
1,1,1-Trichloroethane	4/15/2008	1.6	0.5	--	UG/L	160	
1,1-Dichloroethane	4/15/2008	0.54	0.5	--	UG/L	160	
1,1-Dichloroethylene	4/15/2008	0.86	0.5	--	UG/L	160	
524.2 TVOC	4/15/2008	7.17	--	--	UG/L	160	
Carbon tetrachloride	4/15/2008	0.64	0.5	--	UG/L	160	
Chloroform	4/15/2008	3.2	0.5	--	UG/L	160	
Trichloroethylene	4/15/2008	0.33	0.5	--	UG/L	160	J



LEGEND
STAGING, EXCAVATION, BACK FILL, PAVING NOTES
SECTION A-A ROAD PROFILE - TYPICAL
SCALE: 1" = 5'-0"
WAREHOUSE SITE PLAN
SCALE: 1" = 20'-0"
BROOKHAVEN
NATIONAL LABORATORY
UNDER CONTRACT WITH
UNITED STATES DEPARTMENT OF ENERGY
PLANT ENGINEERING DIVISION
UPTON, NEW YORK 11973
CONSTRUCTION SET
NEW WAREHOUSE
SITE PLAN
PENNSYLVANIA STREET
ROCHESTER STREET
SOUTH HARVARD STREET
SOUTH
496
496-A
R092
8 cars
19 cars
SANMH
STMH
unimproved area
new HIGH BAY WAREHOUSE
LEASED OFFICE modulars
2 @ 672 = 1,344 s.f.
SEEDED ISLAND
RELOCATED X-RAY STORAGE SHED ON SLAB
future GAS CYLINDER STORAGE COVERED SHED
ADA
VISITOR
102'-9 1/4" O.D.

Environmental & Waste Management Services Division

Building 51
P.O. Box 5000
Upton, NY 11973-5000
Phone 631 344-5588
Fax 631 344-7776
howe@bnl.gov

BROOKHAVEN
NATIONAL LABORATORY

Memo

date: *June 5, 2008*

to: *File*

from: *R. Howe* R Howe

subject: SOIL GAS VAPOR EVALUATION FOR NEW BUILDING

This memo documents the potential for soil gas vapor buildup in the proposed Interdisciplinary Science Building (ISB) at BNL that is currently in the planning stage. As identified in the attached preliminary initial screening for this building, the closest groundwater contaminant plume is approximately 500 feet to the southwest. In addition, a clean layer of groundwater exists above this plume. Therefore, the subsurface to indoor air pathway is incomplete, and no further evaluation is needed at this time.

Attachment

Copy: M. Davis
W. Dorsch
G. Penny
File: GWER 59.08

6/4/08
FOR Interdisciplinary Science Bldg (ISB) Soil Vapor Evaluation

IV. TIER 1 - Primary Screening

Primary Screening is designed to help quickly screen out sites at which the vapor intrusion pathway does not ordinarily need further consideration, and point out the sites that do typically need further consideration. This evaluation involves determining whether any potential exists at a specific site for vapor intrusion to result in unacceptable indoor inhalation risks and, if so, whether immediate action may be warranted. Recommended criteria for making these determinations are presented in Questions 1 through 3, which focus on identifying:

a) if chemicals of sufficient volatility and toxicity are present or reasonably suspected to be present (Question 1);

b) if inhabited buildings are located (or will be constructed under future development scenarios – except for Environmental Indicator determinations, see section IV.C below) above or in close proximity to subsurface contamination (Question 2); and

c) if current conditions warrant immediate action (Question 3).

This primary screening process is illustrated in a flow diagram included in Appendix C:

A. Primary Screening – Question #1

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface (e.g., in unsaturated soils, soil gas, or the uppermost portions of the ground water and/or capillary fringe – see Table 1)? (We recommend this consideration involve DQOs (see Appendix A) used in acquiring the site data as well as an appropriately scaled Conceptual Site Model (CSM) for vapor intrusion (see Appendix B).)

_____ If **YES** - check here, check off the relevant chemicals on Table 1, and continue with Question 2. The chemicals identified here (and any degradation products) are evaluated as constituents of potential concern in subsequent questions.

__✓__ If **NO** - check here, provide the rationale and references below, and then go to the Summary Page to document that the subsurface vapor to indoor air pathway is incomplete (i.e., no further consideration of this pathway is needed); or

_____ If sufficient data are not available, go to the Summary Page and document the need for more information. After collecting the necessary data, Question 1 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

1. What is the goal of this question?

This question is designed to help quickly screen out sites at which the vapor intrusion pathway generally does not need further consideration. This evaluation involves determining whether or not any potential exists at a specific site for the vapor intrusion

pathway to result in unacceptable indoor air inhalation risks. Table 1 lists chemicals that may be found at hazardous waste sites and indicates whether, in our judgment, they are sufficiently volatile (Henry's Law Constant > 10^{-5} atm m^3/mol) to result in potentially significant vapor intrusion and sufficiently toxic (either an incremental lifetime cancer risk greater than 10^{-6} or a non-cancer hazard index greater than 1, or in some cases both) to result in potentially unacceptable indoor air inhalation risks. The approach used to develop Table 1 is documented in Appendix D and can be used, where appropriate, to evaluate volatile chemicals not included in the Table. We recommend that if any of the chemicals listed in Table 1 that are sufficiently volatile and toxic are present at a site, those chemicals become constituents of potential concern for the vapor intrusion pathway and are evaluated in subsequent questions in this guidance. If the chemicals listed in Table 1 are not present at a site, and no other volatile chemicals are present, we suggest that the vapor intrusion pathway be considered incomplete and no further consideration of this pathway is needed.

2. *What should you keep in mind?*

In evaluating the available site data, we recommend the DQOs used in collecting the data be reviewed to ensure those objectives are consistent with the DQOs for the vapor intrusion pathway (see Appendix A). We recommend the detection limits associated with the available groundwater data be reviewed to ensure they are not too high to detect volatile contaminants of potential concern. Also, we suggest that the adequacy of the definition of the nature and extent of contamination in groundwater and/or the vadose zone be assessed to ensure that all contaminants of concern and areas of contamination have been identified. Additionally, we recommend groundwater concentrations be measured or reasonably estimated using samples collected from wells screened at, or across the top of the water table. We recommend users read Appendices B (Conceptual Site Model for the Vapor Intrusion Pathway) and E (Relevant Methods and Techniques) to obtain a greater understanding of the important considerations in evaluating data for use in screening assessments of the vapor intrusion pathway.

3. ***Rationale and References:***

No plumes in groundwater exist in the area of the proposed ISB. There is clean groundwater across the top of the water table (See location figure)

B. Primary Screening – Question #2

Q2: Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located *near* (see discussion below) subsurface contaminants found in Table 1?

_____ If **YES** – check here, identify buildings and/or areas of concern below, and document on the Summary Page whether the potential for impacts from the vapor intrusion pathway applies to currently inhabited buildings or areas of concern under reasonably anticipated future development scenarios, or both. (Note that for EI considerations, we recommend only current risks be evaluated.) Then proceed with Question 3.

__✓__ If **NO** – check here, describe the rationale below, and then go to the Summary Page to document that there is no potential for the vapor intrusion pathway to impact either currently inhabited buildings or areas of concern under future development scenarios (i.e., no further evaluation of this pathway is needed). (Note that for EI considerations, only current risks are evaluated.); or

_____ If sufficient data are not available – check here and document the need for more information on the Summary Page. After collecting the necessary data, Question 2 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

1. What is the goal of this question?

The goal of this question is to help determine whether inhabited buildings currently are located (or may be reasonably expected to be located under future development scenarios) above or in close proximity to subsurface contamination that potentially could result in unacceptable indoor air inhalation risks. If inhabited buildings and/or future development are not located "near" the area of concern, we suggest that the vapor intrusion pathway be considered incomplete and no further consideration of the pathway should be needed.

For the purposes of this question, **"inhabited buildings"** are structures with enclosed air space that are designed for human occupancy. Table 1, discussed above in Question 1, lists the **"subsurface contaminants demonstrating sufficient volatility and toxicity"** to potentially pose an inhalation risk. We recommend that an inhabited building generally be considered **"near"** subsurface contaminants if it is located within approximately 100 ft laterally or vertically of known or interpolated soil gas or groundwater contaminants listed in Table 1 (or others not included in table 1 – see Question 1) and the contamination occurs in the unsaturated zone and/or the uppermost saturated zone. If the source of contamination is groundwater, we recommend migration of the contaminant plume be considered when evaluating the potential for future risks. The distance suggested above (100 feet) may not be appropriate for all sites (or contaminants) and,

consequently, we recommend that professional judgment be used when evaluating the potential for vertical and horizontal vapor migration.

2. *How did we develop the suggested distance?*

The recommended distance is designed to allow for the assessment to focus on buildings (or areas with the potential to be developed for human habitation) most likely to have a complete vapor intrusion pathway. Vapor concentrations generally decrease with increasing distance from a subsurface vapor source, and eventually at some distance the concentrations become negligible. The distance at which concentrations are negligible is a function of the mobility, toxicity and persistence of the chemical, as well as the geometry of the source, subsurface materials, and characteristics of the buildings of concern. Available information suggests that 100 feet laterally and vertically is a reasonable criterion when considering vapor migration fundamentals, typical sampling density, and uncertainty in defining the actual contaminant spatial distribution. The recommended lateral distance is supported by empirical data from Colorado sites where the vapor intrusion pathway has been evaluated. At these sites, no significant indoor air concentrations have been found in residences at a distance greater than one house lot (approximately 100 feet) from the interpolated edge of ground water plumes. Considering the nature of diffusive vapor transport and the typical anisotropy in soil permeability, in our judgment a similar criterion of 100 feet for vertical transport is generally conservative. These recommended distances will be re-evaluated and, if necessary, adjusted by EPA as additional empirical data are compiled.

3. *What should you keep in mind when evaluating this criterion?*

It is important to consider whether **significant preferential pathways** could allow vapors to migrate more than 100 feet laterally. For the purposes of this guidance, a "significant" preferential pathway is a naturally occurring or anthropogenic subsurface pathway that is expected to have a high gas permeability and be of sufficient volume and proximity to a building so that it may be reasonably anticipated to influence vapor intrusion into the building. Examples include fractures, macropores, utility conduits, and subsurface drains that intersect vapor sources or vapor migration pathways. Note that naturally occurring fractures and macropores may serve as preferential pathways for either vertical or horizontal vapor migration, whereas anthropogenic features such as utility conduits are relatively shallow features and would likely serve only as a preferential pathway for horizontal migration. In either case, we recommend that buildings with significant preferential pathways be evaluated even if they are further than 100 ft from the contamination.

We also recommend that the potential for mobile "vapor clouds" (gas plumes) emanating from near-surface sources of contamination into the subsurface be considered when evaluating site data. Examples of such mobile "vapor clouds" include: 1) those originating in landfills where methane may serve as a carrier gas; and 2) those originating in commercial/industrial settings (such as dry cleaning facilities) where vapor can be released within an enclosed space and the density of the chemicals' vapor may result in

significant advective transport of the vapors downward through cracks/openings in floors and into the vadose zone. In these cases, diffusive transport of vapors is usually overridden by advective transport, and the vapors may be transported in the vadose zone several hundred feet from the source of contamination.

Finally, this guidance is intended to be applied to existing groundwater plumes as they are currently defined (e.g., MCLs, State Standards, or Risk-Based Concentrations). However, it is very important to recognize that some non-potable aquifers may have plumes that have been defined by threshold concentrations significantly higher than drinking-water concentrations. In these cases, contamination that is not technically considered part of the plume may still pose significant risks via the vapor intrusion pathway and, consequently, the plume definition may need to be expanded. Similarly, we recommend evaluating the technologies used to obtain soil gas and indoor air concentrations to determine if appropriate methods were used to ensure adequate data quality at the time analyses were conducted.

4. *Identify Inhabited Buildings (or Areas With Potential for Future Residential Development) Within Distances of Possible Concern:*

ISB - future potential building - outside of any contaminant plume. The subsurface vapor to indoor air pathway is incomplete and no further evaluation is needed at this time.

C. Primary Screening Stage— Question #3

Q3: Does evidence suggest immediate action may be warranted to mitigate current risks?

_____ If **YES** – check here and proceed with appropriate actions to verify or eliminate imminent risks. Some examples of actions may include but are not limited to indoor air quality monitoring, engineered containment or ventilation systems, or relocation of people. The action(s) should be appropriate for the site-specific situation.

✓ If **NO** – check here and continue with Question 4.

1. What is the goal of this question?

This question is intended to help determine whether immediate action may be warranted for those buildings identified in Question 2 as located within the areas of concern. For the purposes of this guidance, "immediate action" means such action is necessary to verify or abate imminent and substantial threats to human health.

2. What are the qualitative criteria generally considered sufficient to indicate a need for immediate actions?

Odors reported by occupants, particularly if described as "chemical," or "solvent," or "gasoline." The presence of odors does not necessarily correspond to adverse health and/or safety impacts and the odors could be the result of indoor vapor sources; however, we believe it is generally prudent to investigate any reports of odors as the odor threshold for some chemicals exceeds their respective acceptable target breathing zone concentrations.

Physiological effects reported by occupants (dizziness, nausea, vomiting, confusion, etc.) may, or may not be due to subsurface vapor intrusion or even other indoor vapor sources, but, should generally be evaluated.

Wet basements, in areas **where chemicals of sufficient volatility and toxicity** (see Table 1) **are known to be present in groundwater and the water table is shallow enough that the basements are prone to groundwater intrusion or flooding.** This has been proven to be especially important where there is evidence of light, non-aqueous phase liquids (LNAPLs) floating on the water table directly below the building, and/or any direct evidence of contamination (liquid chemical or dissolved in water) inside the building.

Short-term safety concerns are known, or are reasonably suspected to exist, including: a) measured or likely explosive or acutely toxic concentrations of vapors in the building or connected utility conduits, sumps, or other subsurface drains directly connected to the

building and b) measured or likely vapor concentrations that may be flammable/combustible, corrosive, or chemically reactive.

3. *Rationale and Reference(s):*

None

VII. VAPOR INTRUSION PATHWAY SUMMARY PAGE

Facility Name: Interdisciplinary Science Bldg (ISB)
Facility Address: Brookhaven Ave. BNL

Primary Screening Summary

☐ *Q1: Constituents of concern Identified?*

_______ *Yes*

___✓___ *No* (If NO, skip to the conclusion section below and check NO to indicate the pathway is *incomplete.)*

☐ *Q2: Currently inhabited buildings near subsurface contamination?*

_______ *Yes*

___✓___ *No*

Areas of future concern near subsurface contamination?

_______ *Yes*

___✓___ *No* (If NO, skip to the conclusion section below and check NO to indicate the pathway is *incomplete.)*

☐ *Q3: Immediate Actions Warranted?*

_______ *Yes*

___✓___ *No*

Secondary Screening Summary

☐ *Vapor source identified:*

_____ *Groundwater*

_____ *Soil*

_____ *Insufficient data*

☐ *Indoor air data available?*

_____ *Yes*

_____ *No*

☐ *Indoor air concentrations exceed target levels?*

_____ *Yes*

_____ *No*

☐ *Subsurface data evaluation: (Circle appropriate answers below)*

Medium	Q4 Levels Exceeded?	Q5 Levels Exceeded?	Data Indicates Pathway is Complete?
Groundwater	YES / NO / NA / INS	YES / NO / NA / INS	YES / NO / INS
Soil Gas	YES / NO / NA / INS	YES / NO / NA / INS	YES / NO / INS

NA = not applicable
INS = insufficient data available to make a determination

Site-Specific Summary

☐ *Have the nature and extent of subsurface contamination, potential preferential pathways and overlying building characteristics been adequately characterized to identify the most-likely-to-be-impacted buildings?*

_____ *Yes*

_____ *No*

_____ *N/A*

EPA recommends that if a model was used, it be an appropriate and applicable model that represents the conceptual site model. If other means were used, document how you determined the potentially most impacted areas to sample. EPA recommends that predictive modeling can be used to support Current Human Exposures Under Control EI determinations without confirmatory sampling to support this determination. Current Human Exposures Under Control EI determinations are intended to reflect a reasonable conclusion by EPA or the State that current human exposures are under control with regard to the vapor intrusion pathway and current land use conditions. Therefore, if conducting evaluation for an EI determination, document that the **Pathway is Incomplete** and/or does not pose an unacceptable risk to human health for EI determinations.

☐ *Are you making an EI determination based on modeling and does the model prediction indicate that determination is expected to be adequately protective to support Current Human Exposures Under Control EI determinations?*

_____ *Yes*

_____ *No*

_____ *N/A*

☐ *Do subslab vapor concentrations exceed target levels?*

_____ *Yes*

_____ *No*

_____ *N/A*

☐ *Do indoor air concentrations exceed target levels?*

_____ *Yes*

_____ *No*

Conclusion

Is there a Complete Pathway for subsurface vapor intrusion to indoor air?

Below, check the appropriate conclusion for the Subsurface Vapor to Indoor Air Pathway evaluation and attach supporting documentation as well as a map of the facility.

__✓__ NO - the "Subsurface Vapor Intrusion to Indoor Air Pathway" has been verified to be incomplete for the __proposed ISB__ facility, EPA ID # ______________, located at __BNL__.
This determination is based on a review of site information, as suggested in this guidance; check as appropriate:

__✓__ for current and reasonably expected conditions, or

_____ based on performance monitoring evaluations for engineered exposure controls. This determination may be re-evaluated, where appropriate, when the Agency/State becomes aware of any significant changes at the facility.

_____ YES –The "Subsurface Vapor to Indoor Air Pathway" is Complete. Engineered controls, avoidance actions, or removal actions taken include: ____________

____

____

_____ UNKNOWN - More information is needed to make a determination.

Locations where References may be found:

____

____

____

____

____

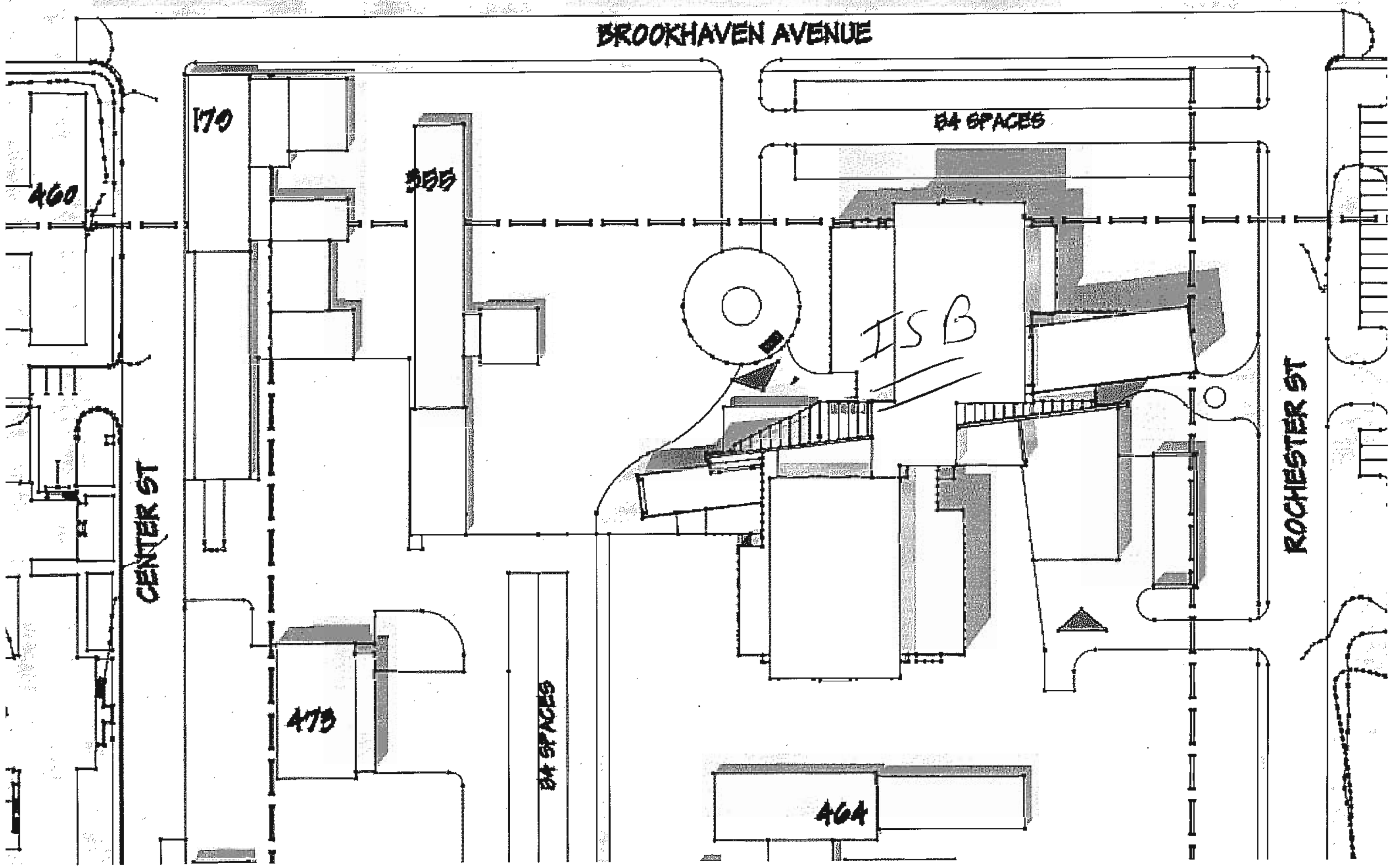
Contact telephone and e-mail numbers:

(name) __Robert Howe 6/4/08__

(phone #) ______________________________

(e-mail) ______________________________


075-01
.35
075-02
.02
0.85 ppb TVOC
Brookhaven Ave
355
ISB
Rochester St.
464
5ppb TVOC
~500'


BROOKHAVEN AVENUE
84 SPACES
170
460
555
ISB
CENTER ST
ROCHESTER ST
473
84 SPACES
464

Monitoring Wells Near ISB (6/4/08)

Site ID: 075-01

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
524.2 TVOC	1/28/2002	0	--	--	UG/L	45	
524.2 TVOC	4/30/2002	0	--	--	UG/L	45	
524.2 TVOC	7/29/2002	0.28	--	--	UG/L	45	
Chloroform	7/29/2002	0.28	0.5	--	UG/L	45	J
524.2 TVOC	11/26/2002	0	--	--	UG/L	45	
524.2 TVOC	2/19/2003	0	--	--	UG/L	45	
524.2 TVOC	6/11/2003	0	--	--	UG/L	45	
524.2 TVOC	9/10/2003	0	--	--	UG/L	45	
524.2 TVOC	12/12/2003	0	--	--	UG/L	45	
524.2 TVOC	11/8/2004	0.17	--	--	UG/L	45	
Chloroform	11/8/2004	0.17	0.5	--	UG/L	45	J
524.2 TVOC	11/7/2005	0.21	--	--	UG/L	45	
Chloroform	11/7/2005	0.21	0.5	--	UG/L	45	J
524.2 TVOC	12/6/2006	0.4	--	--	UG/L	45	
Chloroform	12/6/2006	0.28	0.5	--	UG/L	45	J
Trichloroethylene	12/6/2006	0.12	0.5	--	UG/L	45	J
524.2 TVOC	11/15/2007	0.35	--	--	UG/L	45	
Chloroform	11/15/2007	0.35	0.5	--	UG/L	45	J

Site ID: 075-02

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
524.2 TVOC	1/28/2002	0	--	--	UG/L	50	
524.2 TVOC	4/30/2002	0	--	--	UG/L	50	
524.2 TVOC	7/29/2002	0	--	--	UG/L	50	
524.2 TVOC	11/26/2002	0	--	--	UG/L	50	
524.2 TVOC	2/19/2003	0	--	--	UG/L	50	
524.2 TVOC	6/11/2003	0	--	--	UG/L	50	
524.2 TVOC	9/10/2003	0	--	--	UG/L	50	
524.2 TVOC	12/12/2003	0	--	--	UG/L	50	
524.2 TVOC	11/8/2004	0.1	--	--	UG/L	50	
Chloroform	11/8/2004	0.1	0.5	--	UG/L	50	J
524.2 TVOC	11/7/2005	0	--	--	UG/L	50	
1,1,1-Trichloroethane	12/6/2006	0.092	0.5	--	UG/L	50	J
524.2 TVOC	12/6/2006	3.192	--	--	UG/L	50	
Chloroform	12/6/2006	3.1	0.5	--	UG/L	50	
524.2 TVOC	11/15/2007	0.85	--	--	UG/L	50	
Chloroform	11/15/2007	0.85	0.5	--	UG/L	50	

Environmental & Waste Management Services Division

BROOKHAVEN
NATIONAL LABORATORY

Building 51
P.O. Box 5000
Upton, NY 11973-5000
Phone 631 344-5588
Fax 631 344-7776
howe@bnl.gov

managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

date: *September 12, 2006*

to: *File*

from: *R. Howe* R Howe

subject: SOIL GAS VAPOR EVALUATION FOR NEW BUILDINGS

Two buildings, for Research Support and the Center for Functional Nanomaterials, are currently being constructed at BNL. This memo documents the potential for soil gas vapor buildup in these buildings, as well as the National Synchrotron Light Source II, that is currently in the planning stage.

As identified in the attached preliminary initial screening for these three buildings, a clean layer of groundwater exists above any volatile contaminants within the areas of the three buildings. Therefore, the subsurface to indoor air pathway is incomplete, and no further evaluation is needed at this time.

Attachment

Copy: M. Davis
W. Dorsch
G. Penny
File: GWER 59.06
N. Gmur (w/attach) NSLS

9/12/06

FOR CFN, Research Support, and NSLS II

IV. TIER 1 - Primary Screening

Primary Screening is designed to help quickly screen out sites at which the vapor intrusion pathway does not ordinarily need further consideration, and point out the sites that do typically need further consideration. This evaluation involves determining whether any potential exists at a specific site for vapor intrusion to result in unacceptable indoor inhalation risks and, if so, whether immediate action may be warranted. Recommended criteria for making these determinations are presented in Questions 1 through 3, which focus on identifying:

a) if chemicals of sufficient volatility and toxicity are present or reasonably suspected to be present (Question 1);
b) if inhabited buildings are located (or will be constructed under future development scenarios – except for Environmental Indicator determinations, see section IV.C below) above or in close proximity to subsurface contamination (Question 2); and
c) if current conditions warrant immediate action (Question 3).

This primary screening process is illustrated in a flow diagram included in Appendix C.

A. Primary Screening – Question #1

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface (e.g., in unsaturated soils, soil gas, or the uppermost portions of the ground water and/or capillary fringe – see Table 1)? (We recommend this consideration involve DQOs (see Appendix A) used in acquiring the site data as well as an appropriately scaled Conceptual Site Model (CSM) for vapor intrusion (see Appendix B).)

_____ If **YES** - check here, check off the relevant chemicals on Table 1, and continue with Question 2. The chemicals identified here (and any degradation products) are evaluated as constituents of potential concern in subsequent questions.

__✓__ If **NO** - check here, provide the rationale and references below, and then go to the Summary Page to document that the subsurface vapor to indoor air pathway is incomplete (i.e., no further consideration of this pathway is needed); or

_____ If sufficient data are not available, go to the Summary Page and document the need for more information. After collecting the necessary data, Question 1 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

1. What is the goal of this question?

This question is designed to help quickly screen out sites at which the vapor intrusion pathway generally does not need further consideration. This evaluation involves determining whether or not any potential exists at a specific site for the vapor intrusion

B. **Primary Screening – Question #2**

Q2: Are currently (or potentially) inhabited buildings or areas of couceru under future development scenarios located *near* (see discussion below) subsurface contamiuants found in Table 1?

_____ If **YES** – check here, identify buildings and/or areas of concern below, and document on the Summary Page whether the potential for impacts from the vapor intrusion pathway applies to currently inhabited buildings or areas of concern under reasonably anticipated future development scenarios, or both. (Note that for EI considerations, we recommend only current risks be evaluated.) Then proceed with Question 3.

✓ If **NO** – check here, describe the rationale below, and then go to the Summary Page to document that there is no potential for the vapor intrusion pathway to impact either currently inhabited buildings or areas of concern under future development scenarios (i.e., no further evaluation of this pathway is needed). (Note that for EI considerations, only current risks are evaluated.); or

_____ If sufficient data are not available – check here and document the need for more information on the Summary Page. After collecting the necessary data, Question 2 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

1. What is the goal of this question?

The goal of this question is to help determine whether inhabited buildings currently are located (or may be reasonably expected to be located under future development scenarios) above or in close proximity to subsurface contamination that potentially could result in unacceptable indoor air inhalation risks. If inhabited buildings and/or future development are not located "near" the area of concern, we suggest that the vapor intrusion pathway be considered incomplete and no further consideration of the pathway should be needed.

For the purposes of this question, **"inhabited buildings"** are structures with enclosed air space that are designed for human occupancy. Table 1, discussed above in Question 1, lists the **"subsurface contaminants demonstrating sufficient volatility and toxicity"** to potentially pose an inhalation risk. We recommend that an inhabited building generally be considered **"near"** subsurface contaminants if it is located within approximately 100 ft laterally or vertically of known or interpolated soil gas or groundwater contaminants listed in Table 1 (or others not included in table 1 – see Question 1) and the contamination occurs in the unsaturated zone and/or the uppermost saturated zone. If the source of contamination is groundwater, we recommend migration of the contaminant plume be considered when evaluating the potential for future risks. The distance suggested above (100 feet) may not be appropriate for all sites (or contaminants) and,

significant advective transport of the vapors downward through cracks/openings in floors and into the vadose zone. In these cases, diffusive transport of vapors is usually overridden by advective transport, and the vapors may be transported in the vadose zone several hundred feet from the source of contamination.

Finally, this guidance is intended to be applied to existing groundwater plumes as they are currently defined (e.g., MCLs, State Standards, or Risk-Based Concentrations). However, it is very important to recognize that some non-potable aquifers may have plumes that have been defined by threshold concentrations significantly higher than drinking-water concentrations. In these cases, contamination that is not technically considered part of the plume may still pose significant risks via the vapor intrusion pathway and, consequently, the plume definition may need to be expanded. Similarly, we recommend evaluating the technologies used to obtain soil gas and indoor air concentrations to determine if appropriate methods were used to ensure adequate data quality at the time analyses were conducted.

4. ***Identify Inhabited Buildings (or Areas With Potential for Future Residential Development) Within Distances of Possible Concern:***

- NSLS II - future potential building - outside of any contaminant plume.
- Research Support - in construction - primarily outside plume. No pathway since clean gw exists ~~GW~~ below bldg
- CFN - in construction - sits above very low level contamination in plume, but clean gw exists beneath the building, therefore no pathway.

Overall the subsurface vapor to indoor air pathway is incomplete and no further evaluation is needed at this time.

building and b) measured or likely vapor concentrations that may be flammable/combustible, corrosive, or chemically reactive.

3. ***Rationale and Reference(s):***

None

☐ *Subsurface data evaluation: (Circle appropriate answers below)*

Medium	Q4 Levels Exceeded?	Q5 Levels Exceeded?	Data Indicates Pathway is Complete?
Groundwater	YES / NO / NA / INS	YES / NO / NA / INS	YES / NO / INS
Soil Gas	YES / NO / NA / INS	YES / NO / NA / INS	YES / NO / INS

NA = not applicable
INS = insufficient data available to make a determination

Site-Specific Summary

☐ *Have the nature and extent of subsurface contamination, potential preferential pathways and overlying building characteristics been adequately characterized to identify the most-likely-to-be-impacted buildings?*

_____ *Yes*

_____ *No*

_____ *N/A*

EPA recommends that if a model was used, it be an appropriate and applicable model that represents the conceptual site model. If other means were used, document how you determined the potentially most impacted areas to sample. EPA recommends that predictive modeling can be used to support Current Human Exposures Under Control EI determinations without confirmatory sampling to support this determination. Current Human Exposures Under Control EI determinations are intended to reflect a reasonable conclusion by EPA or the State that current human exposures are under control with regard to the vapor intrusion pathway and current land use conditions. Therefore, if conducting evaluation for an EI determination, document that the **Pathway is Incomplete** and/or does not pose an unacceptable risk to human health for EI determinations.

☐ *Are you making an EI determination based on modeling and does the model prediction indicate that determination is expected to be adequately protective to support Current Human Exposures Under Control EI determinations?*

_____ *Yes*

_____ *No*

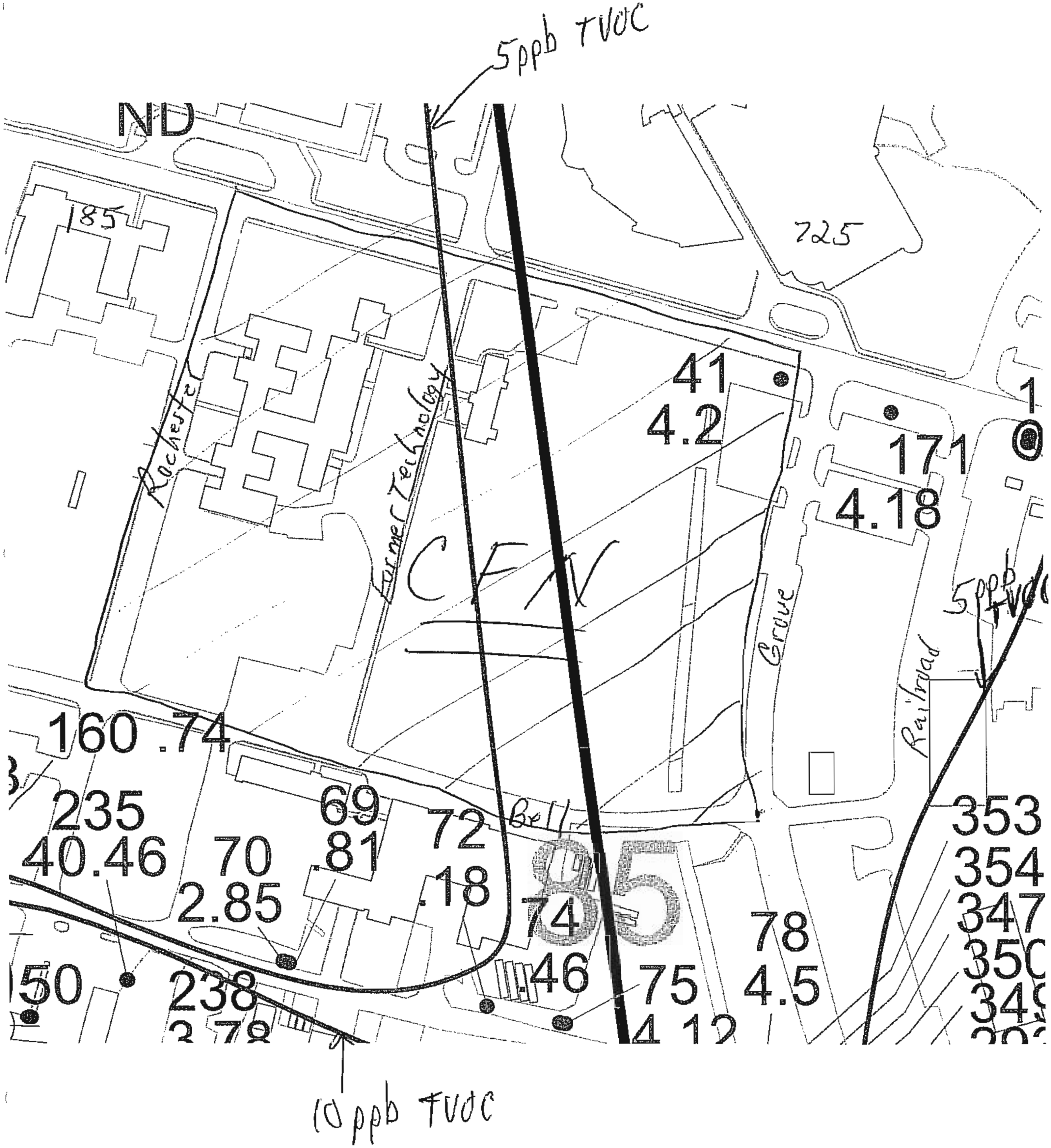
_____ *N/A*

☐ *Do subslab vapor concentrations exceed target levels?*

_____ *Yes*

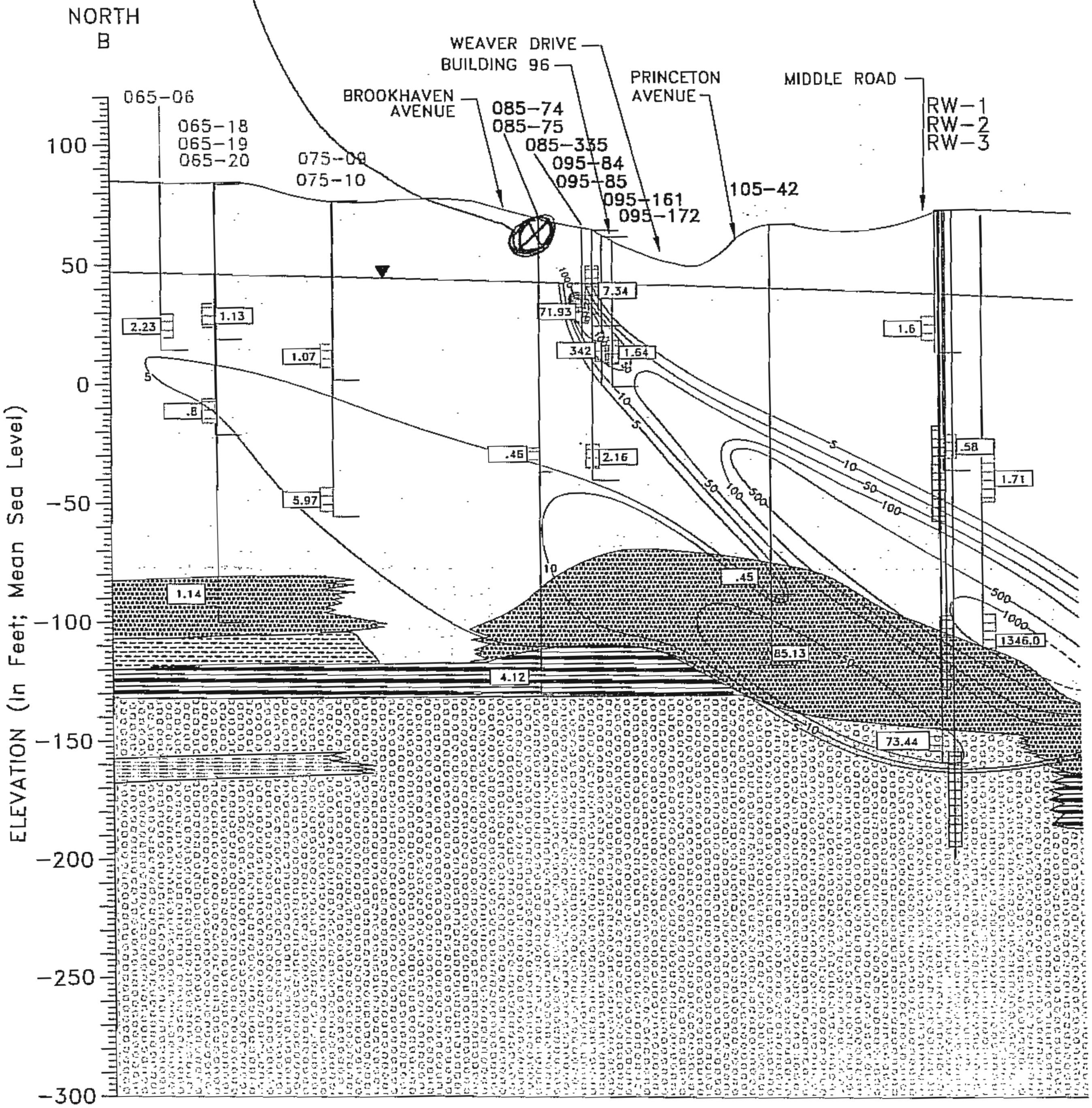
_____ *No*

_____ *N/A*



5ppb TVOC
ND
185
725
Rochester
Former Technology
CFN
Grove
Railroad
Bell
5ppb TVOC
41
4.2
171
4.18
160
.74
235
40.46
70
2.85
69
.81
72
.18
74
.46
75
78
4.5
353
354
347
238
10ppb TVOC

CFN



LEGEND

Upper Glacial aquifer	Gardiners Clay	Magothy aquifer	
UG Upper Glacial Sands	GL Gardiners Clay	MA Magothy Sands and Clay	000-114 BNL W
UC Upper Glacial Silts & Clays	GS Gardiners Clay – Silt	MB Magothy Brown Clay	1.13 TVOC
UU Upton Unit		MC Magothy Clays (undiff)	ND Not d… labora
		MO Magothy – OTHER	NS Not S…
			—50— TVOC (Dashe

HORIZONTAL SCALE
0 500 1000 FEET

\\OERNT\GIS\GW_PROJECTS\CY_2005_GW_REPORT\FINAL_DRAFT_FIGURES\FIG_3.02-02.DWG

BROOKHAVEN
NATIONAL LABORATORY

EWMS DIVISION

TITLE:

TVOC HYDROGEOLOG

2005 BNL GRC

CFN Monitor Wells

9/12/2006

Site ID: 075-01

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
524.2 TVOC	2/25/2000	0.95	--	--	UG/L	45	
Chloroform	2/25/2000	0.95	0.5	--	UG/L	45	
524.2 TVOC	6/16/2000	1.9	--	--	UG/L	45	
Chloroform	6/16/2000	0.7	0.5	--	UG/L	45	
Methylene chloride	6/16/2000	1.2	0.5	--	UG/L	45	
Gross Beta	8/1/2000	5.05	2.28	3.04	PCI/L	50	
Potassium-40	8/1/2000	30.9	0	27.90888	PCI/L	50	
Tritium	8/1/2000	585	320	460	PCI/L	50	
524.2 TVOC	9/11/2000	1.85	--	--	UG/L	45	
Chloroform	9/11/2000	1	0.5	--	UG/L	45	
Methylene chloride	9/11/2000	0.85	0.5	--	UG/L	45	
524.2 TVOC	11/30/2000	1	--	--	UG/L	45	
Chloroform	11/30/2000	1	0.5	--	UG/L	45	
524.2 TVOC	2/20/2001	0.32	--	--	UG/L	45	
Chloroform	2/20/2001	0.32	0.5	--	UG/L	45	J
524.2 TVOC	5/15/2001	0.37	--	--	UG/L	45	
Chloroform	5/15/2001	0.37	0.5	--	UG/L	45	J
1,1-Dichloroethylene	8/9/2001	0.93	0.5	--	UG/L	50	
524.2 TVOC	8/9/2001	2.19	--	--	UG/L	50	
Gross Beta	8/9/2001	1.26	0.908	0.509	PCI/L	50	J-N2
Toluene	8/9/2001	0.66	0.5	--	UG/L	50	
Trichloroethylene	8/9/2001	0.6	0.5	--	UG/L	50	
Tritium	8/9/2001	436	329	209	PCI/L	50	J-N2
524.2 TVOC	10/26/2001	0.37	--	--	UG/L	45	
Toluene	10/26/2001	0.37	0.5	--	UG/L	45	J
524.2 TVOC	1/28/2002	0	--	--	UG/L	45	
524.2 TVOC	4/30/2002	0	--	--	UG/L	45	
524.2 TVOC	7/29/2002	0.28	--	--	UG/L	45	
Chloroform	7/29/2002	0.28	0.5	--	UG/L	45	J
524.2 TVOC	11/26/2002	0	--	--	UG/L	45	
524.2 TVOC	2/19/2003	0	--	--	UG/L	45	
524.2 TVOC	6/11/2003	0	--	--	UG/L	45	
524.2 TVOC	9/10/2003	0	--	--	UG/L	45	
524.2 TVOC	12/12/2003	0	--	--	UG/L	45	
524.2 TVOC	11/8/2004	0.17	--	--	UG/L	45	
Chloroform	11/8/2004	0.17	0.5	--	UG/L	45	J
524.2 TVOC	11/7/2005	0.21	--	--	UG/L	45	
Chloroform	11/7/2005	0.21	0.5	--	UG/L	45	J

Site ID: 075-02

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
524.2 TVOC	2/25/2000	0	--	--	UG/L	50	
524.2 TVOC	6/16/2000	1.1	--	--	UG/L	50	
Cesium-137	6/16/2000	2.46	2.33	2.17	PCI/L	50	J
Gross Beta	6/16/2000	2.24	1.38	0.806	PCI/L	50	J
Methylene chloride	6/16/2000	1.1	0.5	--	UG/L	50	
Gross Beta	8/1/2000	2.61	2.28	2.88	PCI/L	50	
Thallium-208	8/1/2000	3.61	0	1.421618	PCI/L	50	

Tritium	8/1/2000	881	320	490	PCI/L	50	
524.2 TVOC	9/11/2000	0.67	--	--	UG/L	50	
Methylene chloride	9/11/2000	0.67	0.5	--	UG/L	50	
524.2 TVOC	11/30/2000	0	--	--	UG/L	50	
524.2 TVOC	2/20/2001	0	--	--	UG/L	50	
524.2 TVOC	5/15/2001	0	--	--	UG/L	50	
1,1-Dichloroethylene	8/9/2001	3.6	0.5	--	UG/L	50	
524.2 TVOC	8/9/2001	5.84	--	--	UG/L	50	
Chloroform	8/9/2001	0.26	0.5	--	UG/L	50	J
Toluene	8/9/2001	0.81	0.5	--	UG/L	50	
Trichloroethylene	8/9/2001	0.64	0.5	--	UG/L	50	
Trichlorofluoromethane	8/9/2001	0.53	0.5	--	UG/L	50	
524.2 TVOC	10/26/2001	0.32	--	--	UG/L	50	
Chloroform	10/26/2001	0.32	0.5	--	UG/L	50	J
524.2 TVOC	1/28/2002	0	--	--	UG/L	50	
524.2 TVOC	4/30/2002	0	--	--	UG/L	50	
524.2 TVOC	7/29/2002	0	--	--	UG/L	50	
524.2 TVOC	11/26/2002	0	--	--	UG/L	50	
524.2 TVOC	2/19/2003	0	--	--	UG/L	50	
524.2 TVOC	6/11/2003	0	--	--	UG/L	50	
524.2 TVOC	9/10/2003	0	--	--	UG/L	50	
524.2 TVOC	12/12/2003	0	--	--	UG/L	50	
524.2 TVOC	11/8/2004	0.1	--	--	UG/L	50	
Chloroform	11/8/2004	0.1	0.5	--	UG/L	50	J
524.2 TVOC	11/7/2005	0	--	--	UG/L	50	

Site ID: 075-210

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
524.2 TVOC	1/24/2000	0.429	--	--	UG/L	58	
Benzene	1/24/2000	0.1	0.5	--	UG/L	58	J
Benzene, 1,2,4-trimethyl	1/24/2000	0.028	0.5	--	UG/L	58	J
Chloroform	1/24/2000	0.14	0.5	--	UG/L	58	J
Ethylbenzene	1/24/2000	0.034	0.5	--	UG/L	58	J
m/p xylene	1/24/2000	0.061	0.5	--	UG/L	58	J
o-Xylene	1/24/2000	0.022	0.5	--	UG/L	58	J
1,1,1-Trichloroethane	7/20/2000	5.1	0.5	--	UG/L	58	
1,1-Dichloroethane	7/20/2000	0.67	0.5	--	UG/L	58	
1,1-Dichloroethylene	7/20/2000	1.6	0.5	--	UG/L	58	
524.2 TVOC	7/20/2000	8.33	--	--	UG/L	58	
Chloroform	7/20/2000	0.96	0.5	--	UG/L	58	
1,1,1-Trichloroethane	2/7/2001	4.2	0.5	--	UG/L	59	
1,1-Dichloroethane	2/7/2001	0.88	0.5	--	UG/L	59	
1,1-Dichloroethylene	2/7/2001	1.5	0.5	--	UG/L	59	
524.2 TVOC	2/7/2001	7.2	--	--	UG/L	59	
Chloroform	2/7/2001	0.62	0.5	--	UG/L	59	
1,1,1-Trichloroethane	7/12/2001	5.2	0.5	--	UG/L	58	
1,1-Dichloroethane	7/12/2001	1.1	0.5	--	UG/L	58	
1,1-Dichloroethylene	7/12/2001	1.6	0.5	--	UG/L	58	
524.2 TVOC	7/12/2001	8.96	--	--	UG/L	58	
Chloroform	7/12/2001	0.64	0.5	--	UG/L	58	
Methylene chloride	7/12/2001	0.42	0.5	--	UG/L	58	J
Tritium	7/12/2001	1060	409	283	PCI/L	58	

1,1,1-Trichloroethane	10/17/2001	7.9	0.5	--	UG/L	59	
1,1-Dichloroethane	10/17/2001	2.1	0.5	--	UG/L	59	
1,1-Dichloroethylene	10/17/2001	2.9	0.5	--	UG/L	59	
524.2 TVOC	10/17/2001	13.58	--	--	UG/L	59	
Chloroform	10/17/2001	0.68	0.5	--	UG/L	59	
Tritium	10/17/2001	1010	427	291	PCI/L	59	
Tritium	7/22/2002	488	373	236	PCI/L	59	J
1,1,1-Trichloroethane	10/16/2002	2.4	0.5	--	UG/L	59	
1,1-Dichloroethane	10/16/2002	0.75	0.5	--	UG/L	59	
1,1-Dichloroethylene	10/16/2002	0.69	0.5	--	UG/L	59	
524.2 TVOC	10/16/2002	4.63	--	--	UG/L	59	
Chloroform	10/16/2002	0.79	0.5	--	UG/L	59	
Tritium	10/16/2002	660	509	321	PCI/L	59	J
524.2 TVOC	10/30/2003	6	--	--	UG/L	59	
Chloroform	10/30/2003	6	0.5	--	UG/L	59	J
1,1,1-Trichloroethane	10/20/2004	0.27	0.5	--	UG/L	58	J
524.2 TVOC	10/20/2004	3.24	--	--	UG/L	58	
Chloroform	10/20/2004	2.8	0.5	--	UG/L	58	
Tetrachloroethylene	10/20/2004	0.17	0.5	--	UG/L	58	J
524.2 TVOC	10/20/2005	0	--	--	UG/L	58	
Tritium	4/21/2006	330	320	210	PCI/L	59	J

Site ID: 085-171

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
1,1,1-Trichloroethane	1/24/2000	21.8	0.5	--	UG/L	135	
1,1-Dichloroethane	1/24/2000	1	0.5	--	UG/L	135	
1,1-Dichloroethylene	1/24/2000	9.7	0.5	--	UG/L	135	
1,2-Dichloroethane	1/24/2000	0.11	0.5	--	UG/L	135	J
524.2 TVOC	1/24/2000	35.892	--	--	UG/L	135	
Chloroform	1/24/2000	0.36	0.5	--	UG/L	135	J
m/p xylene	1/24/2000	0.032	0.5	--	UG/L	135	J
Methylene chloride	1/24/2000	0.49	0.5	--	UG/L	135	JB
Toluene	1/24/2000	0.08	0.5	--	UG/L	135	JB
Trichloroethylene	1/24/2000	0.22	0.5	--	UG/L	135	J
Trichlorofluoromethane	1/24/2000	2.1	0.5	--	UG/L	135	
1,1,1-Trichloroethane	7/12/2000	19.8	0.5	--	UG/L	130	
1,1-Dichloroethane	7/12/2000	1.6	0.5	--	UG/L	130	
1,1-Dichloroethylene	7/12/2000	7.6	0.5	--	UG/L	130	
524.2 TVOC	7/12/2000	33.99	--	--	UG/L	130	
Chloroform	7/12/2000	0.84	0.5	--	UG/L	130	
Methylene chloride	7/12/2000	0.81	0.5	--	UG/L	130	B
Toluene	7/12/2000	0.38	0.5	--	UG/L	130	J
Trichloroethylene	7/12/2000	0.76	0.5	--	UG/L	130	
Trichlorofluoromethane	7/12/2000	2.2	0.5	--	UG/L	130	
Tritium	7/12/2000	714	412	267	PCI/L	130	J
Tritium	10/19/2000	1230	470	320	PCI/L	130	
1,1,1-Trichloroethane	2/13/2001	6	0.5	--	UG/L	130	
1,1-Dichloroethane	2/13/2001	0.41	0.5	--	UG/L	130	J
1,1-Dichloroethylene	2/13/2001	1.9	0.5	--	UG/L	130	
524.2 TVOC	2/13/2001	9.43	--	--	UG/L	130	
Chloroform	2/13/2001	0.82	0.5	--	UG/L	130	
Trichloroethylene	2/13/2001	0.3	0.5	--	UG/L	130	J

Tritium	2/13/2001	845	320	213	PCI/L	130	J
1,1,1-Trichloroethane	7/19/2001	10.5	0.5	--	UG/L	130	
1,1-Dichloroethane	7/19/2001	0.93	0.5	--	UG/L	130	
1,1-Dichloroethylene	7/19/2001	4.3	0.5	--	UG/L	130	
524.2 TVOC	7/19/2001	17.09	--	--	UG/L	130	
Chloroform	7/19/2001	1	0.5	--	UG/L	130	
Trichloroethylene	7/19/2001	0.36	0.5	--	UG/L	130	J
Tritium	7/19/2001	469	430	268	PCI/L	130	J-N2
1,1,1-Trichloroethane	10/15/2001	13.9	0.5	--	UG/L	130	
1,1-Dichloroethane	10/15/2001	0.8	0.5	--	UG/L	130	
1,1-Dichloroethylene	10/15/2001	5.3	0.5	--	UG/L	130	
524.2 TVOC	10/15/2001	21.48	--	--	UG/L	130	
Chloroform	10/15/2001	0.88	0.5	--	UG/L	130	
Methyl chloride	10/15/2001	0.27	0.5	--	UG/L	130	J
Trichloroethylene	10/15/2001	0.33	0.5	--	UG/L	130	J
1,1,1-Trichloroethane	10/18/2002	16.4	0.5	--	UG/L	130	
1,1-Dichloroethane	10/18/2002	1	0.5	--	UG/L	130	
1,1-Dichloroethylene	10/18/2002	5.1	0.5	--	UG/L	130	
524.2 TVOC	10/18/2002	24.04	--	--	UG/L	130	
Chloroform	10/18/2002	0.96	0.5	--	UG/L	130	
Methylene chloride	10/18/2002	0.29	0.5	--	UG/L	130	J
Trichloroethylene	10/18/2002	0.29	0.5	--	UG/L	130	J
Tritium	8/6/2003	321	273	180	PCI/L	130	
1,1,1-Trichloroethane	10/30/2003	4.4	0.5	--	UG/L	130	J
1,1-Dichloroethane	10/30/2003	0.45	0.5	--	UG/L	130	J
1,1-Dichloroethylene	10/30/2003	1.6	0.5	--	UG/L	130	J
524.2 TVOC	10/30/2003	7.67	--	--	UG/L	130	
Chloroform	10/30/2003	0.77	0.5	--	UG/L	130	J
Methyl tert-butyl ether	10/30/2003	0.45	0.5	--	UG/L	130	J
Tritium	2/10/2004	350	220	180	PCI/L	130	J
1,1,1-Trichloroethane	4/11/2005	2.7	0.5	--	UG/L	130	
1,1-Dichloroethane	4/11/2005	0.53	0.5	--	UG/L	130	
1,1-Dichloroethylene	4/11/2005	1.3	0.5	--	UG/L	130	
524.2 TVOC	4/11/2005	6.01	--	--	UG/L	130	
Chloroform	4/11/2005	1.2	0.5	--	UG/L	130	
Toluene	4/11/2005	0.12	0.5	--	UG/L	130	J
Trichloroethylene	4/11/2005	0.16	0.5	--	UG/L	130	J
1,1,1-Trichloroethane	12/22/2005	2.1	0.5	--	UG/L	130	
1,1-Dichloroethane	12/22/2005	0.49	0.5	--	UG/L	130	J
1,1-Dichloroethylene	12/22/2005	1	0.5	--	UG/L	130	
524.2 TVOC	12/22/2005	4.18	--	--	UG/L	130	
Chloroform	12/22/2005	0.42	0.5	--	UG/L	130	J
Trichloroethylene	12/22/2005	0.17	0.5	--	UG/L	130	J
Tritium	12/22/2005	360	360	230	PCI/L	130	J
Tritium	1/24/2006	550	280	220	PCI/L	130	
Tritium	4/14/2006	460	350	230	PCI/L	130	J
Tritium	7/11/2006	550	390	270	PCI/L	130	

Table 2a

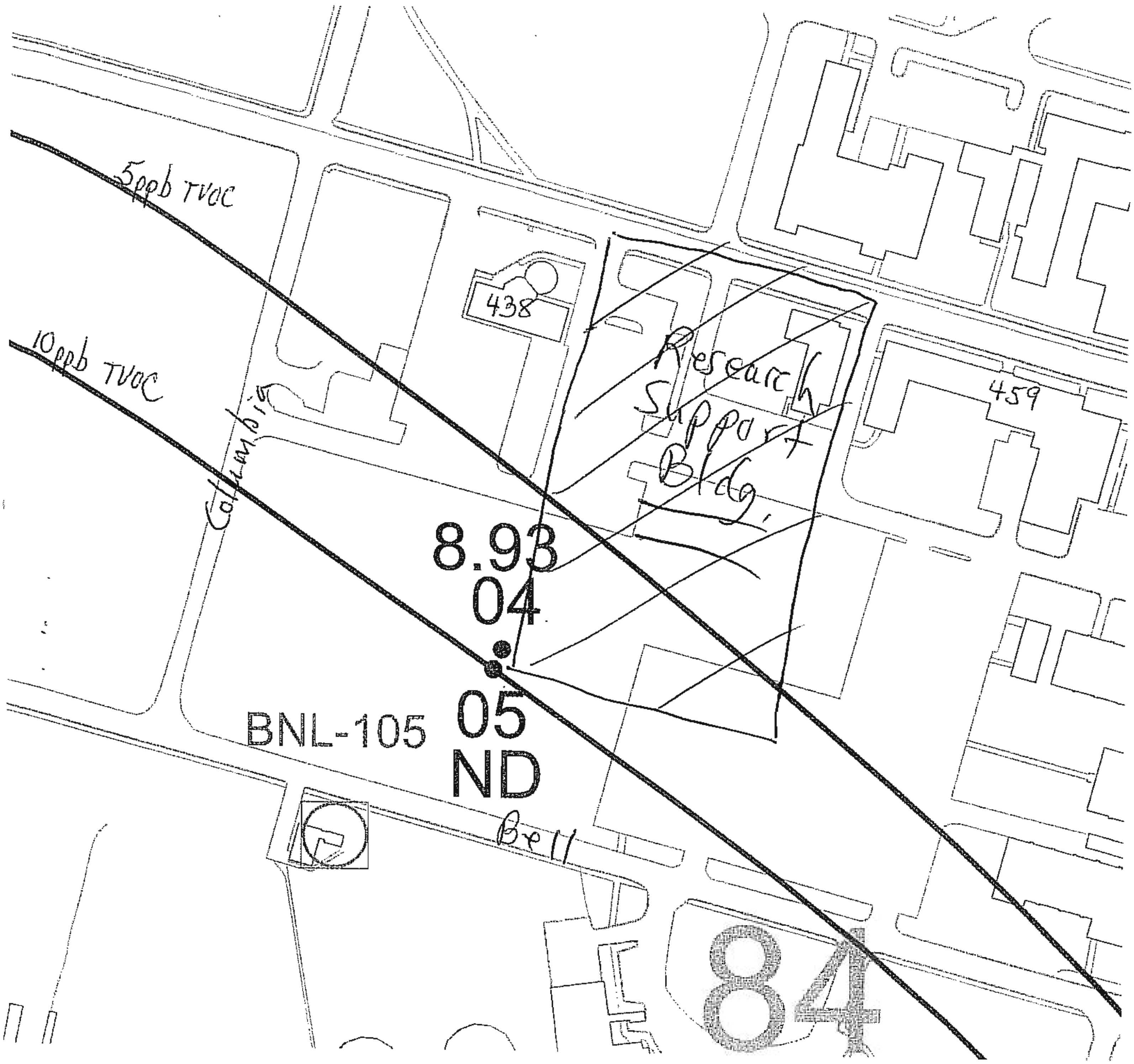
Site ID: 085-41

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
1,1,1-Trichloroethane	1/10/2000	3.5	0.5	--	UG/L	189.5	
1,1-Dichloroethane	1/10/2000	0.5	0.5	--	UG/L	189.5	J

3000

1,1-Dichloroethylene	1/10/2000	1.4	0.5	--	UG/L	189.5		- 190
1,2-Dichloroethane	1/10/2000	0.5	0.5	--	UG/L	189.5	J	- 230
524.2 TVOC	1/10/2000	12.2	--	--	UG/L	189.5		
Benzene	1/10/2000	0.5	0.5	--	UG/L	189.5	JB	
Benzene, 1,2,4-trimethyl	1/10/2000	0.5	0.5	--	UG/L	189.5	JB	
Benzene, 1,3,5-trimethyl-	1/10/2000	0.5	0.5	--	UG/L	189.5	J	
Benzene, 1-methylethyl-	1/10/2000	0.5	0.5	--	UG/L	189.5	J	
Chloroform	1/10/2000	0.65	0.5	--	UG/L	189.5		- 80
Cymene	1/10/2000	0.5	0.5	--	UG/L	189.5	J	
Ethylbenzene	1/10/2000	0.5	0.5	--	UG/L	189.5	J	
m/p xylene	1/10/2000	0.5	0.5	--	UG/L	189.5	J	
n-Propylbenzene	1/10/2000	0.5	0.5	--	UG/L	189.5	J	
Toluene	1/10/2000	0.65	0.5	--	UG/L	189.5	B	
Trichloroethylene	1/10/2000	0.5	0.5	--	UG/L	189.5	J	
Trichlorofluoromethane	1/10/2000	0.5	0.5	--	UG/L	189.5	JB	
1,1,1-Trichloroethane	8/7/2000	0.93	0.5	--	UG/L	189.5		
524.2 TVOC	8/7/2000	1.35	--	--	UG/L	189.5		
Chloroform	8/7/2000	0.42	0.5	--	UG/L	189.5	J	
Tritium	8/7/2000	701	486	311	PCI/L	189.5	J	
Tritium	10/17/2000	1970	453	337	PCI/L	189.5		
1,1,1-Trichloroethane	1/31/2001	3.1	0.5	--	UG/L	189.5		
1,1-Dichloroethane	1/31/2001	0.31	0.5	--	UG/L	189.5	J	
1,1-Dichloroethylene	1/31/2001	1.5	0.5	--	UG/L	189.5		
524.2 TVOC	1/31/2001	4.91	--	--	UG/L	189.5		
Tritium	1/31/2001	2460	429	346	PCI/L	189.5		
1,1,1-Trichloroethane	7/11/2001	0.48	0.5	--	UG/L	189.5	J	
524.2 TVOC	7/11/2001	0.75	--	--	UG/L	189.5		
Methyl chloride	7/11/2001	0.27	0.5	--	UG/L	189.5	J	
Tritium	7/11/2001	410	404	251	PCI/L	189.5	J-N2	
1,1,1-Trichloroethane	10/15/2001	0.31	0.5	--	UG/L	89.5	J	
524.2 TVOC	10/15/2001	0.96	--	--	UG/L	89.5		
Chloroform	10/15/2001	0.39	0.5	--	UG/L	89.5	J	
Toluene	10/15/2001	0.26	0.5	--	UG/L	89.5	J	
Tritium	1/16/2002	721	382	253	PCI/L	189.5	J	
Tritium	7/10/2002	621	514	323	PCI/L	189.5	J	
1,1,1-Trichloroethane	10/17/2002	0.37	0.5	--	UG/L	189.5	J	
524.2 TVOC	10/17/2002	4.27	--	--	UG/L	189.5		
Chloroform	10/17/2002	3.9	0.5	--	UG/L	189.5		
524.2 TVOC	10/27/2003	6.6	--	--	UG/L	189.5		
Chloroform	10/27/2003	6.6	0.5	--	UG/L	189.5		
1,1,1-Trichloroethane	10/13/2004	3.3	0.5	--	UG/L	189.5		
1,1-Dichloroethane	10/13/2004	0.64	0.5	--	UG/L	189.5		
1,1-Dichloroethylene	10/13/2004	1.2	0.5	--	UG/L	189.5		
1,2,3-Trichlorobenzene	10/13/2004	0.44	0.5	--	UG/L	189.5	J	
524.2 TVOC	10/13/2004	15.77	--	--	UG/L	189.5		
Chloroform	10/13/2004	1.7	0.5	--	UG/L	189.5		
Tetrachloroethylene	10/13/2004	8	0.5	--	UG/L	189.5		
Trichloroethylene	10/13/2004	0.49	0.5	--	UG/L	189.5	J	
Tritium	10/13/2004	500	230	200	PCI/L	189.5	J	
Tritium	4/1/2005	410	180	170	PCI/L	187.5	J	
1,1,1-Trichloroethane	10/21/2005	0.15	0.5	--	UG/L	189.5	J	
1,1-Dichloroethane	10/21/2005	0.15	0.5	--	UG/L	189.5	J	

524.2 TVOC	10/21/2005	4.2	--	--	UG/L	189.5	
Chloroform	10/21/2005	3.9	0.5	--	UG/L	189.5	



5ppb TVOC
10ppb TVOC
438
Research Support Bldg.
459
Columbia
8.93
04
BNL-105
05
ND
Bell
84

Research Support Bldg. Monitor Wells

9/12/2006

Site ID: 084-04

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
1,1,1-Trichloroethane	2/28/2000	9.1	0.5	--	UG/L	150	
1,1-Dichloroethane	2/28/2000	4.6	0.5	--	UG/L	150	
1,1-Dichloroethylene	2/28/2000	4.6	0.5	--	UG/L	150	
524.2 TVOC	2/28/2000	19.6	--	--	UG/L	150	
Chloroform	2/28/2000	1.3	0.5	--	UG/L	150	
1,1,1-Trichloroethane	6/16/2000	5.6	0.5	--	UG/L	150	
1,1-Dichloroethane	6/16/2000	4.5	0.5	--	UG/L	150	
1,1-Dichloroethylene	6/16/2000	3.9	0.5	--	UG/L	150	
524.2 TVOC	6/16/2000	15.7	--	--	UG/L	150	
Chloroform	6/16/2000	0.6	0.5	--	UG/L	150	
Trichloroethylene	6/16/2000	1.1	0.5	--	UG/L	150	
1,1,1-Trichloroethane	9/13/2000	7	0.5	--	UG/L	150	
1,1-Dichloroethane	9/13/2000	4.5	0.5	--	UG/L	150	
1,1-Dichloroethylene	9/13/2000	4.3	0.5	--	UG/L	150	
524.2 TVOC	9/13/2000	17.59	--	--	UG/L	150	
Chloroform	9/13/2000	0.92	0.5	--	UG/L	150	
Trichloroethylene	9/13/2000	0.87	0.5	--	UG/L	150	
1,1,1-Trichloroethane	11/30/2000	9.6	0.5	--	UG/L	150	
1,1-Dichloroethane	11/30/2000	3.7	0.5	--	UG/L	150	
1,1-Dichloroethylene	11/30/2000	4.7	0.5	--	UG/L	150	
524.2 TVOC	11/30/2000	19.58	--	--	UG/L	150	
Chloroform	11/30/2000	1.3	0.5	--	UG/L	150	
Trichloroethylene	11/30/2000	0.28	0.5	--	UG/L	150	J
1,1,1-Trichloroethane	2/21/2001	8	0.5	--	UG/L	150	
1,1-Dichloroethane	2/21/2001	3.3	0.5	--	UG/L	150	
1,1-Dichloroethylene	2/21/2001	3.9	0.5	--	UG/L	150	
524.2 TVOC	2/21/2001	16.97	--	--	UG/L	150	
Chloroform	2/21/2001	1.5	0.5	--	UG/L	150	
Trichloroethylene	2/21/2001	0.27	0.5	--	UG/L	150	J
1,1,1-Trichloroethane	5/15/2001	7.2	0.5	--	UG/L	150	
1,1-Dichloroethane	5/15/2001	3.1	0.5	--	UG/L	150	
1,1-Dichloroethylene	5/15/2001	3.8	0.5	--	UG/L	150	
524.2 TVOC	5/15/2001	15.4	--	--	UG/L	150	
Chloroform	5/15/2001	1.3	0.5	--	UG/L	150	
1,1,1-Trichloroethane	8/10/2001	7.8	0.5	--	UG/L	150	
1,1-Dichloroethane	8/10/2001	2.8	0.5	--	UG/L	150	
1,1-Dichloroethylene	8/10/2001	4.1	0.5	--	UG/L	150	
524.2 TVOC	8/10/2001	16.37	--	--	UG/L	150	
Chloroform	8/10/2001	1.4	0.5	--	UG/L	150	
Trichloroethylene	8/10/2001	0.27	0.5	--	UG/L	150	J
Tritium	8/10/2001	389	327	206	PCI/L	150	J-N2
1,1,1-Trichloroethane	10/26/2001	8.9	0.5	--	UG/L	150	
1,1-Dichloroethane	10/26/2001	3.1	0.5	--	UG/L	150	
1,1-Dichloroethylene	10/26/2001	4.5	0.5	--	UG/L	150	
524.2 TVOC	10/26/2001	19.94	--	--	UG/L	150	
Chloroform	10/26/2001	1.6	0.5	--	UG/L	150	
Trichloroethylene	10/26/2001	0.34	0.5	--	UG/L	150	J
Trichlorofluoromethane	10/26/2001	1.5	0.5	--	UG/L	150	

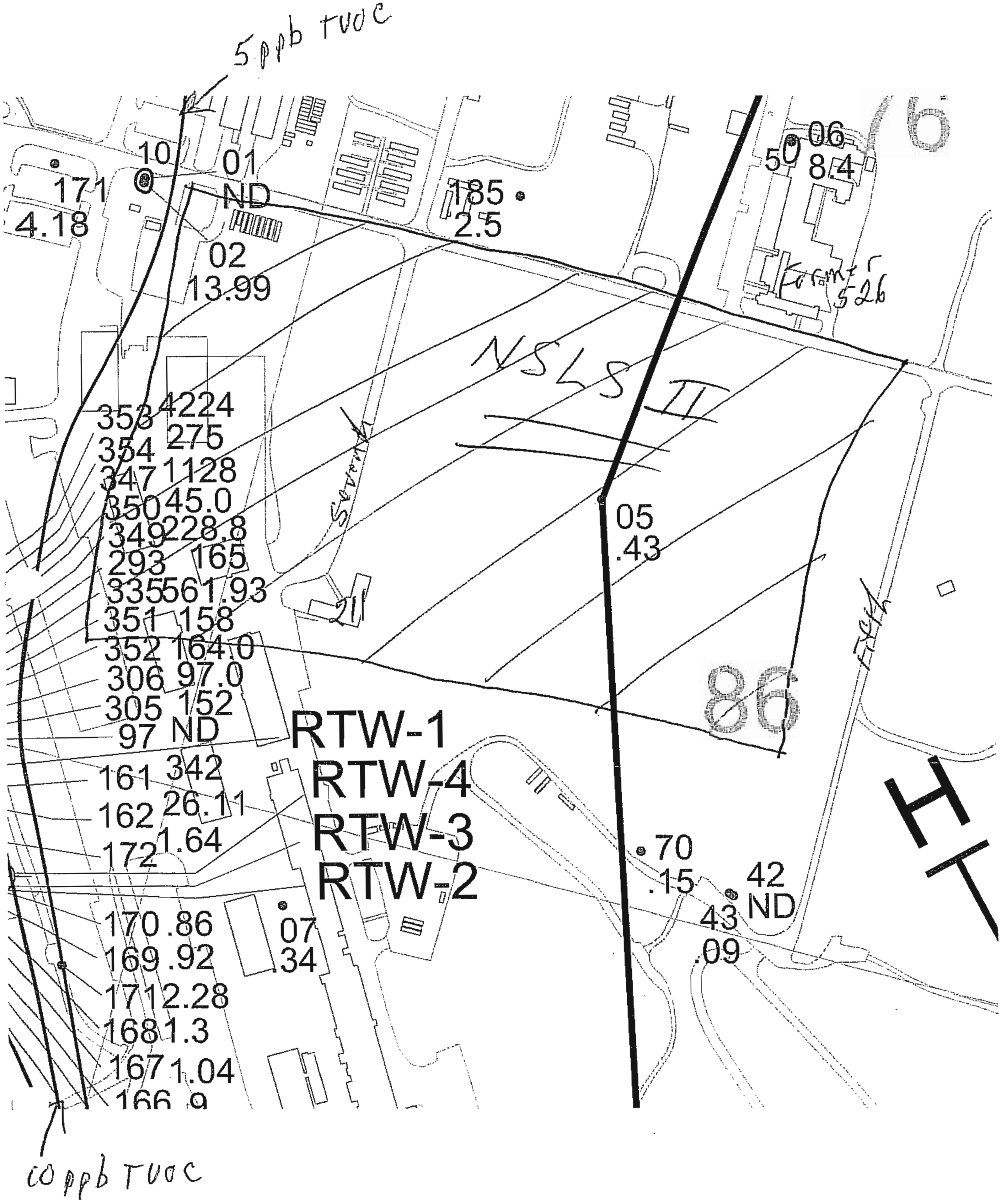
- 2000 TCA
- 2000 -
- 180
- 5
- 180

1,1,1-Trichloroethane	1/28/2002	6.2	0.5	--	UG/L	150	
1,1-Dichloroethane	1/28/2002	2.4	0.5	--	UG/L	150	
1,1-Dichloroethylene	1/28/2002	3.4	0.5	--	UG/L	150	
524.2 TVOC	1/28/2002	13.1	--	--	UG/L	150	
Chloroform	1/28/2002	1.1	0.5	--	UG/L	150	
1,1,1-Trichloroethane	4/30/2002	7	0.5	--	UG/L	150	
1,1-Dichloroethane	4/30/2002	2.9	0.5	--	UG/L	150	
1,1-Dichloroethylene	4/30/2002	3.6	0.5	--	UG/L	150	
524.2 TVOC	4/30/2002	15.3	--	--	UG/L	150	
Chloroform	4/30/2002	1.3	0.5	--	UG/L	150	
Trichloroethylene	4/30/2002	0.5	0.5	--	UG/L	150	
1,1,1-Trichloroethane	7/30/2002	6.4	0.5	--	UG/L	150	
1,1-Dichloroethane	7/30/2002	2.8	0.5	--	UG/L	150	
1,1-Dichloroethylene	7/30/2002	3.2	0.5	--	UG/L	150	
524.2 TVOC	7/30/2002	14.1	--	--	UG/L	150	
Chloroform	7/30/2002	1.4	0.5	--	UG/L	150	
Trichloroethylene	7/30/2002	0.3	0.5	--	UG/L	150	J
1,1,1-Trichloroethane	11/26/2002	7.8	0.5	--	UG/L	150	
1,1-Dichloroethane	11/26/2002	2.9	0.5	--	UG/L	150	
1,1-Dichloroethylene	11/26/2002	3.5	0.5	--	UG/L	150	
524.2 TVOC	11/26/2002	15.97	--	--	UG/L	150	
Chloroform	11/26/2002	1.5	0.5	--	UG/L	150	
Trichloroethylene	11/26/2002	0.27	0.5	--	UG/L	150	J
1,1,1-Trichloroethane	2/20/2003	6	0.5	--	UG/L	150	
1,1-Dichloroethane	2/20/2003	2.5	0.5	--	UG/L	150	
1,1-Dichloroethylene	2/20/2003	3.3	0.5	--	UG/L	150	
524.2 TVOC	2/20/2003	13.5	--	--	UG/L	150	
Carbon tetrachloride	2/20/2003	0.6	0.5	--	UG/L	150	
Chloroform	2/20/2003	1.1	0.5	--	UG/L	150	
1,1,1-Trichloroethane	6/9/2003	6.2	0.5	--	UG/L	150	
1,1-Dichloroethane	6/9/2003	2.3	0.5	--	UG/L	150	
1,1-Dichloroethylene	6/9/2003	3.3	0.5	--	UG/L	150	
524.2 TVOC	6/9/2003	13.1	--	--	UG/L	150	
Chloroform	6/9/2003	1.3	0.5	--	UG/L	150	
1,1,1-Trichloroethane	9/10/2003	6.2	0.5	--	UG/L	150	
1,1-Dichloroethylene	9/10/2003	3.2	0.5	--	UG/L	150	
524.2 TVOC	9/10/2003	11	--	--	UG/L	150	
Chloroform	9/10/2003	1.6	0.5	--	UG/L	150	
1,1,1-Trichloroethane	12/12/2003	5.3	0.5	--	UG/L	150	
1,1-Dichloroethane	12/12/2003	2.1	0.5	--	UG/L	150	
1,1-Dichloroethylene	12/12/2003	3.4	0.5	--	UG/L	150	
524.2 TVOC	12/12/2003	12.2	--	--	UG/L	150	
Chloroform	12/12/2003	1.4	0.5	--	UG/L	150	
1,1,1-Trichloroethane	11/8/2004	3.2	0.5	--	UG/L	150	
1,1-Dichloroethane	11/8/2004	1.9	0.5	--	UG/L	150	
1,1-Dichloroethylene	11/8/2004	1.9	0.5	--	UG/L	150	
524.2 TVOC	11/8/2004	8.77	--	--	UG/L	150	
Chloroform	11/8/2004	1.4	0.5	--	UG/L	150	
Trichloroethylene	11/8/2004	0.37	0.5	--	UG/L	150	J
1,1,1-Trichloroethane	11/8/2005	3.3	0.5	--	UG/L	150	
1,1-Dichloroethane	11/8/2005	2.1	0.5	--	UG/L	150	
1,1-Dichloroethylene	11/8/2005	2.1	0.5	--	UG/L	150	

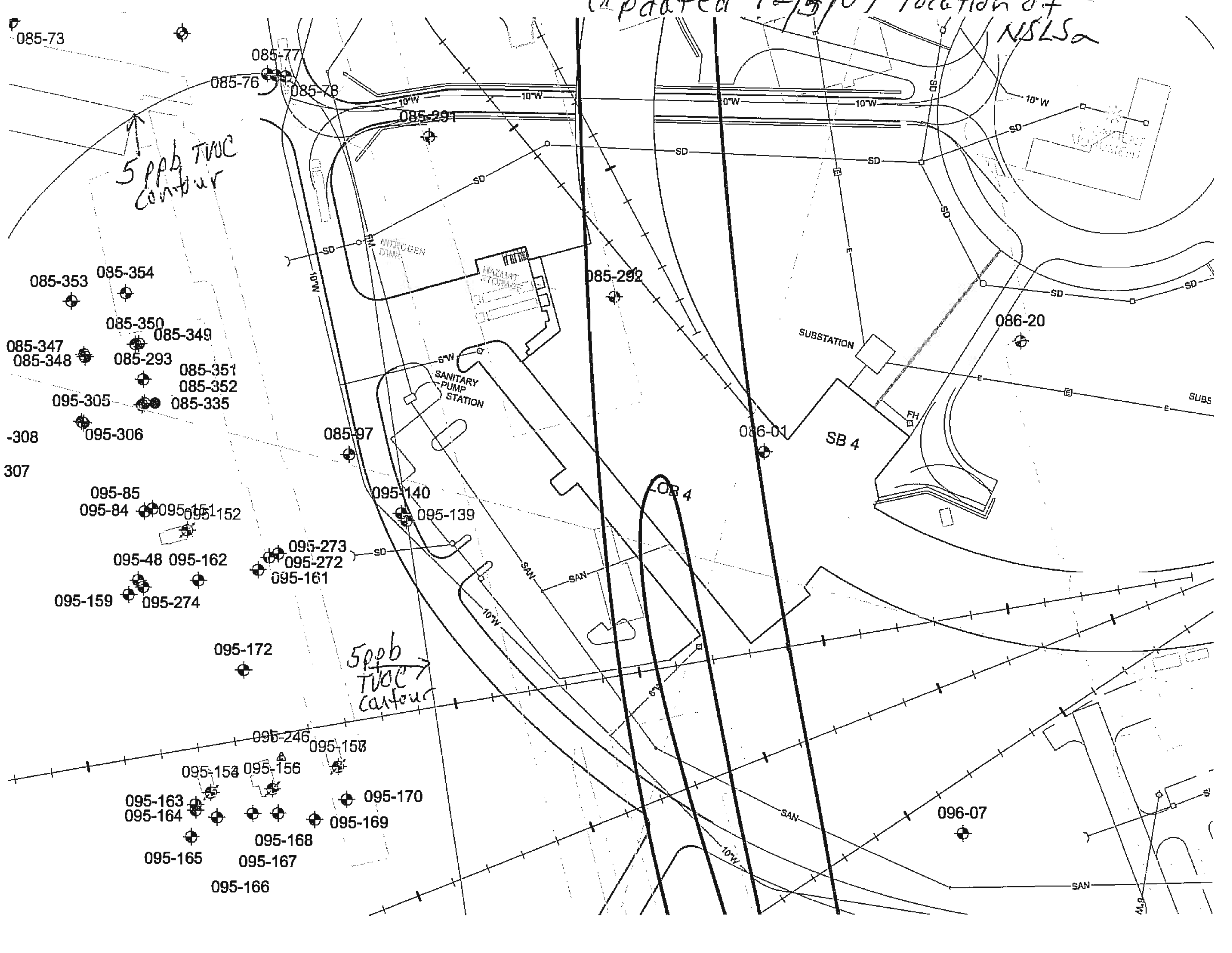
524.2 TVOC	11/8/2005	8.93	--	--	UG/L	150	
Chloroform	11/8/2005	1.1	0.5	--	UG/L	150	
Trichloroethylene	11/8/2005	0.33	0.5	--	UG/L	150	J

Site ID: 084-05

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
524.2 TVOC	2/25/2000	0	--	--	UG/L	184	
524.2 TVOC	6/16/2000	0	--	--	UG/L	184	
Strontium-90	6/16/2000	-0.497	0.83	0.389	PCI/L	184	DL
524.2 TVOC	9/13/2000	0	--	--	UG/L	184	
524.2 TVOC	12/1/2000	0.28	--	--	UG/L	184	
Methylene chloride	12/1/2000	0.28	0.5	--	UG/L	184	J
524.2 TVOC	2/21/2001	0	--	--	UG/L	184	
524.2 TVOC	5/15/2001	0	--	--	UG/L	184	
524.2 TVOC	8/9/2001	0	--	--	UG/L	184	
524.2 TVOC	10/26/2001	0.37	--	--	UG/L	184	
524.2 TVOC	1/28/2002	0	--	--	UG/L	184	
524.2 TVOC	4/30/2002	0	--	--	UG/L	184	
524.2 TVOC	7/30/2002	0	--	--	UG/L	184	
524.2 TVOC	12/6/2002	0.31	--	--	UG/L	184	
Toluene	12/6/2002	0.31	0.5	--	UG/L	184	J
524.2 TVOC	2/20/2003	0	--	--	UG/L	184	
524.2 TVOC	6/9/2003	0	--	--	UG/L	184	
524.2 TVOC	9/9/2003	0	--	--	UG/L	184	
524.2 TVOC	12/12/2003	0	--	--	UG/L	184	
524.2 TVOC	11/8/2004	0.076	--	--	UG/L	184	
Chloroform	11/8/2004	0.076	0.5	--	UG/L	184	J
524.2 TVOC	11/8/2005	0	--	--	UG/L	184	



5 ppb TVOC
10
01
ND
171
4.18
185
2.5
02
13.99
06
50
8.4
76
Former 526
NSLS II
353 4224
354 275
347 1128
350 45.0
349 228.8
293 165
335 561.93
351 158
352 164.0
306 97.0
305 152
97 ND
05
.43
86
RTW-1
RTW-4
RTW-3
RTW-2
161 342
162 26.11
172 1.64
70
.15
42
ND
43
.09
170 .86
169 .92
171 2.28
168 1.3
167 1.04
166 .9
07
.34
10 ppb TVOC


NSLS
5ppb TVOC contour
5ppb TVOC contour
085-73
085-77
085-76
085-78
085-291
085-292
086-20
086-01
SUBSTATION
SB 4
OB 4
FH
SANITARY PUMP STATION
NITROGEN DANK
HAZMAT STORAGE
085-353
085-354
085-350
085-349
085-347
085-348
085-293
085-351
085-352
085-335
095-305
095-306
-308
307
085-97
095-140
095-139
095-85
095-84
095-151
095-152
095-273
095-272
095-161
095-48
095-162
095-159
095-274
095-172
095-246
095-157
095-153
095-156
095-163
095-164
095-170
095-169
095-168
095-167
095-165
095-166
096-07
SD
SAN
10"W
6"W
E
SUBS

NSLS II Monitor Wells

9/12/2006

Site ID: 076-06

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
524.2 TVOC	2/4/2000	14.47	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	2/4/2000	3.4	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	2/4/2000	5	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	2/4/2000	0.66	0.5	--	UG/L	40	
Cymene	2/4/2000	0.71	0.5	--	UG/L	40	
n-Butylbenzene	2/4/2000	0.5	0.5	--	UG/L	40	
n-Propylbenzene	2/4/2000	1.4	0.5	--	UG/L	40	
sec-Butylbenzene	2/4/2000	1.2	0.5	--	UG/L	40	
Tetrachloroethylene	2/4/2000	1.6	0.5	--	UG/L	40	
524.2 TVOC	6/30/2000	7.39	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	6/30/2000	1.9	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	6/30/2000	2.8	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	6/30/2000	0.33	0.5	--	UG/L	40	J
Cymene	6/30/2000	0.52	0.5	--	UG/L	40	
n-Propylbenzene	6/30/2000	0.66	0.5	--	UG/L	40	
sec-Butylbenzene	6/30/2000	0.44	0.5	--	UG/L	40	J
Tetrachloroethylene	6/30/2000	0.74	0.5	--	UG/L	40	
524.2 TVOC	7/31/2000	7.46	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	7/31/2000	1.8	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	7/31/2000	2.6	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	7/31/2000	0.38	0.5	--	UG/L	40	J
Chloroform	7/31/2000	0.25	0.5	--	UG/L	40	J
Cymene	7/31/2000	0.48	0.5	--	UG/L	40	J
n-Propylbenzene	7/31/2000	0.65	0.5	--	UG/L	40	
sec-Butylbenzene	7/31/2000	0.42	0.5	--	UG/L	40	J
Tetrachloroethylene	7/31/2000	0.88	0.5	--	UG/L	40	
1-Methylnaphthalene	10/25/2000	5.6	9.7	--	UG/L	40	J
2-Methylnaphthalene	10/25/2000	1.5	9.7	--	UG/L	40	J
524.2 TVOC	10/25/2000	12.82	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	10/25/2000	2.9	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	10/25/2000	2.8	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	10/25/2000	0.83	0.5	--	UG/L	40	
Cymene	10/25/2000	0.89	0.5	--	UG/L	40	
Naphthalene	10/25/2000	1.4	0.5	--	UG/L	40	
n-Propylbenzene	10/25/2000	1.3	0.5	--	UG/L	40	
sec-Butylbenzene	10/25/2000	0.9	0.5	--	UG/L	40	
Tetrachloroethylene	10/25/2000	1.8	0.5	--	UG/L	40	
524.2 TVOC	1/26/2001	16.09	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	1/26/2001	5.3	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	1/26/2001	4.4	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	1/26/2001	1.1	0.5	--	UG/L	40	
Cymene	1/26/2001	0.56	0.5	--	UG/L	40	
Naphthalene	1/26/2001	0.28	0.5	--	UG/L	40	J
n-Butylbenzene	1/26/2001	0.31	0.5	--	UG/L	40	J
n-Propylbenzene	1/26/2001	1.6	0.5	--	UG/L	40	
sec-Butylbenzene	1/26/2001	0.84	0.5	--	UG/L	40	
Tetrachloroethylene	1/26/2001	1.7	0.5	--	UG/L	40	
1-Methylnaphthalene	5/9/2001	1.2	0.97	--	UG/L	40	

2-Methylnaphthalene	5/9/2001	0.6	0.97	--	UG/L	40	J
524.2 TVOC	5/9/2001	3.7	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	5/9/2001	1	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	5/9/2001	0.93	0.5	--	UG/L	40	
Chloroform	5/9/2001	1.1	0.5	--	UG/L	40	
n-Propylbenzene	5/9/2001	0.37	0.5	--	UG/L	40	J
Tetrachloroethylene	5/9/2001	0.3	0.5	--	UG/L	40	J
524.2 TVOC	7/25/2001	1.08	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	7/25/2001	0.52	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	7/25/2001	0.27	0.5	--	UG/L	40	J
Tetrachloroethylene	7/25/2001	0.29	0.5	--	UG/L	40	J
1-Methylnaphthalene	11/7/2001	19.8	0.98	--	UG/L	40	
2-Chloronaphthalene	11/7/2001	0.21	9.8	--	UG/L	40	J
2-Methylnaphthalene	11/7/2001	13.6	0.98	--	UG/L	40	
524.2 TVOC	11/7/2001	13.05	--	--	UG/L	40	
Acenaphthene	11/7/2001	1.4	9.8	--	UG/L	40	J
Benzene, 1,2,4-trimethyl	11/7/2001	2.9	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	11/7/2001	4.5	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	11/7/2001	0.7	0.5	--	UG/L	40	
Bis(2-ethylhexyl)phthalate	11/7/2001	0.19	9.8	--	UG/L	40	J
Cymene	11/7/2001	0.9	0.5	--	UG/L	40	
Dibenzofuran	11/7/2001	1.3	9.8	--	UG/L	40	J
Fluorene	11/7/2001	2.7	9.8	--	UG/L	40	J
Naphthalene	11/7/2001	0.31	0.5	--	UG/L	40	J
n-Propylbenzene	11/7/2001	1.3	0.5	--	UG/L	40	
Phenanthrene	11/7/2001	1.1	9.8	--	UG/L	40	J
sec-Butylbenzene	11/7/2001	1	0.5	--	UG/L	40	
tert-Butylbenzene	11/7/2001	0.34	0.5	--	UG/L	40	J
Tetrachloroethylene	11/7/2001	1.1	0.5	--	UG/L	40	
1-Methylnaphthalene	2/12/2002	22.2	0.97	--	UG/L	40	
2-Methylnaphthalene	2/12/2002	20.2	0.97	--	UG/L	40	
524.2 TVOC	2/12/2002	9.18	--	--	UG/L	40	
Acenaphthene	2/12/2002	1.5	9.7	--	UG/L	40	J
Benzene, 1,2,4-trimethyl	2/12/2002	1.5	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	2/12/2002	3	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	2/12/2002	0.35	0.5	--	UG/L	40	J
Cymene	2/12/2002	0.86	0.5	--	UG/L	40	
Dibenzofuran	2/12/2002	1.3	9.7	--	UG/L	40	J
Diethyl phthalate	2/12/2002	1.3	9.7	--	UG/L	40	J
Fluorene	2/12/2002	2.8	9.7	--	UG/L	40	J
Methylene chloride	2/12/2002	0.48	0.5	--	UG/L	40	J
n-Propylbenzene	2/12/2002	0.73	0.5	--	UG/L	40	
Phenanthrene	2/12/2002	1.4	9.7	--	UG/L	40	J
sec-Butylbenzene	2/12/2002	0.71	0.5	--	UG/L	40	
Tetrachloroethylene	2/12/2002	1.2	0.5	--	UG/L	40	
1-Methylnaphthalene	5/13/2002	24.1	0.96	--	UG/L	40	
2-Methylnaphthalene	5/13/2002	13.1	0.96	--	UG/L	40	
524.2 TVOC	5/13/2002	29	--	--	UG/L	40	
Acenaphthene	5/13/2002	2.1	9.6	--	UG/L	40	J
Benzene, 1,2,4-trimethyl	5/13/2002	4.8	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	5/13/2002	10.4	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	5/13/2002	1.1	0.5	--	UG/L	40	

Cymene	5/13/2002	2.8	0.5	--	UG/L	40	
Dibenzofuran	5/13/2002	2.1	9.6	--	UG/L	40	J
Fluorene	5/13/2002	4	9.6	--	UG/L	40	J
n-Butylbenzene	5/13/2002	2.8	0.5	--	UG/L	40	
n-Propylbenzene	5/13/2002	2.7	0.5	--	UG/L	40	
Phenanthrene	5/13/2002	0.98	9.6	--	UG/L	40	J
tert-Butylbenzene	5/13/2002	1.1	0.5	--	UG/L	40	
Tetrachloroethylene	5/13/2002	2.4	0.5	--	UG/L	40	
1-Methylnaphthalene	8/9/2002	15.2	0.96	--	UG/L	40	
2-Methylnaphthalene	8/9/2002	4.2	0.96	--	UG/L	40	
524.2 TVOC	8/9/2002	24.1	--	--	UG/L	40	
Acenaphthene	8/9/2002	1.8	9.6	--	UG/L	40	J
Benzene, 1,2,4-trimethyl	8/9/2002	5.8	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	8/9/2002	9.1	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	8/9/2002	1.4	0.5	--	UG/L	40	
Cymene	8/9/2002	2.8	0.5	--	UG/L	40	
Dibenzofuran	8/9/2002	1.5	9.6	--	UG/L	40	J
Fluorene	8/9/2002	3	9.6	--	UG/L	40	J
n-Propylbenzene	8/9/2002	2.6	0.5	--	UG/L	40	
Tetrachloroethylene	8/9/2002	2.4	0.5	--	UG/L	40	
524.2 TVOC	10/29/2002	13.41	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	10/29/2002	2	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	10/29/2002	5.1	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	10/29/2002	0.41	0.5	--	UG/L	40	J
Cymene	10/29/2002	2.2	0.5	--	UG/L	40	
n-Propylbenzene	10/29/2002	1.1	0.5	--	UG/L	40	
Tetrachloroethylene	10/29/2002	2.6	0.5	--	UG/L	40	
524.2 TVOC	1/30/2003	4.02	--	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	1/30/2003	0.7	0.5	--	UG/L	40	
Cymene	1/30/2003	0.77	0.5	--	UG/L	40	
Methylene chloride	1/30/2003	0.36	0.5	--	UG/L	40	J
n-Propylbenzene	1/30/2003	0.31	0.5	--	UG/L	40	J
sec-Butylbenzene	1/30/2003	0.48	0.5	--	UG/L	40	J
Tetrachloroethylene	1/30/2003	1.4	0.5	--	UG/L	40	
524.2 TVOC	5/27/2003	1.24	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	5/27/2003	0.33	0.5	--	UG/L	40	J
Benzene, 1,3,5-trimethyl-	5/27/2003	0.52	0.5	--	UG/L	40	
Tetrachloroethylene	5/27/2003	0.39	0.5	--	UG/L	40	J
524.2 TVOC	8/21/2003	2.27	--	--	UG/L	40	
524.2 TVOC	8/21/2003	1.12	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	8/21/2003	0.54	0.5	--	UG/L	40	
Benzene, 1,2,4-trimethyl	8/21/2003	0.45	0.5	--	UG/L	40	J
Benzene, 1,3,5-trimethyl-	8/21/2003	0.58	0.5	--	UG/L	40	
cis-1,2-Dichloroethylene	8/21/2003	0.64	0.5	--	UG/L	40	
Ethylbenzene	8/21/2003	0.4	0.5	--	UG/L	40	J
m/p xylene	8/21/2003	0.36	0.5	--	UG/L	40	J
Naphthalene	8/21/2003	0.42	0.5	--	UG/L	40	J
524.2 TVOC	12/30/2003	11.48	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	12/30/2003	2.7	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	12/30/2003	3.7	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	12/30/2003	0.66	0.5	--	UG/L	40	
Cymene	12/30/2003	1.9	0.5	--	UG/L	40	

n-Propylbenzene	12/30/2003	1.1	0.5	--	UG/L	40	
sec-Butylbenzene	12/30/2003	0.62	0.5	--	UG/L	40	
Tetrachloroethylene	12/30/2003	0.8	0.5	--	UG/L	40	
524.2 TVOC	3/8/2004	1.92	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	3/8/2004	0.76	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	3/8/2004	0.65	0.5	--	UG/L	40	
Tetrachloroethylene	3/8/2004	0.51	0.5	--	UG/L	40	
524.2 TVOC	6/28/2004	0	--	--	UG/L	40	
524.2 TVOC	8/20/2004	3.23	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	8/20/2004	0.82	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	8/20/2004	1.2	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	8/20/2004	0.24	0.5	--	UG/L	40	J
Cymene	8/20/2004	0.21	0.5	--	UG/L	40	J
n-Propylbenzene	8/20/2004	0.43	0.5	--	UG/L	40	J
Tetrachloroethylene	8/20/2004	0.33	0.5	--	UG/L	40	J
524.2 TVOC	10/27/2004	15.85	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	10/27/2004	3.2	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	10/27/2004	5.7	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	10/27/2004	0.68	0.5	--	UG/L	40	
Cymene	10/27/2004	1.6	0.5	--	UG/L	40	
n-Butylbenzene	10/27/2004	0.56	0.5	--	UG/L	40	
n-Propylbenzene	10/27/2004	1.4	0.5	--	UG/L	40	
sec-Butylbenzene	10/27/2004	1.3	0.5	--	UG/L	40	
tert-Butylbenzene	10/27/2004	0.31	0.5	--	UG/L	40	J
Tetrachloroethylene	10/27/2004	1.1	0.5	--	UG/L	40	
524.2 TVOC	2/4/2005	16.71	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	2/4/2005	4.8	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	2/4/2005	5	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	2/4/2005	0.86	0.5	--	UG/L	40	
Cymene	2/4/2005	1.7	0.5	--	UG/L	40	
n-Propylbenzene	2/4/2005	1.3	0.5	--	UG/L	40	
sec-Butylbenzene	2/4/2005	1.3	0.5	--	UG/L	40	
tert-Butylbenzene	2/4/2005	0.35	0.5	--	UG/L	40	J
Tetrachloroethylene	2/4/2005	1.4	0.5	--	UG/L	40	
524.2 TVOC	6/29/2005	9	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	6/29/2005	2.4	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	6/29/2005	3.7	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	6/29/2005	0.44	0.5	--	UG/L	40	J
n-Propylbenzene	6/29/2005	1	0.5	--	UG/L	40	
sec-Butylbenzene	6/29/2005	0.72	0.5	--	UG/L	40	
tert-Butylbenzene	6/29/2005	0.13	0.5	--	UG/L	40	J
Tetrachloroethylene	6/29/2005	0.61	0.5	--	UG/L	40	
524.2 TVOC	8/31/2005	0.5	--	--	UG/L	40	
Tetrachloroethylene	8/31/2005	0.5	0.5	--	UG/L	40	
524.2 TVOC	12/8/2005	8.4	--	--	UG/L	60	
Benzene, 1,2,4-trimethyl	12/8/2005	2.4	0.5	--	UG/L	60	
Benzene, 1,3,5-trimethyl-	12/8/2005	1.8	0.5	--	UG/L	60	
Benzene, 1-methylethyl-	12/8/2005	0.43	0.5	--	UG/L	60	J
Bis(2-ethylhexyl)phthalate	12/8/2005	4.5	10	--	UG/L	60	J
Butyl benzyl phthalate	12/8/2005	6.2	10	--	UG/L	60	J
Cymene	12/8/2005	1.3	0.5	--	UG/L	60	
Di-n-octyl phthalate	12/8/2005	3.2	10	--	UG/L	60	J

n-Propylbenzene	12/8/2005	0.74	0.5	--	UG/L	60	
sec-Butylbenzene	12/8/2005	0.72	0.5	--	UG/L	60	
tert-Butylbenzene	12/8/2005	0.17	0.5	--	UG/L	60	J
Tetrachloroethylene	12/8/2005	0.84	0.5	--	UG/L	60	
524.2 TVOC	3/2/2006	7.95	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	3/2/2006	2.2	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	3/2/2006	3.2	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	3/2/2006	0.43	0.5	--	UG/L	40	J
Cymene	3/2/2006	0.47	0.5	--	UG/L	40	J
n-Propylbenzene	3/2/2006	0.78	0.5	--	UG/L	40	
sec-Butylbenzene	3/2/2006	0.49	0.5	--	UG/L	40	J
Tetrachloroethylene	3/2/2006	0.38	0.5	--	UG/L	40	J
524.2 TVOC	5/1/2006	5.591	--	--	UG/L	40	
Benzene, 1,2,4-trimethyl	5/1/2006	1.6	0.5	--	UG/L	40	
Benzene, 1,3,5-trimethyl-	5/1/2006	1.6	0.5	--	UG/L	40	
Benzene, 1-methylethyl-	5/1/2006	0.23	0.5	--	UG/L	40	J
Cymene	5/1/2006	0.69	0.5	--	UG/L	40	
n-Propylbenzene	5/1/2006	0.49	0.5	--	UG/L	40	J
sec-Butylbenzene	5/1/2006	0.38	0.5	--	UG/L	40	J
tert-Butylbenzene	5/1/2006	0.091	0.5	--	UG/L	40	J
Tetrachloroethylene	5/1/2006	0.51	0.5	--	UG/L	40	
Benzene, 1,2,4-trimethyl	8/8/2006	0.11	0.5	--	UG/L	40	J
Benzene, 1,3,5-trimethyl-	8/8/2006	0.083	0.5	--	UG/L	40	J
Tetrachloroethylene	8/8/2006	0.18	0.5	--	UG/L	40	J

Site ID: 076-185

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
524.2 TVOC	2/4/2000	0.79	--	--	UG/L	60	
Chloroform	2/4/2000	0.49	0.5	--	UG/L	60	J
Tetrachloroethylene	2/4/2000	0.3	0.5	--	UG/L	60	J
524.2 TVOC	6/29/2000	21.4	--	--	UG/L	25	
cis-1,2-Dichloroethylene	6/29/2000	20.2	0.5	--	UG/L	25	
Gross Beta	6/29/2000	2.26	0.815	0.511	PCI/L	25	J
Strontium-90	6/29/2000	1.64	0.331	0.236	PCI/L	25	
Tetrachloroethylene	6/29/2000	1.2	0.5	--	UG/L	25	
524.2 TVOC	7/31/2000	14.3	--	--	UG/L	25	
cis-1,2-Dichloroethylene	7/31/2000	13.1	0.5	--	UG/L	25	
Tetrachloroethylene	7/31/2000	1.2	0.5	--	UG/L	25	
524.2 TVOC	10/23/2000	9.29	--	--	UG/L	25	
cis-1,2-Dichloroethylene	10/23/2000	7.1	0.5	--	UG/L	25	
Methylene chloride	10/23/2000	0.89	0.5	--	UG/L	25	
Tetrachloroethylene	10/23/2000	1.3	0.5	--	UG/L	25	
524.2 TVOC	1/26/2001	3.5	--	--	UG/L	25	
cis-1,2-Dichloroethylene	1/26/2001	2.2	0.5	--	UG/L	25	
Tetrachloroethylene	1/26/2001	1.3	0.5	--	UG/L	25	
524.2 TVOC	5/9/2001	1.51	--	--	UG/L	40	
cis-1,2-Dichloroethylene	5/9/2001	0.59	0.5	--	UG/L	40	
Tetrachloroethylene	5/9/2001	0.64	0.5	--	UG/L	40	
Toluene	5/9/2001	0.28	0.5	--	UG/L	40	J
524.2 TVOC	7/24/2001	0.48	--	--	UG/L	25	
Tetrachloroethylene	7/24/2001	0.48	0.5	--	UG/L	25	J
524.2 TVOC	11/8/2001	0.66	--	--	UG/L	40	

Bis(2-ethylhexyl)phthalate	11/8/2001	0.43	10	--	UG/L	40	J
Tetrachloroethylene	11/8/2001	0.66	0.5	--	UG/L	40	
524.2 TVOC	2/12/2002	1.5	--	--	UG/L	25	
Methylene chloride	2/12/2002	0.61	0.5	--	UG/L	25	
Tetrachloroethylene	2/12/2002	0.57	0.5	--	UG/L	25	
1,1,1-Trichloroethane	5/14/2002	0.35	0.5	--	UG/L	25	J
524.2 TVOC	5/14/2002	32.67	--	--	UG/L	25	
cis-1,2-Dichloroethylene	5/14/2002	26.6	0.5	--	UG/L	25	
Tetrachloroethylene	5/14/2002	3.4	0.5	--	UG/L	25	
Trichloroethylene	5/14/2002	0.82	0.5	--	UG/L	25	
524.2 TVOC	8/7/2002	7.16	--	--	UG/L	25	
cis-1,2-Dichloroethylene	8/7/2002	5.6	0.5	--	UG/L	25	
Tetrachloroethylene	8/7/2002	1.3	0.5	--	UG/L	25	
Trichloroethylene	8/7/2002	0.26	0.5	--	UG/L	25	J
1,1,1-Trichloroethane	10/30/2002	0.46	0.5	--	UG/L	25	J
524.2 TVOC	10/30/2002	27.16	--	--	UG/L	25	
cis-1,2-Dichloroethylene	10/30/2002	19.7	0.5	--	UG/L	25	
Tetrachloroethylene	10/30/2002	5.9	0.5	--	UG/L	25	
Trichloroethylene	10/30/2002	1.1	0.5	--	UG/L	25	
1,1,1-Trichloroethane	1/31/2003	0.35	0.5	--	UG/L	25	J
524.2 TVOC	1/31/2003	24.96	--	--	UG/L	25	
cis-1,2-Dichloroethylene	1/31/2003	19.3	0.5	--	UG/L	25	
Tetrachloroethylene	1/31/2003	4.5	0.5	--	UG/L	25	
Trichloroethylene	1/31/2003	0.81	0.5	--	UG/L	25	
524.2 TVOC	5/22/2003	2.7	--	--	UG/L	25	
cis-1,2-Dichloroethylene	5/22/2003	1.7	0.5	--	UG/L	25	
Tetrachloroethylene	5/22/2003	1	0.5	--	UG/L	25	
524.2 TVOC	8/21/2003	1.49	--	--	UG/L	25	
Chloroform	8/21/2003	0.64	0.5	--	UG/L	25	
cis-1,2-Dichloroethylene	8/21/2003	0.32	0.5	--	UG/L	25	J
Tetrachloroethylene	8/21/2003	0.53	0.5	--	UG/L	25	
524.2 TVOC	12/29/2003	1.87	--	--	UG/L	25	
cis-1,2-Dichloroethylene	12/29/2003	0.77	0.5	--	UG/L	25	
Tetrachloroethylene	12/29/2003	1.1	0.5	--	UG/L	25	
524.2 TVOC	3/8/2004	6.5	--	--	UG/L	25	
cis-1,2-Dichloroethylene	3/8/2004	3.9	0.5	--	UG/L	25	
Tetrachloroethylene	3/8/2004	2.6	0.5	--	UG/L	25	
524.2 TVOC	6/28/2004	2.1	--	--	UG/L	25	
Tetrachloroethylene	6/28/2004	2.1	0.5	--	UG/L	25	
524.2 TVOC	8/30/2004	6.48	--	--	UG/L	25	
cis-1,2-Dichloroethylene	8/30/2004	4.2	0.5	--	UG/L	25	
Tetrachloroethylene	8/30/2004	2	0.5	--	UG/L	25	
Trichloroethylene	8/30/2004	0.28	0.5	--	UG/L	25	J
1,1,1-Trichloroethane	10/26/2004	0.23	0.5	--	UG/L	25	J
524.2 TVOC	10/26/2004	15.84	--	--	UG/L	25	
cis-1,2-Dichloroethylene	10/26/2004	10	0.5	--	UG/L	25	
Tetrachloroethylene	10/26/2004	4.8	0.5	--	UG/L	25	
Trichloroethylene	10/26/2004	0.81	0.5	--	UG/L	25	
524.2 TVOC	2/4/2005	9.66	--	--	UG/L	25	
cis-1,2-Dichloroethylene	2/4/2005	6.3	0.5	--	UG/L	25	
Tetrachloroethylene	2/4/2005	2.9	0.5	--	UG/L	25	
Trichloroethylene	2/4/2005	0.46	0.5	--	UG/L	25	J

524.2 TVOC	8/31/2005	2.5	--	--	UG/L	25	
cis-1,2-Dichloroethylene	8/31/2005	1.2	0.5	--	UG/L	25	
Tetrachloroethylene	8/31/2005	1.3	0.5	--	UG/L	25	
524.2 TVOC	3/10/2006	0.873	--	--	UG/L	25	
Chloroform	3/10/2006	0.14	0.5	--	UG/L	25	J
cis-1,2-Dichloroethylene	3/10/2006	0.29	0.5	--	UG/L	25	J
Tetrachloroethylene	3/10/2006	0.36	0.5	--	UG/L	25	J
Trichlorofluoromethane	3/10/2006	0.083	0.5	--	UG/L	25	J
Chloroform	8/8/2006	0.11	0.5	--	UG/L	25	J
cis-1,2-Dichloroethylene	8/8/2006	0.23	0.5	--	UG/L	25	J
Methyl chloride	8/8/2006	0.1	0.5	--	UG/L	25	J
Tetrachloroethylene	8/8/2006	0.32	0.5	--	UG/L	25	J
Trichlorofluoromethane	8/8/2006	0.084	0.5	--	UG/L	25	J

Site ID: 085-01

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
1,1,1-Trichloroethane	1/12/2000	0.54	0.5	--	UG/L	75	
1,1-Dichloroethylene	1/12/2000	0.5	0.5	--	UG/L	75	J
524.2 TVOC	1/12/2000	4.71	--	--	UG/L	75	
Benzene	1/12/2000	0.5	0.5	--	UG/L	75	JB
Benzene, 1,2,4-trimethyl	1/12/2000	0.5	0.5	--	UG/L	75	JB
Chloroform	1/12/2000	0.67	0.5	--	UG/L	75	
m/p xylene	1/12/2000	0.5	0.5	--	UG/L	75	JB
Toluene	1/12/2000	0.5	0.5	--	UG/L	75	JB
Trichloroethylene	1/12/2000	0.5	0.5	--	UG/L	75	J
Trichlorofluoromethane	1/12/2000	0.5	0.5	--	UG/L	75	JB
1,1,1-Trichloroethane	7/5/2000	6.3	0.5	--	UG/L	75	
1,1-Dichloroethylene	7/5/2000	2.6	0.5	--	UG/L	75	
524.2 TVOC	7/5/2000	9.32	--	--	UG/L	75	
Chloroform	7/5/2000	0.42	0.5	--	UG/L	75	J
Gross Beta	8/1/2000	3.49	2.28	2.94	PCI/L	75	
Tritium	8/1/2000	1450	320	538	PCI/L	75	
Tritium	10/6/2000	547	508	315	PCI/L	75	JN2
1,1,1-Trichloroethane	1/9/2001	0.62	0.5	--	UG/L	75	
1,1-Dichloroethylene	1/9/2001	0.26	0.5	--	UG/L	75	J
524.2 TVOC	1/9/2001	1.19	--	--	UG/L	75	
Chloroform	1/9/2001	0.31	0.5	--	UG/L	75	J
1,1,1-Trichloroethane	7/3/2001	0.5	0.5	--	UG/L	85	
524.2 TVOC	7/3/2001	1.38	--	--	UG/L	85	
Toluene	7/3/2001	0.88	0.5	--	UG/L	85	
524.2 TVOC	10/8/2001	0	--	--	UG/L	75	
Tritium	4/11/2002	1340	448	321	PCI/L	75	
Tritium	7/10/2002	1400	523	362	PCI/L	75	
524.2 TVOC	10/10/2002	0	--	--	UG/L	75	
Tritium	10/10/2002	10200	381	516	PCI/L	75	
Tritium	1/9/2003	2290	405	330	PCI/L	75	
Tritium	4/24/2003	392	276	215	PCI/L	75	
524.2 TVOC	10/27/2003	0	--	--	UG/L	75	
Tritium	10/27/2003	287	271	180	PCI/L	75	
Tritium	1/29/2004	310	260	190	PCI/L	75	J
524.2 TVOC	10/6/2004	0.94	--	--	UG/L	75	
Chloroform	10/6/2004	0.2	0.5	--	UG/L	75	J

Methylene chloride	10/6/2004	0.74	0.5	--	UG/L	75	
Tritium	4/1/2005	2170	180	380	PCI/L	75	
524.2 TVOC	10/7/2005	0	--	--	UG/L	75	
Tritium	10/7/2005	2560	470	480	PCI/L	75	J(-)-S
Tritium	1/13/2006	3480	340	490	PCI/L	75	
Tritium	4/11/2006	1370	380	320	PCI/L	75	
Tritium	7/19/2006	2460	350	400	PCI/L	75	

Site ID: 085-02

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
1,1,1-Trichloroethane	1/12/2000	3	0.5	--	UG/L	145	
1,1-Dichloroethane	1/12/2000	0.5	0.5	--	UG/L	145	J
1,1-Dichloroethylene	1/12/2000	0.86	0.5	--	UG/L	145	
1,2-Dichloroethane	1/12/2000	0.5	0.5	--	UG/L	145	J
524.2 TVOC	1/12/2000	6.24	--	--	UG/L	145	
Chloroform	1/12/2000	0.88	0.5	--	UG/L	145	
Trichloroethylene	1/12/2000	0.5	0.5	--	UG/L	145	J
1,1,1-Trichloroethane	7/5/2000	5.6	0.5	--	UG/L	145	
1,1-Dichloroethylene	7/5/2000	1.8	0.5	--	UG/L	145	
524.2 TVOC	7/5/2000	7.95	--	--	UG/L	145	
Chloroform	7/5/2000	0.55	0.5	--	UG/L	145	
1,1,1-Trichloroethane	1/9/2001	18.5	0.5	--	UG/L	145	
1,1-Dichloroethylene	1/9/2001	8.7	0.5	--	UG/L	145	
524.2 TVOC	1/9/2001	27.84	--	--	UG/L	145	
Chloroform	1/9/2001	0.64	0.5	--	UG/L	145	
1,1,1-Trichloroethane	7/2/2001	9.3	0.5	--	UG/L	145	
1,1-Dichloroethane	7/2/2001	0.35	0.5	--	UG/L	145	J
1,1-Dichloroethylene	7/2/2001	4.4	0.5	--	UG/L	145	
524.2 TVOC	7/2/2001	16	--	--	UG/L	145	
Chloroform	7/2/2001	0.54	0.5	--	UG/L	145	
Naphthalene	7/2/2001	1.1	0.5	--	UG/L	145	B
Toluene	7/2/2001	0.31	0.5	--	UG/L	145	J
1,1,1-Trichloroethane	10/8/2001	8.2	0.5	--	UG/L	145	
1,1-Dichloroethane	10/8/2001	0.27	0.5	--	UG/L	145	J
1,1-Dichloroethylene	10/8/2001	4.1	0.5	--	UG/L	145	
524.2 TVOC	10/8/2001	13.02	--	--	UG/L	145	
Chloroform	10/8/2001	0.45	0.5	--	UG/L	145	J
Tritium	1/14/2002	487	1150	678	PCI/L	145	DL
1,1,1-Trichloroethane	10/10/2002	24.5	0.5	--	UG/L	145	
1,1-Dichloroethane	10/10/2002	1.7	0.5	--	UG/L	145	
1,1-Dichloroethylene	10/10/2002	13.1	0.5	--	UG/L	145	
524.2 TVOC	10/10/2002	40.85	--	--	UG/L	145	
Chloroform	10/10/2002	0.57	0.5	--	UG/L	145	
Trichlorofluoromethane	10/10/2002	0.98	0.5	--	UG/L	145	
Tritium	10/10/2002	908	400	269	PCI/L	145	J
Tritium	4/24/2003	750	276	233	PCI/L	145	
1,1,1-Trichloroethane	10/27/2003	7	0.5	--	UG/L	145	
1,1-Dichloroethane	10/27/2003	0.96	0.5	--	UG/L	145	
1,1-Dichloroethylene	10/27/2003	3.7	0.5	--	UG/L	145	
524.2 TVOC	10/27/2003	12.46	--	--	UG/L	145	
Chloroform	10/27/2003	0.8	0.5	--	UG/L	145	
Tritium	1/29/2004	680	250	250	PCI/L	145	

Tritium	4/1/2004	370	310	220	PCI/L	175	J
Tritium	7/7/2004	390	340	230	PCI/L	145	J
1,1,1-Trichloroethane	10/6/2004	19	0.5	--	UG/L	145	
1,1-Dichloroethane	10/6/2004	2.7	0.5	--	UG/L	145	
1,1-Dichloroethylene	10/6/2004	10	0.5	--	UG/L	145	
524.2 TVOC	10/6/2004	34.28	--	--	UG/L	145	
Chloroform	10/6/2004	0.84	0.5	--	UG/L	145	
Methylene chloride	10/6/2004	0.68	0.5	--	UG/L	145	
Trichloroethylene	10/6/2004	0.5	0.5	--	UG/L	145	
Trichlorofluoromethane	10/6/2004	0.56	0.5	--	UG/L	145	
Tritium	10/6/2004	380	300	210	PCI/L	145	J
Tritium	1/5/2005	340	260	190	PCI/L	145	J
Tritium	4/1/2005	510	180	180	PCI/L	145	
1,1,1-Trichloroethane	10/7/2005	8.4	0.5	--	UG/L	140	
1,1-Dichloroethane	10/7/2005	1.1	0.5	--	UG/L	140	
1,1-Dichloroethylene	10/7/2005	3.3	0.5	--	UG/L	140	
524.2 TVOC	10/7/2005	13.99	--	--	UG/L	140	
Chloroform	10/7/2005	0.79	0.5	--	UG/L	140	
Trichloroethylene	10/7/2005	0.4	0.5	--	UG/L	140	J
Tritium	1/13/2006	380	340	230	PCI/L	145	J

Site ID: 085-171

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
1,1,1-Trichloroethane	1/24/2000	21.8	0.5	--	UG/L	135	
1,1-Dichloroethane	1/24/2000	1	0.5	--	UG/L	135	
1,1-Dichloroethylene	1/24/2000	9.7	0.5	--	UG/L	135	
1,2-Dichloroethane	1/24/2000	0.11	0.5	--	UG/L	135	J
524.2 TVOC	1/24/2000	35.892	--	--	UG/L	135	
Chloroform	1/24/2000	0.36	0.5	--	UG/L	135	J
m/p xylene	1/24/2000	0.032	0.5	--	UG/L	135	J
Methylene chloride	1/24/2000	0.49	0.5	--	UG/L	135	JB
Toluene	1/24/2000	0.08	0.5	--	UG/L	135	JB
Trichloroethylene	1/24/2000	0.22	0.5	--	UG/L	135	J
Trichlorofluoromethane	1/24/2000	2.1	0.5	--	UG/L	135	
1,1,1-Trichloroethane	7/12/2000	19.8	0.5	--	UG/L	130	
1,1-Dichloroethane	7/12/2000	1.6	0.5	--	UG/L	130	
1,1-Dichloroethylene	7/12/2000	7.6	0.5	--	UG/L	130	
524.2 TVOC	7/12/2000	33.99	--	--	UG/L	130	
Chloroform	7/12/2000	0.84	0.5	--	UG/L	130	
Methylene chloride	7/12/2000	0.81	0.5	--	UG/L	130	B
Toluene	7/12/2000	0.38	0.5	--	UG/L	130	J
Trichloroethylene	7/12/2000	0.76	0.5	--	UG/L	130	
Trichlorofluoromethane	7/12/2000	2.2	0.5	--	UG/L	130	
Tritium	7/12/2000	714	412	267	PCI/L	130	J
Tritium	10/19/2000	1230	470	320	PCI/L	130	
1,1,1-Trichloroethane	2/13/2001	6	0.5	--	UG/L	130	
1,1-Dichloroethane	2/13/2001	0.41	0.5	--	UG/L	130	J
1,1-Dichloroethylene	2/13/2001	1.9	0.5	--	UG/L	130	
524.2 TVOC	2/13/2001	9.43	--	--	UG/L	130	
Chloroform	2/13/2001	0.82	0.5	--	UG/L	130	
Trichloroethylene	2/13/2001	0.3	0.5	--	UG/L	130	J
Tritium	2/13/2001	845	320	213	PCI/L	130	J

1,1,1-Trichloroethane	7/19/2001	10.5	0.5	--	UG/L	130	
1,1-Dichloroethane	7/19/2001	0.93	0.5	--	UG/L	130	
1,1-Dichloroethylene	7/19/2001	4.3	0.5	--	UG/L	130	
524.2 TVOC	7/19/2001	17.09	--	--	UG/L	130	
Chloroform	7/19/2001	1	0.5	--	UG/L	130	
Trichloroethylene	7/19/2001	0.36	0.5	--	UG/L	130	J
Tritium	7/19/2001	469	430	268	PCI/L	130	J-N2
1,1,1-Trichloroethane	10/15/2001	13.9	0.5	--	UG/L	130	
1,1-Dichloroethane	10/15/2001	0.8	0.5	--	UG/L	130	
1,1-Dichloroethylene	10/15/2001	5.3	0.5	--	UG/L	130	
524.2 TVOC	10/15/2001	21.48	--	--	UG/L	130	
Chloroform	10/15/2001	0.88	0.5	--	UG/L	130	
Methyl chloride	10/15/2001	0.27	0.5	--	UG/L	130	J
Trichloroethylene	10/15/2001	0.33	0.5	--	UG/L	130	J
1,1,1-Trichloroethane	10/18/2002	16.4	0.5	--	UG/L	130	
1,1-Dichloroethane	10/18/2002	1	0.5	--	UG/L	130	
1,1-Dichloroethylene	10/18/2002	5.1	0.5	--	UG/L	130	
524.2 TVOC	10/18/2002	24.04	--	--	UG/L	130	
Chloroform	10/18/2002	0.96	0.5	--	UG/L	130	
Methylene chloride	10/18/2002	0.29	0.5	--	UG/L	130	J
Trichloroethylene	10/18/2002	0.29	0.5	--	UG/L	130	J
Tritium	8/6/2003	321	273	180	PCI/L	130	
1,1,1-Trichloroethane	10/30/2003	4.4	0.5	--	UG/L	130	J
1,1-Dichloroethane	10/30/2003	0.45	0.5	--	UG/L	130	J
1,1-Dichloroethylene	10/30/2003	1.6	0.5	--	UG/L	130	J
524.2 TVOC	10/30/2003	7.67	--	--	UG/L	130	
Chloroform	10/30/2003	0.77	0.5	--	UG/L	130	J
Methyl tert-butyl ether	10/30/2003	0.45	0.5	--	UG/L	130	J
Tritium	2/10/2004	350	220	180	PCI/L	130	J
1,1,1-Trichloroethane	4/11/2005	2.7	0.5	--	UG/L	130	
1,1-Dichloroethane	4/11/2005	0.53	0.5	--	UG/L	130	
1,1-Dichloroethylene	4/11/2005	1.3	0.5	--	UG/L	130	
524.2 TVOC	4/11/2005	6.01	--	--	UG/L	130	
Chloroform	4/11/2005	1.2	0.5	--	UG/L	130	
Toluene	4/11/2005	0.12	0.5	--	UG/L	130	J
Trichloroethylene	4/11/2005	0.16	0.5	--	UG/L	130	J
1,1,1-Trichloroethane	12/22/2005	2.1	0.5	--	UG/L	130	
1,1-Dichloroethane	12/22/2005	0.49	0.5	--	UG/L	130	J
1,1-Dichloroethylene	12/22/2005	1	0.5	--	UG/L	130	
524.2 TVOC	12/22/2005	4.18	--	--	UG/L	130	
Chloroform	12/22/2005	0.42	0.5	--	UG/L	130	J
Trichloroethylene	12/22/2005	0.17	0.5	--	UG/L	130	J
Tritium	12/22/2005	360	360	230	PCI/L	130	J
Tritium	1/24/2006	550	280	220	PCI/L	130	
Tritium	4/14/2006	460	350	230	PCI/L	130	J
Tritium	7/11/2006	550	390	270	PCI/L	130	

Site ID: 086-05

Chemical Name	Sample Date	Value	Det. Limit	Error	Units	Depth	Qual.
524.2 TVOC	2/11/2000	0.54	--	--	UG/L	85	
Chloroform	2/11/2000	0.54	0.5	--	UG/L	85	
524.2 TVOC	5/25/2000	0.63	--	--	UG/L	85	

Chloroform	5/25/2000	0.63	0.5	--	UG/L	85	
524.2 TVOC	8/31/2000	0.84	--	--	UG/L	85	
Chloroform	8/31/2000	0.84	0.5	--	UG/L	85	
Vanadium-48	8/31/2000	-4.3	10.4	6.36	PCI/L	85	DL
524.2 TVOC	11/30/2000	0.84	--	--	UG/L	85	
Chloroform	11/30/2000	0.84	0.5	--	UG/L	85	
524.2 TVOC	3/5/2001	0.44	--	--	UG/L	85	
Chloroform	3/5/2001	0.44	0.5	--	UG/L	85	J
524.2 TVOC	5/25/2001	0.75	--	--	UG/L	85	
Chloroform	5/25/2001	0.48	0.5	--	UG/L	85	J
Methylene chloride	5/25/2001	0.27	0.5	--	UG/L	85	J
524.2 TVOC	8/20/2001	0.4	--	--	UG/L	85	
Chloroform	8/20/2001	0.4	0.5	--	UG/L	85	J
524.2 TVOC	10/8/2001	0.33	--	--	UG/L	85	
Chloroform	10/8/2001	0.33	0.5	--	UG/L	85	J
524.2 TVOC	6/28/2002	0	--	--	UG/L	85	
524.2 TVOC	7/18/2003	0.27	--	--	UG/L	85	
Chloroform	7/18/2003	0.27	0.5	--	UG/L	85	J
524.2 TVOC	9/1/2004	0.29	--	--	UG/L	85	
Chloroform	9/1/2004	0.29	0.5	--	UG/L	85	J
Gross Alpha	9/1/2004	1.36	1.2	0.86	PCI/L	85	J
Gross Beta	9/1/2004	2.58	1.2	0.91	PCI/L	85	J
524.2 TVOC	8/29/2005	0.43	--	--	UG/L	85	
Chloroform	8/29/2005	0.43	0.5	--	UG/L	85	J