Brookhaven National Laboratory

ENVIRONMENTAL MONITORING PLAN

Triennial Update
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EXECUTIVE SUMMARY

Brookhaven National Laboratory (BNL) is a multi-program national laboratory operated by Brookhaven Science Associates for the U.S. Department of Energy (DOE) and is located on a 5,265-acre site in Suffolk County, Long Island, New York. BNL has a comprehensive Environmental Management System (EMS) in place, which meets the requirements of the International Organization for Standardization 14001 EMS Standard, as described in the BNL EMS Manual. BNL's extensive environmental monitoring program is one component of the EMS, and the BNL Environmental Monitoring Plan (EMP) describes this program in detail. The data derived from systematically monitoring the various environmental media on site enable BNL to make informed decisions concerning the protection of human health and the environment and to be responsive to community concerns.

BNL's environmental monitoring program was designed in accordance with DOE Order 5400.1, General Environmental Protection Program. This order sets forth the requirements for environmental protection programs at DOE facilities to ensure that operations fully comply with applicable federal, state, and local environmental laws and regulations; executive orders; and DOE policies. BNL uses the Data Quality Objective (DQO) process developed by the U.S. Environmental Protection Agency (EPA) to describe the environmental monitoring matrices, sampling methods, locations, frequencies, and measured parameters, as well as the methods and procedures for data collection, analysis, maintenance, reporting, and archiving.

The EMP summarizes the "drivers" (i.e., compliance, support compliance, surveillance, and restoration), data quality objectives, potential sources and contaminants, extent and frequency of monitoring, analytical procedures, and quality assurance processes. The plan is reviewed and revised annually to reflect any changes made to the monitoring program from the previous year and a complete update is published triennially. The following are some of the highlights of key changes in the 2003 triennial update. Full descriptions of all changes are detailed in each of the DQOs.

The Peconic River estuary (marine) will not be monitored in 2003, since historical results have consistently shown no impact associated with BNL operations. Freshwater monitoring stations are being added at Forge Pond, Swan Pond, and Donahue's Pond, to provide water quality data that will be used in conjunction with aquatic flora and fauna data. Stations HB, HC, and HR are being removed since these are either far removed from BNL operations or are not collocated with aquatic fauna and flora sampling stations.

- Since the BNL research reactors are no longer operational, off-site monitoring of farm vegetables will occur only if unusual or higher than expected radioactive air emissions are observed in the air monitoring program. On-site sampling in the BNL garden will continue. The same type of graded approach will also be used for sitewide vegetation and soil sampling.
- To better characterize the radiological emissions from the Brookhaven Linac Isotope Producer, air monitoring will be expanded to characterize short-lived gaseous emissions.
- To measure local direct radiation at beam stops and collimators, fifteen additional thermoluminescent dosimeter monitors will be deployed in the Relativistic Heavy Ion Collider and the Alternating Gradient Synchrotron.\

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- The Central Steam Facility will undergo stack testing, which must be conducted every five years under the operating permit.
- Sodium-22 will not be monitored as part of the groundwater surveillance program at the accelerator facilities, since tritium is a better indicator of cap or liner performance.
- Groundwater monitoring at the Biology Department Green Houses for pesticides and metals, and at the shotgun and fire range for metals, has been discontinued, since three years of monitoring have shown no impacts.

BNL monitors radiological and nonradiological aspects of ambient air quality, emissions from point sources, wastewater discharges, surface water quality, groundwater quality, precipitation, soil, flora, and fauna. Sampling is performed under one or more types of environmental monitoring: compliance, restoration, or surveillance monitoring. Compliance monitoring ensures adherence to regulatory and permit limits. Restoration monitoring measures the impact of past operations and assesses the effectiveness of remedial measures. Surveillance monitoring evaluates the impacts, if any, of current or historical operations on the various environmental media.

Air surveillance monitoring at BNL involves the analysis of particulate matter collected on filters, as well as vapor chemically trapped in a collection medium. Monitoring is conducted for various airborne radionuclides (including particulates and tritiated water vapor) on the BNL site and at locations off site on eastern Long Island. Continuous radiological monitoring is conducted for operations that have the potential to result in a radiological dose at the site boundary in excess of 0.1 millirem per year. For facilities with emissions below that value, periodic confirmatory monitoring is conducted. Specific diffuse, or nonpoint, sources, arising as a result of environmental restoration activities, are monitored as needed to protect worker and public health. BNL also measures environmental background radiation through a network of on-site and off-site dosimeter units.

Samples of wastewater effluent from BNL operations are collected at the point of discharge. Monitoring is conducted in accordance with permit requirements and includes water quality parameters—such as pH, dissolved oxygen, and temperature—as well as radiological, organic, and inorganic parameters.

The Peconic River is sampled at four off-site locations between the southeast site boundary and the river's terminus at Riverhead, New York; at five locations on site; and at one station off site and upstream of BNL. The Carmans River is also sampled to determine background or ambient conditions. Collected samples are analyzed for radiological and nonradiological parameters.

The BNL site is included on the Comprehensive Environmental Response, Compensation & Liability Act National Priorities List. The U.S. EPA, and the New York State Department of Environmental Conservation have integrated DOE's response obligations into a comprehensive Federal Facilities Agreement. In compliance with this agreement, BNL's comprehensive groundwater protection program evaluates groundwater contamination from historical operations and determines whether measures taken to protect or restore groundwater quality are effective. Wells also monitor research and support facilities where there is a potential for environmental impact to determine whether operational and engineered controls designed to protect groundwater are working effectively.

BNL maintains six groundwater production wells to supply potable water to the BNL community. The supply wells and distribution system are monitored for chemical and radiological parameters to

ensure that concentrations of regulated contaminants present in the domestic water system are less than the maximum contaminant levels specified by regulation.

Data from the sampling and analysis of vegetation and fauna are used to estimate bioaccumulation and potential dose via the ingestion pathway. Precipitation, soil, and sediment are analyzed for contaminants released to the atmosphere and surface water.

All environmental monitoring data must meet appropriate quality assurance requirements. The BNL Analytical Services Laboratory analyzes some of the environmental samples collected on site. BNL also procures and maintains contracts with four off-site laboratories, all of which are certified by New York State for specific parameters and are subject to audits.

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1 INTRODUCTION

1.1 ENVIRONMENTAL MONITORING PLAN PURPOSE

Brookhaven National Laboratory (BNL) has a comprehensive Environmental Management System (EMS) in place. The EMS meets the requirements of the International Organization for Standardization (ISO) 14001 EMS standard, with emphasis on compliance assurance, pollution prevention, and community outreach. An extensive environmental monitoring program is one component of BNL's EMS. The BNL Environmental Monitoring Plan (EMP) is developed by the Environmental and Waste Management Services Division and describes this program in detail.

The EMP is prepared in accordance with the U.S. Department of Energy (DOE) Order 5400.1 (1988), *General Environmental Protection Program*, which requires DOE facilities to develop environmental protection programs to ensure that operations fully comply with applicable federal, state, and local environmental laws and regulations, as well as executive orders and DOE policies. The plan is reviewed and revised annually. A complete update is published triennially to reflect any changes in facility-specific monitoring activities, to address any necessary increased or decreased monitoring based on reviews of previous analytical results, and to respond to stakeholder concerns. The plan is structured to provide people familiar with environmental requirements and monitoring at DOE facilities with an understanding of how BNL fulfills its monitoring requirements.

Using the Data Quality Objectives (DQOs) process developed by the U.S. Environmental Protection Agency (EPA), the EMP describes BNL's environmental monitoring matrices, sampling methods, locations, frequencies, and measured parameters, as well as methods and procedures for data collection, analysis, maintenance, reporting, and archiving. It also addresses quality assurance and quality control of monitoring data.

The EMP is supplemented with standard operating procedures (SOPs), as well as other technical documents, that provide detailed monitoring instructions. Monitoring results are summarized annually in the BNL Site Environmental Report (SER).

1.2 ENVIRONMENTAL MONITORING PLAN ORGANIZATION

The EMP is organized into two parts, and supplementary information is provided in Appendices A through D.

Part I (Chapters 1 through 4):

- Chapter 1 explains the purpose and organization of the EMP.
- Chapter 2 describes the Laboratory's physical setting and the surrounding environment.
- Chapter 3 describes the major facility sources, characterizes their principal effluents and/or emissions, and describes the possible pathways for exposure to radiological and nonradiological contaminants.
- Chapter 4 describes BNL's Quality Assurance Program (QAP).

Part II (Chapters 5 through 12):

Chapters 5 through 12 include the DQOs for the various environmental media (air, surface water, potable water, groundwater, precipitation, flora, fauna, and soil/sediment) and direct radiation

measurements. Each DQO summarizes the proposed changes for 2003, provides a description and technical basis, the drivers for the program, and completes the seven steps of the DQO process developed by the EPA.

Appendix A provides a glossary of terms and acronyms used throughout the plan. Appendix B provides a table showing the combined list of measured parameters by media. Appendix C provides a description of the analytical methods used for on-site analysis. Appendix D provides sampling locations and a crosswalk between pre-2002 and present sampling location identifications.

1.3 ENVIRONMENTAL MONITORING AT BNL

BNL monitors radiological and nonradiological aspects of ambient air quality, emissions from point sources, wastewater discharges, surface water quality, groundwater quality, precipitation, soil, flora, and fauna.

Radiological monitoring consists of the following:

- Assessment of airborne emission impacts through National Emission Standards for Hazardous Air Pollutants (NESHAPs) reviews of facilities that are known to utilize radioactive materials in the course of experimental research.
- Continuous monitoring of facilities, such as medical isotope production areas and accelerators that use large quantities of or generate radioactive materials.
- Liquid effluent monitoring for radiological materials discharged from facilities before release to the environment for compliance with DOE Orders.
- Environmental surveillance of soil, vegetation, and fauna (including aquatic biota).
- Monitoring of potable water for compliance with the Safe Drinking Water Act (SDWA).
- Determination of external exposure component of dose through the use of thermoluminescent dosimeters (TLDs).
- Groundwater monitoring for radiological constituents to evaluate the impact of BNL operations on the EPA designated sole source aquifer, which lies beneath the site.

Nonradiological monitoring involves:

- Monitoring of effluents for parameters listed in the State Pollutant Discharge Elimination System (SPDES) permit.
- Monitoring of fuel oils used by the Central Steam Facility (CSF) for potential polychlorinated biphenyl (PCB) contamination, as needed.
- Monitoring of air emissions from the CSF.
- Monitoring of potable water for parameters regulated by the SDWA and the New York State Department of Health (NYSDOH).
- Environmental surveillance of soil, surface water, and groundwater for nonradiological parameters to assess the impact of BNL operations on the environment.

The BNL environmental monitoring programs fall into three categories:

- *Compliance monitoring* to ensure adherence to regulatory and permit limits.
- *Restoration monitoring* to measure the impact of past operations and assess the effectiveness of remedial measures.
- *Surveillance monitoring* to evaluate what impact, if any, current operations have on the environmental and public health.

1.3.1 Compliance Monitoring

Compliance monitoring is performed in accordance with environmental requirements (permits, regulations, etc.). These requirements may be separated into three categories: air monitoring, wastewater monitoring, and groundwater monitoring.

1.3.1.1 Air Emissions Monitoring

To protect BNL workers, members of the public, and to preserve the environment, radiological and nonradiological air emissions monitoring is conducted in compliance with the Clean Air Act (CAA). Facilities such as the Brookhaven Linac Isotope Producer (BLIP) and the Target Processing Laboratory that have the potential to exceed the NESHAPs dose limit of 0.1 mrem/year ($1\mu\text{Sv}/\text{year}$) are continuously monitored. The Brookhaven Medical Research Reactor (BMRR) is periodically monitored for emissions due to fuel rods, which are still remain in the facility. The CSF is monitored with real-time, continuous monitoring equipment to comply with required permit conditions. An annual NESHAPs report is submitted to EPA for the radiological emission sources.

1.3.1.2 Wastewater Discharge Monitoring

Wastewater discharges are subject to Clean Water Act (CWA) permit monitoring requirements. Monitoring is performed at the point of the wastewater discharge and is conducted to ensure that the effluent complies with release limits. Sixteen point-source discharges are monitored under the BNL CWA program: four under the Environmental Restoration (ER) program and twelve under the SPDES permit program. Samples are collected daily, weekly, monthly, or quarterly, in accordance with permit requirements and are analyzed for organic, inorganic, and radiological parameters. Monthly reports filed with the permitting agency provide analytical results and an assessment of compliance for the reporting period.

1.3.1.3 Groundwater Monitoring

Some groundwater monitoring is also performed in accordance with permit requirements. Specifically, monitoring of groundwater is required under the Major Petroleum Facility (MPF) License for the CSF, and the Resource Conservation and Recover Act (RCRA) permit for the Waste Management Facility. Extensive groundwater monitoring is also conducted under the ER program as required under the Record of Decision (ROD) for many of the Operable Units (OUs) or Areas of Concern (AOC). Additionally, to ensure that BNL maintains a viable potable water supply, groundwater, potable water, and distribution system water samples are monitored as required by NYSDOH regulations under the SDWA.

1.3.2 Restoration Monitoring

Monitoring performed under the ER program is conducted to determine if past operations released or deposited contaminants in the environment or otherwise resulted in degradation of environmental media. This program typically includes collection of soil and groundwater samples to determine the lateral and vertical extent of the contaminated area. Samples are analyzed for organic, inorganic, and radiological contaminants, and the analytical results are compared with recognized guidance or background concentration. Areas where impacts have been confirmed are fully characterized and, if necessary, remediated. Followup monitoring of groundwater is conducted in accordance with a ROD to determine the efficacy of restoration programs (such as groundwater treatment).

1.3.3 Surveillance Monitoring

The focus of the environmental surveillance program is to assess potential environmental impacts resulting from routine facility operations beyond what is required by regulations or permits. This program includes collection of ambient air, surface water, groundwater, soil, flora, fauna, and precipitation samples. Samples are analyzed for radiological, organic, and inorganic contaminants. Additionally, review of data collected with TLDs placed on site and off site is conducted under this program. Surveillance monitoring also includes collection of background samples (sometimes called “reference” or “control” samples) in locations unaffected by BNL operations. Background results are used as a standard of comparison.

1.4 ENVIRONMENTAL DATA REVIEW

The EMP provides the scope, rationale, and justification for the collection and analysis of environmental samples. Samples are collected by trained Laboratory staff, according to approved sample collection procedures and submitted under strict Chain-of-Custody procedures to either the on-site or contract analytical laboratory for the analyses specified under this plan. Within the analytical laboratory, the samples are tracked by a laboratory-assigned sample identification number until analyses are completed and reported.

Analytical results are reviewed to ensure the data are of high quality. Various personnel assess BNL’s compliance with regulatory requirements to compare the data with background levels and to evaluate BNL’s impact on the environment. The Laboratory has established two procedures for addressing data that exceeds permit limits, diverges from “typical” levels, or exceed regulatory standards—the Groundwater Contingency Plan and the Environmental Event Response Procedure. These procedures provide ESD with a framework for responding to an environmental event in order to facilitate protection of environmental quality, compliance with applicable requirements and regulations, and to ensure timely notification to BNL stakeholders. The primary goal is to assure that appropriate, timely, and coordinated actions are taken and communicated by ESD and, when necessary, Laboratory management.

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2 LABORATORY SETTING

2.1 INTRODUCTION

To help evaluate the impacts, past and present, of Laboratory operations on the environment and to better identify potential pathways for possible exposures to the public, local site characteristics are taken into consideration. These characteristics include human population, geology, hydrology, climatic data, and ecological data.

2.2 SITE LOCATION AND LOCAL POPULATION

BNL is located near the geographical center of Suffolk County, Long Island, New York, in Brookhaven Township, about 60 miles east of New York City. Nearly one-third of the 1.43 million people who reside in Suffolk County live in Brookhaven Township (*LIPA 2001*). As with all townships on Long Island, there has been an increase in residential housing in Brookhaven Township in recent years, a trend that is expected to continue. More than 75 percent of BNL's approximately 3,000 employees live within a 15-mile radius of the Laboratory and approximately 150 people reside long-term in the apartments and cottages on site. In addition, approximately 4,000 scientists visit the Laboratory each year and stay short-term in on-site housing.

2.3 FACILITY DESCRIPTION

Most of BNL's principal facilities are located near the center of the 5,265-acre site. The developed area is approximately 1,650 acres, consisting of:

- 500 acres originally developed by the Army (as part of Camp Upton) and still used for offices and other operational buildings
- 550 acres occupied by outlying facilities, such as the Sewage Treatment Plant, research agricultural fields, housing facilities, and fire breaks
- 200 acres occupied by large, specialized research facilities
- 400 acres of roads, parking lots, and connecting areas

The balance of the site, approximately 3,600 acres, is mostly wooded and represents native pine barrens ecology.

2.4 HYDROGEOLOGY AND WATER RESOURCES

The hydrogeology of the BNL site was initially studied by the U.S. Geological Survey in the late 1940's and early 1950's under a cooperative agreement with the Atomic Energy Commission. Since these studies, groundwater flow patterns and groundwater quality have been impacted by a significant increase in the number of BNL research facilities and subsequent demands for water. Since the early 1990's, BNL has been conducting extensive subsurface investigations to better define the hydrogeologic setting of the BNL site and surrounding areas. The BNL hydrogeologic characterization programs have included soil borings, geophysical logging, the installation of monitoring wells and piezometers, water level measurements, aquifer pumping tests, and groundwater modeling.

In general, the terrain of the BNL site is gently rolling, with elevations varying between 44 and 120 feet above sea level. The land lies on the western rim of the shallow Peconic River watershed. The

marshy areas in the northern and eastern sections of the site are part of the headwaters of the Peconic River. The Peconic River both recharges to, and receives water from, the sole source aquifer system underneath Long Island, depending on the position of the water table relative to the base of the riverbed. In times of sustained drought, the river water typically recharges to groundwater, while with normal to above-normal precipitation, the river receives water from the aquifer.

Studies of Long Island hydrology and geology in the vicinity of BNL indicate that the uppermost Pleistocene deposits (referred to as the Upper Glacial aquifer) are between 120 and 250 feet thick, which are composed of highly permeable glacial sands and gravel (Warren *et al.* 1968, Scorca *et al.* 1999). Water penetrates these deposits readily and there is little direct runoff into surface streams unless precipitation is intense. On average, about half of the annual precipitation is lost to the atmosphere through evapotranspiration, and the other half percolates through the soil to recharge the groundwater (Koppleman 1978). The area has a high recharge rate (22 inches per year) that varies seasonally.

The Long Island Regional Planning Board and Suffolk County have identified the BNL site as overlying a deep-flow recharge zone for Long Island groundwater (Koppelman 1978, SCDHS 1987). Precipitation and surface water that recharge within this zone have the potential to replenish the deep Magothy and Lloyd aquifer systems lying below the Upper Glacial aquifer. It is estimated that up to two-fifths of the recharge from rainfall moves into the deeper aquifers. The extent to which groundwater at the BNL site contributes to deep flow recharge has been confirmed through the use of an extensive network of shallow and deep wells installed at BNL and surrounding areas (Geraghty and Miller 1996).

This groundwater system is the primary source of drinking water for both on-site and off-site private and public supply wells and, as such, has been designated a sole source aquifer system by the EPA. BNL uses approximately 2.13 million gallons per day of groundwater to meet site potable water needs and heating and cooling requirements. Approximately 74 percent of the water pumped from BNL supply wells is returned to the aquifer through on-site recharge basins. About 19 percent is discharged into the Peconic River. Human consumption, evaporation (cooling tower and wind losses), and sewer line losses account for the remaining 7 percent. An additional 2.74 million gallons of groundwater are pumped each day from remediation wells for treatment and then returned to the aquifer by way of recharge basins.

Groundwater flow direction across the BNL site is influenced by natural drainage systems moving eastward along the Peconic River, southeast toward the Forge River, and south toward the Carmans River (Figure 2-1). Pumping from on-site water supply wells also affects the direction and speed of groundwater flow, especially in the central, developed areas of the site. Two natural groundwater divides have been identified near BNL (Scorca *et al.* 1999). One divide is located approximately one-half mile north of BNL and a second divide transects portions of the site when the water table is high and the aquifer flows into the streambed of the Peconic River. These divides define the boundaries of the area contributing groundwater to the Peconic watershed.

In most areas at BNL, the horizontal velocity of groundwater is approximately 0.75 to 1.2 feet per day (Geraghty and Miller 1996). In general terms, this means that it takes approximately 20 to 22 years for groundwater to travel from the central, developed area of the site to the BNL southern boundary.

Figure 2-1. Groundwater Flow Map.

2.5 METEOROLOGICAL DATA

The BNL Meteorological Group has been collecting meteorological data on site since 1949. The meteorology of the BNL site can be characterized, like most eastern seaboard areas, as a well-ventilated site. Wind direction, precipitation, and temperature are measured daily and recorded as historic data.

The prevailing ground level winds at BNL are from the southwest during the summer, from the northwest during the winter, and equally from these two directions during the spring and fall. Figure 2-2 shows the 2001 annual wind rose for BNL, which depicts the annual frequency distribution of wind speed and direction, measured at an on site meteorology tower at heights of 33 and 300 feet.

Explanation: The arrows formed by the wedges indicate wind direction. Each concentric circle represents a 5% frequency, that is, how often the wind is coming from that direction. The wind direction was measured at heights of 33 and 300 feet (10 and 90 meters). For example, this diagram indicates that the predominant wind direction at 33 feet (10 meters) was from the south-southwest.

Figure 2-2. Annual Wind Rose (2001).

The BNL site receives an average of 48.4 inches of precipitation annually. The annual average temperature on site is 50 degrees Fahrenheit and has been steadily increasing over the past 53 years, rising approximately 2.05 degrees Fahrenheit as compared with a worldwide average increase of 0.5 degrees Fahrenheit. Figures 2-3 and 2-4 show the annual precipitation and mean temperature trends over the past 53 years.

Figure 2-3. Annual Precipitation Trend (53 Years).

Figure 2-4. Annual Mean Temperature Trend (53 Years).

2.6 ECOLOGICAL RESOURCES

BNL is located in the oak/chestnut forest region of the Coastal Plain. BNL property constitutes about 5 percent of the 100,000-acre New York State designated region known as the Central Pine Barrens. As noted before, because of the general topography and porous soil, the land is very well drained and generally there is little surface runoff or open standing water. However, depressions form small pocket wetlands with standing water on a seasonal basis (vernal pools), and there are six significant, regulated wetlands on site. Thus, a mosaic of wet and dry areas on the site correlates with variations in topography and depth to the water table. Vegetation on site is in various stages of succession, which reflects a history of disturbances to the area. Current operations minimize disturbances to the more natural areas of the site.

More than 230 plant species have been identified on site, including one New York State-threatened plant, the stiff goldenrod (*Solidago rigida*). The 15 mammal species on site include species common to mixed hardwood forests and open grassland habitats. At least 85 species of birds are known to nest at BNL, and an additional 130 species have been documented as “visiting” the site. These numbers are a result of BNL’s location within the Atlantic Flyway and the scrub/shrub habitats that offer food and rest to migratory songbirds. Open fields bordered by hardwood forests at the employee recreation complex are excellent hunting areas for hawks. Permanently flooded retention basins and other watercourses support amphibians and aquatic reptiles. Nine amphibian and ten reptile species have been identified, as well as nine species of fish. Ecological studies at the BNL site have confirmed 15 breeding sites for the New York State endangered eastern tiger salamander (*Ambystoma t. tigrinum*) in vernal pools and some recharge basins. The New York State Department of Environmental Conservation (NYSDEC) listed the banded sunfish (*Etheostoma caeruleum*) as a state threatened species in 1999. It lives solely within the Peconic River system, including backwater areas of the river on site (Scheibel 1990). In 2000, the New York State-threatened swamp darter (*Etheostoma fusiforme*) was positively identified on site in one of the larger ponds associated with the Peconic River. A state threatened insect, the frosted elfin butterfly (*Callophrys irus*), was also added to BNL’s list of protected species due to the potential that the appropriate habitat exists at the Laboratory. Further studies of this small butterfly are planned. Other wildlife species of interest that inhabit the site include the wild turkey, red fox, eastern box turtle, and the red-tailed hawk.

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3 EMISSION/EFFLUENT SOURCES AND PATHWAYS

3.1 INTRODUCTION

BNL estimates potential exposures that could be received by humans and terrestrial and aquatic biota from radioactive and chemical substances through various pathways. To predict these exposures, the character of the pollutant emitted (e.g., identity, amount, rate of release, chemical form, etc.), as well as an understanding of how the pollutants are subsequently absorbed, retained, and passed along by the various possible exposure pathways, must be researched. Sources of radioactive and chemical emissions and effluents from BNL facilities are described below, as well as a general description of the primary exposure pathways to members of the public.

3.2 PATHWAYS

Chemicals and radionuclides released into the environment can move through the biosphere by a number of routes and could eventually lead to exposure of animals, vegetation, and possibly humans. These routes can be direct, as in the inhalation of contaminated air or ingestion of contaminated drinking water; or indirect, involving many complex levels of the food chain and different transport mechanisms.

Exposure is defined as the interaction of an organism with a physical or chemical agent of interest. An exposure pathway is identified based on:

- An examination of the type, location, and source (contaminated soil, raw effluent, etc.) of contaminants
- Principal release mechanisms
- Probable environmental fate and transport (including persistence, partitioning, and intermediate transfer) of contaminants of interest
- Location and activities of the potentially exposed populations

Mechanisms that influence the fate and transport of chemical and radiological contaminants through the environment and also influence the amount of exposure a person might receive at various receptor locations are listed below. While processes that move contaminants through the atmosphere and hydrosphere tend to reduce their concentrations, many pathway components or processes that move contaminants through the food chain to humans can cause bioaccumulation. Once a radionuclide or chemical is released into the environment, it may be:

- *Transported* (e.g., migrate downstream in solution or on suspended sediment, travel through the atmosphere, or be carried off site in contaminated wildlife)
- *Physically or chemically transformed* (e.g., deposition, precipitation, volatilization, photolysis, oxidation, reduction, hydrolysis, or radionuclide decay) *Biologically transformed* (e.g., biodegradation)
- *Accumulated in the receiving media* (e.g., absorbed strongly in the soil column, stored in organism tissues)

The primary pathways for movement of radioactive materials and chemicals from the BNL site to the public are the atmosphere and surface water. Figure 3-1 illustrates the potential routes and

exposure pathways to humans. The significance of each pathway is determined by comparing measurements and calculations that estimate the amount of radioactive material or chemical transported along each pathway with the concentrations or potential doses to environmental and public health protection standards or guides. Pathways are also evaluated based on prior studies and observations of radionuclide and chemical movement through the environment and food chains. Calculations based on effluent and emission data show the expected concentrations beyond the BNL site to be low for all BNL-produced radionuclides and most chemicals. Frequently, concentrations are below the level that can be accurately detected by monitoring technology. To ensure that radiological and chemical analyses of samples are sufficiently sensitive, minimum detection limits of key radionuclides and chemicals have been established at levels well below applicable health standards.

Figure 3-1. Primary Exposure Pathways to Humans.

3.3 SOURCES

3.3.1 Airborne Emissions - Radioactive

Several BNL facilities conduct research activities involving the use of radioisotopes or create radioactive material as part of their normal operations. Facilities with emissions that have the potential to deliver a radiation dose to a member of the public of greater than 0.1 millirem per year (mrem/yr) must be continuously monitored in accordance with the NESHAP requirements of the CAA (40 CFR 61, Subpart H). The facilities that fall below NESHAP levels require only periodic, confirmatory monitoring. Figure 3-2 indicates the location of each of the monitored facilities on the BNL site.

Figure 3-2. Potential Air Emission Release Points.

In the past five years, there have been significant decreases in the types and quantities of radiological emissions from BNL operations. One former source, the Evaporator Facility, has not operated since 2000 (see Section 3.3.1.4). Also, after the discovery of tritium in groundwater near the High Flux Beam Reactor (HFBR) in 1997, the HFBR was permanently shut down in 1999. The BMRR was permanently shut down in the year 2000, as an indirect consequence of the HFBR. (Costs associated with BMRR operation and management were economically unjustified.) Consequently, current emissions from these facilities are a small fraction of their previous levels. Emissions from these facilities will continue to decrease as they are officially decommissioned.

With the reactors shut down, the most significant sources of radionuclide emissions are the BLIP and its associated facility, the Target Processing Laboratory. Of these, the BLIP typically contributes the largest fraction (99 percent or more) of the total annual Effective Dose Equivalent (EDE) to the Maximally Exposed Individual (MEI) residing at the BNL site boundary. The primary radionuclide releases from BNL operations are carbon-11, oxygen-15, and tritium. Table 3-1 presents the airborne radionuclide releases from monitored facilities in calendar year (CY) 2001.

Other facilities that have the potential for radiological emissions are associated with accelerator operations, such as the AGS, the AGS Booster, the 200 MeV Linac Accelerator, and associated experimental facilities. Emissions from these facilities are extremely low and are insignificant contributors to off-site dose. The other potential source of airborne radionuclide emissions is laboratory hoods where work with dispersible radionuclides is performed. Small quantities of radioactive materials are typically used in these hoods, usually on the order of millicuries to microcuries. Compliance of these sources with NESHAP regulations is demonstrated annually through the use of an inventory system, as allowed under Appendix D of the NESHAP regulations. Environmental surveillance air monitoring conducted at the site boundaries also provides independent verification that off-normal emissions from these sources have not occurred.

New facilities or planned activities that will generate environmental releases of airborne radionuclides are reviewed for NESHAP compliance for any potential environmental impact. This review serves to document the details of the operation generating the release, the source terms involved, proposed effluent control equipment, and the calculated dose impact from the release. This evaluation is also used to assess the need for modifications to the environmental monitoring program.

Facility	Nuclide	Half-life	Ci Released
BMRR	Argon-41	1.8 hours	None
HFBR	Tritium	12.3 years	1.93E+00
BLIP	Carbon-11	20.4 minutes	1.41E+03
	Germanium-69	1.6 days	9.20E-05
	Oxygen-15	122 seconds	4.27E+03
	Rubidium-86	18.7 days	4.99E-05
	Tritium	12.3 years	1.80E-01
Evaporator Facility			None
Target Processing Laboratory	Arsenic-74	17.8 days	1.85E-06
	Bromine-77	56 hours	6.94E-05
	Cesium-137	30 years	6.19E-07
	Rubidium-86	18.7 days	2.78E-05
	Selenium-75	119.8 days	9.77E-09
	Thallium-202	12.2 days	6.37E-07
	Tin-113	115.1 days	3.59E-05
	Zirconium-88	83.4 days	8.63E-07
Total			5.682E+03

Table 3-1. Monitored Air Emission Point Releases.

The following sections briefly describe the primary sources of radioactive air emissions from BNL operations.

3.3.1.1 Brookhaven Medical Research Reactor (BMRR)

While in operation, the BMRR was fueled with enriched uranium, moderated and cooled by water, and operated intermittently at power levels up to 3 megawatts (MW) (thermal). Air from the interior of the containment building was used to cool the neutron reflector surrounding the core of the BMRR reactor vessel. When air was drawn through the reflector, it was exposed to a neutron field that reacted with the argon component of the air, activating it or making it radioactive. This radioactive form is argon-41, a chemically inert gas with a short half-life of 1.8 hours ($t_{1/2} = 1.8$ hours). After passage through the reflector, the air was routed through a roughing filter and a high efficiency particulate air (HEPA) filter to remove any particulate matter, and finally, through a charcoal filter for the removal of radioiodines produced by the fissioning of the uranium fuel.

Following the filter bank, the air was exhausted to a 150-foot stack adjacent to the reactor containment building. As previously described, the BMRR was permanently shut down in December 2000. Since the BMRR is no longer operating, the frequency of monitoring was reduced from continuous to semi-annual. Sampling in calendar years 2001 and 2002 showed no air emissions at zero power level with the building ventilation on and the BMRR core unchanged. Real-time monitoring was used to track argon-41 air emissions and passive filter media were used to collect and quantify radioiodines and particulate emissions. The monitoring results for the year showed there were no quantifiable emissions of argon-41 or any other radionuclides. The facility still contains fuel, which is scheduled for removal in 2003.

3.3.1.2 High Flux Beam Reactor (HFBR)

During operations, the HFBR was a small research reactor capable of operating at power levels ranging from 30 to 60 MW. Heavy water was used to cool the reactor fuel and to moderate the neutrons used in the fission process. (Heavy water, or D₂O, is water that is composed of a nonradioactive isotope of hydrogen known as deuterium.) Heavy water flowing in the reactor core was exposed to a dense neutron field that activated the deuterium atoms in the water to produce tritium, which is the heaviest and only radioactive isotope of hydrogen ($t_{1/2} = 12.3$ years). The rate at which the tritium concentration built up in the primary cooling water depended on the reactor power level and the amount of time elapsed since the last reactor shutdown or coolant change out. This, in turn, determined the amount of tritium that may have eventually been released as an airborne emission. The primary mechanism by which tritium was transferred from the interior coolant system to the building atmosphere was depressurization of the reactor vessel and evaporative losses during maintenance and refueling operations. Diffusion of the tritium at valve seals and other fittings also occurred. Tritiated water vapor (abbreviated "HTO") was thus released from reactor systems to the building air, where it was routed to the facility's 320-foot stack. In 2001, much of the heavy water was removed from the HFBR vessel and replaced with light (tap) water. However, high concentrations of tritium in the residual heavy water yielded elevated levels in the light water; consequently, tritium is still released from the HFBR vessel due to vapor leakage.

3.3.1.3 Brookhaven Linac Isotope Producer (BLIP)

Protons produced in the LINAC are sent via an underground beam tunnel to the BLIP, where they strike various metal targets. These metals, which become activated by the proton beam, are then transferred to the Building 801 Target Processing Laboratory (see section 3.3.1.5) for later use in radiopharmaceutical production. At the BLIP, the targets are cooled by a continuously recirculating water system. During irradiation, several radioisotopes are produced in the cooling water. The most significant of these are gaseous oxygen-15 and carbon-11; radionuclides with short half-lives of 2 and 20 minutes, respectively. These isotopes are released as airborne emissions. Other radionuclides, such as tritium are released in much smaller quantities. These values are reported annually in the Site Environmental Report.

The emissions of carbon-11 were not characterized until 2001. A mathematical error was discovered in previously reported emissions and a re characterization effort was initiated to validate the BLIP emissions. During this activity, an in-line sampling/analysis system was installed and samples were counted on the in-line detector during BLIP operations. The analysis time was extended to ensure that the full decay curve could be reviewed. Carbon-11 was confirmed as a major component of the airborne emissions and determined to be the most significant contributor to off-site radiological dose from BNL operations. The dose associated with the BLIP facility for 2001 was conservatively calculated to be 0.137 mrem.

3.3.1.4 Evaporator Facility

The Evaporator Facility (Building 802B) was constructed to reduce the total amount of tritiated water released to the Peconic River from BNL operations through the Sewage Treatment Plant (STP). The Evaporator Facility began processing wastewater in 1995. Aqueous waste generated on site that contained residual radioactive material was processed at the Waste Concentration Facility (WCF), Building 811. At the WCF, suspended solids and a high percentage of the radionuclides were removed from the liquid using a reverse osmosis process. However, because of tritium's chemical properties, it was not removed during this process. The tritiated water that remained following waste concentration was delivered to the Evaporator Facility, where it was converted to steam and released as an airborne emission. The emission was directed to the same stack used for exhausting building air from the HFBR. This method is preferable to release via surface water because there is virtually no potential to influence groundwater (the primary drinking water source on Long Island), and the potential for this tritium to contribute to an off-site dose is minimized by atmospheric dispersion. In calendar years 2001 and 2002, due to the reduced costs of off-site disposal, no liquid waste was processed at the WCF. As a result, the Evaporator Facility was not used, and there were no emissions of tritiated water vapor.

3.3.1.5 Building 801 Target Processing Laboratory

Metal targets that have been irradiated at the BLIP facility are transported to the Building 80 I Target Processing Laboratory where the useful isotopes are chemically extracted. Airborne radionuclides released during the extraction process are drawn through multistage HEP A and charcoal filters and then vented to the HFBR stack through an underground system of duct work (see Table 3-1 for isotopes and quantities).

3.3.1.6 Linear Accelerator (Linac)

The LINAC produces beams of polarized protons of energies up to 200 Me V for use at both the AGS and BLIP facilities. Due to the composition of the beam and the energies involved, production of airborne radionuclides through air activation and/or spallation interactions is possible. The most significant production point of airborne radionuclides inside the tunnel occurs where the beam crosses an air gap as it enters the BLIP vacuum system. These radioactive products are available for atmospheric release via the tunnel ventilation exhaust stack, located adjacent to the BLIP building. However, the exhaust fan has been turned off and the potential for emissions is minimal.

3.3.1.7 Alternating Gradient Synchrotron (AGS) Cooling Tower #2

Magnets used to steer the AGS particle beam experience significant heating and are cooled via a recirculating, non-contact water loop. Under certain conditions (such as high-energy proton operations), low concentrations of radioactive elements may be produced in the cooling water when it circulates in the vicinity of the beam line. Radioisotopes that exist as gases may be liberated from the water when exposed to air during circulation in the outdoor cooling tower, resulting in an airborne emission. The radionuclides that are likely to be released via this mechanism include oxygen-14 ($t_{1/2} = 1.2$ minutes), oxygen-15 ($t_{1/2} = 2.1$ minutes), nitrogen-13 ($t_{1/2} = 10$ minutes), and carbon-11 ($t_{1/2} = 20$ minutes). Tritium is also present and may be emitted from the tower as water vapor in microcurie quantities per year. Modeling using EPA CAP88-PC software indicates that the typical annual dose to the Maximally Exposed Individual from this source is approximately 0.00002 mrem. Note that this cooling tower is only an airborne radionuclide emission source during those times when the AGS C-line is in use. Cooling Tower #2 does not service any other beam lines.

3.3.1.8 Additional Minor Sources

There are several research organizations within BNL that conduct work involving very small quantities of radioactive materials (in the microcurie to millicurie range). The radioactive material is typically used within fume hoods designated for this purpose and equipped with HEP A filters. Operations such as transferring material between containers, pipetting, and chemical compound labeling, are typical of the work conducted with these sources. Due to the use of HEP A filters, the nature of the work conducted, and the small quantities involved, these operations have a very low potential for atmospheric release of any environmentally significant quantity of radioactive material. Facilities characterized as minor sources include Buildings 463 (Biology), 555 (Chemistry), 490 (Medical Research Center), 490A (Environmental Sciences Department), 703W (Energy, Environmental & National Security), and 830 (Environmental Research and Technology Division).

3.3.2 Airborne Emissions-Nonradioactive

Several state and federal regulations covering nonradioactive airborne releases require facilities to conduct periodic or continuous emissions monitoring in order to demonstrate compliance with emission limits. BNL has several nonradiological emission sources subject to state and/or federal regulatory requirements, but the only BNL facility that is required to perform nonradioactive emissions monitoring is the CSF. The CSF supplies steam for heating and cooling to all major facilities on site through an underground steam distribution and condensate grid. The location of the CSF is shown in Figure 3-2. The combustion units at the CSF emit oxides of nitrogen, sulfur dioxide, oxides of carbon, and particulate matter.

3.3.3 Liquid Effluents

BNL 's SPDES permit provides the basis for regulating wastewater effluents at BNL. The SPDES permit establishes release concentration limits and dictates monitoring requirements. The BNL SPDES permit was issued in 1995, renewed in 2000, and modified in 2002. This permit stipulates monitoring requirements and lists effluent limits for the following outfalls:

- Outfall 001 is the discharge of treated effluent from the BNL STP to the Peconic River.
- Outfalls 002-006, 008, 010, 011, and 012 are recharge basins or ground surface discharges used for the discharge of cooling tower blowdown, once-through cooling water, and storm water. The SPDES permit does not require effluent monitoring at Outfalls 003, 011, and 012.
- Outfall 007 is backwash water from the potable Water Treatment Plant (WTP) filter building.

Note: Outfall 009 consists of numerous subsurface and surface wastewater disposal systems that receive predominantly sanitary waste, and steam and air compressor discharges. The **SPDES** permit does not require effluent monitoring of Outfall 009.

3.3.3.1 BNL Sewage Treatment Plant Outfall 001

Sanitary and process wastewaters generated by Laboratory operations are conveyed to the BNL STP for subsequent treatment prior to discharge to the Peconic River. In 1997, the STP underwent significant construction modifications and was upgraded from a primary plant (i.e., separation of settleable solids and floatables) to a tertiary treatment system (i.e., biological reduction of organic matter and reduction of nitrogen). This treatment process became fully functional in 1998. In 2000, additional changes to the plant and sewage system were initiated. These changes included replacing or lining the sewage collection system and replacing the former anaerobic digester with an aerobic digester. These modifications were completed in early 2002. The STP has a design capacity of 3.0 million gallons per day and receives sanitary and certain process wastewaters from BNL facilities for treatment prior to discharge into the Peconic River.

3.3.3.2 BNL Recharge Basins and Stormwater Outfalls 002-008, 010, 011, and 012

Figure 3-3 on the following page depicts the locations of BNL's recharge basins and storm water outfalls.

- Recharge Basins HN (Outfall 002) and HT (Outfall 006) receive once-through cooling water discharges generated at the AGS, as well as cooling tower blowdown and stormwater runoff.
- Recharge Basin HS (Outfall 005) receives predominantly stormwater runoff, once-through cooling water from Building 555, and minimal cooling tower blowdown from the National Synchrotron Light Source (NSLS).
- Basin HX (Outfall 007) receives WTP filter backwash water. Basin HP (Outfall 004) received once-through cooling water from the BMRR. This discharge ceased with the shutdown of the BMRR in 2000.
- Recharge Basin HO (Outfall 003) receives cooling water and cooling tower discharges from the AGS and formerly from the HFBR, as well as stormwater runoff. Discharges from the AGS consist of once-through domestic water used to cool the main magnet heat exchanger located in Building 911.
- In addition, several other recharge areas are used exclusively for discharging stormwater runoff. These include Basin HW (Outfall 008), the CSF storm water outlet (Outfall 010), Outfall 011 located within the Former Hazardous Waste Management Facility, and Basin HZ (Outfall 012), a new recharge basin constructed in 2002.

3.3.3.3 Assessments of Process-Specific Wastewater

Wastewater that may potentially contain constituents above SPDES permit limits or groundwater discharge standards is held and characterized to determine the appropriate means of disposal. The analytical results are compared with the appropriate limit and the wastewater is released only if the discharge would not jeopardize the quality of the effluent.

Examples of process-specific wastewater requiring routine characterization are discharges from photographic developing in Building 197B (Graphic Arts), printed circuit board fabrication in Building 535B (Instrumentation Division), metal cleaning operations in Building 498 (Central Cleaning Facility), cooling tower discharges from Building 902 (Superconducting Magnet Division), and miscellaneous satellite boiler blowdown. These operations are potential sources of contaminants such as inorganic elements (i.e., metals and cyanide), and volatile and semivolatile organic compounds.

Process wastewaters that are not routinely monitored under the SPDES permit are held for characterization before release to the sewer system. Wastewaters routinely evaluated are releases from primary, closed-loop cooling water systems and water collected in berms that provide

secondary containment for tanks and other industrial wastewaters. To determine the appropriate disposal method, samples are analyzed for contaminants specific to the process.

In all instances, any waste that contains hazardous levels of contaminants or elevated radiological contamination is sent to the waste management program for disposal.

Figure 3.3. BNL Outfall Map With H Locations.

3.4 ENVIRONMENTAL RESTORATION (ER) PROGRAM MONITORING

In 1980, the U.S. Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund) to ensure that sites with historical contamination were cleaned up and to hold the responsible party liable for the cleanup. CERCLA established the National Priorities List (also known as the NPL). The NPL is a list of sites nationwide where cleanup of past contamination is required. In November 1989, BNL was included as one of a number of sites on the NPL located on Long Island. Much of the contamination at BNL is due to past practices for handling, storing, and disposing of chemical and radiological materials, as well as to accidental spills.

Since BNL's ER program was established in 1991, ER program staff have been characterizing and removing sources of contamination (e.g., underground tanks and pools) or treating the groundwater and soil contamination resulting from past BNL practices. The ER program staff used historical facility records and sampling to determine where contamination might be present on the site today, and these areas were geographically grouped into GUs. ER groundwater cleanup efforts have included monitoring existing groundwater wells, overseeing the installation of new, permanent groundwater monitoring wells, installing groundwater treatment systems, and extending public water service off site to replace the use of potable supply wells. Soil cleanup efforts have identified contaminated soils through sampling and resulted in various programs involving soil removal and treatment. Several landfills have been capped and 55 waste pits have been excavated.

Many remediation techniques can result in temporary increases in contaminant effluents or emissions and therefore require monitoring to minimize the potential impacts. The BNL Environmental Monitoring Program supports restoration activities by selecting monitoring locations and determining what media samples will best assist the ER staff to evaluate the impact of restoration activities on the environment and public health.

REFERENCES

40 CFR 61, Subpart H. 1999. U.S. Environmental Protection Agency. "National Emissions Standards for Hazardous Air Pollutants, Subpart H, National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities. *"U.S. Code of Federal Regulations* .

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4 QUALITY ASSURANCE

4.1 INTRODUCTION

Responsibility for quality assurance (QA) at BNL starts with the director and extends down through the entire organization. The BNL quality management system coordinates and evaluates QA implementation at BNL and implements quality management methodology throughout the various BNL management systems and associated processes to:

- Plan and perform BNL operations in a safe, reliable, and effective manner to minimize the impact on the environment and public health
- Standardize processes and support continual improvement in all aspects of BNL operations
- Enable the delivery of products and services that meet or exceed stakeholder expectations
- Generate representative and defensible data to achieve regulatory compliance

For environmental monitoring, QA is defined as an integrated system of management activities that include planning, implementation, control, reporting, assessment, and continual improvement. Quality control activities measure each process or service against the QA standards. BNL has an Environmental Monitoring Quality Assurance Program (QAP) in place to ensure that analytical results are representative and defensible and that the data are of the type and quality needed to verify protection of the Laboratory and environment, as well as BNL employees and the public. The BNL QAP complies with requirements in DOE Orders 414.1A (1999), *Quality Assurance*, and 5400.1 (1988), *General Environmental Protection Program*.

4.2 ENVIRONMENTAL MONITORING QAP

BNL's environmental QA practices and procedures are documented in manuals and SOPs, and govern sample collection, radiation measurements, chain-of-custody requirements, and analytical chemistry standards. Environmental samples are analyzed by the on-site Analytical Services Laboratory (ASL) and through contracts with four off-site laboratories. General Engineering Lab (GEL) and Severn-Trent Lab (STL) perform radiological and nonradiological analyses. H2M and Chemtex Labs perform nonradiological analyses. All five laboratories are New York State-certified for specific parameters and are periodically audited to ensure that quality standards are maintained. The labs are required to incorporate QA guidelines into their operations when performing work for BNL. Routine quality control procedures followed by the ASL include daily instrument calibrations, efficiency and background checks, and standard tests for precision and accuracy. These procedures are documented in the *ASL Quality Assurance Project Plan (QAPP)* (BNL 1999a). The ASL, GEL, and STL participate in several national and state performance evaluation (PE) testing programs. (Chemtex performs analyses that are not currently represented in PE test programs.) Results of the PE tests provide information on the quality of a laboratory's results and allow comparisons to be made between labs.

BNL has established a program of internal and external audits to verify the effectiveness of the environmental sampling, analysis, and database activities. Contractor laboratories are subject to audits by BNL personnel, and the ASL is subject to audits by the NYSDOH.

4.3 SPECIFIC GROUNDWATER AND AIR MONITORING QA

The BNL groundwater-monitoring program, “QAPP” (BNL 1999b), describes the QA program and Quality Control (QC) requirements followed for monitoring groundwater quality. The plan defines the project organizational structure, documentation requirements, sample custody requirements, acceptance criteria, auditing functions, corrective action provisions, and guidance on the collection of QA/QC samples. The QAPP was developed using guidance provided in the document EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (EPA 1998). The QAPP for radiological air emissions (2002) was developed and implemented to provide direction for collecting air samples in accordance with the ANSI/HPS N13.1-1999 standard and, where applicable, (ANSI 1999), *Sampling and Monitoring Release of Airborne Radioactive Substance from the Stacks and Ducts of Nuclear Facilities*.

4.4 DATA QUALITY OBJECTIVES (DQOs)

The DQOs included in the 2003 update of the *Environmental Monitoring Plan* were set up using the DQO process, a seven-step planning approach to develop sampling designs for data collection activities that support decision making. This process uses systematic planning and statistical hypothesis testing to differentiate between two or more clearly defined alternatives. The DQO process provides the following benefits:

- Promotes understanding of the real purpose of collecting data (i.e., why the data is needed and what questions the data may help answer)
- Provides a convenient way to document activities and decisions
- Facilitates rapid review and approval by regulators and stakeholders
- Fosters communication between interested parties
- Promotes most efficient use of limited resources
- Outlines methods of assessing performance and states the consequences of decision errors

4.5 SAMPLE COLLECTION

Trained technicians follow procedures outlined in SOPs, which are developed using information in the media-specific DQOs. Technicians use bound logbooks and media-specific log sheets to document sample collection. Chain-of-custody procedures are followed to ensure that each sample is properly handled and controlled.

4.6 DATA MANAGEMENT

Each environmental sample collected is identified with a unique number and accompanied by a Chain-of-Custody form. The sampling data are reported in electronic and hard copy formats. All electronic data are maintained in the BNL Environmental Information Management System (EIMS). The EIMS consists of an environmental data management system platform that is linked with a geographic information system (GIS). Analytical data in the EIMS can be retrieved and evaluated using custom applications, and paper records are filed for future reference.

The EIMS became the sole repository of all environmental data in 2002. Previously, the EIMS held environmental data collected only from ER activities. All data from compliance and environmental surveillance performed by ESD were housed in the environmental database shared with the BNL ASL. The ESD data held in that database from 1995 to 2002 were transferred to EIMS to facilitate its use as the sole repository. This transfer involved changing the identification scheme for sampling locations. Appendix C provides a cross walk between the sampling location

identifications used between 1995 and 2002 and those which will be used from this point on. It also details the framework for assigning identification codes to newly designated sampling locations.

4.7 ELECTRONIC DATA QUALITY ASSURANCE

Data quality assurance steps are detailed in the EIMS Data Management Description (<http://eimsdev.oer.bnl.gov/DMD/>) and in applicable SOPs. When entering data into the EIMS, completeness checks are automatically performed to ensure that all analyses are provided for all samples; that required data fields are not empty; and that certain fields contain only predefined legal values or formats. For analytical results from the groundwater monitoring program, outlier values are automatically flagged and project managers are notified in order to expedite evaluation of these data. Plans have been discussed to extend this capability to other monitoring programs in the future. Presently, for all other programs, the subject matter experts (SMEs) periodically review the data to ensure that concentrations are within typical levels.

4.8 DATA VALIDATION

For in-house analyses, SOPs have been established for calibrating instruments, analyzing samples, and checking quality control. QC checks performed include analysis of blanks or background concentrations, use of Amersham or National Institute for Standards and Technology (NIST) traceable standards, and analysis of reference standards, spiked samples, and duplicate samples. The laboratory supervisor or QA officer reviews all analytical and quality control results before the data are reported and incorporated into the EIMS database. Data packages received from contractor laboratories are reviewed at BNL by SMEs in either radiological analyses or analytical chemistry to ensure compliance with contract specifications. In addition, the data packages are examined to ensure that samples do not exceed holding times, that there are no poor recoveries, that proper sampling method was used, and that field blanks were less than the Minimum Detection Limits (MDL). Nonradiological data analyzed off site are verified and validated using EPA contract laboratory protocol (EPA 1990, 1996). Radiological packages are verified and validated using both BNL and DOE guidance documents (BNL 1997, DOE 1994, DOE 1977).

4.9 DATA QUALITY ASSESSMENT

EPA defines data quality assessment as “the scientific and statistical evaluation of data to determine if data obtained from environmental data operations are of the right type, quality, and quantity to support their intended use” (EPA 1996). The respective SME reviews each set of data provided by an analytical laboratory after data validation and then compares the results to historical results, duplicate samples, and control samples. The quality system diagram on the following page shows that the process, which consists of three stages: planning, implementation, and assessment. The planning stage can be divided into the DQO process, the sampling design, and the QA plans associated with the program. The implementation stage entails the actual collection of samples and analysis in accordance with the SOPs and quality control guidelines. The final stage is data quality assessment. This stage includes data verification and validation, and review of the decision-making process to ensure that effluents, emissions, and receptor data are adequate to assess impacts to the environmental health of the BNL environment. The outcome of the quality process are defensible products and decisions.

Figure 4-1. Data Quality Flowchart.

REFERENCES

- ANSI /HPS N13.1-1999 standard (ANSI 1999), Sampling and Monitoring Release of Airborne Radioactive Substance from the Stacks and Ducts of Nuclear Facilities.
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5 AIR EMISSIONS SOURCE

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AMBIENT AIR QUALITY

DATE 10-29-02

SUMMARY OF PROPOSED CHANGES

Reassess potential impacts of lab hood chloroform emissions using more refined DAR-1 computer-based dispersion model. Confirmatory samples of lab hood emissions may be required to verify estimated emissions rates.

DESCRIPTION AND TECHNICAL BASIS

Airborne emissions are routinely generated as a result of Brookhaven National Laboratory's operations and research activities. These emissions are released to the atmosphere either through a dedicated exhaust system designed to protect workers and building occupants from inhalation exposure to irritants or potentially toxic compounds, or via a building's general ventilation system when emissions from an operation do not present potential health impacts to workers. Airborne emissions may be released as particles, fumes, or gases.

The United States Environmental Protection Agency has previously delegated authority to the New York State Department of Environmental Conservation (NYSDEC) to issue permits in accordance with Part 201 of Title 6 of the New York State Code of Rules and Regulations, for the construction or modification of any stationary source subject to the federal requirements of prevention of significant deterioration (PSD), and for many sources subject to New Source Performance Standards (NSPS) or National Emissions Standards for Hazardous Air Pollutants (NESHAPS). These permits are issued only after NYSDEC is assured from information provided with applicant permit applications that the operation or activity will be operated in compliance with all applicable regulatory requirements, and that emissions from new or modified sources will not adversely impact the ambient air quality or place members of the public at undue risk of inhalation exposure from pollutants of varying levels of toxicity.

The final condition of the Title V Facility permit issued to BNL in January 2002 states that "No person shall cause or allow emissions of air contaminants to the outdoor atmosphere of such quantity, characteristic or duration which are injurious to human, plant or animal life or to property, or which unreasonably interfere with the comfortable enjoyment of life or property. Notwithstanding the existence of specific air quality standards or emissions limits, this prohibition applies, but is not limited to, any particulate, fume, gas, mist, odor, smoke, vapor, pollen, toxic or deleterious emission, either alone or in combination with others." This condition and regulatory requirement (6 NYCRR 211.2) is a facility-wide condition that applies not only to operations and activities that release emissions to the atmosphere and are authorized under the Title V Facility permit issued by NYSDEC, but also to operations and activities that are exempt from New York State permitting requirements.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

- ☒ Compliance
- ☐ Support compliance
- ☐ Surveillance
- ☐ Restoration

The Clean Air Act and Clean Air Act Amendments of 1990 establish a national permitting program for facilities that are considered to be major sources of criteria and/or hazardous air pollutants, specifies emissions standards and monitoring requirements applicable to various industrial source categories that are significant contributors of criteria pollutants, establishes emissions standards applicable to industrial categories which are significant contributors of 189 identified hazardous air pollutants, and seeks to maintain and improve air quality throughout the nation. Many of the statutory requirements of the CAA and the 1990 Amendments aimed at maintaining or improving air quality were promulgated into regulations administered by NYSDEC under Parts 200 – 257 of the New York State Code of Rules and Regulations.

In their evaluations of new applications for permits to operate emissions sources, NYSDEC uses a guidance document called the DAR-1, *Guidelines for the Control of Toxic Ambient Air Contaminants*, to evaluate the potential impact to the public of pollutants released into the atmosphere from a process and to determine whether existing or proposed pollution control devices and administrative controls for the process are sufficient to protect the public from adverse impacts from the source's emissions. Using these guidelines, emissions source-specific information (such as exhaust system stack height and diameter, stack exit velocity, building height) and source-specific potential and actual emissions information are plugged into a conservative dispersion screening model developed by the NYSDEC Division of Air Resources. The model calculates average ambient annual and average short-term concentrations of a compound that would be expected at receptors downwind of the emissions source for the meteorological conditions built into the model. These concentrations are then compared to annual guideline concentrations (AGCs) and short-term concentrations (SGCs) that have been established by the New York State Department of Health based on available toxicology data on the health risks to humans for that compound. To demonstrate compliance with the aforementioned Title V Facility permit condition, the potential impacts for all proposed emissions sources at BNL that have the potential to release toxic compounds are evaluated using the DAR-1 model.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Laboratory operations that release emissions have the potential to impact ambient air quality, the environment, and members of the public if the emissions are not properly controlled at the point where they are generated. Facility-wide procedures are in place requiring owners or operators of new emissions sources to assemble qualitative and quantitative information about potential emissions from the source, along with information about the exhaust system and emissions control devices. This information must then be reviewed to determine whether adequate

engineering and administrative controls are in place to ensure that the environment and members of the public are not adversely impacted by potential emissions from the source.

Step 2: Identify the Decision

The desired decisions for the review of BNL operations with potential emissions of toxic compounds are:

- Have all potential sources of toxic compound emissions been identified and their potential impacts been evaluated?
- Do the DAR-1 assessed impacts of a source's potential emissions show maximum potential concentrations of toxic compounds at downwind receptor locations to be less than corresponding AGCs?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 include:

- Completed Emissions Source Inventory or Emissions Source Modification forms with supporting information on compounds released (i.e., estimated quantities, MSDS, etc.)
- Exhaust system parameters including stack height, building height, and exit velocity, stack exit temperature
- Pollutant emissions rates
- EPA AP-42 emissions factors
- Meteorological data
- Pollution control device efficiencies
- AGC and SGC limits / emissions limits
- NYSDEC DAR-1 Guidelines for the Control of Toxic Ambient Air Contaminants
- Chemical Management System queries and reports on chemical use

Step 4: Define the Study Boundaries

To calculate worst-case impacts to compare with AGC and SGC limits, the DAR-1 model requires estimates of maximum hourly emissions rates (lbs/hr) and maximum annual emissions rates (lbs/yr) for all source pollutants. These estimates are made based on information from completed Emissions Source Inventory forms or Emissions Source Modification Forms provided by BNL personnel. The estimates can be based on material balance calculations, published emissions factors, emissions test results, emissions tests from geometrically similar emissions sources, equipment manufacturer guarantees, and best engineering judgment. Due to atmospheric

dispersion of the pollutants, the model may show that maximum impacts may occur beyond the Laboratory boundaries.

Step 5: Develop the Decision Rules

Decision 1

Have all potential sources of toxic compound emissions been identified and potential impacts of emissions been evaluated?

The SBMS Subject Area *Non-Radioactive Airborne Emissions* requires line personnel who are responsible for operations that generate nonradioactive emissions to complete and submit to the Environmental Services Division (ESD) forms for new emissions sources or existing sources that are being modified. These forms are reviewed to determine if new or modified sources are subject to NYS permit or other regulatory requirements. All new or modified emissions sources that emit toxic air contaminants are assessed using DAR-1, *Guidelines for the Control of Toxic Ambient Air Contaminants*, to ensure that the sources are equipped with the appropriate emissions control equipment and will not have an adverse impact on potential on- or off-site receptors. The SBMS *Environmental Evaluation of Industrial Processes* and *Experimental Research* subject areas also provide an opportunity, through the Process Assessment Procedure, for identifying potential sources of toxic emissions.

If there are potential sources of toxic compound emissions that have not been identified and evaluated for their potential impacts to the public and the environment, **then** periodic assessments of conformance to the Nonradiological Airborne Emissions subject area can be a means to identify additional sources for evaluation. Decisions should then be made as to whether the identified sources are subject to permitting requirements, and DAR-1 assessments of the potential impacts of the sources' emissions to members of the public and the environment be conducted.

Decision 2

Do the DAR-1 assessed impacts of a source's potential emissions show maximum potential concentrations of toxic compounds at downwind receptor locations to be less than corresponding AGCs?

If the calculated downwind receptor concentrations of the compounds emitted from a source are less than the respective AGCs and SGCs, **then** no additional control devices are suggested and the impacts from potential impacts of the source emissions are considered acceptable.

If the calculated downwind receptor concentrations of one or more compounds emitted from a source or from multiple sources having similar emissions exceed the respective AGCs or SGCs, **then** additional modeling of potential impacts with a less conservative NYSDEC computer model that utilizes regional or on-site meteorological data must be performed.

If the more refined NYSDEC model shows calculated downwind receptor concentrations of one or more compounds to be above corresponding AGCs or SGCs, **then** administrative controls (such as the substitution of an environmentally benign product) or the addition of pollution control devices will be explored with the operator of the emissions source.

If administrative controls are implemented or pollution control devices are added to reduce emissions, **then** the potential impacts will be evaluated using the DAR-1 screening method or the less conservative computer model based on reduced emissions rates.

If the assessed impacts from an existing source's emissions are greater than one half the respective AGC or SGC for any highly toxic or moderately toxic compound based on the DAR-1 screening method and estimated emissions rates are in doubt, **then** ESD may request that representative stack samples be collected to verify emissions rates.

Step 6: Specify Acceptable Error Tolerances

To estimate worst-case toxic emissions rates from the source, instructions with the Emissions Source Inventory and the Emissions Source Modification forms direct users to provide information on the maximum number of hours per day and days per year the emissions source will be used. Similarly, the Cavity Impact Method and the Standard Point Source Method equations used in the DAR-1 dispersion screening model were formulated to calculate worst-case impacts under building downwash conditions. As a result, the screening method calculates conservative impacts under all conditions and will likely overestimate both the short-term and annual impacts, when compared to the results derived from the DAR-1 software program.

The NYSDEC Division of Air Resources tries to base every ambient guideline concentration on its own chemical-specific evaluations. However, due to the number of chemicals manufactured and used in the State of New York, NYSDEC does not have sufficient funds to conduct an evaluation for each chemical. In the absence of self-conducted evaluations, NYSDEC uses other qualitative and quantitative information sources to derive AGCs and SGCs, based on the following hierarchy:

- 1) Toxicological assessments conducted by NYSDEC
- 2) Toxicological assessments conducted by NYSDOH
- 3) Information from the U.S. EPA-Integrated Risk Information System (IRIS)
- 4) Information from the U.S. EPA Health Assessment Documents
- 5) Information from the National Toxicology Program
- 6) Data from ACGIH-TLVs and NIOSH-RELs. (whichever is more restrictive)

Interim AGCs can be calculated by applying uncertainty factors (as noted in the equations below) to the most restrictive recognized occupational exposure limits (time-weighted average threshold limit value, TWA-TLV, or the time-weighted average recommended exposure limit, TWA-REL). Interim AGCs are not calculated for high toxicity contaminants such as known or potential human carcinogens.

MODERATE TOXICITY CONTAMINANTS

$$\text{Interim AGC} = \frac{\text{Occupational Exposure Limit}}{420}$$

LOW TOXICITY CONTAMINANTS

$$\text{Interim AGC} = \frac{\text{Occupational Exposure Limit}}{42}$$

Step 7: Optimize the Design

With respect to existing laboratory hoods at BNL, a preliminary evaluation of the potential emissions from this large group of sources has revealed an information gap. Estimates provided in Annual Emissions Statements for calendar years 1997, 1999, and 2001 suggest that the predicted impacts of chloroform emissions would have exceeded one-half the AGC in each of these years. This observation is preliminary; potential impacts must still be evaluated using the more refined DAR-1 computer-based model.

If the results of this modeling also predict downwind receptor concentrations of chloroform to be greater than one-half the AGC, **then** ESD will work with users of chloroform to better assess actual chloroform emissions rates during their research activities. This evaluation may require the collection of representative stack samples from various lab hoods to confirm revised estimates of chloroform emissions.

TOTAL COST FOR PROGRAM

There will be no added costs to do the more refined modeling of potential impacts of chloroform emissions, because the more refined DAR-1 program is an already accessible computer-based model. No additional costs are expected to be incurred through sampling, because mass balance calculations will probably be used to better assess actual chloroform emissions rates from research activities.

CY2002 cost	\$0
CY 2003 cost	\$0
Difference	\$0

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   J. Williams (631) 344-5587

CENTRAL STEAM FACILITY EMISSIONS

DATE 10-29-02

SUMMARY OF PROPOSED CHANGES

- Periodic (once every five years) performance tests of Boilers 1A and 5 for compliance with NO_x limit are due by January 6, 2007. Tests are planned for FY 2003.
- Periodic (once every five years) performance tests of Boilers 1A, 5, 6, and 7 for compliance with total suspended particulates limit is due by January 6, 2007. Tests are planned for FY 2003.
- Continuous opacity monitors will be installed at Boilers 1A, 5, and 6. Monitor installation to be completed February 2003 for Boiler 6 and November 2003 for Boilers 1A and 5.

DESCRIPTION AND TECHNICAL BASIS

Airborne emissions are routinely generated as a result of Brookhaven National Laboratory's operations and research activities. These emissions are released to the atmosphere either through a dedicated exhaust system designed to protect workers and building occupants from inhalation exposure to irritants or potentially toxic compounds, or via a building's general ventilation system when emissions from an operation do not present potential health impacts to workers. Airborne emissions may be released as particles, fumes, or gases.

Emissions released to the atmosphere from many operations and activities at BNL were authorized via individual permits issued by the New York State Department of Environmental Conservation. These permits were issued only after NYSDEC was assured from information provided in permit applications submitted by BNL that the operation or activity would be operated in compliance with all applicable regulatory requirements and that emissions from new sources would not adversely impact the ambient air quality or place members of the public at undue risk of inhalation exposure from pollutants of varying levels of toxicity.

Various state and federal regulations governing nonradiological releases require facilities to conduct periodic or continuous emissions monitoring in order to demonstrate compliance with emissions limits. BNL has several sources subject to state and/or federal regulatory requirements that do not require emissions monitoring. These emissions sources are included in the Title V Facility permit issued by NYSDEC to BNL on January 11, 2002. Conditions within the permit or the applicable requirements themselves require BNL to demonstrate compliance with the federal and state requirements by means other than emissions monitoring. The Central Steam Facility (CSF) is the only BNL Title V permitted source that is required to monitor nonradiological emissions.

The CSF supplies steam for heating and cooling to BNL major facilities through an underground steam distribution and condensate grid. The combustion units at the CSF are designated as Boiler Nos. 1A, 5, 6, and 7. Boiler 1A, which was installed in 1962, has a heat input of 56.7 MMBtu/hr. Boiler 5 was installed in 1965 and has a heat input of 225 MMBtu/hr. The newest units, Boilers No. 6 and 7, were installed in 1984 and 1996, respectively. Each of these boilers has a heat input of 147 MMBtu/hr.

Because of their design, heat inputs, and dates of installation, Boiler Nos. 6 and 7 are subject to Title 6 of NYCRR Part 227-2 and the federal New Source Performance Standard, 40 CFR 60 Subpart Db. As such, these boilers are equipped with continuous emissions monitors for nitrogen oxides (NO_x). Boiler No. 7 is also subject to the 40 CFR 60 Subpart D emissions standard for total suspended particulates. Initial compliance with the total suspended particulate standard was demonstrated during a boiler performance test completed in December 1997. Flue gases released from the Boiler 7 stack are also continuously monitored for opacity. To measure combustion efficiency, both boilers are also monitored for carbon dioxide (CO₂). Continuous emissions monitoring results from the two boilers are reported on a quarterly basis to the U.S. EPA and NYSDEC.

Due to their age, Boilers 1A and 5 are only subject to Title 6 of NYCRR Part 227-2. Initial compliance with the 0.30 lbs/MMBtu NO_x emissions standard of Part 227-2 was demonstrated during a stack test conducted in January 1995 while the boiler burned No. 6 oil with a fuel nitrogen content of less than 0.3 percent and a fuel sulfur content of less than 0.3 percent. Continued compliance with the emissions standard is presumed so long as laboratory analysis of composite residual fuel samples confirms the fuel nitrogen content does not exceed 0.3 percent by weight. Per condition 46.2 of the Title V Facility permit, a stack test must be conducted once during the five-year term of the permit to confirm that Boilers 1A and 5 are meeting the NO_x emissions standard while firing residual fuel and natural gas.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

- ☒ Compliance
- ☐ Support compliance
- ☐ Surveillance
- ☐ Restoration

The Clean Air Act (CAA) and CAA Amendments of 1990 establish a national permitting program for facilities that are considered to be significant contributors of the 189 identified hazardous air pollutants. The permitting program seeks to maintain and improve air quality throughout the nation by specifying emissions standards and the monitoring requirements that apply to various industrial sources. Many of the statutory requirements of the CAA and the 1990 Amendments for maintaining or improving air quality were promulgated into regulations administered by NYSDEC under Parts 200 – 257 of the New York State Code of Rules and Regulations.

Federal and state regulations 40 CFR 60 Subpart Db and 6 NYCRR 227-2 establish emissions standards for NO_x for all four CSF boilers, and continuous emissions monitoring requirements for NO_x covering Boilers 6 and 7. Conditions of the Title V Facility permit require quarterly reports to demonstrate ongoing compliance with the emissions standards. A condition of the permit specific to Boilers 1A and 5 requires that stack tests be conducted once during the five-year term of the permit to confirm that the NO_x emissions standard is being met while burning both residual fuel and natural gas. Another permit condition requires BNL to conduct a stack test of Boiler 7 once during the five-year term of the permit to confirm that the total suspended particulate emissions standard is being met while burning residual fuel. November 2002 revisions to BNL's

permit added conditions requiring BNL to conduct stack tests of Boilers 1A, 5, and 6 once during the five-year term of the permit to confirm that total suspended particulate emissions do not exceed 0.1 pounds per million BTUs of residual fuel burned in the boilers.

In addition, DOE Order 5400.1 (1988) requires that DOE sites comply with federal and state statutes and regulations.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

CSF boilers subject to regulatory emissions and opacity standards rely on continuous emissions monitoring systems, intermittent emissions tests, periodic opacity observations, or sampling and analysis of materials used by the operation. Procedures have been established for operating and maintaining the boilers' continuous emissions monitoring systems (CEMS), and for CSF stationary engineers to make and log daily observations of stack opacity from Boilers 1A, 5, and 6. These procedures are designed to ensure:

- Compliance with regulatory permit monitoring and reporting requirements
- Collection and analysis of samples are performed according to EPA, state, and regulatory agency standards or guidelines
- Compliance with NYSDEC QA and QC requirements for continuous emissions monitoring systems

Step 2: Identify the Decision

The desired decisions for the CSF boilers compliance and monitoring program can be cast as questions.

- Have we collected sufficient monitoring data during periods of boiler operation to meet minimum regulatory and permit data acquisition requirements?
- Are we in compliance with emissions and opacity standards and Title V Facility permit conditions?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 include:

- CEMS CO₂ and NO_x data for Boilers 6 and 7
- Opacity data for Boiler 7
- Analytical results of residual fuel analysis
- CSF Control Room log

- CEMS log
- Smoke Monitoring log sheets
- Daily CEMS calibration reports
- Contractor quarterly CEMS cylinder gas audit and opacity calibration error test results

Step 4: Define the Study Boundaries

The study boundaries incorporate the stacks for each of the four CSF boilers and continuous or periodic emissions monitoring equipment used to capture, analyze, and record representative samples for compliance monitoring purposes. NO_x data is recorded at 15-minute intervals and the data is reduced to one-hour block arithmetic averages. At least three data points are needed for a valid one-hour block average NO_x reading. Pursuant to 6 NYCRR Part 227-2.6, CEMS data for NO_x must demonstrate compliance with the NO_x emissions limits of the Title V permit on a 24-hour heat-weighted arithmetic average basis during the period from May 1 to September 15, and on a 30-day rolling average basis from September 16 to April 30.

The Boiler 7 opacity monitor records light transmittance across the stack diameter at 10-second intervals and automatically converts the data to percent opacity. Collected opacity data is reduced to six-minute averages that are compared to the opacity standards. Excess opacity is any six-minute average reading greater than 27 percent opacity or two or more six-minute average opacity readings in one hour greater than 20 percent opacity.

Periodic testing of Boilers 1A and 5 for conformance with the Title V Permit emissions limit for NO_x will be conducted once during the five-year term of the permit (Jan. 7, 2002 – Jan. 6, 2007). Periodic tests of Boilers 1A, 5, 6, and 7 to confirm that flue gas emissions meet the Title V permit particulate emissions standard will also be done once during the five-year term of the permit. The periodic test of Boiler 1A will consist of three one-hour test runs while the boiler is burning residual fuel oil with a nitrogen content not to exceed 0.34 percent by weight. Separate stack tests of Boiler 5 will be done while the boiler is burning natural gas and residual fuel with each test consisting of three one-hour test runs. The particulate emissions tests of Boilers 1A, 5, 6, and 7 will consist of three one-hour test runs while residual fuel oil is fired.

Step 5: Develop the Decision Rules

Decision 1

Have we collected sufficient monitoring data during periods of boiler operation to meet minimum regulatory and permit data acquisition requirements?

Calibration drift tests are conducted daily on the Boiler 6 and 7 NO_x and CO₂ CEMS. Whenever the measured drift exceeds twice the allowable drift test limits, the CEMS data logger flags this as a warning and the calibration is adjusted.

If the daily drift reading is greater than twice the drift limit five or more consecutive days or the drift reading is more than four times the drift limit, **then** the data logger flags the hourly NO_x as OC (Out of Control) periods. All successive hourly periods are flagged as OC until corrective

actions have been taken and the calibration drift measurements are less than the allowable limits (i.e., either less than two times or four times the allowable limit). Out of Control periods are not counted as valid data. Periods of CEM maintenance, CEM calibration, and periods where erroneous data or system errors occur are all flagged by the CEMS data loggers and are counted as invalid data. Under conditions of the Title V Facility permit and requirements of 40 CFR Subpart Db and 6 NYCRR 227-2, sufficient monitoring data have been collected if there is valid CEMS data for 75 percent of the hours per day for 75 percent of the days of the month and 90 percent of the days in the quarter the boiler was operating.

If at the end of the quarter it is determined that sufficient valid monitoring data has not been collected, **then** the data substitution method of 6 NYCRR 227-2.6(3)(vii) will be used. Using this method, the 90th percentile value of all CEMS NO_x data collected over the last 180 boiler operating days will be substituted for the invalid or missing periods.

If NO_x monitoring data is not available during the quarter, **then** the data loggers flag the invalid data (e.g., OC – Out of Control, MD – CEM down for maintenance, ED – erroneous data/system error.). Out of Control periods and ED periods are the most likely source of insufficient data being captured during a quarter. Stationary engineers manning the CSF must record the apparent causes for invalid data and actions taken to restore proper CEMS operations. The CEMS Calibration Reports, the CSF Control Room log, and the CEMS log, are reviewed quarterly to ensure that the causes of the invalid periods were identified and corrective and preventive actions were taken to prevent reoccurrences.

Decision 2

Are we in compliance with emissions and opacity standards and Title V Facility permit conditions?

If monitoring data, sample results, and opacity observations demonstrate compliance with emissions limits, opacity standards, and permit conditions, **then** said compliance status is communicated to regulators through quarterly Air Emissions and Monitoring System Performance Reports.

If opacity observations show an exceedance of an emissions or opacity standard and the cause is found to be due to regular equipment maintenance activities or due to boiler start-ups or shutdowns, **then** no further notifications beyond those made in quarterly Air Emissions and Monitoring System Performance Reports are required. If NO_x monitoring data shows an exceedance of an emission standard, the cause of the exceedance and the corrective actions taken to bring emissions under the standard are described in the quarterly report. Exceedances of emissions limits or opacity standards are described both quantitatively in Section 1 of the reports and qualitatively (determined causes of exceedances and the corrective or preventative action taken) in Section 5.

If, however, emissions in excess of emissions standards or deviations from permit conditions are found to be due to unavoidable malfunctions of equipment, **then** notification to regulatory agencies shall be made as soon as possible but no later than 48 hours after the occurrence, and an evaluation of the equipment malfunction will be conducted under the BNL Environmental Response Procedure.

Step 6: Specify Acceptable Error Tolerances

CEMS for NO_x have been used on Boilers 6 and 7 to demonstrate compliance with applicable NO_x emissions standards since these boilers became operational in November 1990 and May 1996, respectively. Initial performance tests of the CEMS for each boiler were conducted using EPA-approved methods, to verify their accuracy and ensure that NO_x emissions standards were being met. For Boiler 7, initial testing included an emissions test to confirm that total suspended particulates were below the 40 CFR Subpart Db limit. To ensure that flue gas opacity limits are not exceeded, a continuous opacity meter is required on Boiler 7. This meter also serves as a surrogate monitoring device to ensure ongoing compliance with the total suspended particulates emissions limit.

Because the CEMS are used to continuously demonstrate compliance with NO_x emissions standards and opacity limits, quality assurance is essential to ensure that the CEMS are functioning properly. To satisfy quality assurance requirements of 40 CFR 60 Appendixes B and F that are applicable to CEMS, a quality assurance plan for the CEMS for Boilers 7 was prepared and submitted to NYSDEC in 1994 along with an operating permit application. The quality assurance plan was subsequently amended in the summer of 1999 when a new dedicated CEMS was installed for Boiler 6. Before the installation of the new system, emissions from Boiler No. 6 were monitored by a time-share system that electronically switched between stacks to continuously monitor flue gas concentrations of CO₂ and NO_x in Boilers 6 and 7. The amended plan discusses quality assurance practices that are followed to satisfy the requirements set forth in 40 CFR 60 Appendix B and F.

The CEMS for NO_x and opacity undergo quality assurance checks on a daily and quarterly basis. Daily calibrations to measure the relative accuracy of the CEMS are called calibration drift (CD) tests. The ESC Data Acquisition System initiates the CD tests each day at 8:00 a.m. For the CO₂ and NO_x monitors, samples from calibration gas cylinders are extracted and analyzed by the CEMS. The CD is the difference between the measured CEMS concentration of the cylinder gas sample and the certified concentration of the gas. For the transmissometer (opacity monitor), a calibrated filter screen is automatically placed in the transmissometer path. A spectrophotometer in the transmissometer measures the amount of light trapped by the filter screen and converts the value to an equivalent opacity. The CD is the difference between the measured opacity of the filter screen and the calibration value certified by the filter screen manufacturer. The allowable calibration drift test limits for each type of monitor are noted in the table below.

DAILY DRIFT LIMITS			
CEM Pollutant	Allowable Limit	Maintenance Limit	Out of Control Limit
Opacity	± 1 %	± 2 %	± 4 %
NO _x	± 12.5 ppm	± 25 ppm	± 50 ppm
CO ₂	± 0.5 %	± 1 %	± 2 %

Whenever the measured drift exceeds the maintenance limits for NO_x and CO₂, the CEMS data logger flags this as a warning and the CSF stationary engineers manually adjust the calibrations. If the daily drift reading is greater than the maintenance limit five or more consecutive days or the

drift reading is more than the Out of Control limit, the data logger flags the hourly NO_x as Out of Control periods. All successive hourly periods are flagged as OC until corrective actions have been taken and the calibration drift measurements are less than the allowable limits. If the measured drift for the opacity monitor exceeds the maintenance limit of 2 percent opacity, a calibration adjustment is made and the optical surfaces of the monitor exposed to emissions are cleaned. Cleaning of optical surfaces exposed to monitoring is also required if the OC limit is exceeded.

For NO_x and CO₂ monitors, quarterly cylinder gas audits must be performed during the first, second, and third quarters of the year and a relative accuracy test audit (RATA) of the CEMS is done during the fourth quarter. A quarterly calibration error test must be performed each quarter for the opacity monitor.

Step 7: Optimize the Design

The current monitoring fulfills regulatory and Title V permit requirements for Boilers 1A, 5, 6, and 7. As previously noted, conditions within BNL's Title V permit require the Laboratory to conduct stack tests of Boilers 1A, 5, 6, and 7 once during the five-year term of the permit. The stack tests for Boilers 1A and 5 are to confirm that NO_x emissions from both boilers still meet applicable NO_x emissions standards. Meanwhile, additional stack tests of all four boilers are needed to confirm that the total suspended particulate emissions standard is being met while burning residual fuel. These tests are planned for August or September of 2003.

During periods of operation, the opacity limitations of 6 NYCRR Part 227-1.3 are applicable to CSF Boilers 1A, 5, and 6. This regulatory requirement restricts opacity from a boiler to not more than 20 percent (i.e., a six-minute average) except for one six-minute period per hour of not more than 27 percent opacity. To demonstrate that Boilers 1A, 5, and 6 comply with the opacity limitations of 6 NYCRR Part 227-1.3 during periods of operation, BNL made a commitment to use the flue gas oxygen monitors on each boiler as a surrogate indicator of opacity levels in its Title V permit application. The flue gas monitor data acquisition systems can only be programmed to record measured concentrations at two-minute, five-minute, ten-minute, hourly, or daily intervals. Significant data acquisition system reprogramming would have been needed to report flue gas oxygen concentrations as six-minute averages, the reporting interval that NYSDEC had preferred.

BNL staff discussed this matter with NYSDEC during an annual inspection of Title V permitted processes conducted on March 11, 2002. In the course of these discussions, NYSDEC suggested an option that would allow BNL to certify compliance with the opacity limitations by making and recording daily observations of stack opacity using a method other than EPA Reference Method 9. The Laboratory since developed and began using a new opacity monitoring procedure (BNL Plant Engineering Procedure No. O&M-CSF-018), whereby CSF operators objectively observe and record opacity on a daily basis using a 0 – 10 scale with a reading of two (2) being "Economy Haze", a universally recognized term used by boiler operators that suggests an unacceptable level of opacity.

Because the individual opacity observations under this procedure are but snapshots of visible particulate emissions from each boiler and represent a small fraction of the boiler operating day, periods where excess particulate emissions might exceed 20 percent opacity are likely to go unnoticed. Recognizing the deficiencies in the procedure and the fact that violation of the opacity limits could result in the assessment of civil penalties up to \$25,000 per violation per day, BNL

has requested funds to purchase and install continuous opacity monitors for each of the boilers. Assuming that the requested funds will be approved, the installation and performance testing of the continuous opacity monitors are scheduled for completion by February 1, 2003 (Boiler 6) and November 1, 2003 (Boilers 1A and 5). The Laboratory will continue to use the opacity observation procedure until continuous opacity monitors have been installed and the monitors' performance has been verified in accordance with 40 CFR 60 Appendix B Specification 1.

TOTAL COST OF THE PROGRAM

Approximately \$75K is spent annually for current CSF boiler compliance monitoring. This figure includes \$10 – \$15 K for the annual RATA of the NO_x and CO₂ monitors, \$7 – \$8K for residual fuel oil samples analyses to verify the sulfur and nitrogen contents meet permit limits established for the Boilers 6 and 7, purchases of standard gases for daily CEMS calibrations, and a service contract for EMI, Inc. to conduct quarterly cylinder gas audits of NO_x and CO₂ monitors and quarterly opacity calibration error tests of the opacity monitor.

Estimated costs for the additional periodic stack tests of Boilers 1A, 5, 6, and 7 and the quarterly QA monitoring of the new continuous opacity monitors are shown in the following table.

ESTIMATED COSTS FOR CSF MONITORING			
Compliance and Quality Assurance Monitoring	Frequency	Unit Cost	Total Cost
Stack Tests	Seven tests every five years	\$10,000	\$70,000
Calibration Error Tests	Three tests in 2003 (12 for 2004)	\$1,000	\$3,000 (\$12,000 for 2004)

CY2002 Cost	\$75,000
CY2003 Cost	\$148,000
Difference	\$73,000

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   J. Williams (631) 344-5587

AIR MONITORING AT THE BROOKHAVEN LINAC ISOTOPE PRODUCER

DATE July 16, 2002

SUMMARY OF PROPOSED CHANGES

- Install shroud above the shaft to test the effectiveness of the shroud as a sealant in reducing the emissions.
- Characterize potential emissions by monitoring the short-lived gaseous emissions during the test phase of the shroud.
- Implement continuous monitoring until the emissions are properly characterized and an EPA decision is made with regard to administrative controls.

DESCRIPTION AND TECHNICAL BASIS

The BLIP facility uses a beam of protons for irradiating targets to produce short-lived radioisotopes that are used for medical diagnostic procedures and research. The proton beam from the LINAC degrades through eight different BLIP targets placed in series. The LINAC also accelerates protons into the booster of the Alternating Gradient Synchrotron (AGS). The first target in the series is irradiated with 200 MeV protons, and the last target with 20 MeV protons. The proton beam intensity could reach 145 microamperes, but the average beam intensity usually is 85 microamperes. During the irradiation process, the targets are cooled continuously by recirculating water in an 18-inch diameter shaft, which is enclosed in a 30-foot underground tank. After irradiation the targets are moved to Target Processing Laboratory, Bldg. 801, for processing.

The principle gaseous radionuclides produced during target irradiation are oxygen-15 (122.2 seconds half-life) and carbon-11 (20.38 minutes half-life), due to the activation of cooling water and air. The BLIP facility is monitored on a weekly basis for particulates, tritium emissions, and radioiodines with charcoal cartridges at locations identified as 064-250, 064-350, and 064-150, respectively. The sample collection and analyses are done in accordance with procedure EM-SOP-500, *Air Sampling at Permanent Monitoring Stations*, and 40 CFR 61 Appendix B, Method 114, prescribed by EPA. Emissions of the short-lived gases were measured once a year to show compliance with NESHAPs, but due to increased operation during 2001, the potential dose to the maximally exposed individual exceeded 0.1 mrem, the level at which EPA requires continuous emissions monitoring.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

<u> x </u>	Compliance
<u> x </u>	Support compliance
<u> x </u>	Surveillance
<u> </u>	Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

In order for the BLIP facility to be in compliance with the NESHAPs regulations, radiological air emissions should be measured on a continuous basis and characterized properly. The technical problem is the sampling of the activation radionuclides created from the proton beam, which include tritium, beryllium-7, carbon-11, nitrogen-13, oxygen-15, and sodium-22. The potential hazards associated with BLIP are tritium in water vapor form, Be-7 and Na-22 particulates, and C-11, N-13, and O-15 in gaseous form. Tritium sampling is conducted with silica gel and the particulates are collected on the filter paper along with radioiodines on the charcoal cartridge. The most significant gaseous effluents include oxygen-15 with 122.2 seconds half-life, and carbon-11 with 20.38 minutes half-life. These gaseous effluents decay via positron emissions and contribute mostly to the immersion dose in contaminated air, and therefore should be characterized to comply with regulations.

The radioactive gaseous emissions cannot be captured by conventional methods but can be directly measured using a low-resolution gamma spectrometer with an in-line sampling system connected to the air exhaust system. In addition, C-11, N-13, and O-15 spectra have to be stripped to evaluate the potential dose contribution greater than 10 percent from each of these radionuclides.

Step 2: Identify the Decision

The decisions for BLIP monitoring program can be formulated as questions.

- Does the potential radiological dose to members of the public exceed 1 percent of the federal dose limit of 10 mrem per year?
- Is BNL in compliance with ambient air quality regulatory requirements?
- Have risk and dose to the members of the public exceeded any threshold values?
- Are facility emissions control systems effective?
- Which radionuclides, if any, contribute to dose in excess of the “10 percent of the dose” limit?

Step 3: Identify Inputs to the Decision

Conduct sampling and analysis in accordance with 40 CFR 61, Appendix B, and Method 114. The following items need to be characterized before any dose estimates can be made. The inputs necessary for the decision include:

- Beam current, beam energy, and planned operations at BLIP
- Stack effluent flow rates—measured, characterized, and confirmed
- Short-lived gases emissions rate—sampled, analyzed, and quantified
- Population data
- Meteorological data
- Stack height, stack diameter, precipitation, and other variables
- Model dose to maximally exposed individual (MEI) using CAP-88 PC, Version 2.0
- 40 CFR 61, Subpart H (NESHAPs) regulations
- Regulatory requirements (DOE Order 5400.1)
- Analytical methods and detection limits (as described in this document)
- *Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities: ANSI N13.1 (1999)*
- Tritium – EPA Method 906
- Gamma spectroscopy – EPA Method 901

Step 4: Define the Study Boundaries

The study is to characterize BLIP stack emissions based on prescribed NESHAPs regulations and ANSI N13.1-1999 standards by collecting representative samples from an ideal acceptable sampling point in the BLIP stack. Listed below are the bounding conditions for sampling the effluents.

- Expected temperature range at potential sampling points in the stack
- Air effluent flow rates, composition, and particle size
- Proper air effluent mixing and stable extraction point

Step 5: Develop the Decision Rules

If any radionuclide is identified that is not naturally occurring in the environment, **then** evaluate the raw data to confirm the radionuclide and compare the concentration with the derived concentration guide to assure regulatory compliance. Calculate the effective dose and base the decision on the following:

1. **If** the effective dose to a maximally exposed individual (MEI) is less than 1 percent of the standard, **then** no action is required.
2. **If** the dose is greater than 1 percent of the standard and the facility is not continuously monitored, **then** the facility is noncompliant and the Environmental Event Response Procedure (EC-SOP-400) must be followed.

Step 6: Specify Acceptable Error Tolerances

Factor or consideration	Record sampling	Control Monitoring
Frequency of Sampling	Continuous	Continuous
Frequency of Measurement	Weekly	Real-time
Overall Accuracy	± 30%	± 40%
Overall Precision	± 30%	± 40%
Sampling Accuracy	± 20%	± 20%
Sampling Precision	± 20%	± 20%
Measurement Accuracy	± 20%	± 35%
Measurement Precision	± 20%	± 35%
System Availability	> 95%	> 95%

Step 7: Optimize the Design

The air-monitoring program shall be optimized based on the surveillance data collected, audits, and air surveillance assessments every calendar year.

After collection of air emissions data for a year and proper characterization of the short-lived gases C-11 and O-15, undertake a design review of the sampling. The design basis should assess the cost-benefit impact and consider the frequency of confirmatory sampling.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The annual cost impact of changes at the BLIP could be significant, as an FTE might be required to log data and monitor and record the emissions. As the following table shows, there are some unknowns at this point in time.

ESTIMATED COSTS OF BLIP MONITORING PROGRAM						
Analysis	Minimum Sample Size (m ³)	Detection limit (μCi /mL)	Samples per Year	Turnaround (calendar days)	Cost per analysis	Total Cost
Gross alpha/beta (Filter)	500–700	1.04E-15	1 x 52	14 days	\$75.40	\$ 3,921
Gamma	500-700		1 x 52		\$127.35	\$ 6,622
Charcoal	500-700		1 x 52		\$127.35	\$ 6,622
Tritium	Min 7 ml of tritiated water	4.73E-7	1 x 26		\$52.00	\$ 1,352
Gamma online 511 keV						Unknown

TOTAL COST OF THE PROGRAM

The total cost for the air monitoring program (without the proposed BLIP changes) is shown below. The lower cost is a result of a reduction in the sampling of charcoal cartridges, and fewer tritium sampling locations.

CY 2002 cost	\$144,707
CY 2003 cost	\$132,501
Difference	–\$12,206

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Benny Hooda (631) 344- 8107

See Appendix B for the complete revised CY2003 monitoring program for this media.

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AIR MONITORING AT THE TARGET PROCESSING LABORATORY (BLDG. 801)

DATE August 29, 2002

SUMMARY OF PROPOSED CHANGES

No proposed change.

DESCRIPTION AND TECHNICAL BASIS

The Target Processing Laboratory (TPL), Bldg. 801 (also known as the Hot Laboratory), includes five semi-hot cells, three chemical processing hot cells, and three high-level hot cells for the handling and processing of radioactive materials. Metal targets irradiated at the BLIP facility are transported to the TPL and radiopharmaceuticals are chemically extracted for medical diagnostic use. Airborne radioactive emissions are generated as a result of hood work involving the processing of BLIP targets for the recovery of radioisotopes. Each hot cell is provided with individual exhaust air filters as well as a backup filter preceding discharge to a common duct leading to the HFBR stack. Airborne radionuclides released during the extraction process are drawn through multi-stage HEPA and charcoal filters and then vented to the HFBR stack. The TPL emissions are monitored by a particulate filter system for gross alpha/ beta activity, for analysis of gamma-emitting radionuclides, and by a TEDA-loaded charcoal cartridge for radioiodines. Radionuclides released to the atmosphere from TPL operations have not been significant contributors to the site perimeter dose via the airborne pathway (much less than one percent).

DOE facilities that have the potential to deliver a radiation dose to a member of the public of greater than 0.1 mrem/yr must be continuously monitored in accordance with NESHAPs requirements (40 CFR 61, Subpart H). The facilities that fall below NESHAP levels require only periodic, confirmatory monitoring. The sample collection and analyses are done in accordance with procedure EM-SOP-500, *Air Sampling at Permanent Monitoring Stations*, and 40 CFR 61 Appendix B, Method 114, prescribed by EPA.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☒ Compliance
- ☒ Support compliance
- ☒ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

- Laboratory operations that have the potential to impact the environment through discharge of radioactive emissions should be monitored in accordance with NESHAPs.
- Verify and record air emissions for the facility.
- Monitor emissions compliance with DOE Order 5400.5.
- Monitor unplanned releases.

Step 2: Identify the Decision

- Is BNL in compliance with ambient air quality regulatory requirements?
- Do risk and dose to the members of the public exceed any threshold values?
- Are facility emissions control systems effective?
- Which radionuclides, if any, contribute to dose in excess of the “10 percent of the dose” limit?

Step 3: Identify Inputs to the Decision

Complete sampling and analysis in accordance with 40 CFR 61, Appendix B, and Method 114. The following items need to be characterized before any dose estimates can be made. The inputs necessary for the decision include:

- Stack effluent flow rates
- Qualitatively quantify emissions rates
- Population data
- Meteorological data, wind data
- Agricultural data
- Radionuclide emissions data
- Stack height, stack diameter, precipitation, and other variables
- Model dose to maximally exposed individual (MEI) using CAP-88 PC, version 2.0
- 40 CFR 61, Subpart H (NESHAPs) regulations.
- Regulatory requirements (DOE Order 5400.1)
- Analytical methods and detection limits
- Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities: ANSI N13.1 (1999)

- Tritium – EPA Method 906
- Gamma spectroscopy – EPA Method 901

Step 4: Define the Study Boundaries

Based on prescribed NESHAPs regulations and ANSI N13.1-1999 standards, collect representative effluent and analyze samples from an ideal acceptable sampling point in the HFBR stack duct. The following parameters shall be the bounding conditions for sampling the effluents.

- Expected temperature range at potential sampling points in the stack
- Air effluent flow rates, composition, and particle size
- Proper air effluent mixing and stable extraction point

Step 5: Develop the Decision Rules

If any radionuclide is identified that is not naturally found in the environment, **then** evaluate the raw data to confirm the radionuclide and make comparison with the derived concentration guide to assure regulatory compliance. Calculate effective dose and base the decision on:

1. **If** the dose is less than 1 percent of the standard, **then** no action is required.
2. **If** the dose is greater than 1 percent, **then** evaluate emissions control systems and continuously monitor the facility.

If the potential impact category (PIC) indicates that the facility stack has the potential to discharge airborne radionuclides in quantities that could cause radiological doses to the members of the public in excess of 1 percent of 10 mrem, **then** implement continuous sampling with a real-time detector for the stack, and use actual source term data in the CAP88-PC, Version 2 modeling program to calculate dose.

If the limiting factor for the source term is the inventory (quantity of material and its physical form), **then** use the 40 CFR 61, Appendix D method to calculate the source term for input into the CAP88-PC, Version 2 modeling program to calculate dose.

Step 6: Specify Acceptable Error Tolerances

Factor or consideration	Record sampling	Control Monitoring
Frequency of Sampling	Continuous	Continuous
Frequency of Measurement	Weekly	Real-time
Overall Accuracy	± 30%	± 40%
Overall Precision	± 30%	± 40%
Sampling Accuracy	± 20%	± 20%
Sampling Precision	± 20%	± 20%
Measurement Accuracy	± 20%	± 35%
Measurement Precision	± 20%	± 35%
System Availability	> 95%	> 95%

The baseline condition (i.e., the null hypothesis [H_0]) was established for the emissions rate.

Step 7: Optimize the Design

The air-monitoring program shall be optimized based on the surveillance data collected, audits, and air surveillance assessments every calendar year.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

No change is proposed; thus, there is no associated cost.

TOTAL COST OF THE PROGRAM

The total cost for the air monitoring program is shown below. The lower cost is a result of a reduction in the sampling of charcoal cartridges, and fewer tritium sampling locations.

CY 2002 cost	\$144,707
CY 2003 cost	\$132,501
Difference	-\$12,206

Analysis	Minimum Sample Size (m ³)	Detection Limit (μCi /mL)	No. of Samples per Year	Turnaround Time (calendar days)	Cost per analysis	Total Cost
Gross alpha/beta (Filter)		1.04E-15	1 x 52	14 days	\$75	\$3,921
Gamma			1 x 52		\$127	\$6,622
Charcoal			1 x 52		\$127	\$6,622

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Benny Hooda (631) 344-8107

See Appendix B for the complete revised calendar year 2003 monitoring program for this media.

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6 AIR SURVEILLANCE

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RADIOLOGICAL AIR MONITORING AT THE BNL SITE

DATE August 28, 2002

SUMMARY OF PROPOSED CHANGES

- Reduce the tritium battery-operated sampling stations from 18 to 8 locations. The eight stations would be 049-DC (E), 030-DC (ENE), 011-DC (NNE), 122-DC (SSE), 108-DC (SE), 053-DC (NW), and 084-DC (two in Bldg. 490).
- Change the frequency of tritium sampling from one week per month (periodic) to continuous biweekly for all stations, including the blockhouses and the battery-operated stations.

DESCRIPTION AND TECHNICAL BASIS

Airborne emissions may be generated by BNL operations, research, and scientific activities. These emissions are monitored and released to the atmosphere via stacks, and vents equipped with high efficiency particulate air (HEPA) filters or charcoal filters when potentially toxic pollutants are involved. BNL programs implement engineering as well as administrative controls to prevent, reduce, and eliminate air pollutants from their operations. In accordance with DOE requirements to protect the environmental and health of humans, BNL conducts both air surveillance and facility emissions monitoring to assess the adequacy of these controls and to determine the impact, if any, of the air pollutants on the environment. Facility emissions monitoring and air surveillance monitoring are complementary to each other in assessing potential human health and environmental impacts.

Air surveillance monitoring involves the analysis of particulate matter collected on filters, as well as vapor chemically trapped in a collection medium. Concentrations of various airborne radionuclides (including particulates and tritiated water vapor) are measured on the BNL site and at off-site locations on eastern Long Island. Specific diffuse (nonpoint) sources at BNL arising due to environmental restoration activities are also monitored as needed.

A monitoring method for evaluating environmental impacts from BNL air emissions is the measurement of pollutants at their point of emission. BNL performs continuous air emissions sampling of stacks or vents that discharge to the atmosphere and have a potential to exceed the NESHAP limits. Monitoring at several facilities is done to show compliance with DOE requirements, federal and state laws and regulations, and industry standards.

DRIVERS FOR AIR MONITORING AT THE BNL SITE

<u> x </u>	Compliance
<u> x </u>	Support compliance
<u> x </u>	Surveillance
<u> </u>	Restoration

BNL's air monitoring is governed by the Clean Air Act. The fundamental objective of the CAA is to protect human health and the environment from air pollutants. CAA enables EPA to define and establish standards and criteria for air pollutants that are of major concern. These pollutants and the National Primary and Secondary Ambient Air Quality Standards (NAAQS) are defined in 40 CFR 50. In 1990, Section 112 of the CAA, the National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61), was amended by Title III. Title III lists 189 hazardous air pollutants (HAPs, of which "radionuclides" are counted as one), calls for emissions reductions of air toxics, and imposes new standards on both new and existing sources. While standards have not yet been set for many HAPs, a dose limit has been established for radionuclides.

EPA has established a radiation dose standard for all radiological air emissions of 10 mrem/yr effective dose equivalent (EDE) for members of the public (40 CFR 61, Subpart H). This dose standard is based on emissions that can contribute to human radiation doses via all pathways once released to the air. Facility air emissions monitoring and air surveillance monitoring can provide the actual source terms for modeling to ensure that the NESHAP standard is not exceeded.

DOE Order 5400.5 (1990), *Radiation Protection of the Public and the Environment*, establishes a primary radiation protection standard for members of the public at 100 mrem/yr EDE for prolonged exposure from all sources, including air emissions. For air, derived concentration guides (DCGs) listed in the Order specify the concentrations of radionuclides that can be inhaled continuously 365 days a year without exceeding the DOE primary radiation protection standard for the public. DOE 5400.5 also states that facilities should have the capability, consistent with the types of operations conducted there, to monitor routine and nonroutine releases and to assess doses to members of the public.

DOE Orders 5400.1 (1988), *General Environmental Protection Program*, and 5400.5 define standards for controlling exposures to the public from operations at DOE facilities. 40 CFR 61, Subpart H requires DOE facilities to continuously monitor radiological discharges and to estimate the radiological dose to the public. Guidance on air emissions sampling is provided in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE/EH-0173T 1991), "Standards of Performance for New Stationary Sources" (40 CFR 60), and the NESHAP-cited American National Standards Institute standards (ANSI N13.1 1999).

Federal air quality laws and DOE regulations governing the release of airborne radioactive material include NESHAP and DOE Orders 5400.1 and 5400.5. Under NESHAP, facilities whose emissions have the potential to deliver a radiation dose to a member of the public of greater than 0.1 mrem/yr must be continuously monitored. Facilities with emissions that fall below this value require only periodic, confirmatory monitoring. Figure 3-3 indicates the location of monitored facilities within the BNL site.

The most significant contributor to radioactive air emissions from the BNL site is the Brookhaven LINAC Isotope Producer (BLIP). Releases of gaseous carbon-11 and oxygen -15 from the BLIP typically account for over 99 percent of total radioactivity released annually.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Air emissions from BNL's operations and scientific activities have the potential to impact the public health and the environment. Therefore, an emissions surveillance program is required to measure the radiological emissions both qualitatively and quantitatively. DOE/EH-0173T states that all DOE operations should properly and accurately measure radionuclides in their effluents and in ambient environmental media. This guidance document also specifies that the surveillance program should characterize the radiological conditions of the off-site environment, estimate public doses, confirm predictions of public dose based on effluent monitoring data and modeling, and provide compliance data for all applicable environmental regulations. It also states that surveillance may be necessary for legal reasons, public concerns, and state and local commitments; and that "provisions should be made for the detection and quantification of unplanned releases of radionuclides to the environment."

According to DOE Order 5400.1, environmental surveillance shall be conducted to monitor the effects, if any, of DOE activities on environmental and natural resources both on and off site.

Step 2. Identify the Decisions

The decisions of the air surveillance and monitoring program can be formulated as questions.

- Are the number of air samples collected and their frequency sufficient to assess the potential impact from emissions sources?
- Is BNL in compliance with ambient air quality regulatory requirements?
- Do risk and dose to the members of the public exceed any threshold values?

- Are facility emissions control systems effective?

Step 3: Identify Inputs to the Decisions

- Establish background concentration levels of the pertinent radionuclides.
- Determine the highest concentrations above minimum detection level of the pertinent radionuclide expected to occur in the vicinity of DOE operations.
- Determine representative radionuclide concentrations in areas where public health and other stakeholder concerns exist, to verify that doses to the public through the air pathway from DOE operations remain low relative to the standards.
- Provide early detection of potential increases in public exposures and contamination of the environment through measurements of actual and potential emissions to the air from facilities and areas with surface and soil contamination.
- Obtain pre-operational baseline data and environmental surveillance data for areas near waste units scheduled for treatment or restoration, to assess the integrated effects of individual site actions and over time.
- Obtain measurements at the site perimeter and in nearby communities to provide public assurance that the degree of contamination from DOE operations is known.
- Sample air on site continuously to assess the environmental effects and doses from unusual releases.
- Provide data to evaluate and improve pathway models used to predict and assess public dose compliance and environmental contamination.

Environmental air surveillance samples are collected in accordance with standard operating procedures as set forth in the following SOPs:

- BNL EM-SOP-500, *Air Sampling at Permanent Monitoring Stations*
- BNL EM-SOP-501, *Tritium Air Sampling at Portable Stations*

The particulate matter sampling media consists of a 5-cm (diameter) glass fiber air filter with a backing to hold the filter in place. Samples are collected weekly and counted for gross alpha and gross beta radiation, using an anticoincidence proportional counter. Environmental air sample criteria are based on the premise that representative samples of the ambient air are taken continuously. The preferred sampling height is 1.5 meters above the ground, away from traffic, large buildings, or similar obstructions. Analyses for gamma-emitting nuclides are performed monthly on composites of the weekly filters.

Tritiated water vapor in the air is sampled weekly by drawing a stream of air through silica gel cartridges. After collection, the entrapped liquid is extracted from the desiccant and analyzed for tritium using liquid scintillation techniques. In all cases, flow rates, media volumes, and exposure periods are such that the media are not likely to be saturated during the sampling period and high collection efficiencies are achieved in accordance with the manufacturer's recommendations.

Step 4: Define the Study Boundaries

The site is divided into sixteen wind sectors from the central emissions point, the HFBR stack. An air sampler is located based on considerations of predominant wind directions at the site and the location of population centers at and surrounding BNL (considering access, power availability, and costs). Figure 3-3 depicts the array of monitoring stations in place around the BNL site to collect air samples for determining air quality.

Six air sample collection stations are situated within dedicated blockhouses; P2, P4, P7, and P9 are located at the boundary perimeter; S5 is adjacent to the Sewage Treatment Plant and S6 is adjacent to the old Waste Hazardous Waste Management Facility. At each of the six blockhouses, glass fiber filter paper is used to capture airborne particulate matter and silica gel tubes collect water vapor for tritium analysis (except at Station S5, which does not contain a tritium sampler). Five battery-powered silica gel samplers (049DC in the east sector, 030DC in the east-northeast sector, 011DC in the north-northeast sector, 122DC in the south-southeast sector, 108DC in the southeast sector, and 053DC in the northwest sector) are distributed between blockhouses, primarily along the site boundary, to measure ambient tritium concentrations. Two battery-powered silica gel samplers (084DC) are in Bldg. 490, rooms 9-507 and 9-527. Tritiated water vapor (HTO) is collected using a pump that draws air through a column of silica gel, which retains moisture. The absorbed water is recovered in the BNL Analytical Services Laboratory and analyzed using liquid scintillation counting techniques.

Filter papers are collected weekly and analyzed for gross alpha and beta activity using a gas-flow proportional counter. Silica gel samples are collected bi-weekly and processed for liquid scintillation analysis. In addition to these samples, NYSDOH receives duplicate filter samples, which are collected at Station P7, located at the southeast boundary. These samples are also collected on a weekly basis and are analyzed by an independent NYSDOH Laboratory.

Step 5: Develop the Decision Rules

As part of a statewide monitoring program, NYSDOH also collects air samples in Albany, New York, a control location with no potential to be influenced by nuclear facility emissions. NYSDOH reports that typical airborne gross beta activity at that location varies between 5 and 25 fCi/m³ (femtocuries per cubic meter). Sample results measured at BNL fall well within this range, demonstrating that on-site radiological air

quality is consistent with that observed at New York locations not located near radiological facilities.

If the gross alpha activity in the filters is greater than 3 fCi/m³, **then** collect more samples in the vicinity.

If the gross beta activity in the filters is greater than 25 fCi/m³, **then** collect more samples in the vicinity.

If the tritium concentrations are greater than 8 pCi/m³, **then** investigate the source of elevated tritium at that location and implement corrective actions.

If the effective dose from all sources exceeds 0.1 mrem/year, **then** implement continuous monitoring of the facility.

If values are greater than the above-stated gross alpha /beta concentrations, **then** investigate that wind sector sampling location to assess the effectiveness of emissions control in the relevant facilities.

Step 6: Specify Acceptable Limits on Decision Areas

Air surveillance data are analyzed with the intent of satisfying the following goals:

- Estimate concentrations at each sampling point.
- Compare current concentrations to previous concentrations in order to identify changes or inconsistencies.
- Compare concentrations to established DCGs or permit limits.
- Compare concentrations at a single location, or a group of locations, to the concentrations at control or background locations; evaluate the reliability of the comparisons.

Step 7: Optimize the Design

The air-monitoring program shall be optimized based on the surveillance data, audits, and air surveillance assessments during the calendar year.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Analysis	Minimum Sample Size (m ³)	Detection Limit (μCi /mL)	Number of Samples per Year	Turnaround Time (calendar days)	Cost per analysis	Total Cost
Gross alpha/beta (filter)	500–700	1.04E-15	9 x 52	14 days	\$75	\$35,287

Gamma on Composite	Composite		9 x 13	45 days	\$127	\$14,900
Charcoal	500–700		2 x 52	14 days	\$127	\$13,244
Tritium	Min- 7 ml of tritiated water	4.73E-7	15 x 26	30 days	\$52	\$20,280

TOTAL COST OF THE MONITORING PROGRAM

The total cost for the air monitoring is shown below. The lower cost is a result of a reduction in the sampling of charcoal cartridges, and fewer tritium sampling locations.

CY2002	\$ 144,707
CY2003	\$132,501
Difference	–\$12,206

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Benny Hooda (631) 344-8107

7 DIRECT RADIATION: TLD PROGRAM

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DIRECT RADIATION: TLD PROGRAM

DATE August 28, 2002

PROPOSED CHANGES

Increase the number of TLDs posted in the vicinity of the RHIC and the AGS locations, resulting in an increase of the total number of TLDs from 41 to 56 TLDs on site.

- Post four additional TLDs at Bldg.1006
- Post four additional TLDs at Bldg.1005
- Post two TLDs at Bldg.1002
- Post two TLDs at Bldg.1004
- Post two TLDs in the vicinity of Bldg. 914
- Post one additional TLD at Bldg. 356

DESCRIPTION AND TECHNICAL BASIS

Brookhaven National Laboratory measures environmental background radiation through a network of on- and off-site thermoluminescent dosimeters (TLDs). These devices measure direct, penetrating gamma radiation originating from cosmic and terrestrial sources, as well as any contribution from Laboratory operations. The TLDs measure the total amount of penetrating radiation, both natural background and man-made radiation, at a particular location.

When certain crystals in the TLD are exposed to gamma radiation, the impurities in the crystals form low-temperature trapping sites for electrons excited to higher energy states. The electrons remain in a high-energy state at normal ambient temperatures. Processing at the analytical laboratory consists of three phases. First, the TLD is heated, causing the electrons to be released from the trapping sites and dropping to a lower energy state where photons are emitted. Second, the photons are measured with a photomultiplier tube. The light intensity measurement is recorded, with the light intensity being proportional to the original absorbed dose of radiation. Third, after the TLD is read, it is heated and read again for any residual dose, to ascertain that all of the gamma-radiation-induced stored energy has been released. This second heat treatment is referred to as “annealing” and verifies that the TLD is ready for reuse in the field.

External radiation exposure can be produced by various sources on and around the BNL site. The environmental pathways through air and surface water can transport radionuclides from emission or effluent sources (point or diffuse) to locations near the public and other biota. Many of these released radionuclides produce penetrating particles

and photons (i.e., beta and gamma radiation) during decay processes in media external to an organism.

In accordance with DOE Orders 5400.1 (1998) and 5400.5 (1990), BNL monitors direct radiation to establish background levels and to determine public doses resulting from its operations. The *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE/EH-0173T 1991) recommends using TLDs to monitor direct gamma radiation in the environment.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support compliance
- ☒ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Radioactive materials or potential sources could give external radiation exposure to the uninvolved worker or on-site terrestrial biota. These sources include routine facility emissions and effluents, radiation generating facilities and equipment, environmental restoration sites, and on-site vehicle transport of sources or wastes. The external dose from these sources varies significantly in each quarter and from the on-site average.

Step 2: Identify the Decision

The primary purpose of direct radiation monitoring is to measure radiation doses and evaluate the maximum dose, if any, to members of the public from direct gamma radiation originating from BNL sources. The decisions can be formulated as questions.

- On site, are members of the public and noninvolved workers exposed (if at all) to direct gamma radiation doses that are as low as reasonably achievable (ALARA)?
- At the site perimeter and in nearby communities, is the external radiation exposure from site operations known and in the range of natural background levels?

Step 3: Identify Inputs to the Decision

- All measured doses at BNL monitoring locations are compared to both recent and historical background measurements to determine the contribution, if any, from BNL operations.

- When a TLD is missing, the annual dose is calculated as four times the average quarterly dose determined from available data.
- TLDs that are wet, damaged, or found on the ground are not accepted for use in monitoring analyses.
- The annual *Site Environmental Report* discusses which TLDs were reported as missing or damaged.

- If an accident occurs where a rise in background is suspected, the dosimeters may be immediately retrieved and processed.
- TLDs are read and annealed by the personnel monitoring group within BNL's radiological control program.
- The 8807 monitors are calibrated annually at Pacific Northwest National Laboratory, utilizing sources traceable to NIST.
- Each quarter, the environmental TLDs are read using Harshaw TLD readers, which are calibrated using NIST-traceable radiation sources.
- The DOE dose limit from all environmental pathways to the members of public is 100 mrem /year; therefore, to keep the dose ALARA to the members of the public, the TLD dose measurements are made.

Step 4: Define the Study Boundaries

External radiation sampling locations are selected to accomplish the surveillance objectives. Several sources of information are used to help determine the potential for detecting increased exposures to the public. Some important factors that influence the determination of sampling locations are the radiation source characteristics, meteorology, geography, hydrology, sedimentation, population distribution, and recreational activities or lifestyles. There is a continual need for emergency preparedness dosimetry, confirmation of emissions controls and dose modeling, and background monitoring for public assurance. The fulfillment of these needs requires TLD placement in strategic off-site locations that are generally upwind, for the background location(s), and in population centers located within prevailing wind directions. Because the BNL site is large, maximum predicted concentrations from airborne emissions are typically on site, and sampling at these locations continues although the data do not indicate public exposures.

External radiation exposures are measured with consideration for the types and levels of exposure expected from the various pathway transport media and other direct radiation sources. Some of the critical environmental media or sources causing potential external radiation exposure are airborne cloud passage and exposure to contaminated surface water, vegetation, or soil. Most of the types of radiation causing external exposures are gamma photons and beta particles.

Historical data support the approach of designing the measurement methods mainly for photon sources, but pure beta emitters can exist in the environment unaccompanied by gamma emitters.

The normal exchange frequency for all TLDs is on a quarterly basis (designed so that "fading" remains at minimal), determined as the approximate exposure time needed to generate statistically confident results above the limit of detection. Sampling frequencies are determined based on the potential for detecting elevated external radiation levels and

for public exposure. Sampling frequencies for on-site TLDs may require adjustments that reflect changes, such as the potential for elevated exposure rates due to modifications in operations or transportation of radiation sources. If intermittent or sporadic operations have significant potential for elevated environmental exposures, survey frequencies are adjusted.

Step 5: Develop the Decision Rules

Decision 1

On site, are members of the public and noninvolved workers exposed (if at all) to direct gamma radiation doses that are as low as reasonably achievable (ALARA)?

Obtain radiation exposure data near specific facilities or waste sites to assess the integrated effects of those operations. Measure on- and off-site external radiation exposure to assess the environmental effects and doses from unplanned releases.

- **If** the annual dose is statistically above 75.5 ± 10 mrem at a 2-sigma confidence interval, **then** investigate the cause of higher dose at the on-site location, and take corrective action to reduce the dose to normal background levels.
- Perform statistical tests to ascertain the variability in on-site, off-site, and natural background exposures. **If** the variability is higher than normal, **then** notify the facility manager of corrective actions.
- **If** the TLD readings continue to remain above normal background, **then** radiological access/ postings or other corrective actions should be taken, and the radiological manager should be informed about the high exposure facility/areas.

Decision 2

At the site perimeter and in nearby communities, is the external radiation exposure from site operations known and in the range of natural background levels?

If the annual dose is statistically above 71.5 ± 7.9 mrem at a 2-sigma confidence interval, **then** investigate the cause of higher dose at the off-site location to keep the dose ALARA.

Step 6: Specify Acceptable Limits on Decision Areas

The TLD readings' arithmetical average, normalized to 365 days, is acceptable at 72 ± 8 mrem/year at 2 sigma.

Step 7: Optimize the Design

The TLD data will be evaluated on a quarterly basis to upgrade the monitoring program until dose rates are at normal background levels or a radiological boundary is posted. BNL's personnel dosimetry program participates in the DOE Laboratory Accreditation Program (DOELAP) every two years, and must meet specified interlaboratory comparison performance goals. The TLD program at BNL is DOELAP-accredited for use of TLD dosimeters for personnel radiation monitoring purposes. Although no comparable DOE program exists for environmental monitoring, BNL has participated in the field testing of a proposed comparable program and has incorporated the key features into the BNL environmental monitoring program. The quality control features in this program are in the following list.

- Calibration, maintenance, and audits of the TLD reading/recording system
- Evaluation of anomalous data
- Personnel training
- Following procedures, which includes maintaining records

The quality control program within the personnel monitoring group achieves routine quality control of the TLD process cycle. The quality control program provides a measure of the quality of the complete TLD processing cycle. Intercomparison studies are conducted to determine and document TLD processing performance.

Anomalous TLD results are evaluated promptly to confirm or dismiss unusual results. Investigation into an anomalous result includes, as necessary, verification of the quality of the result (sampling and analytical aspects), questioning staff at facilities near the location with anomalous results about unusual situations, reviewing nearby air sampling results, and following up with immediate portable instrument measurements and/or gamma spectroscopy.

The TLDs are handled carefully during transport to keep them away from significant external radiation fields that would generate false positive data. Comments describing any unusual handling of TLDs or any findings that may affect TLD results are recorded in the field notebook. Sample collection and handling procedures are documented in EM-SOP-502, *Placement and Collection of Thermoluminescent Dosimeters*.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Increase: 15 TLDs

Purchase price of one TLD (\$40) x number of TLDs (15)	\$600
Cost of reading one TLD (\$25) x total number of readings for 15 TLDs (60)	\$1,500
Total Cost of Change	\$2,100

TOTAL COST OF THE MONITORING PROGRAM

Adding 15 TLDs will lead to an increase in program costs of \$2,100.

CY 2002 cost	\$7,100
CY 2003 cost	\$9,200
Difference	\$2,100

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Benny Hooda (631) 344- 8107

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8 FLORA, FAUNA, PRECIPITATION, AND SOILS

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FISH, SHELLFISH, AQUATIC VEGETATION, AND SEDIMENT

DATE 10-30-02

SUMMARY OF CHANGES

- Eliminate duplicative efforts with surface water monitoring
- Eliminate shellfish sampling
- Eliminate marine sediment sampling
- Eliminate marine vegetation sampling
- Eliminate marine water sampling
- Continue fish, vegetation, and sediment sampling off site along the Peconic River, Swan Pond, and Lower Lake on the Carmans River
- Continuation of fish population surveys on site at BNL

DESCRIPTION AND TECHNICAL BASIS

BNL has historically carried out surveillance monitoring of fish, shellfish, aquatic vegetation, sediments and water within the Peconic River and control locations. The purpose of the surveillance monitoring has been in support of reactor operations, STP operations, environmental management programs (CERCLA), and the Peconic Estuary Program. Historic data typically indicates the presence of cesium-137, various heavy metals, polychlorinated biphenyls (PCBs), and certain pesticides within the various aquatic media at locations on site with declining concentrations downstream of BNL. Historic data consistently indicate that there is no effect from BNL operations far downstream of the site boundary and suggest that a reduction in the surveillance monitoring is justified. This DQO will establish the decision criteria to decrease or increase aquatic surveillance monitoring as necessary. This balanced approach will provide flexibility to the monitoring program.

Fish have been sampled since the early 1990s to support both reactor operations as well as discharge, monitoring, and environmental restoration activities. Fish sampling has historically occurred at several locations along the Peconic River, including on-site reaches, Swan Pond, Donahue's Pond, and Forge Pond, and at Lower Lake on the Carmans River (control location). Annual sampling on site at BNL between 1990 and 1999 has resulted in a depletion of the number and size of fish available for sampling. As a result, BNL sampling was suspended for at least three years to allow the fish population to recover. Results of sampling at other areas along the Peconic River have shown a decline in the levels of cesium-137 found in fish both over time and distance from BNL. However, fish sampling has also consistently shown the presence of PCBs, pesticides,

and some heavy metals, attributable to historical BNL practices, in fish tissues along the Peconic River.

Shellfish has been sampled since 1995 in the Peconic River from Connecticut Avenue downstream to the Peconic Bay, with control locations varying from place to place away from the river system. Shellfish sampling was conducted to document any potential impacts posed by BNL operations as well as to monitor contaminants potentially affecting the Peconic Estuary. Historic data has indicated levels of cesium-137 that can be considered background in nature (≤ 1.0 pCi/g wet weight), most likely due to atomic weapons testing fallout. The continued need for collecting shellfish samples at significant distances from BNL can now be evaluated, and sampling of shellfish can possibly be discontinued, provided adequate protocols are in place to allow for the resumption of shellfish sampling, should the need arise.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

- ☐ Compliance
- ☒ Support compliance
- ☒ Surveillance
- ☐ Restoration

DOE Order 5400.1, *General Environmental Protection Program* (1988), requires that DOE sites maintain surveillance to monitor the effects, if any, of DOE activities on the on- and off-site environment and natural resources. DOE Order 5400.5, *Radiation Protection of the Public and Environment* (1990), requires DOE sites to maintain surveillance monitoring for determining radiological impacts to the public and environment.

Surveillance monitoring to determine impacts from discharges from the Sewer Treatment Plant can also be considered a “best management practice” to ensure the early detection of potential contamination in order to better protect the public and environment.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Past practices at BNL have resulted in contaminants being released to the Peconic River System. These contaminants were released from the STP and entered the river at the discharge point with eventual migration downstream. Recent upgrades to the STP include treatment to a tertiary level and have greatly reduced the potential of future releases of contaminants (conventional and radiological). Radiological effects may have been lessened due to the E-ALARA process as well as sewer cleaning and remediation of the sand filter beds at the STP. However, there is always a slight potential that contaminants could be released in an upset situation (tritium and other contaminants are continually

released, under permit). The problem that exists for the monitoring program is documentation of the continued decline in existing contaminants, documentation of the success of future cleanup operations along the river should they take place, and having a mechanism to complete additional sampling of sediments, shellfish, and aquatic vegetation far downstream in the Peconic River and Peconic Estuary, should the need arise.

Step 2: Identify the Decision

The desired decisions for the fish, shellfish, vegetation, and sediment surveillance monitoring programs can be represented through the following questions:

- Are contaminants attributable to BNL operations present in fish, shellfish, vegetation, and sediment within the Peconic River System?
- Are fish populations and fish sizes on site large enough to support resumption of surveillance monitoring?
- Are the levels of known BNL-contributed contaminants declining in fish, vegetation, and sediment within the Peconic River System?
- Are cleanup actions reducing contaminants in fish, vegetation, and sediments within the Peconic River?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 include:

- DOE-established dose guideline of 10 mrem/year for the general public
- STP discharge monitoring data
- NYSDEC consumption guidelines: 15 lb/year/person of fish for dose assessment
- ESD field logs and records maintained by field sampling personnel
- ESD Environmental Monitoring standard operating procedures
- Documented remediation of contaminated river sediments
- Records of Decision for the STP remediation in OU V
- Historic aquatic vegetation sampling results
- Historic sediment sampling results
- Historic Peconic River surface water sampling results
- Historic shellfish results
- Historic fish results

Step 4: Define the Study Boundaries

The boundaries of this study include the Peconic River system from the STP outfall on site extending downstream to the Peconic Bay. Control locations for comparison data are

Lower Lake on the Carmans River for fish, sediment, and vegetation, and Moriches Bay for shellfish, sediment, and vegetation related to shellfish sampling. Sampling is carried out during the summer months when peak growth periods occur, generally June through September each year.

Step 5: Develop the Decision Rule

Decision 1

Are contaminants attributable to BNL operations present in fish, shellfish, vegetation, and sediment within the Peconic River System?

- **If** surveillance monitoring of fish, shellfish, vegetation, and sediments detect BNL-attributed contaminants such as heavy metals, cesium-137, PCBs, or pesticides, **then** surveillance monitoring shall continue.
- **If** historic data for fish, shellfish, vegetation, and sediment in an area of the Peconic River System indicates that BNL-attributed contaminants are not present or are at background levels or below, **then** surveillance monitoring shall be suspended. In a situation where surveillance monitoring in a section of the Peconic River is suspended, the following decision rule will apply.

If upstream surveillance monitoring of any media indicates increasing levels of a contaminant of concern, **then** an evaluation will be conducted under the ESD Environmental Event Response Procedure.

- **If** during the evaluation it is determined that additional monitoring is necessary, then monitoring at downstream locations, with appropriate control locations, will be reinstituted.

Decision 2

Are fish populations and fish sizes on site large enough to support resumption of surveillance monitoring?

If annual fish population and size surveys indicate that sufficient numbers of fish exist at large enough sizes, **then** surveillance monitoring of fish shall resume on site at BNL.

If annual fish population and size surveys indicate insufficient numbers of fish and/or fish are not of significant size for sampling, **then** surveillance monitoring will remain suspended and annual population and size surveys will continue to facilitate population recovery.

Note: In the above decision rules, “sufficient” body and population size means that enough fish exist to (1) support the preparation of a 1-kg-sample of each species desired and (2) be taken without disrupting the population. This requires that enough fish of reproductive age remain in the river for the population of each species to survive and reproduce so we are able to obtain surveillance samples the following year.

Decision 3

Are the levels of known BNL-contributed contaminants declining in fish, vegetation, and sediment within the Peconic River System?

Historic sampling of river flora and fauna has typically indicated that radionuclide concentrations are declining, while other contaminants have no consistent pattern of increase or decline.

- **If** trending continues to show declining levels of contaminants in fish, vegetation, and sediments, **then** re-evaluation of the monitoring program will occur when values reach background.
- **If** trends in contaminant concentrations in fish, vegetation, and sediment are found to be increasing, **then** an evaluation will be conducted under the ESD Environmental Event Response Procedure to review the data and determine any changes in the environmental monitoring requirements and whether further action should be taken.

Decision 4

Are remediation actions resulting in reduction of contaminants in fish, vegetation, and sediments within the Peconic River?

As cleanup of the upper reaches of the Peconic River is completed, surveillance monitoring should document the effectiveness of the cleanup.

- **If** surveillance-monitoring trends indicate a decline in contaminants in fish, vegetation, and sediments in the Peconic River, **then** surveillance will continue until values reach the background level (found in control locations). When values are at background levels, the need for further surveillance shall be evaluated.
- **If** surveillance-monitoring trends indicate a flat or climbing trend, **then** the data shall be reviewed and the need for modifications to the monitoring program shall be assessed.
- **If** the assessment indicates that further monitoring is necessary, **then** an evaluation under the ESD Environmental Event Response Procedure shall be completed to identify all aspects of the continued presence of contaminants in the Peconic River System.
- **If** the final decision is not to clean up the Peconic River, **then** the surveillance monitoring will continue until levels reach background levels, at which time the need for further surveillance will be determined.

Step 6: Specify Acceptable Error Tolerances

Because the upper reaches of the Peconic River are typically fed by the discharges from the BNL STP, the effects of these discharges must be monitored. Historic discharges

have resulted in various contaminants accumulating in river sediments. Monitoring data should be of sufficient quality to measure constituents to the same level of detection used for drinking water standards. False positives and negatives should be minimized and data should not have excessive qualifiers attached if the values are above minimum detection limits. Duplicate sampling will be submitted (when possible) at a rate of 10 percent of the sample collection in order to check and verify lab quality.

Step 7: Optimize the Design

In order to document recovery of fish populations and size classes in the on-site portion of the Peconic River, an annual survey will be conducted. The survey will utilize electro-shocking techniques to collect the highest number fish possible with reasonable effort. All fish collected will be identified to species, and at a minimum will have total body length measured. Total numbers sampled will be recorded. Areas of coverage will be (at a minimum) from 150 ft east of the east firebreak up to the outfall of the STP.

Fish sampling will include at least one sample of each species of fish, as is practical or available, including brown bullhead, creek chubsucker, pumpkinseed, chain pickerel, golden shiner, and largemouth bass. Fish from different feeding guilds (bait fish, bottom feeders, predatory fish, etc.) are sampled to document potential pathways of contaminants through the food chain and up to the level of potential human consumption (game fish). Samples will be taken from the following locations, including but not limited to, Swan Pond, Donahue's Pond, and Forge Pond on the Peconic River, and Lower Lake on the Carmans River (control location).

In addition to fish sampling from the above ponds, a sediment sample and a single vegetation sample of any abundant emergent aquatic plant will be taken. Sufficient material will be taken in order to complete analysis for gamma-emitting radionuclides, Sr-90, PCBs/pesticides, and metals.

2003 AQUATIC SURVEILLANCE MONITORING PROGRAM				
MATRIX	NUMBER OF SAMPLES	ANALYSIS	FREQUENCY	SAMPLE TYPE
Fish	33 + 3QA	Gamma	Annual	Grab
	33 + 3QA	Sr-90	Annual	Grab
	33 + 3QA	PCBs/Pesticides	Annual	Grab
	33 + 3QA	Metals	Annual	Grab
Vegetation	8 + 1QA	Gamma	Annual	Grab
	8 + 1QA	Sr-90	Annual	Grab
	8 + 1QA	PCBs/Pesticides	Annual	Grab
	8 + 1QA	Metals	Annual	Grab
Sediment	8 + 1QA	Gamma	Annual	Grab
	8 + 1QA	Sr-90	Annual	Grab
	8 + 1QA	PCBs/Pesticides	Annual	Grab
	8 + 1QA	Metals	Annual	Grab
Fish	Population Survey	Length & Width	Annual	Grab

TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

The proposed sampling program will result in a \$15,377 reduction in sampling and analysis cost.

FY2002 Costs	\$66,143
FY2003 Costs	\$50,766
Difference	-\$15,377

IMPLEMENTATION DATE January 1, 2003

POINT OF CONTACT Tim Green (631) 344-3091

FARM AND GARDEN VEGETABLES AND SOILS

DATE 10-30-02

SUMMARY OF CHANGES

There have been no off-site detections of BNL attributable radionuclides in farm vegetables and soil. Therefore, the following changes are proposed for this program.

- Discontinue annual farm vegetable sampling.
- Discontinue annual farm soil sampling.
- Apply graded approach to any future farm vegetable and soil sampling using BNL's air monitoring as a mechanism for determining sampling requirements.
- Conduct confirmatory sampling every five years for farm vegetables and soil.

On-site garden vegetable and soil sampling will continue.

DESCRIPTION AND TECHNICAL BASIS

Farm and garden vegetables and associated soils have been sampled in the past in order to document potential impacts from reactor operations and to address potential concerns on the part of the public. Sampling locations for farm vegetables and soil are downwind of Brookhaven National Laboratory (primarily northeast and southeast). Results from this sampling program have consistently indicated that no man-made radionuclides attributable to BNL operations have ever been found in any farm vegetation or soil in the local area. In 2000, BNL added on-site garden vegetables and soil from a garden at the apartment complex to the sampling program, with only one vegetable showing any detectable levels (and those were very low) of cesium-137, a radionuclide found in some on-site soils.

Historically, reactor operations had the potential to release fission products; therefore, downwind sampling was necessary to detect the presence of these materials in air, soil, water, and biota. The three reactors on site are no longer operating, as Chapter 3 discusses. The BGRR and HFBR shared a 300-ft stack for air emissions and the BMRR had its own 100-ft stack for air emissions. Due to the nature of the emissions from the reactors, both stacks required continuous emissions monitoring.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

_____	Compliance
<u> x </u>	Support compliance
<u> x </u>	Surveillance
_____	Restoration

DOE Order 5400.1, *General Environmental Protection Program* (1988), requires DOE sites to maintain surveillance monitoring to determine possible effects of DOE activities on the on- and off-site environment and natural resources. DOE Order 5400.5, *Radiation Protection of the Public and Environment* (1990), requires DOE sites to maintain surveillance monitoring for determining radiological impacts to the public and environment.

Surveillance monitoring to determine impacts from reactor operations can also be considered a “best management practice” to ensure the early detection of potential contamination in order to better protect the public and environment.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

The problem for study under this DQO is the conversion of the sampling program for farm vegetables and associated soil from an *annual* program to one in which sampling occurs once every five years, or as necessary as determined by other sampling procedures or the ESD Environmental Event Response Procedure, while maintaining the annual sampling program for garden vegetables grown on site as well as soils taken from the on-site garden.

Step 2: Identify the Decision

The desired decisions under this DQO can be stated as questions.

- Are radionuclides attributable to BNL operations present in off-site soil used to grow vegetables, and in the vegetables themselves?
- Does the cessation of reactor operations justify the suspension or reduction in frequency of farm and garden vegetable sampling?
- Will a graded approach to farm vegetable and soil sampling that allows for tiered sampling as needed or required based on results from monitoring other media (i.e., air, water, soil), be sufficiently protective of the public and environment?
- Does soil used to grow garden vegetables on site, and do the vegetables themselves, contain radionuclides attributable to BNL operations?

Step 3: Identify Inputs to the Decision

Inputs to support the decisions in Step 2 above are listed below:

- Date of reactor closures
- Historic farm and garden vegetation results as reported in *Site Environmental Reports*
- Identification of other points of air discharge that could potentially release long-lived radionuclides that could reach and be incorporated in farm and garden vegetables
- Prevailing wind direction
- Results from other monitoring data (e.g., air)
- ESD field logs and records maintained by field sampling staff
- ESD Environmental Monitoring standard operating procedures
- Documentation of the sampling and analysis program
- Historic soil analysis data from area farms, the BNL apartment area garden, and control locations

Step 4: Define the Study Boundaries

The areas for inclusion in this study are area farms downwind of Brookhaven National Laboratory. Based on prevailing winds, that includes farms to the northeast and southeast. Also included in the boundary is the on-site vegetable garden located at the apartment area, and control locations upwind of the Laboratory. Sampling would be conducted once every five years to confirm the presence or absence of anthropogenic radionuclides originating from BNL in farm vegetation, and annually for garden vegetables and soil taken on site.

Step 5: Develop the Decision Rule**Decision 1**

Are radionuclides attributable to BNL operations present in off-site soil used to grow farm vegetable,s and in the farm vegetables themselves?

If historical data on farm vegetables and soil indicate that no anthropogenic radionuclides attributable to BNL are present, **then** consider reduction or elimination of off-site farm vegetables and soil sampling.

Decision 2

Does the cessation of reactor operations justify the suspension or reduction in frequency of farm and garden vegetable sampling?

If all BNL research reactors are permanently shut down, **then** annual surveillance monitoring in support of reactor operations of local farm vegetables and soils can be discontinued. **If** BNL guests and apartment dwellers continue to utilize the on-site vegetable garden, **then** annual sampling of garden vegetables and the soil they grow in should continue, due to the continued presence of historic radionuclide contamination in some BNL soils.

Decision 3

Will a graded approach to farm and garden vegetable and soil sampling that allows for tiered sampling as needed or required, based on results from monitoring other media (i.e. air, water, soil), be sufficiently protective of the public and environment?

If surveillance monitoring under the air and soil programs indicate the presence of anthropogenic radionuclides at the BNL boundary air monitoring stations, or confirmatory sampling indicates the presence of radionuclides originating from BNL, **then** the BNL Environmental Event Response Procedure shall be followed to determine the need for resuming annual farm vegetable surveillance monitoring.

Decision 4

Does soil used to grow garden vegetables on site, and do the vegetables themselves, contain radionuclides attributable to BNL operations?

If garden vegetables and soils taken on site contain significant levels of radionuclides attributable to BNL operations, **then** the BNL Environmental Event Response Procedure shall be followed to determine the need to close or move the garden to a more appropriate location and inform gardeners of the identified contamination.

Step 6: Specify Acceptable Error Tolerances

Surveillance monitoring is used to identify areas that may be potentially affected by operations of BNL facilities. BNL has historically sampled local farm vegetation for the presence of anthropogenic radionuclides potentially released from BNL operations. Historic data indicates that no BNL-related anthropogenic radionuclides have ever been detected in nearby farm vegetation or soils. Since all BNL reactors are no longer operational, there should be no potential for the release of long-lived anthropogenic radionuclides from BNL operations. Other environmental surveillance (including on-site

soil, vegetation, and air monitoring) allow for early detection of operational constituents that could potentially affect human health and the environment. Confirmatory sampling every five years is designed to verify the continued absence of anthropogenic radionuclides originating from BNL. The ESD Environmental Event Response Procedure provides a mechanism for the reestablishment of annual surveillance sampling of farm vegetables and associated soils if necessary after a documented event and can be used should evidence of BNL-attributable radionuclides be discovered in confirmatory sampling.

Errors for radiological data associated with on-site garden vegetables and soil should be no larger than 20 percent at a 2-sigma significance level. Data with higher errors should be reviewed for accuracy and re-analysis or may be considered not to be valid data.

Step 7: Optimize the Design

Monitoring requirements for farm vegetation and associated soils are shown in the table on the facing page. These sampling and analysis requirements will be implemented every five years to confirm the continued absence of anthropogenic radionuclides attributable to BNL. The next scheduled sampling of farm vegetables would occur in 2007. Garden vegetables and associated soil will be sampled annually.

<i>2007 Farm Vegetables and Associated Soil Monitoring Program</i>		
<i>Analysis</i>	<i>Sampling Location</i>	<i>Frequency (times per summer)</i>
Radiological (gamma)	Lewin's Farm	5 to 7 vegetables 1 soil sample
	Bruno Farm	4 to 5 vegetables 1 soil sample
	Mays Farm	5 to 7 vegetables 1 soil sample
	Rt. 25 Farm	1 to 2 vegetables 1 soil sample
	River Road Farm	1 to 2 vegetables 1 soil sample
	Cornell Farm (control)	1 to 3 vegetables 1 soil sample

<i>Annual Garden Vegetables and Associated Soil Monitoring Program</i>		
Radiological (gamma)	BNL Garden	5 to 7 vegetables 1 soil sample

TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

Changing to a five-year sampling schedule for off-site produce and soils will result in a \$13,739 reduction in sampling and analysis costs for the program as a whole.

FY2002 Costs	\$17,206
FY2003 Costs	\$3,467
Difference	– \$13,739

IMPLEMENTATION DATE January 1, 2003

POINT OF CONTACT Tim Green (631) 344-3091

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PRECIPITATION MONITORING

DATE 10-30-02

PROPOSED CHANGES

There are no proposed changes. We will continue monitoring as in the past: two on-site locations will be sampled quarterly and analyzed for gross alpha/beta, gamma, tritium, and Sr-90.

DESCRIPTION AND TECHNICAL BASIS

BNL currently samples precipitation on a quarterly basis at two locations on site (Station P4 at the apartment area and S5 at the STP) in support of reactor operations. BNL's three reactors are all in permanent shutdown status. The BGRR ceased operations in 1968 and is currently undergoing decontamination and decommissioning. The HFBR was permanently closed in 1999 and has been placed in a safe and secure configuration. The BMRR was permanently closed in December 2000 and is also in a safe and secure configuration. Historical precipitation data has been reported as providing little if any indication of BNL-related radionuclides in precipitation. However, historical data within the past decade does indicate several high values of gross alpha/beta, tritium, and strontium-90 that had been considered erroneous but were never investigated. Although reactor operations have terminated, questions from historical precipitation data persist. Therefore, continued monitoring is warranted until sufficient documentation exists to discontinue monitoring.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

- ☐ Compliance
- ☒ Support compliance
- ☒ Surveillance
- ☐ Restoration

DOE Order 5400.1, *General Environmental Protection Program* (1988), requires that DOE sites maintain surveillance to monitor the effects, if any, of DOE activities on the on- and off-site environment and natural resources. DOE Order 5400.5, *Radiation Protection of the Public and Environment* (1990), requires DOE sites to maintain surveillance monitoring to determine radiological impacts to the public and environment.

Surveillance monitoring to determine impacts from BNL operations can also be considered a "best management practice" to ensure the early detection as well as long-term accumulation of potential contamination in order to better protect the public and environment.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Historical precipitation data suggests the occasional detection of radionuclides related to BNL operations. Therefore, the problem is that BNL-related radionuclides may be deposited in the environment through precipitation.

Step 2: Identify the Decision

The desired decision for precipitation monitoring is:

Does precipitation contain radionuclides attributable to BNL operations?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 are listed below.

- Historical precipitation data
- Closure of all nuclear reactors at BNL (source term)
- ESD sampling logs and field notebooks

Step 4: Define the Study Boundaries

This DQO only affects the current precipitation sampling at BNL stations P4 and S5. Sampling occurs on a quarterly basis at both locations. P4 is located near the apartment complex and S5 is located at the Sewage Treatment Plant. No off-site precipitation is collected for analysis.

Step 5: Develop the Decision Rule

Decision 1

Does precipitation contain radionuclides attributable to BNL operations?

If quarterly precipitation data show no evidence of BNL-related radionuclides, **then** report data as usual in the annual *Site Environmental Report* and continue quarterly monitoring.

If quarterly data indicate the potential presence of BNL-related radionuclides, **then** initiate the Environmental Event Response Procedure to investigate the data validity and source, and report the data in the annual *Site Environmental Report*.

If data covering a period of five years post-reactor operations indicate that no BNL-attributable radionuclides are present, **then** precipitation monitoring may be discontinued.

Step 6: Specify Acceptable Error Tolerances

Radiological data should have reported values with associated two-sigma errors no greater than 20 percent. All gross alpha values above 15 pCi/L should be analyzed to identify the nuclide-specific composition. For gross beta, the prompt for identification of the nuclide-specific composition is values above 50 pCi/L.

Step 7: Optimize the Design

Quarterly precipitation data should be acquired from both of the on-site precipitation-monitoring locations and analyzed for gross alpha/beta, tritium, and gamma emitting radionuclides. Results should be reported to the subject matter expert and reviewed quarterly, and any abnormalities in the data investigated accordingly.

<i>Precipitation Surveillance Monitoring</i>				
Matrix	No. of Samples	Analysis	Frequency	Type
Precipitation	8	Alpha/Beta	Annual	Grab
	8	Gamma	Annual	Grab
	8	Tritium	Annual	Grab
	8	Sr-90	Annual	Grab

TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

The sampling program described in Step 7 will result in no net change in sampling and analysis costs.

FY2002 Costs	\$3,065
FY2003 Costs	\$3,065
Difference	\$0

IMPLEMENTATION DATE January 1, 2003

POINT OF CONTACT Tim Green (631) 344-3091

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TERRESTRIAL VEGETATION AND SOIL MONITORING

DATE 10-30-02

SUMMARY OF CHANGES

- Establish the program as a “graded approach.”
- Any occurrence of air monitoring data above historical background levels would trigger sampling of terrestrial vegetation and soils.
- Small mammal samples above 10 pCi/g wet weight would result in soil and vegetation monitoring in the immediate vicinity if area is not known to contain radiological contaminants.

DESCRIPTION AND TECHNICAL BASIS

Historical operations of Brookhaven National Laboratory have resulted in the distribution of cesium-137 (Cs-137) in landscape soils. The majority of this contamination has been remediated. However, low levels of cesium-137 remain in specific landscape areas at or below cleanup goals. In addition, soils at or below cleanup goals in these areas have been covered with clean fill material six to twelve inches in depth. Other areas containing higher levels of cesium-137 contamination are either in the process of cleanup or are scheduled for cleanup. The continued presence of soil contamination and the potential for uptake by plants and the potential to pass it along to animals must be monitored. This monitoring can be performed under a graded approach using small mammal sampling.

The terrestrial vegetation and soil-monitoring program at BNL is being designed to supplement and support other monitoring efforts in a graded approach. Historically, soil and vegetation monitoring have been somewhat limited to farm and garden vegetation and soils associated with the locations where the produce was sampled. This sampling had been conducted in support of reactor operations to document impacts or lack thereof from these operations. Since the farm and garden vegetable sampling is linked to reactor operations and the reactors have been placed into a permanent shutdown mode, sampling is no longer necessary. In addition, since all other current operations only produce short-lived radionuclides that are not transported at significant distances, the need for continuous or routine soil and vegetation monitoring is no longer necessary.

In addition, vegetation and soil sampling occurred along with sampling of goose fecal material in an attempt to document uptake of Cs-137 by the geese. The goose fecal material study lasted for two years, with only slight indications that geese are obtaining Cs-137 through ingestion. That program was dropped because it was not precise enough to provide a clear indication of uptake. Therefore, the terrestrial vegetation and soil monitoring should continue in a graded approach in order to document any effects that

BNL operations may have on the local environment. As stated above, this approach will be graded based on results from surveillance air monitoring and surveillance small mammal monitoring.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

- ☐ Compliance
- ☒ Support compliance
- ☒ Surveillance
- ☐ Restoration

DOE Order 5400.1, *General Environmental Protection Program* (1988), requires that DOE sites maintain surveillance to monitor the effects, if any, of DOE activities on the on- and off-site environment and natural resources. DOE Order 5400.5, *Radiation Protection of the Public and Environment* (1990), requires DOE sites to maintain surveillance monitoring for determining radiological impacts to the public and environment.

Surveillance monitoring to determine impacts from BNL operations can also be considered a “best management practice” to ensure the early detection of long-term accumulation of potential contamination to better protect the public and environment.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

BNL has been in operation since 1947. This long history of operation has included various large-scale experiments as well as large user facilities such as reactors and accelerators. The primary source of potential contamination was the operation of reactors. Since all reactor operations have been permanently shut down, the need for continued soil and vegetation monitoring is less necessary and can be carried out under a graded approach. Since air monitoring is conducted at six fixed positions, it is reasonable to expect that any deposition of airborne materials would occur at the same location. Therefore, in order to support the air-monitoring program, both soil and vegetation samples should be obtained from the vicinity of the six air monitoring locations when radionuclides attributable to BNL or particulate contamination are detected that may affect biota. In addition, small mammal (squirrel) sampling indicates that squirrels may periodically uptake contamination in a limited area. This can trigger a graded requirement for soil and vegetation sampling if unusually high concentrations (levels greater than 10 pCi/g, wet weight of cesium-137) of radionuclides are detected in squirrel tissues.

Step 2: Identify the Decision

The desired decision for this monitoring program can be stated as follows.

- Will a graded approach to soil and vegetation monitoring using the results of air and small mammal sampling be protective of the environment?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 are listed below.

- DOE-established dose to biota guidelines of 1 mrad/day for flora and fauna
- ESD field logs and records maintained by field sampling personnel
- ESD Environmental Monitoring standard operating procedures
- Closure reports for Landscape Soils Remediation
- Project work plans for Operable Units I, IV, and VI
- Historic soil and vegetation data
- Historic and current air monitoring data

Step 4: Define the Study Boundaries

The boundaries of this study include the entire BNL site as well as control locations west and northwest of the Laboratory. Deposition of airborne particulates is likely to occur at any location on the Laboratory, but detection is most likely in the downwind sectors. For this reason, soil and vegetation samples will primarily be taken in the vicinity of air monitoring stations (six locations) when air monitoring indicates that sampling is needed. In addition, soil and vegetation monitoring will occur near small mammal sampling when results indicate Cs-137 concentrations greater than 10 pCi/g wet weight in tissues. Small mammal sampling occurs quarterly. Data are received and reviewed on a quarterly basis. Air monitoring occurs on a routine basis and allows for early detection of potential environmental releases. If airborne contaminants that may affect biota are detected at levels above historic background, soil and vegetation sampling can be carried out.

Step 5: Develop the Decision Rule

Decision 1

Will a graded approach to soil and vegetation monitoring using results of air and small mammal sampling be protective of the environment?

If small mammal sampling results indicate gamma-emitting radionuclides (primarily cs-137) at levels greater than 10 pCi/g, **then** the location will be reviewed in order to determine if it is an area in or adjacent to known historic contamination.

If the area is not a known location of historic contamination, **then** vegetation and soil samples will be obtained in an attempt to locate the specific source of the contamination.

If air monitoring identifies particulates containing levels of gamma-emitting radionuclides higher than historic background levels, **then** soil and vegetation samples will be taken near the air station with the higher than background detection levels.

If soil and vegetation sampling is triggered, and results indicate an area of previously unknown contamination or levels higher than establish cleanup criteria, **then** an evaluation will be completed under the ESD Environmental Event Response Procedure to determine a path forward.

Step 6: Specify Acceptable Error Tolerances

Terrestrial vegetation and soil sampling will be conducted based on a graded approach that relies on the detection of contaminants in small mammals and air samples. Therefore, it is acceptable to act on reasonable data. If air samples confirm the presence of contaminants potentially affecting soil and vegetation (i.e., above historic background levels), then it is prudent to obtain soil and vegetation samples to verify effect or lack thereof in these media. Likewise, when small mammal sampling indicates the presence of Cs-137 (known to be present at BNL) at levels greater than 10 pCi/g wet weight and the animal was taken in an area not known to have contamination, it is prudent to locate and verify the presence or absence of that contamination in the soil and vegetation in the vicinity where the small mammal was obtained. Likewise if small mammals are sampled in an area that has been cleaned up and have Cs-137 above 10 pCi/g, soil and vegetation sampling should occur to verify the source.

Step 7: Optimize the Design

If air sampling indicates the presence of a contaminant in the particulate filters above historic background levels, soil and vegetation sampling will occur within 100 ft of the air monitoring station. Four soil samples and four vegetation samples will be taken following established procedures. One sample of each media will be taken in each of the four major compass directions to document whether the airborne contaminant is

detectible in either the soil or vegetation. When a small mammal is sampled and a positive result above 10 pCi/g wet weight is obtained, the Subject Matter Expert will visit the location and determine the sampling requirements and area to be covered. Sampling triggered by small mammal data will initially not exceed 10 soil and 10 vegetation samples within the designated sampling area. When soil and vegetation sampling occurs, at least one off-site soil and vegetation sample must be obtained from established background locations.

Historically, at least one small mammal sample results in a Cs-137 concentration greater than 10 pCi/g wet weight. Therefore, the following tables are based on 10 soil and 10 vegetation samples analyzed for gamma emitting radionuclides annually.

<i>Terrestrial Soil and Vegetation Surveillance Monitoring</i>				
Matrix	Number of Samples	Analysis	Frequency	Type
Vegetation	10 + 1QA	Gamma	Annual	Grab
Soil	10 + 1QA	Gamma	Annual	Grab

TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

The sampling program described in Step 7 will result in no net change in sampling and analysis cost.

FY2002 Costs	\$8,474
FY2003 Costs	\$8,474
Difference	\$0

IMPLEMENTATION DATE January 1, 2003

POINT OF CONTACT Tim Green (631) 344-3091

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DEER AND SMALL MAMMAL SAMPLING

DATE 10-30-02

SUMMARY OF PROPOSED CHANGES

No changes compared to 2002.

DESCRIPTION AND TECHNICAL BASIS

BNL has documented the presence of the radionuclide cesium-137 (Cs-137) within landscape soils and other operational areas on site. Faunal monitoring of various wildlife species in 1992 identified the presence of Cs-137 in the tissue of deer and other small mammals. Of all the mammals inhabiting BNL, deer are the only species that are in the direct consumption pathway of humans. Deer are known to acquire Cs-137 through the ingestion of vegetation that has Cs-137 uptake as well as by direct ingestion of contaminated soils. In 1996, BNL began a program of sampling deer on and off site for gamma analysis of meat and liver. Strontium-90 analysis in bone was added to the program in 2000 in order to investigate levels present in this matrix. Statistical analysis on the sampling requirements of deer taken through 1998 suggested that 25 samples on site and 40 samples off site were necessary to have sufficient confidence in detecting the average presence of Cs-137 within the deer population. Fewer samples were required on site due to the fact that Cs-137 is known to be higher in on-site deer. The higher number of off-site samples was needed to verify the lower concentrations seen off site. It should be noted that in most years the required number of samples has not been acquired due to the method of acquisition (road-killed deer or hunter donations).

Landscape soils containing Cs-137 were remediated in 2000, with the remaining contamination at or below assigned clean-up standards. Other areas known to contain Cs-137 include the 650 Sump Outfall, Sewage Treatment Plant sand filter beds, and the Former Hazardous Waste Management Facility. These locations are either in the process of being remediated or are scheduled for future cleanup.

In 2000, BNL began sampling squirrels in order to build a baseline of information on small mammals. Squirrels were chosen because of the ease of obtaining samples, the similarity of their diet to that of deer (except that deer also ingest soil), and squirrels' smaller home range. The smaller home range enables BNL ecologists to determine where an animal may have obtained contamination, should any be found. Sampling squirrels also allows for a much broader understanding of where radiological contamination at BNL exists because samples can be gathered across the Laboratory site instead of relying on road kill, as in the current deer-sampling program.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

_____	Compliance
_____	Support compliance
<u> x </u>	Surveillance
_____	Restoration

DOE Order 5400.1, *General Environmental Protection Program* (1988), requires that DOE sites maintain surveillance to monitor the effects, if any, of DOE activities on the on- and off-site environment and natural resources. DOE Order 5400.5, *Radiation Protection of the Public and Environment* (1990), requires DOE sites to determine radiological impacts to the public and environment.

Surveillance monitoring to determine impacts from past practices can be considered a “best management practice” to ensure the early detection of potential radiological contamination in order to better protect the public and environment.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Past practices at BNL have resulted in soil contaminated with Cs-137. Although most areas of radiological soil contamination have been remediated, two areas with higher contamination (STP and HWMF) are in the process of cleanup or are scheduled for cleanup in the next few years. Regardless of when cleanup is completed, low levels of radiological contamination will persist in the environment and may be available to wildlife through the consumption of plants contaminated via uptake from the soil, or through the direct consumption of contaminated soils. To determine the impact of Cs-137 on wildlife and the potential for transfer to the human food pathway, BNL should monitor the deer population to track and trend Cs-137 levels tissues that are normally eaten. In addition, since small mammals have smaller home ranges, a program to monitor small mammals should be maintained to refine the understanding of Cs-137 contamination on site.

Step 2: Identify the Decision

The desired decisions for the deer and small mammal surveillance monitoring programs are:

- Are cesium-137 levels in deer meat above levels considered protective of human health?

- Are the cesium-137 levels in deer continuing to decline after remediation of contaminated soils?
- Are levels of cesium-137 in deer from areas within one mile of the BNL identical to on-site levels?
- Do small mammals (squirrels) accurately depict cesium-137 contamination across the Laboratory site?
- Can small mammals be a surrogate sampling medium for deer?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 are listed below.

- DOE-established dose guideline of 10 mrem/year for the general public
- NYSDOH guideline consumption rate - 64 lb/year/person of deer meat > 6.9 pCi/g of cesium-137 (wet weight)
- Field logs and records maintained by ESD field sampling personnel
- ESD environmental monitoring SOPs
- Documented remediation of radiologically contaminated soils
- Records of Decision for Operable Units I, IV, and VI
- Historic vegetation sampling results
- Historic soil sampling results
- Special vegetation sampling results
- Historic deer and small mammal sampling results

Step 4: Define the Study Boundaries

The boundaries of the study include a comparison of deer taken on site and those taken within one mile of BNL's boundary, as well as deer taken more than one mile from BNL (generally considered background or control deer). Sampling is conducted annually (with trends developed for a rolling five-year period) and is conducted as evenly across months as can be achieved through opportunistic sampling of deer killed in vehicle accidents.

The study boundary for small mammal sampling is within the BNL property, with control samples taken at distances greater than one mile from the Lab. Sampling is on an annual basis, with sample events spread across the four calendar quarters.

Step 5: Develop the Decision Rules

Decision 1

Are cesium-137 levels in deer meat above levels considered protective of human health?

If the monitoring data show the data to be consistently below 6.9 pCi/g wet weight, **then** the monitoring will be maintained.

If deer meat samples suggest an average annual value of cesium-137 higher than 6.9 pCi/g wet weight, **or** if a single value in a deer sample is higher than 11.64 pCi/g wet weight (highest value to date), **then** an evaluation will be conducted under the ESD Environmental Event Response Procedure to determine the path forward.

Decision 2

Are the cesium-137 levels in deer continuing to decline after remediation of contaminated soils?

If cesium-137 levels in on-site deer meat samples indicate a continued decline after remediation of contaminated soils, **then** monitoring will be maintained.

If cesium-137 levels in on-site deer reach background levels, **then** a review of the program and data will determine whether the program should continue.

If cesium-137 values in on-site deer meat samples begin to increase after remediation of contaminated soils, **then** an evaluation will be conducted under the ESD Environmental Event Response Procedure to determine the path forward.

Decision 3

Are levels of cesium-137 in deer from areas within one mile of BNL identical to on-site levels?

If cesium-137 concentrations in deer meat samples taken within one mile of BNL are statistically the same as on-site values, **then** monitoring will be maintained.

If cesium-137 concentrations in deer meat samples taken within one mile of BNL indicate an increasing trend or steady trend compared to on-site values, **then** an investigation will be conducted under the Environmental Event Response Procedure to determine the path forward.

Decision 4

Do small squirrels accurately depict cesium-137 contamination across the Laboratory site?

If squirrel sampling clearly shows cesium-137 contamination in wildlife across the Laboratory site, **then** the sampling program will be reviewed for a possible reduction in deer sampling and increase in squirrel sampling.

If squirrel sampling does not appear to provide a clear indication of cesium-137 contamination in wildlife across the Laboratory, **then** small mammal sampling shall be reviewed for reduction or elimination.

Decision 5

Can small mammals be an alternate sampling medium for deer?

If statistical comparison of on-site small mammal sampling data and on-site deer data for cesium-137 indicates that small mammal data are comparable to deer data, **then** the faunal monitoring program will be evaluated for a possible reduction in deer sampling and increased sampling of small mammals.

If statistical comparison of small mammal and deer data indicates that they are not similar or comparable, **then** the small mammal sampling will be considered for elimination.

Step 6: Specify Acceptable Error Tolerances

The presence of cesium-137 in some deer samples indicates that cesium-137 in the environment is available to humans through the ingestion pathway. Hunters take approximately 2,000 deer each year in Suffolk County, some of which are obtained within one mile of BNL. In the past, high values have been examined, considered to be accurate, and released to the general public, then subsequently discovered to be in error. The values were, in fact, much lower than first reported. This “false positive” caused substantial concern to the community at large. False positives should be minimized. All values greater than historic high values are to be investigated and verified through multiple retesting. Cesium-137 is the single highest contributing factor for potential exposures to the general public from BNL operations. BNL must have an accurate understanding of cesium-137 distribution in deer.

Small mammal sampling was initiated in 2000 to determine its appropriateness as a surrogate for deer sampling. Out of twenty on-site samples over two years, three samples could be considered high for cesium-137 in comparison to all others. The three samples originated near known sources of cesium-137 contamination. Because squirrels are available to other wildlife as a food source, having an understanding of where squirrels are acquiring cesium-137 is important in order to protect other wildlife. Accuracy of data is important to verify the presence or absence of cesium-137 concentrations in the squirrels sampled.

Step 7: Optimize the Design

To get sufficient data for comparison and in order to be statistically sound, samples must be taken both on and off site. Past efforts indicate that 25 on-site and 40 off-site samples should be obtained annually in order to produce a statistically accurate average concentration for cesium-137 in deer tissues. The lower number of on-site samples is due to the higher concentration of cesium-137 in on-site deer, which results in better detection. The higher number of samples off site is necessary due to the high incidence of nondetections and very low detectable levels in off-site deer. All deer sampled will be tested for gamma-emitting radionuclides in the flesh (meat) and liver (when available), and strontium-90 in bone (when available).

BNL historically has relied on opportunistic sampling through hunter donations and notification of road-killed deer on site. BNL recently (2002) acquired the ability to selectively sample deer on site. Therefore, BNL should utilize both methods of obtaining deer for sampling purposes on site (e.g., continue utilizing road-killed deer, but supplement this by obtaining the number of deer necessary to reach the required 25). Selective sampling should utilize five designated sampling locations that have been established on the Laboratory property. Off-site sampling of up to 40 deer will still be conducted through collection of road-killed deer and acceptance of hunter donations, and acceptance of deer obtained through donation by other agencies such as the New York State Department of Environmental Conservation and the U.S. Fish & Wildlife Service. Small mammal sampling requires that 10 squirrels be collected from random locations around the Laboratory using live traps. Collection of the 10 samples will be spread across four quarters during each sampling. In addition, four squirrels (one per quarter) must be obtained from an off-site control location for comparative purposes. All samples will be analyzed for gamma-emitting radionuclides in the flesh (meat) of the animal as well as strontium-90 in the bone.

<i>2003 Deer and Small Mammal Sampling Program</i>				
Deer	No. of Samples	Analysis	Frequency	Sample Type
Flesh (meat)	25 on site 40 off site + 6 QA	Gamma	Annually	Grab
Liver (as available)	25 on site 40 off site +6 QA	Gamma	Annually	Grab
Bone (as available)	25 on site 40 off site + 6 QA	Sr-90	Annually	Grab
Squirrel	No. of Samples	Analysis	Frequency	Sample Type
Flesh (meat)	10 on site 4 off site 1 QA	Gamma	Annually (divided quarterly)	Grab
Bone	10 on site 4 off site 1 QA	Sr-90	Annually (divided quarterly)	Grab

TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

CY2002 cost   \$46,206

CY2003 Cost   \$46,206

Difference   \$0

IMPLEMENTATION DATE January 1, 2003

POINT OF CONTACT   Tim Green (631) 344-3091

9 LIQUID EFFLUENTS

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AQUATIC SURVEILLANCE MONITORING PROGRAM (FISH, SHELLFISH, AQUATIC VEGETATION, AND SEDIMENT)

DATE 10-30-02

SUMMARY OF CHANGES

- Elimination of duplicative efforts with surface water monitoring
- Elimination of shellfish sampling
- Elimination of marine sediment sampling
- Elimination of marine vegetation sampling
- Elimination of marine water sampling
- Continuation of fish, vegetation, and sediment sampling off site along the Peconic River, Swan Pond, and Lower Lake Carmans River
- Continuation of fish population surveys on site at BNL

DESCRIPTION AND TECHNICAL BASIS

Brookhaven National Laboratory has historically carried out surveillance monitoring of fish, shellfish, aquatic vegetation, sediments and water within the Peconic River and control locations. The purpose of the surveillance monitoring has been in support of reactor operations, sewage treatment plant operations, environmental management programs (CERCLA), and the Peconic Estuary Program. Historic data typically indicates the presence of cesium-137, various heavy metals, polychlorinated biphenyls (PCBs), and certain pesticides within the various aquatic media at locations on site with declining concentrations downstream of BNL. Historic data indicate that there is no effect from BNL operations far downstream of the site boundary and suggest that a reduction in the surveillance monitoring is justified. This DQO will establish the decision criteria to decrease and/or increase aquatic surveillance monitoring as necessary. This balanced approach will provide flexibility to the monitoring program.

Fish have been sampled since the early 1990s to support both reactor operations as well as discharge, monitoring, and environmental restoration activities. Fish sampling has historically occurred at several locations along the Peconic River including on-site reaches, Swan Pond, Donahue's Pond and Forge Pond, and at Lower Lake on the Carmans River (control location). Annual sampling on site at BNL between 1990 and 1999 has resulted in a depletion of the number and size of fish available for sampling. As a result, BNL sampling was suspended for at least three years to allow the fish population to recover. Results of sampling at other areas along the Peconic River have shown a decline in the levels of cesium-137 found in fish both over time and distance from BNL. However, fish sampling has also consistently shown the presence of

PCBs, pesticides, and some heavy metals attributable to historical BNL practices in fish tissues along the Peconic River.

Shellfish has been sampled since 1995 within the Peconic River from Connecticut Avenue down to the Peconic Bay, with control locations varying from place to place away from the Peconic River System. Shellfish sampling was conducted to document any potential impacts posed by BNL operations as well as to monitor contaminants potentially affecting the Peconic Estuary. Historic data has indicated levels of cesium-137 that can be considered background in nature (≤ 1.0 pCi/g wet weight) most likely due to atomic weapons testing fallout. The continued need for collecting shellfish samples at significant distances from BNL can now be evaluated, and sampling of shellfish can possibly be discontinued, provided adequate protocols are in place to allow for the addition of shellfish sampling should the need arise.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

- ☐ Compliance
- ☒ Support compliance
- ☒ Surveillance
- ☐ Restoration

DOE Order 5400.1, General Environmental Protection Program (1988), requires that DOE sites maintain surveillance to monitor the effects, if any, of DOE activities on the on- and off-site environment and natural resources. DOE Order 5400.5, Radiation Protection of the Public and Environment (1990), requires DOE sites to maintain surveillance monitoring for determining radiological impacts to the public and environment.

Surveillance monitoring to determine impacts from discharges from the Sewer Treatment Plant can also be considered a “best management practice” to ensure the early detection of potential contamination in order to better protect the public and environment.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Past practices at BNL have resulted in contaminants being released to the Peconic River System. These contaminants were released from the Sewage Treatment Plant and entered the river at the discharge point with eventual migration down stream. Recent upgrades to the STP include treatment to a tertiary level and have greatly reduced the potential of future releases of contaminants (conventional and radiological). Radiological lessened due to the E-ALARA process as well as sewer cleaning and remediation of the sand filter beds at the STP. However, there is always a slight potential that contaminants could be release in an upset situation (tritium and other contaminants are continually released, under permit). The problem that exists for the monitoring program is documentation of the continued decline in existing contaminants, documentation of the success of future cleanup operations along the river should they take place, and having a mechanism to complete additional sampling of sediments, shellfish, and aquatic vegetation far downstream in the Peconic River and Peconic Estuary should the need arise.

Step 2: Identify the Decision

The desired decisions for the fish, shellfish, vegetation, and sediment surveillance monitoring programs can be represented through the following questions.

- Are contaminants attributable to BNL operations present in fish, shellfish, vegetation, and sediment within the Peconic River System?
- Are fish populations and fish sizes on site large enough to support resumption of surveillance monitoring?
- Are the levels of known BNL contributed contaminants declining in fish, vegetation, and sediment within the Peconic River System?
- Are cleanup actions reducing contaminants in fish, vegetation, and sediments within the Peconic River?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 are listed below.

- DOE-established dose guideline of 10 mrem/year for the general public
- NYSDEC guideline of consumption rate - 15 lb/year/person of fish for dose assessment
- ESD field logs and records maintained by field sampling personnel
- ESD Environmental Monitoring standard operating procedures
- Documented remediation of contaminated river sediments
- Records of Decision for the Sewage Treatment Plant remediation in Operable Unit V
- Historic aquatic vegetation sampling results
- Historic sediment sampling results
- Historic Peconic River surface water sampling results
- Historic shellfish results
- Historic fish results

Step 4: Define the Study Boundaries

The boundaries of this study include the Peconic River system from the STP outfall on site extending down to the Peconic Bay. Control locations for comparison of data are obtained from Lower Lake on the Carmans River for fish, sediment, and vegetation, and Moriches Bay for shellfish, sediment, and vegetation related to shellfish sampling. Sampling is carried out during

the summer months when peak growth periods occur in fish, shellfish, and vegetation, generally June through September each year.

Step 5: Develop the Decision Rule

Decision 1

Are contaminants attributable to BNL operations present in fish, shellfish, vegetation, and sediment within the Peconic River System?

If surveillance monitoring of fish, shellfish, vegetation, and sediments detect BNL-attributed contaminants, such as heavy metals, cesium-137, PCBs, or pesticides, **then** surveillance monitoring shall continue.

If historic data for fish, shellfish, vegetation, and sediment in an area of the Peconic River System indicates that BNL-attributed contaminants are not present or are at background levels or below, **then** surveillance monitoring shall be suspended. In a situation where surveillance monitoring in a section of the Peconic River is suspended the following decision rule will apply.

If upstream surveillance monitoring of any media indicates increasing levels of a contaminant of concern, **then** an evaluation will be conducted under the ESD Environmental Event Response Procedure.

If during the evaluation it is identified that additional monitoring is necessary, **then** monitoring at downstream locations, with appropriate control locations, will be re-instituted.

Decision 2

Are fish populations and fish sizes on site large enough to support resumption of surveillance monitoring?

If annual fish population and size surveys indicate that sufficient numbers of fish exist at large enough sizes, **then** surveillance monitoring of fish shall resume on site at BNL.

If annual fish population and size surveys indicate insufficient numbers of fish and/or fish are not of significant size for sampling, **then** surveillance monitoring will remain suspended and annual population and size surveys will continue to facilitate population recovery.

Note: In the above decision rules, sufficient population size and body size means that sufficient numbers of fish exist to (1) allow collection of enough fish to make a 1 kg-sample of each species desired and (2) be taken without disrupting the population. This requires that enough fish of reproductive age remain in the river for the population of each species to survive and reproduce so we are able to obtain surveillance samples the following year.

Decision 3

Are levels of known contaminants attributable to BNL operations declining in fish, vegetation, and sediment within the Peconic River System?

Historic sampling of river flora and fauna has typically indicated that radionuclide concentrations are declining, while other contaminants have no consistent pattern of increase or decline. Therefore, **if** trending continues to show declining levels of contaminants in fish, vegetation, and

sediments, **then** re-evaluation of the monitoring program will occur when values reach background.

If trends in contaminant concentrations in fish, vegetation, and sediment are found to be increasing, **then** an evaluation will be conducted under the ESD Environmental Event Response Procedure to review the data and determine any changes in the environmental monitoring requirements and whether further action should be taken.

Decision 4

Are remediation actions resulting in reduction of contaminants in fish, vegetation, and sediments within the Peconic River?

As cleanup of the upper reaches of the Peconic River is completed, surveillance monitoring should document the effectiveness of the cleanup.

If surveillance-monitoring trends indicate a decline in contaminants in fish, vegetation, and sediments in the Peconic River, **then** surveillance will continue until values reach the background level (found in control locations). When values are at background levels, the need for further surveillance shall be evaluated.

If surveillance-monitoring trends indicate a flat or climbing trend, **then** the data shall be reviewed and the need for modifications to the monitoring program shall be assessed.

If the assessment indicates that further monitoring is necessary, **then** an evaluation under the ESD Environmental Event Response Procedure shall be completed to identify all aspects of the continued presence of contaminants in the Peconic River System.

If the final decision is not to clean up the Peconic River, **then** the surveillance monitoring will continue until levels reach background; then, the need for further surveillance will be determined.

Step 6: Specify Acceptable Error Tolerances

Because the upper reaches of the Peconic River are typically fed by the discharges from the BNL Sewage Treatment Plant, the effects of these discharges must be monitored. Historic discharges have resulted in various contaminants being released to and accumulating in river sediments. Monitoring data should be of sufficient quality to measure constituents to the same level of detection used for drinking water standards. False positives and negatives should be minimized and data should not have excessive qualifiers attached if the values are above minimum detection limits. Duplicate sampling will be submitted (when possible) at a rate of 10 percent of the sample collection in order to check and verify lab quality.

Step 7: Optimize the Design

In order to document recovery of fish populations and size classes in the on-site portion of the Peconic River, an annual survey will be conducted. The survey will utilize electro-shocking techniques to collect the highest number fish possible with reasonable effort. All fish collected will be identified to species, and at a minimum will have total body length measured. Total numbers sampled will be recorded. Areas of coverage will be at a minimum from 150 ft east of the east firebreak up to the outfall of the STP.

Fish sampling will include at least one sample of each species of fish, as is practical or available, including brown bullhead, creek chubsucker, pumpkinseed, chain pickerel, golden shiner, and largemouth bass. Fish from different feeding guilds (bait fish, bottom feeders, predatory fish, etc.) are sampled to document potential pathways of contaminants through the food chain and up to the level of potential human consumption (game fish). Samples will be taken from the following locations, including but not limited to, Swan Pond, Donahue's Pond, and Forge Pond on the Peconic River, and Lower Lake on the Carmans River (control location).

In addition to fish sampling from the above ponds, a sediment sample and a single vegetation sample of any abundant emergent aquatic plant will be taken. Sufficient material will be taken in order to complete analysis for gamma-emitting radionuclides, Sr-90, PCBs/pesticides, and metals.

TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

The sampling program will result in a \$15,377 reduction in sampling and analysis cost.

FY2002 Costs   \$66,143

FY2003 Costs   50,766

Difference   –\$15,377

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Tim Green (631) 344-3091

2003 Aquatic Surveillance Monitoring Program				
Matrix	Number of Samples	Analysis	Frequency	Sample Type
Fish	33 + 3QA	Gamma	Annual	Grab
	33 + 3QA	Sr-90	Annual	Grab
	33 + 3QA	PCBs/Pesticides	Annual	Grab
	33 + 3QA	Metals	Annual	Grab
Vegetation	8 + 1QA	Gamma	Annual	Grab
	8 + 1QA	Sr-90	Annual	Grab
	8 + 1QA	PCBs/Pesticides	Annual	Grab
	8 + 1QA	Metals	Annual	Grab
Sediment	8 + 1QA	Gamma	Annual	Grab
	8 + 1QA	Sr-90	Annual	Grab
	8 + 1QA	PCBs/Pesticides	Annual	Grab
	8 + 1QA	Metals	Annual	Grab
Fish	Population Survey	Length & Width	Annual	Grab

SEWAGE TREATMENT PLANT

January 01, 2003

PROPOSED CHANGES

There are no proposed changes to the Sewage Treatment Plant (STP) monitoring program for 2003.

DESCRIPTION AND TECHNICAL BASIS

The STP receives the majority of the wastewater generated by site operations and treats these wastes prior to discharging them to the Peconic River. Approximately 600,000 gallons of wastewater per day are processed by the STP. The treatment process includes separation of heavy inert matter (sand, grit, and other inorganic matter), removal of floatables (e.g., oils), aerobic treatment of the wastewater using a suspended-growth, activated-sludge process, and partial nitrogen removal via oxygen minimization during aeration. The treated waste is then settled, filtered, and treated by ultraviolet disinfection prior to discharge to the Peconic River. Wastewater streams received at the STP include: sanitary wastes (kitchen and bathroom wastes), process wastes (industrial cleaning operations, photographic developing rinse water, cooling tower blowdown, air conditioning and air compressor condensate, glassware cleaning wastewater, plating and metal cleaning rinse water, boiler blowdown, floor drains, etc.), and noncontact cooling water used in experimental and mechanical systems. Radionuclides and chemical constituents are present in these wastewaters as a result of research facility operations, nonregulated releases associated with medical patients, and routine maintenance operations.

In addition to those contaminants released from routine operations, contaminants are also present in sludge that was deposited by former BNL operations and that still resides in the building piping systems and the main sewage collection piping. These contaminants slowly leach into the main wastewater stream and become a component of the STP discharge. Analysis of this sludge shows it to contain mercury and other inorganics, cesium-137, and other manmade and natural radionuclides.

Potential contaminants entering the STP include all chemicals used in a laboratory setting. The list of contaminants is exhaustive and includes acids and bases, inorganics (metals and salts thereof), volatile and semivolatile organic compounds, conventional pollutants such as nitrogen bearing compounds (organic and inorganic nitrogen compounds, nitrates, nitrites, etc.), phosphates, radioisotopes, oils, and so on. While administrative procedures are in place to limit the release of chemicals to the STP, accidental releases are possible and routine release of residual chemicals during glassware cleaning is probable.

In addition to monitoring liquid effluents at the point of release to the environment, several processes that generate and routinely discharge wastewater to the sewage treatment plant are monitored at the source to ensure that the discharge does not compromise the quality of the STP effluent. These sources include photographic developing operations, metal cleaning, and electro-

plating facilities. The sewage collection system is also monitored in real time using a gross beta and gamma detection system to ensure that no unplanned releases enter the STP effluent.

Discharges are monitored to support documented compliance with the Laboratory's State Pollutant Discharge Elimination System (SPDES) permit requirements and compliance with DOE orders. Two monitoring programs are established to meet these requirements. Compliance monitoring specifically addresses SPDES compliance, whereas surveillance monitoring is conducted to meet DOE requirements for radiological releases, improve knowledge of influent and effluent variability, and determine the overall effectiveness of pollution prevention initiatives and engineered controls.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

- ☒ Compliance
- ☒ Support compliance
- ☒ Surveillance
- ☐ Restoration

The Federal Water Pollution Control Act establishes a national permitting program, specifies minimum treatment levels for sewage treatment plants, establishes pretreatment standards for indirect discharges of industrial wastes, and develops quality-based water criteria. Wastewater discharges from BNL operations are subject to the Act. BNL maintains an SPDES permit, issued by the New York State Department of Environmental Conservation (NYSDEC), which has been authorized to implement Clean Water Act (CWA) provisions under Part 750 of Title 6 of the New York State Codes, Rules, and Regulations (6 NYCRR Part 750). The SPDES permit authorizes releases to the environment through 13 designated outfalls and specifies monitoring requirements for each, including the frequency of monitoring and specification of analytical requirements. Effluent limitations specified for each analytical parameter are based on the receiving water classification and the corresponding water quality standards. Water quality standards have been established for each water classification and are codified under 6 NYCRR Parts 700-705. A map showing the locations of each of the monitoring stations is provided as Figure 3-3.

In addition to the federal and state water quality regulations, DOE Order 5400.1 (1988) requires that DOE sites not only comply with federal and state statutes and regulations, but also establish effluent monitoring and environmental surveillance programs. These programs ensure that DOE operations are conducted in a manner that minimizes impacts to the environment and public health, and anticipates and addresses potential environmental problems before causing adverse conditions.

Because NYSDEC does not regulate radioactive effluents, the DOE Order is used as justification for monitoring the STP effluent for radioactivity. With the shutdown of the Laboratory's two research reactors in 2001, releases of radioactive components have declined drastically. The Laboratory has implemented procedures and guidelines to maintain releases of radioactivity to the Peconic to a maximum of 25 percent of the drinking water standard. However, there remains risk of short unplanned releases should engineering controls fail.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Laboratory operations have the potential to impact the environment either through direct or indirect discharge of wastewater to the environment. Impacts include contamination of drinking water and freshwater ecosystems, including associated aquatic and terrestrial flora and fauna that rely on these water systems for survival. To ensure that wastewater effluents discharged to the environment pose minimal impact to surface waters and groundwater, a sampling and analysis program has been developed that evaluates concentrations of natural and BNL-contributed contaminants and compares them to background levels and established water quality standards. This program has been designed to ensure that:

- BNL complies with regulatory permit monitoring requirements.
- Collection and analysis of samples is performed according to EPA, state, or other regulatory agency standards or guidelines.
- Samples are representative of routine discharges and monitoring locations are appropriate.
- Analytical parameters are appropriate to the processes generating the waste.
- Treatment systems remain efficient and effective.
- The sampling and analysis program is well documented.

The effluent monitoring program relies on both real-time analysis of wastewater streams and collection and analysis of flow-proportional composite and grab samples.

Step 2: Identify the Decisions

The desired decisions for this STP monitoring program can be formulated as questions.

- Are all discharges in compliance with permit limits or ambient water quality standards (or both)? In other words, is no action required?
- Are treatment systems effective at removing or immobilizing contaminants to prevent their release to the environment (i.e., operating as designed)?
- Are radiological releases remaining ALARA and continuing to decline as institutional controls are implemented and enforced?
- Are pollution prevention initiatives effective, and is the quality of the effluent continually improving?

Step 3: Identify Inputs to the Decisions

- Identification of process effluents contributing to the discharge
- Historical and current analyses of process discharges and the STP influent and effluent

- STP Operators' logs and records
- ESD Field Sampling personnel field logs and records
- SPDES permit limits or other NYS ambient water quality standards
- Real-time radiological monitoring system data

Step 4: Define the Study Boundaries

This study incorporates all BNL operations that contribute wastewater to the STP—including from the point of generation (e.g., sink) and contributions from the collection system. These operations include facility operations (mechanical systems operations and maintenance), process discharges (metal cleaning operations, photographic developing), and research activities (including bench-top and pilot scale).

Data quality objectives for the liquid effluent monitoring program are derived largely by permit condition or regulatory guidance. The SPDES permit contains specific monitoring requirements, including analytical method reference, effluent limitations, and sampling frequencies. Identification of analytical parameters is based on known BNL operations and processes, chemical inventories, and historical analysis of wastewater effluents. Effluent limitations directly influence the methodology detection limits and are directly related to established water quality standards. Similarly, the effluent limits and ambient water quality standards are also the basis for the monitoring implemented under the environmental surveillance program. In the case of radiological parameters, the drinking water standard has been utilized as the comparative standard regardless of the potential pathway analysis of the effluent.

Review of the past two years of analytical data shows the quality of the STP effluent to be very consistent, with most volatile and semivolatile organic compounds being nondetectable. In accordance with permit conditions, volatile organic compounds are analyzed several times monthly. Annual analysis for semivolatile organic compounds should be adequate to verify characterization. Metallic elements are the only routinely detected contaminants, some of which have been found to occasionally exceed established effluent limits. Effluent samples are collected several times monthly in accordance with SPDES permit requirements.

Influent analyses similarly show that only inorganics are routinely detected at concentrations that could potentially exceed SPDES permit limits if they were to pass through the treatment process. Monitoring for inorganics is conducted in conjunction with effluent monitoring so that plant performance can be evaluated. Additionally, monitoring for biological oxygen demand and total suspended solids is also conducted in conjunction with effluent monitoring to assess plant performance.

Surveillance monitoring includes collection of samples monthly for metals (24-hour composite), volatile organics (grab) and three times (48- to 72-hour composites) weekly for radiological analyses. While radiological analyses over the last two years have shown significant decreases in concentration and nuclide detection, public perception issues drive the frequency of sample collection to a very high level.

Step 5: Develop the Decision Rules

Decision 1

Are all discharges in compliance with permit limits or ambient water quality standards (or both)? In other words, is no action required?

Analytical data collected from the STP effluent are continuously compared to SPDES permit limits or NYS ambient water quality standards.

If this comparison yields a violation of either a permit limit or water quality standard, **then** an evaluation is conducted under the BNL Environmental Event Response Procedure to determine the source of contaminant and additional samples are collected to better define the extent (i.e., duration and magnitude) of the violation.

If the comparison shows the data to be consistently below regulatory limits or standards, **then** the monitoring frequency may be reduced.

Decision 2

Are treatment systems effective at removing or immobilizing contaminants to prevent their release to the environment?

Influent and effluent samples are collected routinely from the STP and compared to typical values. The STP is effective at reducing the concentration of conventional pollutants (e.g., BOD, nitrates or nitrites), and inorganics.

If the concentration of either the influent or effluent exceeds typical ranges, **then** an investigation will be conducted to identify sources and additional samples will be collected to determine the magnitude of the excursion. STP operations will be evaluated as part of this investigation including clarifier efficiencies, dissolved oxygen levels, mixed liquor suspended solids, pH, and so on.

Decision 3

Are radiological releases remaining ALARA and continuing to decline as institutional controls are implemented and enforced?

Radiological monitoring is conducted in real-time and samples are collected continuously under the environmental surveillance program to ensure the STP effluent is adequately characterized and effluents remain ALARA.

If either routine monitoring or analytical data show levels of radiological constituents approaching administrative limits (i.e., 25 percent of the drinking water standard), **then** the plant may be placed into a bypass mode and the wastewater collected for full evaluation under the Environmental Response procedure.

Decision 4

Are pollution prevention initiatives effective, and is the quality of the STP effluent continually improving as a result of reduced pollutant loads?

The Laboratory has implemented many pollution prevention projects with the goal of reducing the volume of wastewater treated at the STP and reducing releases of chemical and radiological constituents to the STP and ultimately the Peconic River. Routine monitoring data are compared with historical and permit levels to ensure concentrations decline or at a minimum remain below permit limits.

If comparison of data shows levels are increasing, **then** an evaluation is conducted to determine the source of the contaminant effectiveness of P2 initiatives and measures to mitigate the increase.

Step 6: Specify Acceptable Error Tolerances

There are several potential errors associated with monitoring of the STP. These include failure to collect a representative sample, failure of a sample collection device, and analytical errors. Because there are several samples collected from the STP monthly, loss of a single sample would not have a detrimental impact on BNL's ability to adequately characterize the effluents from the STP. Sample collection devices are monitored daily to ensure they are operating properly. After collection, the sample is inspected to determine whether its volume is appropriate for the collection period, and whether the sample looks representative (e.g., color, settleable solids, etc.). Deviations are noted on the field team sample log. If a sample device fails during a sample collection period or if the sample volume seems inappropriate, samples are either collected on a subsequent day or a grab sample is taken. The field log is appropriately annotated to document the failure of the sample collection device.

Once wastewater enters the plant, it commingles with approximately 500,000 gallons of water contained in the clarifiers. Consequently, if a slug of chemical contaminant were to enter the plant, it would take several days for it to completely discharge. A delay of a day would therefore not preclude detection. Because radiological samples are collected continuously, no impact is expected from a single day's failure of a sample collection device. Real-time monitoring of the influent and effluent also provides added protection against an unmonitored radiological or inorganic discharge.

Analytical errors could have a greater impact on monitoring. Because the sample is consumed in analysis, if an error is made during the analysis, complete loss of a sample is possible. If the error is not discovered soon enough, the loss could be unrecoverable. To prevent such an occurrence additional sample volume is collected to allow for repeat analyses.

If any of the aforementioned errors or malfunctions were to occur, contingency measures would mitigate loss of samples and potential violations of permit conditions. Failure to implement these mitigative measures could result in SPDES permit violations, which would lead to loss in public and regulatory confidence in BNL operations.

Step 7: Optimize the Design

Monitoring the STP includes routine sampling of both the influent and effluent. Sampling frequency ranges from daily to monthly, depending on the contaminant in question. Samples are tested for radioactivity (daily), conventional pollutants such as Biochemical Oxygen Demand, nitrogen, suspended solids, (several times monthly), volatile organics and inorganics (several times monthly), semivolatile organics (yearly), PCBs (several times quarterly), and pesticides

(yearly). Data collected over the past several years show that inorganics are the contaminants most frequently detected at or above permit limits. Organics, both volatile and semivolatile compounds, PCBs, and pesticides are rarely detected above method detection limits. Although radioactive elements are detected, they are seldom detected at concentrations approaching limits established by EPA for drinking water, which is the comparative standard adopted by BNL. Additionally, the SPDES permit requires that Whole Effluent Toxicity testing be conducted quarterly. This sampling evaluates the toxicity of the STP effluent using live organisms. During this testing, organisms are exposed to various concentrations of the STP effluent and their rate of survival and growth (or reproduction) are monitored and compared with controls. This test is conducted for a period of seven days, during which three water samples are collected and used as make-up water for the test organisms.

The compliance monitoring program is dictated by SPDES permit conditions. A full list of parameters and the frequency of sample collection appear in Appendix B.

Radiological monitoring is not a condition of the SPDES permit. However, samples are collected from the STP influent and effluent continuously and analyzed three times weekly under the surveillance program. The radiological monitoring frequency was reduced in 2002 from five times weekly to three times weekly. This reduction was justified after a review of radiological data collected over the previous two years showed little detection of tritium and other BNL-generated nuclides in both the STP influent and effluent. In addition, the sewage collection system is monitored in real-time using beta and gamma detection systems to ensure that no unplanned releases occur that could jeopardize the quality of the STP effluent. Surveillance monitoring of the STP includes monthly sampling and analysis for volatile organics, inorganics, and anions. Field data including pH, dissolved oxygen, and conductivity are also recorded. Surveillance monitoring is conducted due to the variability in the quality of the STP influent and is compared with regulatory compliance data. The surveillance monitoring program may be further reduced if the trend of radiological detection continues to decline and if reviews of analytical results show uniform consistency in STP influent and effluent quality.

TOTAL SAMPLING AND ANALYSIS COSTS OF THE PROGRAM

See the tables on the next two pages for a breakdown of the costs associated with this program.

IMPLEMENTATION DATE   January 01, 2003

POINT OF CONTACT   Bob Lee, (631) 344-3148

Cost of STP Monitoring Program			
STP SPDES Program			
Analyses	Frequency per year	Unit Cost	Total Cost
Inorganics	68 times	\$115	\$7,820
Volatile Organics	68 times	\$195	\$13,260
Semi-Volatiles	5 times	\$280	\$1,400
Wet Chemistry	68 times	\$203	\$13,804
PCBs	20 times	\$130	\$2,600
Toxicity Testing	4 times	\$2500	\$10,000
Influent TSS and BOD	52 times	\$40	\$2,080
Pesticides	5 times	\$280	\$1,400
SPDES Process Monitoring			
Analyses	Frequency per year	Unit Cost	Total Cost
UCON Oil	4 times	\$200	\$800
TAL Metals	8 times	\$120	\$960
Silver	8 times	\$35	\$280
Volatile Organics	4 times	\$170	\$680
Semi-Volatile Organics	8 times	\$280	\$2,240
Nitrogen Series, Cyanide, Phenols	8 times	\$336	\$2,688
Subtotal SPDES			\$60,012

continued

Environmental Surveillance			
Analyses	TIMES / year	Unit Cost	Total Cost
Inorganics (influent and effluent)	24	\$130	\$3,120
Anions (influent and effluent)	24	\$47	\$1,128
Volatile Organics	12	\$107	\$1,284
Radiological (influent and effluent) gross alpha, beta, tritium	312	\$128	\$39,936
Gamma (influent and effluent)	24	\$127	\$3,048
Strontium 90 (influent and effluent)	24	\$95	\$2,280
Subtotal Surveillance Monitoring			\$50,800
TOTAL Analytical			\$110,812
QA/QC @ 20%			\$22,162
TOTAL Analytical and QA Costs for Sewage Treatment Plant			\$132,974

STP Sample Collection (Compliance)			
Analyses	Frequency per year	Unit Cost	Total Cost
STP Effluent	28 samples	\$32.15	\$900
STP Influent	28 samples	\$32.15	\$900
Sub-Outfalls	4 locations quarterly	\$32.15	\$514

STP Sample Collection (Surveillance)			
	Frequency	Unit Cost	Total Cost
EA	3 samples per week	\$32	\$5015
DA	3 samples per week	\$32	\$5015
MH192 source check	250 times per year	\$32	\$8037
Subtotal Sample Collection			\$20,383

TOTAL Monitoring Costs for Sewage Treatment Plant   \$153,357

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10 SURFACE WATER

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PECONIC RIVER WATER QUALITY SURVEILLANCE

DATE 11-6-02

SUMMARY OF PROPOSED CHANGES

- In an effort to improve the efficiency and usability of data collected under the Surface Water Monitoring Program, several locations downstream of the Sewage Treatment Plant are being deleted and one added.
- Stations HB, HC, and HR, all located along the Peconic and downstream of the STP, are being deleted because data collected from these stations are not indicative of changing BNL conditions.
- Three new stations will be established, one at the effluent of Forge Pond, one at the effluent from Swan Pond, and one at the effluent of Donahue's Pond. These sampling locations will be used for evaluating water quality within Forge and Swan Ponds and will be used to correlate water quality with fish and sediment samples collected from these water bodies.

DESCRIPTION AND TECHNICAL BASIS

The headwaters of the Peconic River, a designated Wild and Scenic River that discharges to the Peconic Estuary, originate on the BNL campus. The BNL Sewage Treatment Plant discharges treated sanitary effluent to the Peconic River. In addition, the Peconic River is subject to potential non-point sources of pollution as it flows through the BNL campus, including stormwater runoff from developed areas and contaminated groundwater during periods of high groundwater elevation.

The Peconic River enters the BNL site at the northwest corner, west of the Relativistic Heavy Ion Collider (RHIC) ten o'clock experimental hall. The Peconic River traverses the RHIC site, exiting at the ring on the east side of the two o'clock experimental hall. To facilitate construction of the RHIC, a corrugated metal conduit was installed under the ring at the ten o'clock and two o'clock positions to permit continuous river flow. The Peconic River is an intermittent stream in the RHIC area, with flow occurring predominantly in the spring and fall (a "gaining" stream) and completely drying up during dry periods (a "losing" stream). Several areas of low topography and areas with near surface silts and clays, located within the northern sections of RHIC, accumulate water during the wet seasons.

After exiting the RHIC, the Peconic River flows easterly, then in a southeasterly direction and exits the site along the southeast boundary. With the exception of the RHIC construction, there has been nominal development along the Peconic River corridor. The Peconic River flows through a wooded area of BNL formerly used in the 1960s to study the effects of nuclear fallout. During these studies, the native vegetation was subjected to a radiation field emitted from a sealed cobalt-60 source and the effects on the vegetation were noted.

The BNL STP discharge to the Peconic River (Outfall 001) is shown in Figure 3-3 and is located approximately at the midpoint of the Peconic River on the BNL site. Due to the STP contribution,

the Peconic River flow is continuous downstream for several hundred yards throughout the year. During dry periods, the river again becomes a losing stream and all water evaporates or percolates to recharge groundwater. During periods of extensive precipitation, such as the spring or fall, flow is continuous throughout the BNL site.

In addition to contributions from the STP, surface runoff and groundwater comprise the only other contributed sources of water to the Peconic River. Potential contaminants include all constituents related to the STP discharge; sediment, oil, and grease from surface runoff; and contaminants contributed from groundwater. Investigation of the Peconic River conducted under the CERCLA program indicated that historical releases of radiological materials, PCBs, pesticides, and inorganics have resulted in their accumulation within the Peconic River sediments (ITC 1998). Resuspension of sediments due to scouring can result in the migration of these contaminants off site.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

- ☐ Compliance
- ☐ Support compliance
- ☒ Surveillance
- ☐ Restoration

Surface water quality monitoring is not required by BNL's SPDES permit. The monitoring of surface water at BNL is performed in accordance with DOE Order 5400.1 (1988), *General Environmental Protection Program*, which requires that monitoring be conducted in order to:

- Verify compliance with federal, state, and local regulations
- Determine compliance with commitments made in the Environmental Impact Statements, Environmental Assessments, or other official documents
- Identify potential environmental problems
- Detect, characterize, and report unplanned releases

Additionally, DOE Order 5400.1 requires that monitoring be conducted to measure the effects, if any, of DOE activities on and off site, to establish baselines of environmental quality, and to characterize and define trends in the physical, chemical, and biological condition of environmental media. The New York State Department of Environmental Conservation (NYSDEC) has established ambient water quality standards for the Peconic River and other local water bodies. These standards have been codified under Parts 700-706 of Title 6 of the New York Code of Rules and Regulations (6 NYCRR Parts 700-706).

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Laboratory operations have the potential to impact the Peconic River and its environment through routine discharges from the BNL Sewage Treatment Plant, failure of the STP, any unplanned and untreated releases to the STP, nonpoint-source spills, and disturbance of legacy contamination in the riverbed. Impacts include contamination of surface water and associated fresh water ecosystems, including associated aquatic and terrestrial flora and fauna that rely on these water systems for survival, and river sediments.

Step 2: Identify the Decision

The desired decisions for the surface water monitoring program are:

- Are BNL operations causing the Peconic River segments on the BNL campus and immediately downstream of the Laboratory to exceed ambient water quality standards and historical levels?
- Are BNL's efforts to continually improve its environmental management improving the quality of the Peconic River?
- Are BNL operations contributing to any river use restrictions?
- Are engineered and operational controls effective in preventing the activation of the Peconic River water that flows via a culvert beneath the RHIC ring?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 are listed below.

- Analytical data (and trends) for the Peconic River both up- and downstream of the STP discharge
- Analytical data (and trends) for control locations (i.e., Carmans River)
- Historical analyses of process discharges and the STP effluent
- ESD Field Sampling personnel field logs and records
- NYS ambient water quality standards
- River flow data
- Peconic River cleanup activities

Step 4: Define the Study Boundaries

The study area incorporates all BNL operations that contribute wastewater or runoff to the Peconic River, either through direct or indirect discharge via the STP. In 2003, the Peconic River will be sampled at three off-site locations between the southeast site boundary and Riverhead, New York (stations HA, HD, and Forge Pond), and at six locations on site (stations HY, HV, HE, HMn, HMs, and HQ) (see Figures 3-3 and 10-1). Three of the on-site stations are located upstream of the BNL STP discharge, with the remaining three downstream. Carmans River, located southwest of the site, is sampled at station HH to determine background or ambient conditions. Swan Pond is also being added as a new site in 2003, as a location on the Peconic not influenced by BNL discharges. Samples are collected and analyzed for radiological parameters (gross alpha, gross beta, and tritium activity, as well as strontium-90 and other gamma-emitting radionuclides), nonradiological parameters (e.g., metals, volatile organic compounds, and water quality parameters).

Water samples have historically been collected on a quarterly basis for most locations with daily analyses conducted at points directly downstream from the STP discharge. Review of the past two years of analytical data shows the quality of the Peconic River to be very consistent with most volatile and semivolatile organic compounds, and radionuclides being nondetectable. Inorganics are detected throughout the Peconic and Carmans Rivers. The concentration of some inorganics is highest immediately downstream of the STP discharge. To assess the physical state of inorganic contaminants, filtered and unfiltered samples are collected and the analytical data compared. Evaluation of the data shows that many of the inorganic detections are due to suspension of sediments. Radiological analyses over the past two years have shown significant decreases in concentration and nuclide detection.

Historical data show no significant variations in water quality throughout the Peconic River system. Drastic changes in concentrations are unexpected, because unplanned releases would be detected via effluent monitoring at the STP outfall. The focus of the surface water-monitoring program is to assess the long-term, cumulative impact of BNL discharges on surface waters. Because cumulative effects are the focus of this monitoring/decision process, quarterly to annual decisions are appropriate.

Step 5: Develop the Decision Rule

Decision 1

Are BNL operations causing the Peconic River segments on the BNL campus and immediately downstream of the Laboratory to exceed ambient water quality standards and historical levels?

Analytical data collected from the Peconic River are compared to NYS ambient water quality standards and historical and control points analyses.

If this comparison yields an excursion of an ambient water quality standard or a significant deviation from historical data that may be attributable to BNL, **then** implement the BNL Environmental Event Response Procedure to determine the source of contaminant and collect additional samples to better define the extent (i.e., duration and magnitude) of the excursion.

If the comparison shows the data to be consistently below regulatory limits or standards or within historical levels, **then** the routine monitoring and reporting is continued.

Decision 2

Are BNL's efforts to continually improve its environmental management improving the quality of the Peconic River?

Analytical data collected from the Peconic River are evaluated and compared with historical trends and with data collected from the off-site control location and background Peconic River stations to determine the impact of BNL discharges on the environment.

If contaminant trends for stations HM-n, HQ, and HA show improving or stable trends in Peconic River quality and these can be correlated with BNL actions, **then** BNL will claim credit under its Environmental Management System.

If the evaluation shows declining water quality that may be attributable to BNL, **then** an assessment is triggered.

Decision 3

Are BNL operations contributing to any river use restrictions?

There are no fish advisories issued that are specific to the Peconic River. A general advisory has been issued statewide to protect against eating fish that have not been tested or that may contain unidentified contaminants. BNL will keep apprised of specific health advisories and will maintain data for water and fish to determine if BNL is contributing to any future issued advisory. All data is shared routinely with NYSDEC and NYSDOH and BNL continually strives to reduce the impact of its discharges by implementing waste minimization and pollution prevention practices and by imposing strict effluent limitations on pollutant sources.

If NYSDEC issues a health advisory for the Peconic River, **then** BNL will work with the issuing authority to determine if BNL is contributing to the advisory and what steps could be taken to reduce the impact.

Decision 4

Are engineered and operational controls effective in preventing the activation of the Peconic River water that flows via a culvert beneath the RHIC ring?

Concentrations of radionuclides collected at stations HY and HV are compared to determine if activation is resulting from RHIC operations.

If radionuclide concentrations at station HV are significantly greater than HY, **then** investigate whether this is an impact from RHIC and determine the cause.

Step 6: Specify Acceptable Error Tolerances

The Laboratory has monitored the surface waters of the Peconic River and Carmans River routinely for many years and documents these results annually. Due to the low concentration of contaminants in BNL's discharge to the Peconic River, cumulative impacts occur over years and it is very unlikely there will be an immediate impact to the environment. The risks of not

detecting an impact are erosion in stakeholder confidence and possible cleanup costs. Although BNL has a history of impacting the river, recent improvements in Laboratory management and reductions in effluent releases have significantly reduced the impact.

The most obvious potential error associated with decisions regarding the quality of the Peconic River is in the sample design. Potential errors include failure to collect a representative sample, failure of a sample collection device, and impacts to sampling collection schedules due to flow conditions of the river. Monitoring of the Peconic River is limited to quarterly analysis for most locations; consequently, loss of a single sample could have a detrimental impact on BNL's ability to characterize the Peconic and Carmans Rivers. However, diligence on the part of the field sampling team precludes loss of samples. Seasonal flow of the Peconic also impacts the ability to collect sample and characterize this stream. Again, awareness on the part of the field sampling team enables them to maximize the collection of samples when possible. Sample collection devices are monitored daily to ensure they are operating properly and are collecting samples. Upon sample collection, the sample is inspected to determine if the volume is appropriate for the period of sample collection and that the sample looks representative (e.g., color, settleable solids, etc.). Deviations are noted on the field team sample log. Should a sample device fail during a sample collection period or if the sample volume seems inappropriate for the collection period, samples either are collected on a subsequent day or a grab sample is taken. The field log is appropriately annotated to document the failure of the sample collection device and to describe the action taken.

Analytical errors could have a greater impact on monitoring. Because the sample is consumed in analysis, if an error is made during the analysis, complete loss of a sample is possible. If the error is not discovered soon enough, the loss could be unrecoverable. To prevent such an occurrence, additional sample volume is collected to allow for repeat analyses. Deviations in analytical methods are not expected to impact the results.

Step 7: Optimize the Design

The surface water monitoring program is required under the DOE Order 5400.1 and is geared toward determining impacts of BNL operations on the environment. A full listing of parameters and frequency of sample collection appear in Appendix B. Due to reduced releases of radiological constituents from the BNL STP and the reduced concentration of radionuclides in the STP discharge, radiological monitoring was reduced in 2002 from daily to three times weekly for the sampling station immediately downstream of the STP discharge, and monthly for the site boundary monitoring station.

COST OF SURFACE WATER PROGRAM

Peconic River (HMN and HQ)	Freq. / Yr	Unit Cost	Total Cost
Inorganics (filtered and unfiltered)	12	\$130	\$6,240
Volatile organics	12	\$107	\$2,568
Anions	12	\$47	\$1,128
Radiological: alpha, beta, gamma, tritium	12	\$256	\$6,144
Strontium-90	4	\$95	\$760
HY, HV, HMS, HA, HD, HH, HE, Forge Pond, Swan Pond	Freq. / Yr	Unit Cost	Total Cost
Inorganics (filtered and unfiltered)	4	\$130	\$9,360
Volatile organics	4	\$107	\$3,852
Anions	4	\$47	\$1,692
Radiological: alpha, beta, gamma, tritium	4	\$256	\$921z6
Strontium-90	4	\$95	\$,3420
Subtotal Surface Water Costs			\$44,380
QA/QC			\$8,876
Total			\$53,256

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Robert Lee (631) 344-3148

11 POTABLE WATER

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POTABLE WATER MONITORING

Date: 10-10-02

SUMMARY OF CHANGES

- Triennial lead and copper sampling due in 2003. Next required sampling is in 2006.
- Reduce tritium surveillance sampling from twice per quarter to once per quarter.

DESCRIPTION AND TECHNICAL BASIS

Brookhaven National Laboratory maintains six potable water wells, a water treatment plant, and a distribution system to supply drinking water and water for heating and cooling purposes. In doing so, the Laboratory is considered a public water supplier and must meet the requirements of the Safe Drinking Water Act (SDWA). The laboratory's six potable wells are screened in the shallow Upper Glacial aquifer. This EPA-designated sole source aquifer is susceptible to contamination. The quality of the water supply is protected through (1) a comprehensive program of engineered and operational controls of existing aquifer contamination and potential sources of new contamination, (2) groundwater monitoring, and (3) potable water treatment and monitoring. The Laboratory has enacted a monitoring program to demonstrate compliance with the SDWA regulations under the guidance of the Suffolk County Department of Health Services (SCDHS). The objective of the potable water compliance monitoring efforts is to ensure that the concentrations of regulated contaminants present in the domestic water system are less than the maximum contaminant levels specified by regulation. Monitoring is conducted at the supply wellheads, the water treatment plant, and within the distribution system.

BNL's Source Water Assessment concluded that the Upper Glacial aquifer at BNL is susceptible to contamination. A number of potential sources of groundwater contamination are within two years of travel to supply wells. In addition, some supply wells are located on the margins of existing contamination. To provide early warning of impacts to potable water supply wells, BNL also conducts surveillance monitoring to discern trends in declining water quality.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

<u> x </u>	Compliance
<u> x </u>	Support compliance
<u> x </u>	Surveillance
<u> </u>	Restoration

The SDWA establishes minimum national standards for levels of contaminants in drinking water. These standards assure that water quality is healthy and wholesome for public consumption and include primary standards (health-based) and secondary standards (aesthetics-based). The contaminants that are regulated under the primary standards include microorganisms, inorganic chemicals, synthetic organic chemicals, volatile organic chemicals, radionuclides, and disinfection byproducts. It also establishes a program for the protection of sole source aquifers

and implements an underground injection control program that regulates and restricts the subsurface emplacement of fluids. Potable water system monitoring requirements are contained in Title 40 of the Code of Federal Regulations (40 CFR 141-149) and in the New York State Sanitary Code (10 NYCRR Part 5). Because BNL distributes domestic water to more than 25 users, the Laboratory's water supply is considered a public water system and therefore must meet the performance and monitoring requirements specified by the SDWA, and follow corresponding state regulations. These requirements include specific chemical and radiological monitoring and the enforcement of a strict cross connection control program. The SDWA requirements are implemented at the state level by the New York State Department of Health (NYSDOH) and locally by SCDHS, which specifies yearly the locations and frequency of sample collection as well as the required methods used in sample analysis.

In addition to the federal and state water quality regulations, DOE Order 5400.5, Radiation Protection of the Public and Environment, established Derived Concentration Guides (DCGs) for radionuclides not covered by existing federal or state regulations. A DCG is the concentration of a radionuclide in air or water that, under conditions of continuous exposure for one year by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation), would result in an effective dose equivalent of 100 mrem (1 mSv). DOE Order 5400.5 states that public water systems either operated by DOE directly or through a DOE contractor shall not cause persons consuming the water to receive an effective dose equivalent greater than 4 mrem (0.04 mSv) in a single year.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

To assure the quality of groundwater, the quality of drinking water during treatment and distribution and to confirm compliance with federal and state drinking water regulations, the Laboratory performs monitoring of the BNL potable water supply.

Step 2: Identify the Decision

Does the Laboratory's potable water supply comply with the federal and state drinking water standards?

Is the groundwater quality at the wellhead declining such that the Groundwater Protection Contingency Plan should be implemented?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 are listed below.

- Federal and State potable water system monitoring requirements in 40 CFR 141-149 and 10 NYCRR Part 5
- NYSDEC Long Island Well Permit 1-4722-00032/00113
- Brookhaven National Laboratory Annual Potable Water Sampling Plan
- SCDHS Annual Minimum Monitoring Requirements for Brookhaven National Laboratory
- Brookhaven National Laboratory Source Water Assessment for Drinking Water Supply Wells

- BNL Monthly Water Treatment Plant Reports
- Annual Consumer Confidence Report
- Collection and analysis of samples performed according to EPA, state, or other regulatory agency standards or guidelines
- EP Procedure O&M-WTF-006, Collection of Potable Water Samples
- Analytical results for the supply wells and distribution system

Step 4: Define the Study Boundaries

The study boundary includes the BNL supply wells, treatment systems, water treatment plant, and the BNL distribution system. In accordance with SDWA requirements, potable water samples are collected at the wellhead, post treatment, and from the distribution system. The specific location for collecting each sample is contingent upon the type of analysis, method of water treatment, and the purpose of the sample (i.e., to assess groundwater quality or impacts of distribution system piping). Yearly requirements are developed under the guidance of SCDHS and usually exceed the sampling requirements under the SDWA. To assess source water quality, water samples are collected typically at the wellhead. Analytes assessed at the wellhead include volatile organic compounds (VOCs), pesticides and synthetic organic chemicals, inorganics, and bacteriology. To assess the efficiency of water treatment systems, samples are collected immediately post treatment for VOCs and/or inorganic analysis. To ensure that the potable water is not corrosive to the BNL distribution system, that the piping system material is sound, and to ensure proper disinfection, analyses for asbestos, trihalomethane, and inorganics are conducted on water samples collected at the point of consumption.

Step 5: Develop the Decision Rule

Decision 1

Does the Laboratory's potable water supply comply with the federal and state drinking water standards?

The analytical data generated from the potable water monitoring programs are compared with the drinking water standards.

If the comparison shows the data to be below regulatory limits, **then** the water supply operations and monitoring continue.

If this comparison yields a violation of a regulatory standard, **then** stakeholders are notified and long- and short-term corrective actions are taken in accordance with the Safe Drinking Water Act and the Groundwater Protection Contingency Plan. Additional samples will be collected as required by the drinking water regulations and an evaluation will be conducted under the Groundwater Protection Contingency Plan Subject area to determine the cause of contamination.

Decision 2

Is the groundwater quality at the wellhead declining such that the Groundwater Protection Contingency Plan should be implemented?

Analytical data generated from the potable water monitoring program will be evaluated and compared with historical levels to ensure that existing engineered and operational controls of

known aquifer contamination are working correctly and to ensure potential sources of new contamination are located.

If this evaluation reveals that a contaminant is present at levels approaching drinking water standards, **then** an evaluation will be conducted under the BNL Groundwater Protection Contingency Plan to determine the source of the contaminant and to identify any operational controls needed to manage the groundwater contaminant.

Step 6: Specify Acceptable Error Tolerances

National Primary Drinking Water Regulations (NPDWRs, or “primary standards”) are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. EPA has issued drinking water standards, or Maximum Contaminant Levels (MCLs), for more than 80 contaminants. MCLs are set based on known or anticipated adverse human health effects, the ability of various technologies to remove the contaminant, the effectiveness of the technologies, and the cost of treatment. In addition, EPA has established National Secondary Drinking Water Regulations that set nonmandatory water quality standards for 15 contaminants. EPA does not enforce these “secondary maximum contaminant levels” or “SMCLs,” but New York State does regulate some of the contaminants. They are established only as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, and odor. These contaminants are not considered to present a risk to human health at the SMCL.

The Laboratory’s compliance monitoring program exceeds the requirements issued by the Suffolk County Department of Health Services in their oversight of the implementation of the SDWA. The Laboratory performs more analyses on a greater frequency and collects additional samples under the surveillance program to ensure the highest quality drinking water. The Laboratory should maintain this heightened sampling program, because the standards are health-based. A violation of the standards could produce adverse health effects for the Laboratory population and visitors on site, regulatory violations and fines, and well as a loss of employee, public, and regulatory confidence.

Historically the Laboratory’s drinking water has been in full compliance with the requirements of the SDWA and has not violated any maximum contaminant level standard. However, some wells were shut down in the early to mid 1980ss due to 1,1,1-trichloroethane (TCA) groundwater contamination. Operational controls were installed (granulated activated carbon filtration) to remove the contamination before distribution. Water removed from the western well field (wells #4, #6, and #7) has exceeded the secondary contaminant levels (aesthetic, not health-based) for color and iron, because there are naturally high levels of this element in the groundwater on Long Island. However, this water is treated at the Water Treatment Plant to remove the iron, and after treatment the water meets all primary and secondary standards. In early 2002, bacteriology results were positive for coliform at three wells. Upon disinfection, by heating of the sampling line, the drinking water tested negative for coliform. Although coliform levels exceeded the primary drinking water standards, it was detected in raw water and not in the treated water distributed for consumption. All sampling results for coliform at the point of distribution were negative during this time period, assuring the quality of the Laboratory’s drinking water.

Step 7: Optimize the Design

The following table summarizes the potable water monitoring programs. As discussed in Step 6, the Laboratory’s compliance monitoring program exceeds the requirements issued by the Suffolk

County Department of Health Services in their oversight of the implementation of the SDWA. Furthermore, BNL's compliance monitoring program is supplemented by the surveillance program.

TOTAL SAMPLING AND ANALYSIS COSTS FOR POTABLE WATER MONITORING PROGRAM

The proposed changes will result in a slight reduction in cost.

CY2002 Costs	\$51,348
CY2003 Costs	\$50,900
Difference	-\$448

POTABLE WATER COMPLIANCE MONITORING PROGRAM		
Analysis	Sampling Location	Frequency
Bacteriological	Distribution System	7 times per month
	Supply wells	1 per quarter
	GAC and Air Stripper Towers	1 per quarter
Inorganic Compounds	Distribution System	2 per year
	Supply Wells	1 per year
Nitrate/Nitrite	Distribution System	2 per year
	Supply Wells	1 per year
Asbestos	Distribution System	1 per year
Water Quality	Distribution System	1 per quarter
Principal Organic Compounds, Vinyl Chloride, and MTBE	Supply Wells	1 per quarter
	Treated Water	1 per quarter
Synthetic Organic Compounds and Pesticides	Supply Wells	2 composite samples per year
Lead and Copper	Distribution System	20 samples once every three years
POTABLE WATER SURVEILLANCE MONITORING PROGRAM		
Analysis	Sampling Location	Frequency
Radiological (gross alpha and beta, Sr-90, and gamma analysis)	Supply Wells	1 per quarter
Volatile Organic Compounds	Supply Wells pre- and post-GAC treatment	1 per quarter
Tritium	Supply Wells	1 per quarter

See additional table on next page.

2003 POTABLE WATER MONITORING COSTS*			
Compliance Program	Frequency	Unit Cost	Total Cost
Bacteriological	132 per year	\$12	\$1,584
Inorganic Chemicals	8 per year	\$99	\$792
Nitrate/Nitrite	8 per year	\$18	\$144
Asbestos	1 per year	\$120	\$120
Water Quality	12 per year	\$20	\$240
Principal Organic Contaminants, Vinyl Chloride, and MTBE	40 per year	\$225	\$9,000
Synthetic Organic Contaminants and Pesticides	2 per year		\$4,850
Lead and Copper	20, once every 3 years	\$40	\$800
Radiological (gross alpha and beta, gamma analysis, and Sr-90)	24 per year	\$298	\$7,152
Tritium	24 per year	\$52	\$1,248
QA/QC Costs		20%	\$5,186
Compliance Program Subtotal			\$31,116
Environmental Surveillance	Frequency	Unit Cost	Total Cost
Volatile Organic Compounds	36 per year	\$107	\$3,852
Anions	6 per year	\$47	\$282
Metals	6 per year	\$130	\$780
QA/QC Costs		20%	\$982
Environmental Surveillance Program Subtotal			\$5,896
Sampling Program Costs*	No. analyses	Unit Cost	Total Cost
Compliance Sampling*	24 sampling events	\$289	\$6,944
Surveillance Monitoring	24 sampling events	\$289	\$6,944
Sampling Program Subtotal			\$13,888
Potable Water Monitoring Program Total Cost			\$50,900

*Compliance sampling is conducted by the Plant Engineering Division except for the radiological sampling, which is completed by the Environmental Services Division.

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Allocco, (631) 344-3166

12 GROUNDWATER DQOs

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Table 12.1.1 ER Monitoring Schedule and Analytical Breakdown

Project	Sampling Event	Start Date	End Date	# of Wells
Chemical/Animal Holes Sr-90	1st Quarter	03/14/2003	03/14/2003	6
Chemical/Animal Holes Sr-90	2nd Quarter	06/26/2003	06/30/2003	24
Chemical/Animal Holes Sr-90	3rd Quarter	09/29/2003	09/29/2003	6
Chemical/Animal Holes Sr-90	4th Quarter	12/26/2003	12/31/2003	36
CLF	1st Quarter	01/13/2003	01/15/2003	11
CLF	2nd Quarter	04/07/2003	04/09/2003	11
CLF	3rd Quarter	07/07/2003	07/09/2003	11
CLF	4th Quarter	10/06/2003	10/08/2003	11
FLF	1st Quarter	01/13/2003	01/15/2003	8
FLF	2nd Quarter	04/07/2003	04/09/2003	8
FLF	3rd Quarter	07/07/2003	07/09/2003	8
FLF	4th Quarter	10/06/2003	10/08/2003	8
OU I (South Boundary)	1st Quarter	03/27/2003	03/28/2003	12
OU I (South Boundary)	2nd Quarter	06/23/2003	06/30/2003	42
OU I (South Boundary)	3rd Quarter	09/24/2003	09/25/2003	12
OU I (South Boundary)	4th Quarter	12/09/2003	12/22/2003	45
OU III North Street	1st Quarter	01/16/2003	01/21/2003	20
OU III North Street	2nd Quarter	04/10/2003	04/14/2003	20
OU III North Street	3rd Quarter	07/10/2003	07/14/2003	23
OU III North Street	4th Quarter	10/09/2003	10/13/2003	20
OU III (AOC 29/HFBR Tritium Low Flow)	1st Quarter	01/06/2003	03/05/2003	25
OU III (AOC 29/HFBR Tritium Low Flow)	2nd Quarter	04/01/2003	06/04/2003	25
OU III (AOC 29/HFBR Tritium Low Flow)	3rd Quarter	07/01/2003	09/03/2003	25
OU III (AOC 29/HFBR Tritium Low Flow)	4th Quarter	10/09/2003	11/04/2003	25
OU III (AOC 29/HFBR Tritium)	1st Quarter	01/02/2003	01/29/2003	117
OU III (AOC 29/HFBR Tritium)	2nd Quarter	04/01/2003	04/25/2003	112
OU III (AOC 29/HFBR Tritium)	3rd Quarter	07/01/2003	07/25/2003	117
OU III (AOC 29/HFBR Tritium)	4th Quarter	10/01/2003	12/03/2003	127
OU III (BGRR/WCF Sr-90)	2nd Quarter	04/22/2003	04/30/2003	61
OU III (BGRR/WCF Sr-90)	4th Quarter	10/22/2003	11/07/2003	61
OU III (Bldg 96)	1st Quarter	02/06/2003	02/10/2003	20
OU III (Bldg 96)	2nd Quarter	04/28/2003	04/30/2003	20
OU III (Bldg 96)	3rd Quarter	07/22/2003	07/24/2003	20
OU III (Bldg 96)	4th Quarter	11/11/2003	11/13/2003	20
OU III (Carbon Tet)	1st Quarter	02/24/2003	02/26/2003	30
OU III (Carbon Tet)	2nd Quarter	05/21/2003	05/23/2003	30
OU III (Carbon Tet)	3rd Quarter	08/12/2003	08/14/2003	30
OU III (Carbon Tet)	4th Quarter	11/05/2003	11/07/2003	30
OU III (Central)	1st Quarter	02/20/2003	02/21/2003	19
OU III (Central)	2nd Quarter	05/19/2003	05/20/2003	19
OU III (Central)	3rd Quarter	08/08/2003	08/11/2003	19
OU III (Central)	4th Quarter	12/03/2003	12/04/2003	19
OU III (Industrial Park)	1st Quarter	01/22/2003	01/31/2003	35
OU III (Industrial Park)	2nd Quarter	04/15/2003	04/21/2003	35
OU III (Industrial Park)	3rd Quarter	07/15/2003	07/21/2003	35

ER Monitoring Schedule and Analytical Breakdown

OU III (Industrial Park)	4th Quarter	10/14/2003	10/21/2003	41
OU III (Off-site)	1st Quarter	02/27/2003	02/28/2003	14
OU III (Off-site)	2nd Quarter	05/29/2003	06/06/2003	20
OU III (Off-site)	3rd Quarter	08/19/2003	08/20/2003	14
OU III (Off-site)	4th Quarter	11/14/2003	11/18/2003	20
OU III (South Boundary)	1st Quarter	02/14/2003	02/14/2003	5
OU III (South Boundary)	2nd Quarter	05/08/2003	05/14/2003	39
OU III (South Boundary)	3rd Quarter	07/30/2003	07/30/2003	5
OU III (South Boundary)	4th Quarter	11/19/2003	11/24/2003	30
OU III Magothy	2nd Quarter	05/27/2003	05/28/2003	14
OU III Magothy	3rd Quarter	08/15/2003	08/18/2003	14
OU III Magothy	4th Quarter	11/12/2003	11/13/2003	14
OU III Middle Road	1st Quarter	02/11/2003	02/13/2003	26
OU III Middle Road	2nd Quarter	05/05/2003	05/07/2003	26
OU III Middle Road	3rd Quarter	07/25/2003	07/29/2003	26
OU III Middle Road	4th Quarter	11/14/2003	11/18/2003	26
OU III (Western South Boundary)	1st Quarter	02/18/2003	02/19/2003	17
OU III (Western South Boundary)	2nd Quarter	05/15/2003	05/16/2003	17
OU III (Western South Boundary)	3rd Quarter	07/31/2003	08/07/2003	17
OU III (Western South Boundary)	4th Quarter	12/01/2003	12/02/2003	17
OU IV (AOC 5 AS/SVE)	1st Quarter	03/06/2003	03/10/2003	22
OU IV (AOC 5 AS/SVE)	2nd Quarter	06/09/2003	06/11/2003	22
OU IV (AOC 5 AS/SVE)	3rd Quarter	08/21/2003	08/25/2003	23
OU IV (AOC 5 AS/SVE)	4th Quarter	11/19/2003	11/21/2003	22
OU IV (AOC 6 Sr-90)	1st Quarter	03/11/2003	03/13/2003	30
OU IV (AOC 6 Sr-90)	3rd Quarter	08/27/2003	08/29/2003	30
OU V	1st Quarter	03/20/2003	03/26/2003	34
OU V	3rd Quarter	09/05/2003	09/12/2003	34
OU VI EDB	1st Quarter	03/26/2003	03/28/2003	27
OU VI EDB	2nd Quarter	06/19/2003	06/24/2003	27
OU VI EDB	3rd Quarter	09/18/2003	09/23/2003	27
OU VI EDB	4th Quarter	11/24/2003	12/08/2003	27
Site Background	3rd Quarter	09/26/2003	09/29/2003	10
Water Levels	1st Quarter	03/17/2003	03/19/2003	957
Water Levels	2nd Quarter	06/16/2003	06/18/2003	957
Water Levels	3rd Quarter	09/15/2003	09/17/2003	957
Water Levels	4th Quarter	12/15/2003	12/17/2003	957

Table 12.1.2 ER Sampling Information CY 2003

Well ID	Project 1	Project 2	Decision Subunit	EP 524.2 VOCs	EP 504 EDB	EP 625 Semi-VOCs	Pesticides Method 608	PCBs Method 606	MTBE	TSS/TDS	Sulfates/Chlorides/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Hexavalent Chromium	EPA 900 Gross Alpha/Beta	Isotope C-137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Bind Dup. calc. MS/MSD	Frequency (event/year)
105-04	Chemical/Animal Holes Sr-90		Plume Perimeter	X																						4
105-13	Chemical/Animal Holes Sr-90		Plume Perimeter	X																						4
105-14	Chemical/Animal Holes Sr-90		Plume Perimeter	X																						4
105-15	Chemical/Animal Holes Sr-90		Plume Perimeter	X																						4
105-16	Chemical/Animal Holes Sr-90		Plume Perimeter	X																						4
105-17	Chemical/Animal Holes Sr-90		Plume core	X																						4
105-20	Chemical/Animal Holes Sr-90		Plume Perimeter	X																						4
105-21	Chemical/Animal Holes Sr-90		Sentinel	X																						4
105-22	Chemical/Animal Holes Sr-90		Sentinel	X																						4
105-23	Chemical/Animal Holes Sr-90		Sentinel	X																						4
105-24	Chemical/Animal Holes Sr-90		Sentinel	X																						4
105-25	Chemical/Animal Holes Sr-90		Sentinel	X																						4
105-43	Chemical/Animal Holes Sr-90		Sentinel	X																						4
105-44	Chemical/Animal Holes Sr-90		Sentinel	X																						4
105-45	Chemical/Animal Holes Sr-90		Plume core	X																						4
105-46	Chemical/Animal Holes Sr-90		Plume core	X																						4
105-47	Chemical/Animal Holes Sr-90		Plume Perimeter	X																						4
105-48	Chemical/Animal Holes Sr-90		Plume Perimeter	X																						4
105-49	Chemical/Animal Holes Sr-90		Plume Perimeter	X																						4
105-50	Chemical/Animal Holes Sr-90		Plume core	X																						4
105-62	Chemical/Animal Holes Sr-90		Plume core	X																						4
105-63	Chemical/Animal Holes Sr-90		Sentinel	X																						4
105-64	Chemical/Animal Holes Sr-90		Sentinel	X																						4
114-01	Chemical/Animal Holes Sr-90		Sentinel	X																						4
New-1	Chemical/Animal Holes Sr-90		Sentinel	X																						4
New-2	Chemical/Animal Holes Sr-90		Sentinel	X																						4
New-3	Chemical/Animal Holes Sr-90		Plume core	X																						4
New-4	Chemical/Animal Holes Sr-90		Plume core	X																						4
New-5	Chemical/Animal Holes Sr-90		Plume core	X																						4
New-6	Chemical/Animal Holes Sr-90		Plume core	X																						4
New-7	Chemical/Animal Holes Sr-90		Plume core	X																						4
New-8	Chemical/Animal Holes Sr-90		Plume core	X																						4
New-9	Chemical/Animal Holes Sr-90		Plume core	X																						4
New-10	Chemical/Animal Holes Sr-90		Plume core	X																						4
New-11	Chemical/Animal Holes Sr-90		Plume core	X																						4
New-12	Chemical/Animal Holes Sr-90		Plume core	X																						4
087-09	CLF		Background	X																						4
087-11	CLF		Downgradient	X																						4
087-23	CLF		Downgradient	X																						4
087-24	CLF		Downgradient	X																						4
087-26	CLF		Downgradient	X																						4
087-27	CLF		Downgradient	X																						4
088-109	CLF		Downgradient	X																						4
088-110	CLF		Downgradient	X																						4
088-21	CLF		Downgradient	X																						4
088-22	CLF		Downgradient	X																						4
088-23	CLF		Downgradient	X																						4
086-42	FLF		Downgradient	X																						4
086-72	FLF		Downgradient	X																						4
087-22	FLF		Background	X																						4

OU III Middle Road

Table 12.1.2 ER Sampling Information CY 2003

WellID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Sem-VOCs	Pesticides Method 608	PCBs Method 608	MTBE	TSS/DS	Sulfates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Ammonia	TAL Metals	Cyanide	Hexavalent Chromium	EPA 900 Gross Alpha/Beta	Isotopic C-137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Blank Duplicate/M/MSD	Frequency (events/year)
097-17	FLF		Downgradient	X																					
097-277	FLF		Downgradient																						
097-64	FLF		Downgradient																						
106-02	FLF		Downgradient																						
106-30	FLF		Downgradient																						
065-01	OU III (AOC 20HFBF Trilium)	BGRWCF Sr-90	Plume Perimeter																						
065-37	OU III (AOC 20HFBF Trilium)	BGRWCF Sr-90	Outer Plume Perimeter																						
065-38	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
065-39	OU III (AOC 20HFBF Trilium)	BGRWCF Sr-90	Plume Perimeter																						
065-40	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
065-41	OU III (AOC 20HFBF Trilium)	BGRWCF Sr-90	Plume Perimeter																						
065-42	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-11	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-12	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-208	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-209	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-210	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-211	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-220	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-227	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-228	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-229	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-232	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-233	OU III (AOC 20HFBF Trilium)		Plume core																						
075-234	OU III (AOC 20HFBF Trilium)		Plume core																						
075-235	OU III (AOC 20HFBF Trilium)		Plume core																						
075-236	OU III (AOC 20HFBF Trilium)		Plume core																						
075-239	OU III (AOC 20HFBF Trilium)		Plume core																						
075-240	OU III (AOC 20HFBF Trilium)		Plume core																						
075-241	OU III (AOC 20HFBF Trilium)		Plume core																						
075-245	OU III (AOC 20HFBF Trilium)		Plume core																						
075-285	OU III (AOC 20HFBF Trilium)		Plume core																						
075-286	OU III (AOC 20HFBF Trilium)		Plume core																						
075-287	OU III (AOC 20HFBF Trilium)		Plume core																						
075-288	OU III (AOC 20HFBF Trilium)		Plume core																						
075-289	OU III (AOC 20HFBF Trilium)		Plume core																						
075-291	OU III (AOC 20HFBF Trilium)		Plume core																						
075-292	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-293	OU III (AOC 20HFBF Trilium)		Plume core																						
075-294	OU III (AOC 20HFBF Trilium)		Plume core																						
075-295	OU III (AOC 20HFBF Trilium)		Plume core																						
075-39	OU III (AOC 20HFBF Trilium)	BGRWCF Sr-90	Plume Perimeter																						
075-40	OU III (AOC 20HFBF Trilium)	BGRWCF Sr-90	Plume Perimeter																						
075-41	OU III (AOC 20HFBF Trilium)	BGRWCF Sr-90	Plume Perimeter																						
075-413	OU III (AOC 20HFBF Trilium)		Plume core																						
075-42	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-44	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-45	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-46	OU III (AOC 20HFBF Trilium)		Plume Perimeter																						
075-47	OU III (AOC 20HFBF Trilium)	BGRWCF Sr-90	Outer Plume Perimeter																						

Table 12.1.2 ER Sampling Information CY 2003

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EOB	EPA 625 Sem-VOCs	Pesticides Method 608	PCBs Method 608	MTBE	TSS/TDS	Sulfates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Hexavalent Chromium	EPA 900 Gross Alpha/Beta	Isotope Ca-137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Blind Duplicate MS/MSD	Frequency (event/year)
075-48	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							1a
075-50	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Outer Plume Perimeter																							2
075-85	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Outer Plume Perimeter																							2
075-86	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Outer Plume Perimeter																							2
075-87	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
075-88	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
075-89	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
076-10	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Outer Plume Perimeter																							2
076-11	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
076-12	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
076-173	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
076-174	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
076-175	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
076-177	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
077-10	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
077-11	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-01	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-02	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-170	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-171	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-200	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
085-291	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
085-292	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-39	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-40	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-41	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-65	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-66	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-67	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
085-68	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
085-69	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
085-70	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Outer Plume Perimeter																							2
085-71	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Outer Plume Perimeter																							2
085-72	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Outer Plume Perimeter																							2
085-73	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-74	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-75	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-76	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
085-77	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
085-78	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
085-79	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-139	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-273	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-274	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
085-275	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume core																							2
085-276	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-42	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2
085-43	OU III (AOC 20HFBF Trilium)	BGRROWCF Sr-90	Plume Perimeter																							2

Table 12.1.2 ER Sampling Information CY 2003

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EOB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	MTBE	TSS/TDS	Sulfates/Chlorides/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Hexavalent Chromium	EPA 900 Gross Alpha/Beta	Isotopic C-137	EPA 901 Gamma Spec	EPA 908 Tritium	EPA 905 Sr-90	Bind Duplicate/MS/MSD	Frequency (events/year)
000-251	OU III (Industrial Park)		Plume Perimeter	X																						
000-252	OU III (Industrial Park)		Plume Perimeter	X																						
000-253	OU III (Industrial Park)		Plume Core	X																						
000-255	OU III (Industrial Park)		Plume Perimeter	X																						
000-256	OU III (Industrial Park)		Plume Core	X																						
000-258	OU III (Industrial Park)		Plume Perimeter	X																						
000-259	OU III (Industrial Park)		Plume Core	X																						
000-261	OU III (Industrial Park)		Plume Perimeter	X																						
000-262	OU III (Industrial Park)		Plume Core	X																						
000-264	OU III (Industrial Park)		Plume Perimeter	X																						
000-265	OU III (Industrial Park)		Plume Core	X																						
000-267	OU III (Industrial Park)		Plume Perimeter	X																						
000-268	OU III (Industrial Park)		Plume Core	X																						
000-270	OU III (Industrial Park)		Plume Perimeter	X																						
000-271	OU III (Industrial Park)		Plume Core	X																						
000-272	OU III (Industrial Park)		Plume Perimeter	X																						
000-273	OU III (Industrial Park)		Plume Core	X																						
000-274	OU III (Industrial Park)		Bypass Detection	X																						
000-275	OU III (Industrial Park)		Bypass Detection	X																						
000-276	OU III (Industrial Park)		Bypass Detection	X																						
000-277	OU III (Industrial Park)		Bypass Detection	X																						
000-278	OU III (Industrial Park)		Bypass Detection	X																						
000-279	OU III (Industrial Park)		Bypass Detection	X																						
000-280	OU III (Industrial Park)		Plume Core	X																						
New-1	OU III (Industrial Park)		Plume Perimeter	X																						
New-2	OU III (Industrial Park)		Bypass Detection	X																						
005-03	OU III (BGRW/CF Sr-90)		Bypass Detection	X																						
005-04	OU III (BGRW/CF Sr-90)		Plume Perimeter	X																						
005-06	OU III (BGRW/CF Sr-90)		Background	X																						
005-11	OU III (BGRW/CF Sr-90)		Background	X																						
005-160	OU III (BGRW/CF Sr-90)		Background	X																						
005-161	OU III (BGRW/CF Sr-90)		Background	X																						
005-162	OU III (BGRW/CF Sr-90)		Background	X																						
005-163	OU III (BGRW/CF Sr-90)		Background	X																						
005-164	OU III (BGRW/CF Sr-90)		Background	X																						
005-165	OU III (BGRW/CF Sr-90)		Background	X																						
005-166	OU III (BGRW/CF Sr-90)		Background	X																						
005-167	OU III (BGRW/CF Sr-90)		Background	X																						
005-168	OU III (BGRW/CF Sr-90)		Background	X																						
005-169	OU III (BGRW/CF Sr-90)		Background	X																						
005-170	OU III (BGRW/CF Sr-90)		Background	X																						
005-171	OU III (BGRW/CF Sr-90)		Background	X																						
005-172	OU III (BGRW/CF Sr-90)		Background	X																						
005-173	OU III (BGRW/CF Sr-90)		Background	X																						
005-174	OU III (BGRW/CF Sr-90)		Background	X																						
005-175	OU III (BGRW/CF Sr-90)		Background	X																						
005-176	OU III (BGRW/CF Sr-90)		Background	X																						
005-177	OU III (BGRW/CF Sr-90)		Background	X																						
005-178	OU III (BGRW/CF Sr-90)		Background	X																						
005-18	OU III (BGRW/CF Sr-90)		Plume Perimeter	X																						

Table 12.1.2 ER Sampling Information CY 2003

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EOB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	MTBE	TSS/TDS	Sulfates/Chloride/Alkalinity	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Hexavalent Chromium	EPA 900 Gross Alpha/Beta	Isotopic C-137	EPA 901 Gamma Spec	EPA 908 Tritium	EPA 905 Sr-90	Blank Duplicates/MIS/MSD	Frequency (events/year)
095-169	OU III (Blkg 96)		Bypass Detection	X																					
095-170	OU III (Blkg 96)		Bypass Detection	X																					
095-171	OU III (Blkg 96)		Plume Perimeter	X																					
095-172	OU III (Blkg 96)		Plume Core	X																					
New-1	OU III (Blkg 96)		TBD	X																					
New-2	OU III (Blkg 96)		TBD	X																					
New-3	OU III (Blkg 96)		TBD	X																					
105-52	OU III Middle Road		Plume Perimeter	X																					
105-53	OU III Middle Road		Plume Core	X																					
105-54	OU III Middle Road		Plume Core	X																					
113-16	OU III Middle Road		Bypass Detection	X																					
113-17	OU III Middle Road		Bypass Detection	X																					
113-18	OU III Middle Road		Bypass Detection	X																					
113-19	OU III Middle Road		Bypass Detection	X																					
113-20	OU III Middle Road		Bypass Detection	X																					
113-21	OU III Middle Road		Bypass Detection	X																					
113-22	OU III Middle Road		Bypass Detection	X																					
114-12	OU III Middle Road		Bypass Detection	X																					
105-23	OU III Middle Road		Plume Core	X																					
105-25	OU III Middle Road		Plume Core	X																					
105-44	OU III Middle Road		Plume Core	X																					
113-08	OU III Middle Road		Plume Core	X																					
113-07	OU III Middle Road		Plume Core	X																					
113-09	OU III Middle Road		Plume Core	X																					
113-11	OU III Middle Road		Plume Core	X																					
105-53	OU III Middle Road		Plume Core	X																					
105-54	OU III Middle Road		Plume Core	X																					
105-55	OU III Middle Road		Plume Core	X																					
105-56	OU III Middle Road		Plume Core	X																					
105-58	OU III Middle Road		Plume Core	X																					
105-59	OU III Middle Road		Plume Core	X																					
105-62	OU III Middle Road		Plume Core	X																					
000-280	OU III (South Boundary)		Chemical/Animal Holes Sr-90	X																					
121-06	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
121-09	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
121-12	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
121-18	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
121-21	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
122-10	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
122-15	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
122-18	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
114-00	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
114-07	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
121-10	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
121-11	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
121-13	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
121-14	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
121-20	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						
121-23	OU III (South Boundary)		OU III (South Boundary) Radionuclide																						

Table 12.1.2 ER Sampling Information CY 2003

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Sem-VOCs	Pesticides Method 608	PCBs Method 608	MTBE	TSS/TDS	Sulfates/Chlorides/Alkalinity	TN Nitrogen	Nitrites	Nitrates	Ammonia	TAL Metals	Cyanide	Hexavalent Chromium	EPA 900 Gross Alpha/Beta	Isotopic C-137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Band Dup: Calc/M/S/M/SD	Frequency (Events/Year)
083-02	OU III (Central)		Plume Core	X																					
084-04	OU III (Central)		Plume Core	X																					
084-05	OU III (Central)		Plume Core	X																					
086-07	OU III (Central)		Plume Core	X																					
105-05	OU III (Central)		Plume Core	X																					
105-08	OU III (Central)		Plume Core	X																					
108-03	OU III (Central)		Plume Core	X																					
108-04	OU III (Central)		Plume Core	X																					
085-07	OU III (Carbon tet)		Plume Core	X																					
085-13	OU III (Carbon tet)		Plume Core	X																					
085-16	OU III (Carbon tet)		Plume Core	X																					
085-160	OU III (Carbon tet)		Plume Core	X																					
085-161	OU III (Carbon tet)		Plume Core	X																					
085-162	OU III (Carbon tet)		Plume Core	X																					
085-163	OU III (Carbon tet)		Plume Core	X																					
085-17	OU III (Carbon tet)		Plume Core	X																					
085-236	OU III (Carbon tet)		Plume Core	X																					
085-237	OU III (Carbon tet)		Plume Core	X																					
085-238	OU III (Carbon tet)		Plume Core	X																					
085-28	OU III (Carbon tet)		Plume Core	X																					
085-183	OU III (Carbon tet)		Plume Core	X																					
085-185	OU III (Carbon tet)		Plume Core	X																					
085-188	OU III (Carbon tet)		Plume Core	X																					
085-189	OU III (Carbon tet)		Plume Core	X																					
085-42	OU III (Carbon tet)		Plume Core	X																					
085-43	OU III (Carbon tet)		Plume Core	X																					
085-45	OU III (Carbon tet)		Plume Core	X																					
085-47	OU III (Carbon tet)		Plume Core	X																					
085-53	OU III (Carbon tet)		Plume Core	X																					
085-58	OU III (Carbon tet)		Plume Core	X																					
085-59	OU III (Carbon tet)		Plume Core	X																					
085-90	OU III (Carbon tet)		Plume Core	X																					
085-92	OU III (Carbon tet)		Plume Core	X																					
104-11	OU III (Carbon tet)		Plume Core	X																					
105-23	OU III (Carbon tet)		Plume Core	X																					
105-42	OU III (Carbon tet)		Plume Core	X																					
085-277	OU III (Carbon tet)		Plume Core	X																					
085-279	OU III (Carbon tet)		Plume Core	X																					
085-280	OU III (Carbon tet)		Plume Core	X																					
104-38	OU III (Carbon tet)		Plume Core	X																					
109-12	OU III (Magdaly)		Plume Core	X																					
109-13	OU III (Magdaly)		Plume Core	X																					
115-50	OU III (Magdaly)		Plume Core	X																					
121-40	OU III (Magdaly)		Plume Core	X																					
122-41	OU III (Magdaly)		Plume Core	X																					
MW-1	OU III (Magdaly)		Plume Core	X																					
MW-2	OU III (Magdaly)		Plume Core	X																					
MW-3	OU III (Magdaly)		Plume Core	X																					
MW-4	OU III (Magdaly)		Plume Core	X																					
MW-5	OU III (Magdaly)		Plume Core	X																					
MW-6	OU III (Magdaly)		Plume Core	X																					

Table 12.1.2 ER Sampling Information CY 2003

Well ID	Project 1	Project 2	Decision Submitt	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Sem-VOCs	Pesticides Method 608	PCBs Method 608	MTBE	TSS/TDS	Sulfates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Hexavalent Chromium	EPA 900 Gross Alpha/Beta	Isotopic C-137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Blind Duplicate/M/S/V/SD	Frequency (events/year)
MW-8	OU III (Marginal)			X																						
New-1	OU III (Marginal)																									
New-2	OU III (Marginal)																									
000-101	OU III (off-site)			X																						
000-102	OU III (off-site)			X																						
000-104	OU III (off-site)			X																						
000-105	OU III (off-site)			X																						
000-107	OU III (off-site)			X																						
000-131	OU III (off-site)			X																						
000-97	OU III (off-site)			X																						
000-98	OU III (off-site)			X																						
000-99	OU III (off-site)			X																						
800-21	OU III (off-site)			X																						
800-22	OU III (off-site)			X																						
800-23	OU III (off-site)			X																						
800-40	OU III (off-site)			X																						
800-41	OU III (off-site)			X																						
800-43	OU III (off-site)			X																						
800-44	OU III (off-site)			X																						
800-50	OU III (off-site)			X																						
800-51	OU III (off-site)			X																						
800-52	OU III (off-site)			X																						
800-53	OU III (off-site)			X																						
076-02	OU IV (AOC 5 AS/SVE)			X																						
076-04	OU IV (AOC 5 AS/SVE)			X																						
076-05	OU IV (AOC 5 AS/SVE)			X																						
076-06	OU IV (AOC 5 AS/SVE)			X																						
076-08	OU IV (AOC 5 AS/SVE)			X																						
076-178	OU IV (AOC 5 AS/SVE)			X																						
076-179	OU IV (AOC 5 AS/SVE)			X																						
076-180	OU IV (AOC 5 AS/SVE)			X																						
076-185	OU IV (AOC 5 AS/SVE)			X																						
076-186	OU IV (AOC 5 AS/SVE)			X																						
076-18	OU IV (AOC 5 AS/SVE)			X																						
076-19	OU IV (AOC 5 AS/SVE)			X																						
076-21	OU IV (AOC 5 AS/SVE)			X																						
076-23	OU IV (AOC 5 AS/SVE)			X																						
076-380	OU IV (AOC 5 AS/SVE)			X																						
076-07	OU IV (AOC 5 AS/SVE)			X																						
076-09	OU IV (AOC 5 AS/SVE)			X																						
076-181	OU IV (AOC 5 AS/SVE)			X																						
076-182	OU IV (AOC 5 AS/SVE)			X																						
076-183	OU IV (AOC 5 AS/SVE)			X																						
076-184	OU IV (AOC 5 AS/SVE)			X																						
076-22	OU IV (AOC 5 AS/SVE)			X																						
076-24	OU IV (AOC 5 AS/SVE)			X																						
066-17	OU IV (AOC 5 AS/SVE)			X																						
066-18	OU IV (AOC 5 AS/SVE)			X																						
066-189	OU IV (AOC 5 AS/SVE)			X																						
066-190	OU IV (AOC 5 AS/SVE)			X																						
066-191	OU IV (AOC 5 AS/SVE)			X																						
066-192	OU IV (AOC 5 AS/SVE)			X																						
066-193	OU IV (AOC 5 AS/SVE)			X																						
066-194	OU IV (AOC 5 AS/SVE)			X																						
066-195	OU IV (AOC 5 AS/SVE)			X																						
066-196	OU IV (AOC 5 AS/SVE)			X																						
066-197	OU IV (AOC 5 AS/SVE)			X																						
066-198	OU IV (AOC 5 AS/SVE)			X																						
066-199	OU IV (AOC 5 AS/SVE)			X																						
066-200	OU IV (AOC 5 AS/SVE)			X																						

Table 12 1.2 ER Sampling Information CY 2003

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	MTBE	TSS/TDS	Sulfate/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Ammonia	Nitrites	Nitrates	Hexavalent Chromium	EPA 900 Gross Alpha Beta	Isotopic C-137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Blank Duplicate/MS/MSD	Frequency (events/year)
076-13	OU IV (AOC 6 Sr-90)																							2d
076-187	OU IV (AOC 6 Sr-90)																							2d
076-188	OU IV (AOC 6 Sr-90)																							2d
076-169	OU IV (AOC 6 Sr-90)																							2d
076-20	OU IV (AOC 6 Sr-90)																							2d
076-25	OU IV (AOC 6 Sr-90)																							2d
076-26	OU IV (AOC 6 Sr-90)																							2d
076-262	OU IV (AOC 6 Sr-90)																							2d
076-263	OU IV (AOC 6 Sr-90)																							2d
076-264	OU IV (AOC 6 Sr-90)																							2d
076-265	OU IV (AOC 6 Sr-90)																							2d
076-27	OU IV (AOC 6 Sr-90)																							2d
076-28	OU IV (AOC 6 Sr-90)																							2d
076-314	OU IV (AOC 6 Sr-90)																							2d
076-317	OU IV (AOC 6 Sr-90)																							2d
076-373	OU IV (AOC 6 Sr-90)																							2d
076-10	OU IV (AOC 6 Sr-90)																							2d
New-1	OU IV (AOC 6 Sr-90)																							2d
000-122	OU V																							2d
000-123	OU V																							2d
000-141	OU V																							2d
000-142	OU V																							2d
000-143	OU V																							2d
000-144	OU V																							2d
000-145	OU V																							2d
000-146	OU V																							2d
000-147	OU V																							2d
007-02	OU V																							2d
007-03	OU V																							2d
007-04	OU V																							2d
041-01	OU V																							2d
041-02	OU V																							2d
041-03	OU V																							2d
049-05	OU V																							2d
049-06	OU V																							2d
050-01	OU V																							2d
050-02	OU V																							2d
051-03	OU V																							2d
051-04	OU V																							2d
051-05	OU V																							2d
600-15	OU V																							2d
600-16	OU V																							2d
600-18	OU V																							2d
600-19	OU V																							2d
600-20	OU V																							2d
600-21	OU V																							2d
600-22	OU V																							2d
600-23	OU V																							2d
600-24	OU V																							2d
600-25	OU V																							2d

Table 12.1.2 ER Sampling Information CY 2003

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	MTBE	TSS/TDS	Sulfate/Chloride/Alkalinity	TX Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Hexavalent Chromium	EPA 900 Gross Alpha/Beta	Scallop Ce-137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Blank Duplicates/M/MSD	Frequency (events/year)
600-26	OU V		Sentinel	X																						2
600-27	OU V		Sentinel	X																						2
000-110	OU VI EDB		Plume Core	X	X																					4
000-170	OU VI EDB		Plume Core	X	X																					4
000-174	OU VI EDB		Plume Perimeter	X	X																					4
000-175	OU VI EDB		Plume Core	X	X																					4
000-176	OU VI EDB		Plume Perimeter	X	X																					4
000-177	OU VI EDB		Plume Perimeter	X	X																					4
000-178	OU VI EDB		Sentinel	X																						4
000-179	OU VI EDB		Plume Perimeter	X	X																					4
000-180	OU VI EDB		Plume Perimeter	X	X																					4
000-181	OU VI EDB		Plume Perimeter	X	X																					4
000-201	OU VI EDB		Plume Perimeter	X	X																					4
000-209	OU VI EDB		Plume Core	X	X																					4
000-02	OU VI EDB		Background	X	X																					4
000-13	OU VI EDB		Background	X	X																					4
000-14	OU VI EDB		Background	X	X																					4
000-06	OU VI EDB		Plume Perimeter	X	X																					4
000-10	OU VI EDB		Plume Perimeter	X	X																					4
000-11	OU VI EDB		Plume Perimeter	X	X																					4
100-12	OU VI EDB		Plume Perimeter	X	X																					4
100-13	OU VI EDB		Plume Perimeter	X	X																					4
100-14	OU VI EDB		Plume Perimeter	X	X																					4
800-24	OU VI EDB		Sentinel	X																						4
800-25	OU VI EDB		Sentinel	X																						4
800-54	OU VI EDB		Plume Core	X	X																					4
800-283	OU VI EDB		Plume Perimeter	X	X																					4
800-284	OU VI EDB		Plume Perimeter	X	X																					4
800-285	OU VI EDB		Plume Perimeter	X	X																					4
000-176	OU I (South Boundary)		Sentinel	X																						4
000-137	OU I (South Boundary)		Plume Core	X	X																					4
000-138	OU I (South Boundary)		Plume Core	X	X																					4
000-139	OU I (South Boundary)		Plume Perimeter	X	X																					4
000-21	OU I (South Boundary)		YED	X																						4
000-21	OU I (South Boundary)		YED	X																						4
000-13	OU I (South Boundary)		Background	X																						4
000-14	OU I (South Boundary)		Background	X																						4
000-20	OU I (South Boundary)		Background	X																						4
000-21	OU I (South Boundary)		Background	X																						4
000-22	OU I (South Boundary)		Plume Perimeter	X	X																					4
000-30	OU I (South Boundary)		Plume Perimeter	X	X																					4
000-33	OU I (South Boundary)		Plume Perimeter	X	X																					4
000-35	OU I (South Boundary)		Plume Perimeter	X	X																					4
000-36	OU I (South Boundary)		Plume Perimeter	X	X																					4
000-59	OU I (South Boundary)		Plume Perimeter	X	X																					4
000-61	OU I (South Boundary)		Plume Perimeter	X	X																					4
000-04	OU I (South Boundary)		Plume Core	X	X																					4
100-10	OU I (South Boundary)		Plume Perimeter	X	X																					4
100-23	OU I (South Boundary)		Plume Perimeter	X	X																					4
100-24	OU I (South Boundary)		Plume Perimeter	X	X																					4
100-25	OU I (South Boundary)		Plume Perimeter	X	X																					4
100-26	OU I (South Boundary)		Plume Perimeter	X	X																					4

CHEMICAL/ANIMAL HOLES STRONTIUM-90 POST-ROD

DATE November 20, 2002

PROPOSED CHANGE

Twelve new monitoring wells were installed during 2002 as part of the pilot study/groundwater remediation system construction to address the Chemical/Animal Holes strontium-90 plume.

DESCRIPTION AND TECHNICAL BASIS

Between 1960 and 1966, waste, glassware containing chemical and radioactive waste, and animal carcasses containing radioactive tracers were disposed in shallow pits in an area directly east of the Chemical/Animal Holes area. Used glassware continued to be disposed in shallow pits directly north of this area from 1966 through 1981. Remediation of the impacted soil in the Chemical/Animal Holes area, including waste excavation, treatment and disposal, was completed in September 1997.

The monitoring well network for the Chemical/Animal Holes consists of 24 wells. Fifteen wells are located downgradient of the Chemical/Animal Holes area (106-04, 106-13 through 106-17, 106-43 through 106-50 and 106-64). There are also eight sentinel wells along Middle Road (106-20 through 106-25, 106-62 and 106-63) and one sentinel well south of Middle Road (114-01). No upgradient wells are sampled as part of this program. The wells comprising the Chemical/Animal Holes program are listed in Table 12.2.2. Well locations are shown on Figure 12.2.1. The wells are sampled semi-annually for strontium-90 analysis and annually for analysis of volatile organic compounds (VOCs).

Strontium-90 has routinely been detected downgradient of the Chemical/Animal Holes at levels exceeding the New York State groundwater standard. During calendar year 2000, five wells in the downgradient area (106-16, 106-47, 106-49, 106-50 and 106-64) contained strontium-90 at concentrations exceeding the New York State groundwater standard, indicating individual disposal pits as the sources for the strontium-90. None of the sentinel wells contained strontium-90 at levels exceeding the New York State groundwater standard, although concentrations in some sentinel wells (such as 106-25) increased during calendar year 2000. VOCs have also routinely been detected downgradient of the Chemical/Animal Holes, but generally at levels below New York State groundwater standards. During calendar year 2000, two sentinel wells included in the Chemical/Animal Holes sampling program (106-25 and 106-47) each contained one VOC at a concentration slightly exceeding New York State groundwater standards. A plume of VOC-impacted groundwater originating in the area of the Chemical/Animal Holes and extending off site will be addressed by the North Street Groundwater Remediation System that is currently being designed. During calendar year 2001,

fluctuations in strontium-90 activities have been observed for some wells within the area of high concentrations.

A pilot study is currently being constructed to extract and treat groundwater within the high-concentration portion of the strontium-90 plume. As currently planned, operation of the pilot system will begin in May 2003. At that time, additional wells will be incorporated into the Chemical/Animal Holes monitoring network and the Data Quality Objective (DQO) Summary will be reviewed and revised as necessary. This DQO Summary addresses only the current (pre-operational) monitoring program.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

Compliance

Support Compliance

x Surveillance

_____ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

The Chemical/Animal Holes area has been an historic source of strontium-90 contamination to groundwater. In response, BNL has conducted remediation (waste excavation, treatment and disposal) to eliminate future releases. Data are needed to confirm that the soil remediation was adequate and to track existing contaminant plumes downgradient of the Chemical/Animal Holes area. In addition, data are required during the design process in the immediate pilot study area for design decisions and potential system modifications. The pilot study is targeted for the area of high strontium-90 concentrations.

Problem Statement: Existing strontium-90 and VOC plumes have degraded groundwater quality downgradient of the Chemical/Animal Holes area and could impact downgradient receptors. Data are needed to:

- Verify that the soil source areas have been remediated
- Track the portions of the strontium-90 plumes that are targeted for remediation by monitored natural attenuation
- Track the distribution of the high concentration area to be addressed by the upcoming pilot study

Step 2: Identify the Decisions

- Is the BNL Groundwater Contingency Plan triggered?
- Are the strontium-90 plumes targeted for monitored natural attenuation attenuating as planned?
- Is the high concentration strontium-90 plume to be addressed by the upcoming pilot study still located in the pilot study area?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Strontium-90 and VOC results in groundwater
- Location of existing wells relative to flow patterns
- Regulatory drivers (OU I ROD and OU III ROD)
- Action Levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL Environmental Monitoring Plan
- Estimated retardation rate for strontium-90
- Variability of data.

Step 4: Define the Study Boundaries

The decision unit limits for this project are the area impacted by detectable activities of strontium-90 from the Chemical/Animal Holes and Former Landfill areas. The vertical limits are from the water table surface to the deep zone of the Upper Glacial aquifer.

The time periods over which decisions are made will be limited to the pre-operational period for the pilot study. Due to the low travel velocity for strontium-90 in groundwater, decisions for most wells will be made on a timeframe of 180 days. Since wells 106-04, 106-16, 106-17, 106-48, 106-49 and 106-50 are located within the high-concentration area to be addressed by the planned pilot study and strontium-90 concentrations in this area have recently shown fluctuations, decisions will be made using a timeframe of 90 days to ensure that the design of the pilot study will be effective.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from all wells will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Are the strontium-90 plumes targeted for monitored natural attenuation attenuating as planned?

If the detected strontium-90 activities are consistent with the attenuation model, groundwater model results and professional judgment, **then** continue monitoring. If not, consider refining the conceptual model and/or conducting an evaluation to determine whether outside factors (such as additional contaminant sources) are affecting the results.

Decision 3

Is the high concentration strontium-90 plume to be addressed by the upcoming pilot study still located in the pilot study area?

If analytical results for strontium-90 indicate that the high-concentration area is no longer in the area to be addressed by the pilot study and these results are confirmed by resampling, **then** consider an engineering evaluation to determine whether modification of pilot system design elements is warranted.

STEP 6: SPECIFY ACCEPTABLE ERROR TOLERANCES

Table 12.2.1 summarizes the decision and possible decision errors for this project.

STEP 7: OPTIMIZE THE DESIGN

Number and Location of Wells

The existing monitoring well network consists of 15 wells immediately downgradient of the Chemical/ Animal Holes area and 9 sentinel wells further downgradient. The current network was developed using expert judgment and groundwater model results to detect groundwater contamination well before it approaches the site boundary. The number and

locations of the existing downgradient and sentinel wells are considered adequate. However, since some of the sentinel wells located along Middle Road have recently contained low levels of strontium-90 (below New York State groundwater standards), the need for additional downgradient sentinel wells will be evaluated as part of the DQO Summary review to be conducted when operation of the pilot system begins.

Parameters and Frequency

Wells 106-04, 106-16, 106-17, 106-48, 106-49 and 106-50 are located within the area of the planned pilot study and are sampled quarterly. The remaining wells in the program are sampled on a semi-annual basis. The monitoring schedule is provided in Table 12.1.1.

Due to the recent exceedances of New York State groundwater standards and historic detections, sampling for analysis of VOCs should continue to be conducted annually.

A summary of the proposed revised sampling program for this project is shown in Table 12.2.2, on page 12.2-6.

Table 12.2.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Are the strontium-90 plumes targeted for monitored natural attenuation attenuating as planned?	See Step 3 for inputs.	(1) Data indicate that the plumes are not attenuating as planned when they are. (2) Data indicate that the plumes are attenuating as planned when they are not.	(1) Wasted resources refining conceptual model and conducting evaluations of other factors. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.
Is the high-concentration strontium-90 plume to be addressed by the upcoming pilot study still located in the pilot study area?	See Step 3 for inputs.	(1) Data indicate plume is not located in pilot study area when it is. (2) Data indicate plume is located in pilot study area when it is not.	(1) Wasted resources modifying system design, potentially inaccurate results/conclusions from pilot study. (2) Potentially inaccurate results/ conclusions from pilot study.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications described in Step 7 will result in an increase in sampling and analysis costs of \$5,332 per year.

TOTAL COST FOR MONITORING PROGRAM

FY 2002	\$21,513
FY2003	\$26,826
Difference	\$5,312

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   Thomas Burke (631) 344-3130
William Dorsch (631) 344-5186

Table 12.2.2 Proposed Modifications to the Chemical/Animal Holes Monitoring Wells

Well ID	Current Sampling Frequency	Proposed Sampling Frequency	Affected Parameters
106-04	Quarterly	No Change	None
106-13	Semi-annually	No Change	None
106-14	Semi-annually	No Change	None
106-15	Semi-annually	No Change	None
106-16	Quarterly	No Change	None
106-17	Quarterly	No Change	None
106-20	Semi-annually	No Change	None
106-21	Semi-annually	No Change	None
106-22	Semi-annually	No Change	None
106-23	Semi-annually	No Change	None
106-24	Semi-annually	No Change	None
106-25	Semi-annually	No Change	None
106-43	Semi-annually	No Change	None
106-44	Semi-annually	No Change	None
106-45	Semi-annually	No Change	None
106-46	Semi-annually	No Change	None
106-47	Semi-annually	No Change	None
106-48	Quarterly	No Change	None
106-49	Quarterly	No Change	None
106-50	Quarterly	No Change	None
106-62	Semi-annually	No Change	None
106-63	Semi-annually	No Change	None
106-64	Semi-annually	No Change	None
114-01	Semi-annually	No Change	None
New-1	None	Semiannual	Sr-90
	None	Annual	VOCs
New-2	None	Semiannual	Sr-90
	None	Annual	VOCs
New 3	None	Semiannual	Sr-90
	None	Annual	VOCs
New 4	None	Semiannual	Sr-90
	None	Annual	VOCs
New 5	None	Semiannual	Sr-90
	None	Annual	VOCs
New 6	None	Semiannual	Sr-90
	None	Annual	VOCs
New 7	None	Semiannual	Sr-90
	None	Annual	VOCs
New 8	None	Semiannual	Sr-90
	None	Annual	VOCs
New 9	None	Semiannual	Sr-90
		Annual	VOCs
New 10	None	Semiannual	Sr-90
		Annual	VOCs
New 11	None	Semiannual	Sr-90
		Annual	VOCs
New 12	None	Semiannual	Sr-90
		Annual	VOCs

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ENVIRONMENTAL
SERVICES DIVISION

TITLE:
OU III CHEMICAL/ANIMAL HOLES
STRONTIUM-90 PRE-DESIGN
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT:HZ: -	DATE: 11/26/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV.: 1	NOTES: -
FIGURE NO.:		1	

FORMER LANDFILL POST-CLOSURE

DATE September 18, 2002

PROPOSED CHANGES

- Since semi-volatile organic compounds (SVOCs) and ethylene dibromide (EDB) were not detected in groundwater during calendar year 2001, these parameters should be eliminated from the monitoring program.
- At most, only trace levels of volatile organic compounds (VOCs) have historically been detected in upgradient wells 86-42, 86-72 and 87-22, and no detections have exceeded New York State Ambient Water Quality Standards (NYS AWQS). As a result, the frequency of sampling for analysis of VOCs in these wells should be reduced from quarterly to annually.
- Historically, tritium has not been detected at concentrations exceeding the NYS AWQS (the highest tritium concentration recorded at the Former Landfill was 746 picoCuries per liter (pCi/L) in well 106-30 in December 1998). Strontium-90 has not been detected above the NYS AWQS of 8 pCi/L with the exception of well 97-64, and a declining trend has been demonstrated for several years in this well with the concentration during the last two rounds of 2001 below 2 pCi/L. As a result, the frequency of sampling for analysis of radionuclides should be reduced from quarterly to annually. The exception will be well 86-42 in which tritium was detected below the NYS AWQS of 20,000 pCi/L in 2001. This well will be sampled quarterly for analysis of tritium.
- Metals were all below applicable NYS AWQS during calendar year 2001, with the exception of iron, manganese, sodium, antimony, and aluminum. Therefore, the sampling frequency for analysis of metals and cyanide should be reduced from quarterly to semi-annually.

DESCRIPTION AND TECHNICAL BASIS

The Former Landfill Area includes three unlined areas historically used for waste disposal, the Former Landfill, the Slit Trench and the Interim Landfill. Due to the proximity of these three areas, they have been addressed collectively under the term Former Landfill Area.

The Former Landfill was used by the United States Army during World War I and World War II, and by BNL from 1947 through 1966. Material disposed in the landfill by BNL included construction and demolition debris, sewage sludge, chemical and low level radioactive waste, used equipment and animal carcasses. The Slit Trench was reportedly used during the 1960s. In November 1996, the Former Landfill and Slit Trench were capped in accordance with NYCRR Part 360 requirements. The Interim Landfill was reportedly used for one year after closure of the Former Landfill and was capped in October 1997.

The monitoring well network for the Former Landfill Area consists of eight existing wells, including three wells upgradient of the Former Landfill Area (086-42, 086-72 and 087-22), one well upgradient of the Former Landfill and downgradient of the Interim Landfill (097-277), and four wells downgradient of the Former Landfill Area (097-17, 097-64, 106-02 and 106-30). All wells except 86-42 are screened in the shallow Upper Glacial aquifer. Well 86-42 is screened in the mid-Upper Glacial aquifer. This well is also used to monitor for VOCs originating from the OU IV AOC 6 1977 Soil/Solvent Spill Area. The screen zone and aquifer screened by each of the wells currently sampled are summarized in Table 12.3.1 below. Well locations are shown on Figure 12.3.1.

TABLE 12.3.1 FORMER LANDFILL AREA WELL NETWORK		
Well	Screen Zone *	Aquifer Screened
086-42	65–75	Mid Upper Glacial
086-72	41.5–56.5	Shallow Upper Glacial
087-22	43–53	Shallow Upper Glacial
097-17	29–39	Shallow Upper Glacial
097-64	29–44	Shallow Upper Glacial
097-277	40–55	Shallow Upper Glacial
106-02	55–65	Shallow Upper Glacial
106-30	29–44	Shallow Upper Glacial

All eight wells are sampled quarterly for analysis of VOCs, EDB, metals, cyanide, gross alpha, gross beta, gamma spectroscopy, strontium-90, tritium and landfill leachate parameters (Table 12.1.2). Samples are also collected annually for analysis of SVOCs, pesticides and PCBs. Contaminants historically detected from the Former Landfill at levels exceeding New York State groundwater standards have been chlorinated VOCs (1,1,1-trichloroethane, 1,1-dichloroethane and chloroform) and strontium-90. During calendar year 2001, no VOCs, radionuclides or leachate parameters were detected at concentrations exceeding New York State groundwater standards, and SVOCs, EDB, PCBs and tritium were not detected in any well. Several pesticides, including delta-BHC, dieldrin, endrin aldehyde and Lindane, were detected in one upgradient well (086-72) and one downgradient well (106-02) at estimated concentrations exceeding New York State groundwater standards. Metals, including antimony, aluminum and sodium, were also detected at concentrations above the New York State groundwater standards in several upgradient and downgradient wells. Data collected from 1997 through 2001 indicate that, with the exception of iron and manganese, the parameters detected in the Former Landfill Area wells have shown stable or generally decreasing concentration trends.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☒ Compliance
- ☒ Support Compliance
- ☐ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Potential failure of the landfill cap could lead to continued releases from the Former Landfill Area into groundwater at levels exceeding New York State groundwater standards.

Step 2: Identify the Decisions

The decision for the project is:

Are the controls effectively improving groundwater quality below and downgradient of the Former Landfill Area?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Comparison of pre- and post-capping groundwater quality by analysis of VOCs, SVOCs, EDB, pesticides, PCBs, metals, cyanide, radionuclides, tritium and landfill water quality parameter concentrations in groundwater
- Location of existing wells relative to flow patterns (Figure 12.3.1)
- Regulatory drivers (NYCRR Part 360)
- Action Levels (MCLs and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL Environmental Monitoring Plan.

Step 4: Define the Study Boundaries

The decision unit limits for this project are the immediate vicinity of the Former Landfill and the eight wells that comprise the groundwater monitoring program. The period for which the decisions will be made depends on the individual parameters, as summarized in Table 12.3.2.

The periods over which decisions will be made were determined based on the low risk to potential receptors of contamination from the Former Landfill. The factors considered to determine that risk is low are:

- Engineered control (landfill cap) is a proven conventional technology with a low failure rate
- Low travel velocities for some of the contaminants
- Proximity of the downgradient monitoring network

- Absence of downgradient receptors
- The resource has already been degraded

TABLE 12.3.2 FACTORS AFFECTING THE PERIOD FOR DECISIONS FOR THE FORMER LANDFILL				
Parameter	Relative Travel Time *	Above MCLs 1997-2001?	Trend 1997-2001	Time for Decision
VOCs	< 60 days	Yes	Decreasing	365 days
Tritium	< 60 days	No	Stable	365 days
SVOCs	Variable	No	---	None
EDB/ PCBs	Variable	No	None	365 days
Pesticides	Variable	No	None	365 days
Metals/Cyanide	Varies	Yes	Stable to increasing	365 days
Strontium-90	1,200 days	Yes	Decreasing	2 years **
Gross alpha	--	No	Stable	2 years **
Gross beta	--	No	Stable	2 years **
Gamma Spectroscopy	--	NA	--	2 years **
Leachate Parameters	< 60 days	No	Stable to decreasing	365 days

* Relative travel time is an approximate time for contamination to travel from the waste pile to downgradient wells.

** Based on trend

Step 5: Develop the Decision Rules

Decision 1

Are the controls effectively eliminating further discharges to soils and groundwater below the landfill?

The sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If, for any downgradient well, the current annual mean concentration for an individual contaminant of concern exceeds the mean concentration in that well computed from data collected from that well over the past three years AND is greater than MCLs, and this result is confirmed by resampling appropriate wells as well as by an evaluation of upgradient and downgradient conditions, **then** an evaluation will be made as to whether an increase in sampling frequency for that parameter or parameter group (for example, metals) would be appropriate. If not, then continue detection monitoring.

Decision 2

Is the capping system performing as planned?

If the system is performing as planned (based on groundwater model prediction, trend analysis and expert judgment), then continue monitoring. If not, then consider an engineering evaluation.

Notes:

- a. Use concentration plots over time to visually assess data for trends and model predictions.
- b. Slope analysis suggests that the goal will be achieved within the planned period (2-10 years).
- c. If the water quality for the majority or key wells (as defined by the Subject Matter Expert) is improving as planned, then the entire system is considered to be properly operating.

Step 6: Specify Acceptable Error Tolerances

TABLE 12.3.3 DECISIONS, POTENTIAL DECISION ERRORS, AND POTENTIAL CONSEQUENCES			
DECISION	Inputs	Potential Errors Based on Data	Potential Consequences
Are the controls effective at eliminating further discharges to groundwater below the Former Landfill?	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are.	(1) A discrete contaminant slug could exist and not be detected. (2) Delay in notifying stakeholders and taking corrective actions.

There are no potential receptors immediately downgradient of the Former Landfill and groundwater travel time to the site boundary is approximately 10 to 15 years. Due to these factors, it is very unlikely that decision error will result in adverse consequences to human health or non-compliance with the OU III Record of Decision. The consequences of decision error relate primarily to possible enforcement actions for environmental degradation, and erosion of stakeholder trust and BNL credibility.

Step 7: Optimize the Design

Number and Location of Wells

The eight monitoring wells around the Former Landfill Area are adequate considering the potential consequences of a decision error. The current well network was developed using expert judgment and groundwater modeling. No refinements are recommended at

this time since the groundwater flow direction has been relatively constant in recent years and the size of the source area is relatively small.

Parameters and Frequency

Since SVOCs and EDB were not detected in groundwater during calendar year 2001, these parameters should be eliminated from the monitoring program.

At most, only trace levels of VOCs have historically been detected in upgradient wells 86-42, 86-72 and 87-22, and no detections have exceeded NYS AWQS. As a result, the frequency of sampling for analysis of VOCs in these wells should be reduced from quarterly to annually.

Historically, tritium has not been detected at concentrations exceeding the NYS AWQS (the highest tritium concentration recorded at the Former Landfill was 746 pCi/L in well 106-30 in December 1998). Strontium-90 has not been detected above the NYS AWQS of 8 pCi/L with the exception of well 97-64, and a declining trend has been demonstrated for several years in this well with the concentration during the last two rounds of 2001 below 2 pCi/L. As a result, the frequency of sampling for analysis of radionuclides should be reduced from quarterly to annually. The exception will be well 86-42 in which tritium was detected below the NYS AWQS of 20,000 pCi/L in 2001. This well will be sampled quarterly for analysis of tritium.

Metals were all below applicable NYS AWQS during calendar year 2001, with the exception of iron, manganese, sodium, antimony, and aluminum. Therefore, the sampling frequency for analysis of metals and cyanide should be reduced from quarterly to semi-annually. A summary of the proposed sampling program for the Former Landfill Area is provided in Table 12.3.4.

TABLE 12.3.4 PROPOSED MODIFICATIONS TO THE FORMER LANDFILL MONITORING WELLS		
Parameter	Current Frequency	Proposed Frequency
VOCs	Quarterly	Quarterly *
Tritium	Quarterly	Annually**
SVOCs	Annually	None
EDB	Quarterly	None
Pesticides/PCBs	Annually	Annually
Metals/Cyanide	Quarterly	Semi-annually
Strontium-90	Quarterly	Annually
Gross alpha	Quarterly	Annually
Gross beta	Quarterly	Annually
Gamma Spectroscopy	Quarterly	Annually

* Annually for upgradient wells 086-42, 086-72 and 087-22. **Quarterly for well 86-42.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications described in Step 7 will result in a decrease in sampling and analysis cost of \$13,916 per year.

TOTAL COST FOR MONITORING PROGRAM

FY 2002	\$46,738
FY2003	\$32,822
Difference	-\$13,916

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   William Dorsch (631) 344-5186

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SERVICES DIVISION

TITLE:

OU I FORMER LANDFILL
POST-CLOSURE
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT:HZ.: —	DATE: 11/25/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV.: 1	NOTES: —

FIGURE NO.:

1

CURRENT LANDFILL POST-CLOSURE

DATE November 20, 2002

PROPOSED CHANGE

A recommendation in the Five Year Review Report (BNL 2001) was to reduce the frequency of VOC sampling from quarterly to semi-annually. After discussions with NYSDEC it was agreed to maintain the quarterly frequency for another year and evaluate the data at that point. Based on the stability of the VOC data, it is recommended that the frequency of VOC analysis is reduced to semi-annually for all wells except 88-109. This well exhibited a significant spike in chloroethane concentrations during the fourth quarter of 2001.

DESCRIPTION AND TECHNICAL BASIS

The Current Landfill operated from 1967 through 1990. Putrescible waste, sludge from the BNL Water Treatment Plant, anaerobic digester sludge from the Sewage Treatment Plant and limited quantities of laboratory waste were disposed in the landfill. The landfill was capped in accordance with NYCRR Part 360 requirements in 1995.

The monitoring well network for the Current Landfill consists of 11 existing wells, including 1 upgradient well (087-09), 3 wells immediately downgradient of the landfill (087-11, 088-109 and 088-110), and 7 wells further downgradient of the landfill (087-23, 087-24, 087-26, 087-27, 088-21, 088-22 and 088-23). Well locations are shown in Figure 12.4.1. All 11 wells are sampled quarterly and samples are analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), ethylene dibromide (EDB), pesticides, PCBs, metals, radionuclides, tritium and landfill leachate parameters.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☒ Compliance (NYCRR Part 360)
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

The Current Landfill has been an historic source of contamination and remains a potential source of contaminants to groundwater. In response, BNL has constructed an engineered cap over the landfill to mitigate future releases.

Problem Statement: Potential failure of the landfill cap could lead to continued releases from the Current Landfill into groundwater at levels exceeding MCLs.

Step 2: Identify the Decision

- Are the controls effectively improving groundwater quality below and downgradient of the landfill?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Comparison of pre- and post-capping groundwater quality by analysis of VOCs, SVOCs, EDB, pesticides, PCBs, metals, radionuclides, tritium and landfill water quality parameter concentrations in groundwater
- Location of existing wells relative to flow patterns
- Regulatory drivers (NYCRR Part 360)
- Action Levels (MCLs and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in this EMP.

Step 4: Define the Study Boundaries

The decision unit limits for this project are the immediate vicinity of the Current Landfill and the 11 wells that comprise the groundwater monitoring program. The period for which the decisions will be made depends on the individual parameters, as summarized in Table 12-4.1.

TABLE 12.4.1 FACTORS AFFECTING THE PERIOD FOR DECISIONS FOR THE CURRENT LANDFILL					
Parameter	Historical Detection?	Relative Travel Time **	Above MCLs 1995–2000	Trend 1995–2000	Time for Decision
VOCs	Yes	< 60 days	Yes	Decreasing	365 days
Tritium	Yes	< 60 days	No	Decreasing	365 days
SVOCs	No	300 days	No	--	None
EDB/Pesticides / PCBs	No	NA	No	--	365 days
Metals	Yes	Varies	Yes	Stable	2 years *
Strontium-90	Yes	1,200 days	Yes	Stable	2 years *
Gross alpha	Yes	--	No	Stable	2 years *
Gross beta	Yes	--	No	Stable	2 years *

Gamma Spectroscopy	Yes	--	NA	Stable	2 years *
Leachate Parameters	Yes	< 60 days	Yes	Decreasing	365 days

Notes: * Based on trend.

** Relative travel time is approximate time for contamination to travel from waste pile to surrounding wells.

The 1995–2000 concentration trends for the wells are steadily decreasing and contain no large variabilities. Exceptions to this are iron and manganese.

The periods over which decisions will be made were determined based on the low risk to potential receptors of contamination from the Current Landfill. The factors considered to determine that risk is low are:

- Engineered control (landfill cap) is a proven conventional technology with a low failure rate
- Low travel velocities for contaminants
- absence of downgradient receptors
- The resource has already been degraded
- A groundwater pump and treat system is currently operating downgradient of the Current Landfill (to address historical releases from the landfill)

Step 5: Develop the Decision Rules

Decision 1

Are the controls effectively eliminating further discharges to soils and groundwater below the landfill?

The sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If for any downgradient well, the current annual mean concentration for an individual contaminant of concern exceeds the mean concentration in that well computed from data collected from that well over the past three years AND is greater than MCLs, and this result is confirmed by resampling appropriate wells, as well as by an evaluation of upgradient and downgradient conditions, **then** an evaluation will be made as to whether an increase in sampling frequency for that parameter or parameter group (for example, metals) would be appropriate. In addition, consider conducting an engineering evaluation

to determine whether the capping system is performing as planned. If the current annual mean concentration for an individual contaminant of concern does not exceed the mean concentration in that well computed from data collected from that well over the past three years, then continue detection monitoring.

Notes

- a. Use concentration plots over time to visually assess data for trends and model predictions.
- b. Slope analysis suggests that the goal will be achieved within the planned period (2 to 10 years).
- c. If the water quality for the majority and/or key wells (as defined by the Subject Matter Expert) is improving as planned, then "the system" as a whole is considered to be properly operating.

Step 6: Specify Acceptable Error Tolerances

Table 12.4.2 summarizes the decision and possible decision errors for this project.

TABLE 12.4.2 DECISIONS, POTENTIAL DECISION ERRORS AND POTENTIAL CONSEQUENCES			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Are the controls effective at eliminating further discharges to groundwater below the Current Landfill?	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are.	(1) A discrete VOC contaminant slug of up to 300 feet long and 300 feet wide could exist and not be detected. (2) Delay in notifying stakeholders and taking corrective actions, prolonged operation of the OU I RA V groundwater treatment system.

There are no potential receptors immediately downgradient of the Current Landfill and groundwater travel time to the site boundary is approximately 10 to 15 years. In addition, a groundwater treatment system is already operating and treating historical releases from the landfill.

Due to these factors, it is very unlikely that decision error will result in adverse consequences to human health or non-compliance with the OU I ROD. The consequences of decision error relate primarily to possible enforcement actions for environmental degradation, and erosion of stakeholder trust and BNL credibility.

Step 7: Optimize the Design

Number and Location of Wells

The 11 existing monitoring wells around the landfill are adequate considering the potential consequences of a decision error. The current network was developed using expert judgement, groundwater models and particle-tracking computer codes. No refinements are recommended at this time since the groundwater flow direction has been relatively constant in this area in recent years and the potential source is relatively small in size.

Parameters and Frequency

A recommendation in the Five Year Review Report (BNL 2001) was to reduce the frequency of VOC sampling from quarterly to semi-annually. After discussions with NYSDEC it was agreed to maintain the quarterly frequency for another year and evaluate the data at that point. Based on the stability of the VOC data during 2001, it is recommended that the frequency of VOC analysis is reduced to semi-annually for all wells except 88-109. This well exhibited a significant spike in chloroethane concentrations during the fourth quarter of 2001. Table 12.1.1 lists the monitoring schedule for CY 2003. A detailed summary of analytical parameters and sampling frequency is provided in Table 12.1.2. A summary of the proposed modifications to the Current Landfill sampling program is provided in Table 12.4.3.

Number and Location of Wells

The 11 existing monitoring wells around the landfill are adequate considering the potential consequences of a decision error. The current network was developed using expert judgement, groundwater models and particle-tracking computer codes. No refinements are recommended at this time since the groundwater flow direction has been relatively constant in this area in recent years and the potential source is relatively small in size.

TABLE 12.4.3 PROPOSED MODIFICATIONS TO THE CURRENT LANDFILL MONITORING WELLS			
Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
087-09	Quarterly	Semiannual	VOCs
087-11	Quarterly	Semiannual	VOCs
087-23	Quarterly	Semiannual	VOCs
087-24	Quarterly	Semiannual	VOCs
087-26	Quarterly	Semiannual	VOCs
087-27	Quarterly	Semiannual	VOCs
088-21	Quarterly	Semiannual	VOCs
088-22	Quarterly	Semiannual	VOCs

088-23	Quarterly	Semiannual	VOCs
088-109	Quarterly	No Change	None
088-110	Quarterly	Semiannual	VOCs

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications described in Step 7 will result in a decrease in sampling and analysis costs of \$9,523.00 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$51,005
FY2003	\$41,469
Difference	– \$9,536

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   William Dorsch (631) 344-5186

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BROOKHAVEN
NATIONAL LABORATORY
ENVIRONMENTAL
SERVICES DIVISION

TITLE:

**OU 1 CURRENT LANDFILL
POST-CLOSURE
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE**

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
KCK	-	11/18/02	07176
CHKD:	APPD:	REV.:	NOTES:
WRD	WRD	1	-
FIGURE NO.:			1

OU I SOUTH BOUNDARY (RA V REMEDIAL ACTION) POST-ROD

DATE October 31, 2003

PROPOSED CHANGES

The following are changes related to the OU I South Boundary groundwater monitoring programs:

- A baseline of over five years of groundwater data has been obtained from many of the OU I South Boundary Program wells, and it has been demonstrated that the system is functioning as planned. A routine operation and maintenance monitoring frequency were implemented in October of 2003. Plume core and perimeter wells will be monitored on a semi-annual frequency. Sentinel, and bypass wells will continue to be sampled at a quarterly frequency. This reduction in sampling frequency for plume core and perimeter wells was already implemented for many of the OU I South Boundary Program wells in 2001. Maintain current monitoring for tritium and strontium-90. Extraction wells EW-1 and EW-2 will be sampled quarterly instead of every two months beginning in August 2003.
- Drop wells 000-137, 000-138, 000-124, and 800-54 from the OU I South Boundary Program and transfer them to the new North Street East Sampling Program

DESCRIPTION AND TECHNICAL BASIS

The Operable Unit (OU) I South Boundary project monitors the downgradient extent of commingled contaminant plumes from several sources, including the Current Landfill and the former Hazardous Waste Management Facility (HWMF). The groundwater contaminant plume, consisting of VOCs, extends approximately 3,000 feet south of the BNL property boundary. Since December 1996, a remediation system comprised of two extraction wells screened within the deep Upper Glacial aquifer has been in operation at the southern property boundary to prevent groundwater with total VOCs exceeding 50 micrograms per liter (ug/l) from migrating off site. The extracted groundwater is treated via air stripping and recharged northwest of the source areas. In addition, radiological parameters, including tritium and strontium-90, have been detected in several wells near the source areas.

The monitoring well network for the OU I South Boundary project consists of 46 wells. Well locations are shown on Figure 12.5.1. The wells are sampled semiannually for analysis of VOCs, tritium and strontium-90, and annually for gamma spectroscopy as shown in Table 12.1.2.

The contaminants of concern associated with the OU I South Boundary plume are primarily VOCs. During CY 2002, the plume core wells consistently contained total VOC concentrations greater than 50 ug/l. The fringe wells contained total VOC concentrations less than 50 ug/l, although some compounds were detected at levels exceeding New York State groundwater standards. No exceedances of New York State groundwater standards for VOCs were detected in any of the upgradient wells during calendar year 2002.

Several wells exceed the NYS groundwater standards for tritium and strontium-90 during calendar year 2002. Since the area impacted by strontium-90 and tritium at levels above New York State groundwater standards is limited, this evaluation will focus on the VOC contamination

only. However, recommendations regarding sampling and analysis for radiological parameters are made in Step 7 below.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

☐	Compliance
☐	Support Compliance
☐	Surveillance
☒	Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A plume of groundwater contaminated by VOCs has been identified within the Upper Glacial aquifer in the southern portion of the BNL Site and off site. In response, groundwater remediation was implemented at the southern site boundary in December 1996. An existing plume of contaminated groundwater off site to the south will be addressed by the North Street East remediation system.

Data are needed to demonstrate that:

- The existing groundwater remediation system is intercepting the on-site groundwater plume
- Influent concentrations to the existing treatment system will not exceed the design criteria
- Groundwater quality is improving according to plan

Problem Statement: A VOC plume that could represent a potential risk to human health has been defined on the BNL site. Remediation of the on-site plume has been conducted since December 1996. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decision

The decisions for the project are:

1. Is the BNL Groundwater Contingency Plan triggered?
2. If not, has the plume been controlled?
3. Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?
4. Can the groundwater treatment system be shut down?

Step 3: Identify Inputs to the Decision

The project was divided into four decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Background (upgradient) wells (Decisions 1 and 3)
- Plume Core wells (Decisions 1, 2, and 4)

- Plume Perimeter wells, used to define the extent of the plume (Decisions 1 and 2)
- Bypass Detection wells (Decisions 1, 2, and 4)

The wells included in each subunit are shown in Table 12.5.1. The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs and radionuclides in groundwater
- Location of existing wells relative to flow patterns (Figure 12.5.1)
- Evaluation of capture zone for extraction wells
- Action Levels
- Analytical methods and detection limits as described in the BNL Environmental Monitoring Plan
- Variability of data.

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- North side of the Current Landfill to the north
- Crestwood Drive East (well 000-054) to the south
- West side of the Current Landfill and well 077-02 to the west
- Wells 088-19, 088-62, 088-63 and 108-30 to the east
- Saturated thickness of the Upper Glacial aquifer

Separate decisions will be made in the four subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire study system. The temporal boundaries of the study area vary, based on the decision. Some decisions are based on the most recent sampling event, while others are based on historic trends (two to three years).

Background: Background water quality results will be utilized to determine whether a contaminant slug is traveling toward the remediation system. Therefore, the timeframe for decisions utilizing background results is 365 days.

Plume Core: Because the rate of water quality improvement in this area is relatively slow and historic results indicate that the on-site plume is being controlled by the extraction system, the timeframe for decisions for this subunit is 180 days.

Plume Perimeter: Because the wells included in this subunit define the plume horizontally and vertically, which is used to determine whether the plume is being captured, the timeframe for decisions here is 180 days.

Bypass Detection Area: Because the wells in this area indicate whether plume capture performance objective is being met, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, then the Contingency Plan will be implemented.

Decision 2

If not, has the plume been controlled?

This decision applies to the plume perimeter and bypass detection wells.

If the cleanup goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume perimeter or bypass detection wells to above 50 µg/l (if currently less than 50 µg/l) or a significant increase in total VOC concentration (if currently above 50 µg/l).

If the trend in each plume perimeter and bypass detection well has a negative or zero slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 50 µg/l, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?

This decision applies to the plume core and bypass detection wells.

If the system is performing as planned, **then** actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation.

Note: **If** the majority and/or “key” wells, as defined by a subject matter expert, are performing as planned, **then** “the system” as a whole is considered to be properly operating.

Decision 4

Can the groundwater treatment system be shut down?

All of the following decision subunits must be satisfied in order to shut an extraction well down.

4a. Have asymptotic TVOC concentrations been reached in core wells?

This decision applies to the plume core wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. Asymptotic conditions are demonstrated by analyzing the average trends in TVOC concentrations in the plume core wells. The Kendall-Mann statistical test is a nonparametric trend analysis (Gilbert, 1987) used to aid in determining the slope in groundwater quality data. It is particularly useful when the residuals from a regression analysis are not normally distributed, or for an unknown distribution.

To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

4b. Is the mean TVOC concentration in core wells less than 50 ug/L by 2025?

This decision also applies to the plume core wells. It is anticipated that approximately seven to ten years of active groundwater treatment will reduce the mean TVOC concentrations in the plume core to less than 50 µg/l. **If** this occurs, **then** it is reasonable to expect (based on model projections) that MNA of the remaining contamination in the plume core will be reduced further to meet the cleanup goals of restoring the Upper Glacial aquifer to MCLs within 30 years. **If** the TVOC concentration remains above 50 ug/L, **then** consider operational adjustments and/or engineering evaluation.

4c. Are there individual plume core wells above 50 ug/L TVOC ?

If the total VOC concentration in each plume core well has been reduced to less than 50 µg/l in less than seven to ten years of active remediation, **then** proceed with pulsed operation of the system (see Decision subunit 4c). **If** not and treatment has occurred for less than seven to ten years, **then** continue treatment. **If** not and treatment has occurred for at least seven to ten years, **then** perform an engineering evaluation to predict the fate of the remaining contamination and determine whether MCLs will be met by 2030.

4d. During pulsed operation of the system, is there significant concentration rebound in the core wells?

This decision is to determine whether there is significant concentration rebound after system pulsing. **If** yes, and system has operated for less than seven to ten years, **then** continue operation. **If** yes and system has operated for more than seven to ten years, **then** an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted (see Decision subunit 4d to help with this decision). **If** no significant rebound is observed within a one-year time period, **then** petition for system shutdown and continue with MNA.

4e. Have the groundwater cleanup goals been met? Specifically, have MCLs been achieved by 2030?

If the mean concentration of TVOCs in groundwater, calculated from analytical results from all plume core wells for the most recent sampling event, is less than 50 µg/l, and if the mean TVOC concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous two years, is less than 50 µg/l, and pulsing of the remediation system has not resulted in significant rebound of contaminant concentrations, **then** petition for system shutdown and continue with MNA until MCLs are met. **If not, then** consider the need for continued remediation.

Note: This assumes that system operation is already considered “optimal.”

Step 6: Specify Acceptable Error Tolerances

Table 12.5.1 summarizes the decision and possible decision errors for this project.

TABLE 12.5.1 DECISIONS, POTENTIAL DECISION ERRORS AND POTENTIAL CONSEQUENCES			
Table 12.17.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based On Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Can the groundwater treatment system be shut down?	See Step 3 for inputs.	(1) Determine system can be shut down when operation should continue. (2) Determine to continue operating system when shut down is warranted.	(1) Plume growth continues, ultimate project delays. (2) Wasted resources , project delays.
Is the system operating as planned?	See Step 3 for inputs.	(1) Determine system operating as planned when it is not. (2) Determine system isn't operating as planned when it is.	(1) Premature petition for system shutoff, potential to have to restart system. (2) Continue remediation that is no longer effective.

Number and Location of Wells

The well network consists of 46 wells located both on and off-site. Four wells, 000-137, 000-138, 000-124, and 800-54, will be transferred from the OU I South Boundary Program to the new North Street East Sampling Program

Parameters and Frequency

The wells are sampled semiannually for analysis of VOCs, tritium and strontium-90, and annually for gamma spectroscopy as shown in Table 12.1.2.

A summary of the proposed changes to the OU I South Boundary monitoring program is provided in Table 12.5.2, on the following page.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications described in Step 7, along with reductions in sampling and analytical unit costs, will result in a **decrease** in sampling and analysis cost of \$33,742 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2003	\$84,734
FY2004	\$50,992
Difference	-\$33,742

IMPLEMENTATION DATE   January 1, 2004

POINTS OF CONTACT   William Dorsch (631) 344-5186
Michael Hauptmann (631) 344-4202

Table 12.5.2 Proposed Modifications to the South Boundary Monitoring Wells			
Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
000-124	Quarterly	Transfer to OU III North Street East Program	VOCs, Tritium, Gamma, Sr-90
000-137	Quarterly	Transfer to OU III North Street East Program	VOCs, Tritium, Gamma, Sr-90
000-138	Quarterly	Transfer to OU III North Street East Program	VOCs, Tritium, Gamma, Sr-90
087-21	Annually	No Change	None
088-13	Annually	No Change	None
088-14	Annually	No Change	None
088-20	Annually	No Change	None
088-26	Quarterly	No Change	None
098-21	Semi-annual	No Change	None
098-22	Semi-annual	No Change	None
098-30	Semi-annual	No Change	None
098-33	Semi-annual	No Change	None
098-58	Semi-annual	No Change	None
098-59	Semi-annual	No Change	None
098-61	Semi	No Change	None
099-04	Semi	No Change	None
107-10	Semi	No Change	None
107-23	Semi	No Change	None
107-24	Semi	No Change	None
107-25	Semi	No Change	None
107-26	Semi-annual	No Change	None
108-08	Semi	No Change	None
108-12	Semi	No Change	None
108-13	Semi	No Change	None
108-14	Semi	No Change	None
108-17	Semi	No Change	None
108-18	Semi	No Change	None
115-03	Semi	No Change	None
115-13	Semi-annually	No Change	None
115-14	Semi-annually	No Change	None
115-15	Semi-annually	No Change	None
115-16	Semi-annually	No Change	None
115-28	Semi-annually	No Change	None
115-29	Semi-annually	No Change	None
115-30	Semi-annual	No Change	VOCs, Tritium, Sr-90
115-31	Quarterly	No Change	None
115-36	Semi-annually	No Change	None
115-41	Quarterly	No Change	None
115-42	Quarterly	No Change	None
116-05	Semi	No Change	VOCs, Tritium, Sr-90
116-06	Semi	No Change	VOCs, Tritium, Sr-90
800-54	Semi-annually	Transfer to OU III North Street East Program	VOCs, Tritium, Gamma, Sr-90
108-43	Quarterly	No Change	Sr-90
108-44	None	Quarterly	Sr-90
107-34	None	Quarterly	Sr-90
107-35	None	Quarterly	Sr-90

- For analysis of VOCs, tritium and strontium-90. Sampling for analysis of gross alpha, gross beta and gamma spectroscopy to be conducted annually for all wells.

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TITLE: OU I SOUTH BOUNDARY
(RA V REMOVAL ACTION)
PUMP AND TREAT SYSTEM
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT: HZ.: —	DATE: 11/20/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV.: 1	NOTES: —
FIGURE NO.: 12.5.1			

OU I/IV NORTH STREET POST-ROD/PRE-OPERATION

DATE November 20, 2002

PROPOSED CHANGE

There are no proposed modifications to this program in 2003.

DESCRIPTION AND TECHNICAL BASIS

The Operable Unit (OU) I/IV North Street project monitors the downgradient extent of commingled contaminant plumes from several sources, including the Former Landfill, Chemical/Animal Holes, and the OU IV fuel oil/solvent spill. The North Street plume is defined as groundwater with total volatile organic compounds (VOCs) exceeding 50 micrograms per liter ($\mu\text{g/l}$) and has been detected within the deep Upper Glacial aquifer. Groundwater remediation systems are currently being designed to address the existing contamination. Additional predesign groundwater characterization activities, including construction of new monitoring wells, is planned. The source areas for this plume, including the Former Landfill, Chemical/Animal Holes and Building 650 area, are monitored under separate projects.

The monitoring well network for the North Street project consists of 25 wells. Three wells (086-05, 086-43, and 086-70) are located upgradient of the defined North Street VOC plume and four wells (000-154, 106-54, 106-58, and 122-24) are located within the VOC plume core (total VOCs greater than 50 $\mu\text{g/l}$). The remaining 18 wells are located within the plume fringe. Well locations are shown on Figure 12.6.1. The wells are sampled quarterly for analysis of VOCs and annually for gross alpha/beta, gamma spectroscopy, tritium, and strontium-90. A monitoring schedule is provided in Table 12.1.1.

The contaminants of concern associated with the OU I/IV North Street plumes are VOCs. During calendar year 2000, the plume core wells consistently contained total VOC concentrations greater than 50 $\mu\text{g/l}$. The fringe wells contained total VOC concentrations less than 50 $\mu\text{g/l}$, although some compounds were detected at levels exceeding New York State groundwater standards. No exceedances of New York State groundwater standards for VOCs were detected in any of the upgradient wells during calendar year 2000.

The OU I/IV North Street project wells also serve as downgradient monitoring points for historic strontium-90 and tritium releases from the Building 650 sump that are monitored under the OU IV Area of Concern (AOC) 6 project. These data are used to evaluate a migration scenario raised by outside stakeholders that the historic strontium-90 releases from the Building 650 sump may be migrating faster than predicted due to the activity of chelating agents within the aquifer. Based on groundwater modeling studies, the radionuclide plume could be mobilized by commingling with chelating agents discharged to nearby Basin HO. Under the worst-case scenario (retardation factor of 1), it was

estimated that a plume could reach the BNL southern boundary by 1999. Radionuclides detected during calendar years 1999 and 2000 are summarized in Table 12.6.1 on the following page. These results, which are consistent with previous results dating back to 1997, do not support the scenario that chelating agents are mobilizing the radionuclides from the Building 650 sump.

Table 12.6.1 Radionuclide Detections in OU I/IV North Street Wells				
Well	Date	Radionuclide	Detected Activity*	NYS Groundwater Standard
000-108	6/4/99	Tritium	1,095.96	20,000
000-211	6/4/99	Gross Beta	6.42	1,000
000-215	6/4/99	Tritium	1,142.17	20,000
000-215	9/11/00	Tritium	4,690.00	20,000
098-33	6/4/99	Gross Beta	5.63	1,000
098-33	6/4/99	Tritium	1,140.90	20,000
106-54	6/2/99	Cesium-137	75.35	--
106-55	9/8/00	Cesium-137	11.60	--
115-35	9/12/00	Strontium-90	2.38	8
122-24	8/9/99	Gross Beta	5.23	1,000
800-59	5/27/99	Gross Beta	2.12	1,000

* picoCuries per liter

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater in the south-central portion of the BNL site and off site has been impacted by VOCs at concentrations exceeding New York State groundwater standards. Since active remediation of these commingled plumes is currently being planned or designed, data are needed to verify that the contaminants are naturally degrading in the interim and to determine the nature and extent of the VOC plumes for system design. In addition, data from this program are used to monitor for any evidence of a mobile radionuclide plume from the Building 650 sump.

Problem Statement: A VOC plume that could represent a potential risk to human health has been defined both on the BNL site and off-site. Remediation of the contaminant plume will be initiated in the near future. Data are needed to determine whether the existing contaminant plume represents a potential risk to downgradient receptors and to confirm the vertical and horizontal extent of the VOC plume so that the design of the remediation system can be optimized. Data are also needed to monitor for any evidence of a mobile radionuclide plume from the Building 650 sump.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Does the existing contaminant plume represent a potential risk to downgradient receptors?
- Is the planned remediation system adequate to intercept and treat the existing contamination to prevent impacts to potential downgradient receptors?
- Is there evidence of a mobile radionuclide plume from the Building 650 sump that would trigger additional actions?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include

- Direction and velocity of groundwater flow
- VOC and radionuclide analytical results in groundwater
- Location of existing wells relative to flow patterns
- Action Levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL EMP

Step 4: Define the Study Boundaries

The project decision unit limits are listed below.

- Background water quality is defined by the three monitored wells upgradient of the plume core wells (086-05, 086-43, and 086-70).
- The VOC plume core is defined as the area impacted by total VOCs above 50 µg/l, including wells 000-153, 000-154, 106-54, 106-58, 115-32, and 122-24.
- The VOC plume fringe is the area surrounding the plume core (horizontally and vertically) where total VOC concentrations are less than 50 µg/l.

Because the VOC contaminant plume has already passed the southern BNL site boundary and therefore has the potential to impact off-site receptors, tracking the plume configuration over time is of critical importance. In addition, the remediation system design will depend on the VOC plume configuration. Since the analytical results from the plume core and plume fringe wells will be used to monitor the VOC plume configuration,

the timeframe for decisions using these results is 90 days. Because the analytical results from 1997 to the present do not support the scenario that chelating agents are mobilizing radionuclides from the Building 650 sump area, the timeframe for decisions relating to radionuclides is 365 days.

Background water quality results will be utilized to evaluate the need for project-specific remediation and to determine whether a contaminant slug is traveling toward the remediation system. Therefore, the timeframe for decisions utilizing background results is 365 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Does the existing contaminant plume represent a potential risk to downgradient receptors?

Analytical results from plume core and plume fringe wells will be utilized for this decision. Future sample results will be utilized to determine the plume configuration with respect to potential receptors.

If for any plume core or plume fringe well, the current annual mean concentration for an individual contaminant of concern exceeds the mean concentration in that well computed from data collected from that well over the past three years AND is greater than New York State groundwater standards, and this result is confirmed by resampling appropriate wells, as well as by an evaluation of historic and current upgradient and downgradient conditions, **then** an evaluation will be made as to whether the plume will present a potential risk to downgradient receptors. If so, then an evaluation will be made as to whether an increase in sampling frequency for that parameter or parameter group (for example, VOCs) would be appropriate. If not, then continue detection monitoring.

Decision 3

Is the planned remediation system adequate to intercept and treat the existing contamination to prevent impacts to potential downgradient receptors?

Analytical results from plume core and upgradient wells will be utilized for this decision, as these results represent the future influent to the remediation system.

If evaluation of analytical results for any contaminant of concern in any upgradient or plume core well sample, in conjunction with historic analytical results and trends, groundwater model predictions, site conceptual model and professional judgment, indicates that contamination will reach the remediation system at a concentration exceeding the system design criteria, **then** consider an engineering evaluation to determine whether modifications to the remediation system are warranted.

Decision 4

Is there evidence of a mobile radionuclide plume from the Building 650 sump that would trigger additional actions?

If analytical results for radionuclides in groundwater, in conjunction with evaluation of historic analytical results and trends, groundwater model predictions, site conceptual model and professional judgment, indicates the presence of a mobile radionuclide plume from the Building 650 sump, and these results are confirmed by resampling, **then** take appropriate actions to address the radionuclide plume.

Step 6: Specify Acceptable Error Tolerances

Table 12.6.2 summarizes the decision and possible decision errors for this project.

Table 12.6.2 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Does the existing contaminant plume represent a potential risk to downgradient receptors?	See Step 3 for inputs.	(1) Data indicate the plume represents a risk when it does not. (2) Data indicate the plume does not represent a risk when it does.	(1) Wasted resources conducting technical evaluations and possible system modifications. (2) Potential risk to downgradient receptors.

Is the planned remediation system adequate to intercept and treat the existing contamination to prevent impacts to potential downgradient receptors?	See Step 3 for inputs.	(1) Data indicate the system will not be adequate when it will be. (2) Data indicate the system will be adequate when it will not be.	(1) Wasted resources conducting technical evaluations and possible system modifications. (2) Potential bypass of contaminants.
Is there evidence of a mobile radionuclide plume from the Building 650 sump that would trigger additional actions?	See Step 3 for inputs.	(1) Data indicate evidence for a plume when one does not exist. (2) Data indicate no evidence for a plume when one exists.	(1) Wasted resources evaluating and implementing additional actions. (2) Potential risk to downgradient receptors.

Step 7: Optimize the Design

Number and Location of Wells

The existing monitoring well network consists of 25 wells, including 3 upgradient wells, 6 plume core wells and 16 plume fringe wells. The number and location of wells for this program are considered adequate.

Parameters and Frequency

The analytical parameters and sampling frequency currently conducted for this project are considered adequate. Therefore, no modifications are recommended at this time. A summary of the revised sampling program is provided in Table 12.6.3 below.

Table 12.6.3 Proposed Modifications to the OU I/IV North Street Monitoring Wells			
Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
000-108	Quarterly	No Change	None
000-153	Quarterly	No Change	None
000-154	Quarterly	No Change	None
000-211	Quarterly	No Change	None
000-212	Quarterly	No Change	None
000-213	Quarterly	No Change	None
000-215	Quarterly	No Change	None
086-05	Annually	No Change	None
086-43	Annually	No Change	None

086-70	Annually	No Change	None
106-53	Quarterly	No Change	None
106-54	Quarterly	No Change	None
106-55	Quarterly	No Change	None
106-56	Quarterly	No Change	None
106-58	Quarterly	No Change	None
106-59	Quarterly	No Change	None
115-32	Quarterly	No Change	None
115-33	Quarterly	No Change	None
115-34	Quarterly	No Change	None
115-35	Quarterly	No Change	None
800-59	Quarterly	No Change	None
800-60	Quarterly	No Change	None
800-63	Quarterly	No Change	None

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Since no modifications to the sampling program are recommended, there is no change in the annual sampling and analysis cost.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$38,010
FY2003	\$38,010
Difference	\$0

Implementation Date January 1, 2003

POINTS OF CONTACT	William Dorsch (631) 344-5186
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BROOKHAVEN
NATIONAL LABORATORY

ENVIRONMENTAL
SERVICES DIVISION

TITLE:

OU III NORTH STREET
PRE-DESIGN
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT:HZ: -	DATE: 11/19/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV.: 1	NOTES: -

FIGURE NO.:

1

OU III HIGH FLUX BEAM REACTOR POST-ROD

DATE November 20, 2002

PROPOSED CHANGE

Based on the results of groundwater monitoring well data, up to five additional vertical profiles and monitoring wells will be installed in order to better define the tritium plume.

DESCRIPTION AND TECHNICAL BASIS

In late 1996, tritium was detected in wells near the High Flux Beam Reactor (HFBR). The source of the release was traced to the HFBR spent fuel pool. In response, the fuel rods were removed from the pool for off-site disposal, the spent fuel pool was drained and the HFBR was removed from service in 1997. Also, numerous monitoring wells were constructed to characterize the tritium plume downgradient of the HFBR. In May 1997, operation of a three-well groundwater extraction system began. This system was constructed on Princeton Avenue approximately 3,500 feet downgradient of the HFBR to capture the tritium contamination to ensure that off-site migration of the plume would not occur. Extracted water was recharged through the RA V recharge basin. Because it has been demonstrated that the tritium plume will naturally attenuate to below drinking water standards before reaching the BNL site boundary, the extraction system was placed on standby status in September 2000.

As described in the Operable Unit (OU) III Record of Decision (ROD), the selected remedy to address the HFBR tritium plume includes implementation of monitoring and low-flow extraction programs to prevent or minimize plume expansion. A tritium activity above 25,000 picoCuries per liter (pCi/l) in wells at the Chilled Water Plant Road or above 20,000 pCi/l in wells along Weaver Drive will necessitate implementation of specific actions described in the ROD, including possible low-flow pumping of impacted groundwater or reactivation of the Princeton Avenue pumping system.

The monitoring well network for the OU III HFBR project includes 141 wells that provide groundwater quality data in the vicinity of the source area and at downgradient locations. The locations of the many of the wells were selected using the BNL Regional Groundwater Flow Model. Well locations are shown on Figure 12.7.1. Depending on location, wells are sampled biweekly, monthly, or quarterly for analysis of tritium, and semi-annually for analysis of VOCs, as shown in Table 12.1.1.

The contaminant of concern associated with the OU III HFBR wells is tritium. The extent of the tritium plume, determined using data collected during the third quarter of calendar year 2000, is shown on Figure 12.7.1.

Groundwater flow in the vicinity of the HFBR can be influenced by BNL pumping and recharge sources in the area. In general, groundwater flow is toward the south or southeast. Evaluation of groundwater flow and quality data indicates that the

downgradient portion of the tritium plume (south of Brookhaven Avenue) has shifted to the east since 1977 in response to changing flows to the HO recharge basin, the use of the OU III recharge basin, and the pumping of BNL supply wells 10, 11, and 12.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater beneath the BNL site has been impacted by tritium from leakage from the HFBR spent fuel pool. Data are needed to verify that the tritium is naturally degrading according to the attenuation model.

Step 2: Identify the Decision (identify the decision that will solve the problem using data)

The decisions for the project are

1. Is the BNL Groundwater Contingency Plan triggered?
2. Is the tritium plume growing?
3. Are observed conditions consistent with the attenuation model?
4. Is the tritium plume migrating toward the zone of influence of BNL water supply wells 10, 11, and 12?
5. Has any segment of the plume migrated beyond the current monitoring network?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the tritium plume. The identified subunits and the decisions supported by each are:

- Plume core wells, located within the high concentration segment of the plume (Decisions 1 and 3)

- Perimeter wells, located outside the high concentration segment of the plume and contain tritium at low or non-detect activities (Decisions 1, 2, 3, and 5)
- Outer perimeter wells, located further from the high concentration segment of the plume than the perimeter wells (Decisions 1, 3, 4 and 5)

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Tritium analytical results in groundwater
- Location of existing wells relative to flow patterns
- Action Levels defined in the OU III ROD
- Analytical methods and detection limits
- Variability of data.

Step 4: Define the Study Boundaries

The project decision unit limits are defined by:

- Rutherford Drive on the north
- Middle Road (wells 113-08, 113-09 and 113-11) on the south
- RA V Basin on the east
- Rochester Street on the west
- Upper Glacial aquifer.

Due to variability in groundwater flow direction for different areas of the plume and the specific actions to be taken in response to certain observed conditions (as specified in the ROD), the project has also been divided into geographic segments based on the timeframe for decisions to be made for wells in these areas. The segments and timeframes for each decision subunit within the area are

- HFBR Area: This segment encompasses the wells around the HFBR, including upgradient wells and the area extending to approximately 250 feet south of Temple Place. Since this is the area of greatest tritium activities, the decision timeframe for plume core wells is 30 days. The decision timeframe for perimeter wells in the HFBR Area is 90 days, due to the expected slow change in tritium activities for these wells. For the outer perimeter wells, decisions will be made using a 365-day timeframe, because perimeter wells are located between the outer perimeter wells and the plume core wells.

- RA V Recharge Basin: This segment includes the wells surrounding the RA V Basin (076-171 through 076-175, 076-177, 077-10, and 077-11), which are utilized to monitor water quality from the basin. The decision timeframe for these wells is 90 days.
- Brookhaven Avenue: This segment is downgradient of the HFBR Area and includes the wells along Brookhaven Avenue except those around the RA V Basin. Wells in this area measure the rate of attenuation. Therefore, decisions for plume core will be made using a 30-day timeframe and decisions for perimeter wells will be made using a 90-day timeframe. As with the HFBR Area, the decision timeframe for outer perimeter wells in this segment is 365 days.
- Rowland Street: This segment includes the wells located along Rowland Street. Evaluation of data from these wells measures plume attenuation. Therefore, a timeframe for decisions of 90 days for plume core and perimeter wells in this area is warranted. As with the HFBR Area, the decision timeframe for outer perimeter wells in this segment is 365 days.
- Chilled Water Plant Road and Weaver Drive: The wells located in these two segments are located along and east of the Chilled Water Plant Road (Chilled Water Plant Road segment) and along Weaver Drive and Grove Street (Weaver Drive segment). Because data from wells in these segments will be utilized to determine whether the contingency actions specified in the ROD will be implemented, the decision timeframe for plume core and perimeter wells in these segments is 90 days. As with the HFBR Area and Rowland Street segments, the decision timeframe for outer perimeter wells in these segments is 365 days.
- Princeton Avenue: This segment includes outer perimeter wells located downgradient of the plume along Princeton Avenue and Middle Road. As with the other outer perimeter wells, because perimeter wells are located between these wells and the plume core wells, the decision timeframe is 365 days.

The wells included in each project segment and decision subunit are shown in Table 12-7.2.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Is the tritium plume growth minimized?

As described in the OU III ROD, plume growth is defined as a detection of tritium at an activity above 25,000,000 pCi/l in wells at the Chilled Water Plant Road or above 20,000 pCi/l in wells along Weaver Drive. Exceedances of these activities will necessitate implementation of specific actions described in the ROD.

If the detected tritium activity exceeds 25,000 pCi/l in perimeter wells at the Chilled Water Plant Road or exceeds 20,000 pCi/l in perimeter wells at Weaver Drive, **then** implement the response actions prescribed in the OU III ROD.

Decision 3

Are observed conditions consistent with the attenuation model?

If the detected tritium concentrations are consistent with the attenuation model, groundwater model results and professional judgment, **then** continue attenuation monitoring. If not, consider refining the conceptual model or conducting an engineering evaluation to determine if other actions are required.

Decision 4

Is the tritium plume migrating toward the zone of influence of BNL water supply wells 10, 11, and 12?

If evaluation of supply well zones of influence, drawdown measurements in key monitoring wells and detected tritium activities in outer perimeter wells located between the plume and the supply wells indicates that the plume is migrating toward the supply well zone of influence, **then** consider an evaluation of alternatives to prevent capture of the tritium plume by the supply wells.

Decision 5

Has any segment of the plume migrated beyond the current monitoring network?

If tritium activities detected in perimeter wells indicate that the plume has migrated beyond the current monitoring network, **then** consider an engineering evaluation to determine if other monitoring wells are required.

Step 6: Specify Acceptable Error Tolerances

The table on the facing page summarizes the decision and possible decision errors for this project.

Step 7: Optimize the Design

Number and Location of Wells

A network of 157 wells is utilized to monitor the HFBR tritium plume. The wells are located in Figure 12.7.1 and their decision subunits are provided in Table 12.7.2.

Parameters and Frequency

Based on the decision timeframes described in Step 4, the sampling frequency for plume core wells should be monthly for the HFBR Area and Brookhaven Avenue project segments, and quarterly for the RA V Recharge Basin, Rowland Street, Chilled Water Plant Road, and Weaver Drive project segments. The sampling frequency for perimeter wells should be quarterly for the HFBR Area, Brookhaven Avenue, Rowland Street, Chilled Water Plant Road, and Weaver Drive project segments. The sampling frequency for outer perimeter wells should be annually for HFBR Area, Rowland Street, Chilled Water Plant Road, Weaver Drive, and Princeton Avenue project segments. The monitoring schedule is shown in Table 12-1.1.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

There are no changes in sampling and analysis costs for 2003.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$69,740
FY2003	\$69,740
Difference	\$0

IMPLEMENTATION DATE	January 1, 2003

POINTS OF CONTACT	Michael Hauptmann (631) 344-4202 William Dorsch (631) 344-5186

Table 12.7.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Is the tritium plume growth minimized?	See Step 3 for inputs.	(1) Data indicate that the plume is growing when it is not. (2) Data indicate that the plume is not growing when it is.	(1) Wasted resources, loss of stakeholder confidence. (2) Potential bypass of tritium, project delays, potential risk to downgradient receptors.
Are observed conditions consistent with attenuation model?	See Step 3 for inputs.	(1) Data indicate that conditions are not consistent with model when they are. (2) Data indicate that conditions are consistent with model when they are not.	(1) Wasted resources conducting attenuation model refinements. (2) Potential bypass of tritium, project delays, potential risk to downgradient receptors.
Is the tritium plume migrating toward the zone of influence of BNL water supply wells 10, 11, and 12?	See Step 3 for inputs.	(1) Data indicate that the plume is migrating toward the supply wells when it is not. (2) Data indicate that the plume is not migrating toward the supply wells when it is.	(1) Wasted resources conducting continued unnecessary monitoring. (2) Potential bypass of tritium, project delays, potential risk to receptors.
Has any segment of the plume migrated beyond the current monitoring network?	See Step 3 for inputs.	(1) Data indicate that plume has migrated beyond the network when it has not. (2) Data indicate that plume has not migrated beyond the network when it has.	(1) Wasted resources conducting evaluation of alternatives. (2) Potential bypass of tritium, project delays, potential risk to downgradient receptors.

See also Table 12.7.2 on the following pages for sampling frequency and affected parameters.

Table 12.7.2 Proposed Modifications to the HFBR Monitoring Wells			
Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
065-01	Quarterly	No Change	None
065-37	Semi-annually	No Change	None
065-38	Quarterly	No Change	None
065-39	Quarterly	No Change	None
065-40	Quarterly	No Change	None
065-41	Quarterly	No Change	None
065-42	Quarterly	No Change	None
075-11	Quarterly	No Change	None
075-12	Quarterly	No Change	None
075-208	Quarterly	No Change	None
075-209	Quarterly	No Change	None
075-210	Quarterly	No Change	None
075-211	Quarterly	No Change	None
075-224	Monthly	No Change	None
075-225	Monthly	No Change	None
075-226	Quarterly	No Change	None
075-227	Quarterly	No Change	None
075-228	Quarterly	No Change	None
075-229	Quarterly	No Change	None
075-230	Monthly	No Change	None
075-231	Monthly	No Change	None
075-232	Quarterly	No Change	None
075-233	Quarterly	No Change	None
075-234	Quarterly	No Change	None
075-235	Quarterly	No Change	None
075-236	Monthly	No Change	None
075-237	Monthly	No Change	None
075-238	Quarterly	No Change	None
075-239	Quarterly	No Change	None
075-240	Quarterly	No Change	None
075-241	Quarterly	No Change	None
075-242	Monthly	No Change	None
075-244	Monthly	No Change	None
075-245	Quarterly	No Change	None

continued					
Well	Current Frequency	Sampling	Proposed Frequency Changes	Sampling	Affected Parameters
075-285	Quarterly		No Change		None
075-286	Quarterly		No Change		None
075-287	Quarterly		No Change		None
075-288	Quarterly		No Change		None
075-289	Quarterly		No Change		None
075-291	Quarterly		No Change		None
075-292	Quarterly		No Change		None
075-293	Quarterly		No Change		None
075-294	Quarterly		No Change		None
075-295	Quarterly		No Change		None
075-296	Monthly		No Change		None
075-297	Monthly		No Change		None
075-298	Monthly		No Change		None
075-299	Monthly		No Change		None
075-39	Quarterly		No Change		None
075-40	Quarterly		No Change		None
075-41	Quarterly		No Change		None
075-413	Quarterly		No Change		None
075-414	Monthly		No Change		None
075-415	Monthly		No Change		None
075-416	Monthly		No Change		None
075-417	Monthly		No Change		None
075-418	Monthly		No Change		None
075-419	Monthly		No Change		None
075-42	Quarterly		No Change		None
075-43	Monthly		No Change		None
075-44	Quarterly		No Change		None
075-45	Quarterly		No Change		None
075-46	Semi-annually		No Change		None
075-47	Quarterly		No Change		None
075-48	Quarterly		No Change		None
075-50	Annually		No Change		None
075-558	Monthly		No Change		None
075-85	Semi-annually		No Change		None

075-86	Semi-annually	No Change	None
<i>continued</i>			
Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
075-87	Quarterly	No Change	None
075-88	Quarterly	No Change	None
075-89	Quarterly	No Change	None
076-10	Semi-annually	No Change	None
076-171	Quarterly	No Change	None
076-172	Quarterly	No Change	None
076-173	Quarterly	No Change	None
076-174	Quarterly	No Change	None
076-175	Quarterly	No Change	None
076-177	Quarterly	No Change	None
077-10	Quarterly	No Change	None
077-11	Quarterly	No Change	None
085-01	Quarterly	No Change	None
085-02	Quarterly	No Change	None
085-170	Quarterly	No Change	None
085-171	Quarterly	No Change	None
085-285	Monthly	No Change	None
085-286	Monthly	No Change	None
085-287	Monthly	No Change	None
085-288	Monthly	No Change	None
085-289	Monthly	No Change	None
085-290	Quarterly	No Change	None
085-291	Quarterly	No Change	None
085-292	Quarterly	No Change	None
085-39	Quarterly	No Change	None
085-40	Quarterly	No Change	None
085-41	Quarterly	No Change	None
085-65	Quarterly	No Change	None
085-66	Quarterly	No Change	None
085-67	Quarterly	No Change	None
085-68	Quarterly	No Change	None
085-69	Annually	No Change	None
085-70	Annually	No Change	None
085-71	Annually	No Change	None

085-72	Annually	No Change	None
<i>continued</i>			
Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
085-73	Quarterly	No Change	None
085-74	Quarterly	No Change	None
085-75	Quarterly	No Change	None
085-76	Quarterly	No Change	None
085-77	Quarterly	No Change	None
085-78	Quarterly	No Change	None
086-09	Quarterly	No Change	None
095-139	Quarterly	No Change	None
095-140	Quarterly	No Change	None
095-272	Quarterly	No Change	None
095-273	Quarterly	No Change	None
095-274	Quarterly	No Change	None
095-275	Quarterly	No Change	None
095-276	Quarterly	No Change	None
095-42	Quarterly	No Change	None
095-43	Quarterly	No Change	None
095-44	Quarterly	No Change	None
095-45	Quarterly	No Change	None
095-46	Quarterly	No Change	None
095-47	Quarterly	No Change	None
095-48	Quarterly	No Change	None
095-51	Quarterly	No Change	None
095-52	Quarterly	No Change	None
095-53	Quarterly	No Change	None
095-54	Quarterly	No Change	None
095-55	Quarterly	No Change	None
095-87	Quarterly	No Change	None
095-88	Quarterly	No Change	None
095-89	Quarterly	No Change	None
095-90	Quarterly	No Change	None
095-91	Quarterly	No Change	None
095-92	Quarterly	No Change	None
095-93	Quarterly	No Change	None

096-55	Quarterly	No Change	None
096-82	Quarterly	No Change	None
<i>continued</i>			
Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
096-83	Annually	No Change	None
096-84	Annually	No Change	None
096-88	Quarterly	No Change	None
104-10	Annually	No Change	None
104-11	Annually	No Change	None
104-25	Annually	No Change	None
105-07	Annually	No Change	None
105-22	Annually	No Change	None
105-23	Annually	No Change	None
105-24	Annually	No Change	None
105-29	Annually	No Change	None
105-42	Annually	No Change	None
105-43	Annually	No Change	None
105-44	Annually	No Change	None
113-07	Annually	No Change	None
113-08	Annually	No Change	None
113-09	Annually	No Change	None
113-11	Annually	No Change	None

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BROOKHAVEN NATIONAL LABORATORY ENVIRONMENTAL SERVICES DIVISION	TITLE: OU III HFBR POST-ROD MONITORING WELL LOCATIONS 2003 DATA QUALITY OBJECTIVES UPDATE	DWN: KCK	VER: —	DATE: 11/19/02	PROJECT NO.: 07176
		CHKD: WRD	APPD: WRD	REV.: 1	NOTES: —
		FIGURE NO.: 1			

OU III BGRR/WCF STRONTIUM-90 POST-ROD

DATE November 20, 2002

PROPOSED CHANGES

- Two sentinel wells will be installed south of Brookhaven Avenue at two separate locations (total of four wells) to monitor the leading edge of the strontium-90 plumes.
- The HFBR stack will be evaluated as a potential source for the strontium-90 (detected during HFBR characterization work in 2001) as part of the BGRR pre-design characterization work beginning in the fall of 2003. The groundwater monitoring well network will also be re-evaluated at that time.

DESCRIPTION AND TECHNICAL BASIS

The Operable Unit (OU) III Brookhaven Graphite Research Reactor (BGRR)/Waste Concentration Facility (WCF) project monitors the extent of a strontium-90 plume in groundwater. Some of the wells included in the OU III BGRR/WCF network are also monitored as part of the OU III AOC 29 (High Flux Beam Reactor) program. The overlapping wells are sampled concurrently for both programs to avoid duplication of effort. Since this summary only addresses the OU III BGRR/WCF project, evaluation of the sampling frequency and analytical parameters for the OU III AOC 29 project will be conducted separately.

The OU III BGRR/WCF project only monitors the existing strontium-90 groundwater plumes and was not designed to monitor the contaminant sources. Other monitoring programs have been implemented to address the demolition of the BGRR and issues resulting from the Engineering Evaluation/Cost Analysis (EE/CA) process. The monitoring well network for the OU III BGRR/WCF project consists of 57 wells. Well locations are shown on Figure 12.8.1. The wells are sampled semi-annually for analysis of strontium-90. The monitoring schedule is provided in Table 12.1.1.

During calendar year 2000, strontium-90 was detected at an activity exceeding the New York State groundwater standard in 14 wells. The analytical results show two separate areas of elevated strontium-90, one emanating from the WCF and extending approximately 1,500 feet south, and the other beginning south of the BGRR and the Pile Fan Sump (PFS) area, and extending south for a distance of approximately 600 feet (see Figure 12.8.1). Variability in groundwater flow directions due to changes in pumping and recharge patterns in the plume vicinity over time have resulted in lateral spreading of the contamination. Additional characterization of the strontium-90 plumes is planned for calendar year 2003, with design and construction of a groundwater remediation system planned for calendar years 2004 and 2005.

In addition, evaluation of various scenarios for potable water supply at the BNL Site has shown that if supply wells 10, 11 and 12 are used as the primary source of potable water

for an extended period of time, the capture zone for these supply wells may extend to near the BGRR. This could result in the strontium-90 contamination being drawn into the supply wells. This is not an imminent threat, due to the slow travel time for strontium-90 in groundwater and the current use of supply wells other than 10, 11 and 12 as the primary source of potable water on site.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

In the Upper Glacial aquifer beneath the central portion of the BNL site, there is an area of groundwater contaminated by strontium-90. In response, additional groundwater characterization and remediation are planned. Data are needed to track the vertical and horizontal extent of the contamination prior to pre-design characterization activities planned for calendar year 2003.

Step 2: Identify the Decisions

The decisions for the project are:

1. Is the BNL Groundwater Contingency Plan triggered?
2. Is the extent of the strontium-90 plume still defined by the existing monitoring well network?
3. Can strontium-90 contaminate existing or planned groundwater remediation systems?
4. Is the strontium-90 plume migrating toward BNL supply wells 10, 11, and 12?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Strontium-90 analytical results in groundwater
- Location of existing wells relative to flow patterns

- Regulatory drivers (OU III ROD)
- Action Levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL Environmental Monitoring Plan
- Variability of data
- Status of potential downgradient receptors
- Estimated retardation rate for strontium-90.

Step 4: Define the Study Boundaries

The horizontal extent of the study area is defined by the area of the Upper Glacial aquifer downgradient of the BGRR/PFS/WCF with detectable activities of strontium-90. It should be noted that the downgradient extent of the western (BGRR) plume has not completely been determined. Due to the slow travel time for strontium-90 in groundwater, the timeframe for decisions is 180 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from all wells will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Is the extent of the strontium-90 plume still defined by the existing monitoring well network?

If evaluation of strontium-90 results, in conjunction with historic analytical results and trends, groundwater model predictions, site conceptual model and professional judgement, indicates that the strontium-90 plume can still be defined by the existing monitoring well network, **then** continue monitoring. If not, consider adding additional wells to the monitoring network.

Decision 3

Can strontium-90 contamination impact existing or planned groundwater remediation systems?

If evaluation of strontium-90 results indicates that the plume has migrated to within the two-year capture zone for any existing or planned groundwater remediation system, **then** consider an engineering evaluation to determine the appropriate actions to eliminate or minimize potential impacts to the remediation system.

Decision 4

Is the strontium-90 plume migrating toward BNL supply wells 10, 11, and 12?

If evaluation of strontium-90 results in wells 065-06, 065-11, 065-160, 065-161, 065-162, 065-175, 065-176 and 065-177 indicates that the strontium-90 plume may impact BNL supply wells 10, 11, and 12, **then** implement the actions specified in the BNL Groundwater Contingency Plan.

Step 6: Specify Acceptable Error Tolerances

Table 12.8.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Is the extent of the strontium-90 plume still defined by the existing monitoring well network?	See Step 3 for inputs.	(1) Data indicate the plume is not defined by existing wells when it is. (2) Data indicate the plume is defined by existing wells when it is not.	(1) Wasted resources evaluating, possibly constructing and sampling additional wells. (2) Potential bypass of contaminants and potential risk to downgradient receptors.
Can strontium-90 contamination impact existing or planned groundwater remediation systems?	See Step 3 for inputs.	(1) Data indicate the plume will impact systems when it will not. (2) Data indicate the plume will not impact systems when it will.	(1) Wasted resources conducting technical evaluations and possible system modifications. (2) Potential for inadequate treatment or system failure due to contamination beyond design limits.
Is the strontium-90 plume migrating toward BNL supply wells 10, 11 and 12?	See Step 3 for inputs.	(1) Data indicate the plume is migrating toward supply wells when it is not. (2) Data indicate the plume	(1) Wasted resources conducting technical evaluations, loss of use of supply wells 10, 11 and 12. (2) Potential risk to receptors

		is not migrating toward supply wells when it is.	through ingestion of impacted water.

Step 7: Optimize the Design

Number and Location of Wells

Since the downgradient extent of the western strontium-90 plume has not been completely determined by the wells currently sampled under this project, four additional wells should be constructed downgradient of the leading edge of the strontium-90 plume in the vicinity of Cornell Avenue and Brookhaven Avenue. The locations and depths of these new wells will be determined at a later date.

Wells 065-06, 065-11, 065-160, 065-161, 065-162, 065-175, 065-176 and 065-177 will be utilized as sentinel wells to monitor potential impacts to BNL potable water supply wells 10, 11 and 12 from the strontium-90 plume.

Parameters and Frequency

Samples are collected semi-annually for analysis of strontium-90. Due to the slow travel time for strontium-90, this frequency is sufficient and no modifications are proposed at this time. The proposed revised sampling program is summarized in the table below. Well-specific sampling frequency and parameter information is provided in Table 12.8.2 below.

Table 12.8.2 Proposed Modifications to the BGRR/WCF Monitoring Wells			
Well ID	Current Sampling Frequency	Proposed Sampling Frequency	Affected Parameters
065-03	Semi-annually	No Change	None
065-04	Semi-annually	No Change	None
065-06	Semi-annually	No Change	None
065-11	Semi-annually	No Change	None
065-18	Semi-annually	No Change	None
065-19	Semi-annually	No Change	None
065-20	Semi-annually	No Change	None
065-37	Semi-annually	No Change	None
065-38	Semi-annually	No Change	None
065-39	Semi-annually	No Change	None
065-40	Semi-annually	No Change	None
065-160	Semi-annually	No Change	None
065-161	Semi-annually	No Change	None

065-162	Semi-annually	No Change	None
065-163	Semi-annually	No Change	None
065-164	Semi-annually	No Change	None
065-165	Semi-annually	No Change	None
065-166	Semi-annually	No Change	None
065-167	Semi-annually	No Change	None
065-168	Semi-annually	No Change	None
065-169	Semi-annually	No Change	None
065-170	Semi-annually	No Change	None
065-171	Semi-annually	No Change	None
065-172	Semi-annually	No Change	None
065-173	Semi-annually	No Change	None
065-174	Semi-annually	No Change	None
065-175	Semi-annually	No Change	None
065-176	Semi-annually	No Change	None
065-177	Semi-annually	No Change	None
065-178	Semi-annually	No Change	None

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications described in Step 7 will result in an increase in sampling and analysis costs of \$4,087.00 per year.

TOTAL COST FOR MONITORING PROGRAM

FY 2002	\$32,687
FY2003	\$36,774
Difference	\$4,087

For wells sampled as part of the OU III BGRR/WCF and OU III AOC 29 projects, only costs for analysis of strontium-90 have been included in this evaluation. Since it is assumed that sampling will be conducted concurrently for both projects, sampling costs for wells included in both projects have been incorporated into the OU III AOC 29 project costs.

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   Thomas Burke (631) 344-3130
William Dorsch, (631) 344-5186

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LEGEND

- 39 MONITORING WELL ID
- 65 2001 EXTENT OF Sr-90 CONTAMINATION GREATER THAN 6pCi/L
- 32 BNL GRID NUMBER
- 005-267 PLUME CORE
- 005-267 PLUME PERIMETER
- 005-267 SENTINEL
- 005-267 OUTER PLUME PERIMETER
- 005-267 BACKGROUND

NOTES:

CONTOUR INTERVAL AS SHOWN

IN WELL CLUSTERS THE HIGHEST Sr-90 VALUE WAS USED IN CONTOURING AND DETERMINING EXTENTS.

Sr-90 PLUME DISTRIBUTION BASED ON FOURTH QUARTER 2001 SAMPLING EVENT.

SCALE
0 150 300 FEET

BROOKHAVEN
NATIONAL LABORATORY

ENVIRONMENTAL
SERVICES DIVISION

TITLE:
OU III BGRR/WCF STRONTIUM-90
POST ROD
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT:HZ.: -	DATE: 11/19/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV.: 1	NOTES: -
FIGURE NO.: 1			

OU III CARBON TETRACHLORIDE SOURCE CONTROL

DATE November 20, 2002

PROPOSED CHANGE

There will be no modifications to the monitoring program for 2003. The monitoring network will be evaluated once again before 2004.

DESCRIPTION AND TECHNICAL BASIS

A 1,000-gallon underground storage tank (UST) utilized to store carbon tetrachloride at the former Chemistry Department Complex during the 1950s was removed in April 1998. At that time, carbon tetrachloride within the UST was apparently inadvertently released. Plume characterization was conducted during the summer and fall of 1998. A groundwater remediation system, consisting of two shallow extraction wells and carbon treatment, was constructed and began operation during the fall of 1999. Shallow groundwater flow in this area is toward the southeast.

Groundwater characterization data collected since the fall of 2000 indicate that the distribution of the carbon tetrachloride contamination is complex, with a shallow component and a deeper component. The plume distribution is thought to be complicated by the following:

- Significant influences on groundwater flow patterns near Weaver Drive by stormwater recharge at the Weaver Drive basin
- A more complicated source than the spill which occurred during the April 1998 tank removal, and/or
- Stratigraphic variability that is not yet fully identified by borings nor incorporated in the groundwater models

The shallower contamination is consistent with the April 1998 tank spillage and is sufficiently defined to implement supplemental remedial action. The deeper contamination appears to be more discontinuous and is currently not completely defined. This deeper contamination may be related to:

- The physical properties of carbon tetrachloride (specific gravity of 1.59 at 20 degrees C)
- Releases from the carbon tetrachloride tank prior to the April 1998 spill, and/or
- Other historical sources further upgradient

Additional data are likely needed to determine the extent of the deeper contamination in the Carbon Tetrachloride Tank Spill Area. If free-phase carbon tetrachloride (dense nonaqueous phase liquid or DNAPL) is not detected, then the Carbon Tetrachloride Tank Spill Area source control action, in combination with other existing or planned downgradient groundwater treatment systems, are expected to achieve groundwater cleanup goals.

An additional extraction well was constructed in 2001 to capture high concentrations of the shallow carbon tetrachloride plume and remove the majority of the mass of contamination, thereby minimizing plume growth and providing source remediation. A remediation plan for the deeper contamination will be developed when this portion of the plume has been characterized.

The monitoring well network for the OU III Carbon Tetrachloride project currently consists of 13 wells, some of which were located using the BNL Regional Groundwater Flow Model. Well locations are shown on Figure 12.9.1.

Currently, the wells are sampled quarterly for analysis of VOCs. The monitoring schedule is detailed in Table 12.1.1. During calendar year 2000, 10 of the 13 wells contained concentrations of individual VOCs greater than New York State groundwater standards, although only 8 of these contained carbon tetrachloride at concentrations above the standard. Also during calendar year 2000, wells in the vicinity of the treatment system showed generally decreasing trends in carbon tetrachloride concentrations, confirming the effectiveness of the treatment system. Data from downgradient wells indicate that the depth of contamination is increasing to the southeast.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A carbon tetrachloride plume that could represent a potential risk to human health has been defined downgradient of a former carbon tetrachloride UST in the central portion of the BNL site. In response, remediation of the plume was implemented in the fall of 1999, and additional remediation measures will soon be implemented, with the goal of minimizing plume growth and completing the cleanup of the groundwater in the Upper

Glacial aquifer within 30 years. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decision

The decisions for the project are:

1. Is the BNL Groundwater Contingency Plan triggered?
2. Have the source control goals been met?
3. Has the plume been controlled?
4. Is the system operating as planned?
5. Have asymptotic conditions been demonstrated?
6. Is an engineering evaluation needed to modify the Middle Road treatment system to ensure capture and remediation of the carbon tetrachloride plume?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the carbon tetrachloride contamination. The identified subunits and the decisions supported by each are:

- Plume Core wells (Decisions 1, 2, 4, and 5)
- Sentinel (Bypass Detection) wells (Decisions 1, 3, and 4)
- Sentinel (Middle Road Tracking) wells (Decisions 1 and 6)

The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Carbon tetrachloride analytical results in groundwater
- Location of existing wells relative to flow patterns (Figure 12.9.1)
- Evaluation of capture zone for extraction wells
- Action Levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Rowland Street and well 085-160 to the north
- Middle Road to the south
- Rochester Street (wells 085-160, 085-162, and 095-185) to the west
- Grove Street to the east
- the saturated thickness of the Upper Glacial aquifer.

Step 5: Develop the Decision Rules

Separate decisions will be made in the three subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire study system. The timeframe for decisions for each subunit varies, as described below. The wells to be included in each subunit, based on the recommended (revised) sampling program, are presented in Step 7.

- Plume Core Wells: Because the treatment system is located in the contaminant source area, contamination already downgradient of the treatment area will not be captured by the existing system. In addition, plume core wells will be used to provide data for measuring the performance of the source control measure. Decisions for most of the plume core wells will be made using a 90-day timeframe. However, a longer timeframe of 365 days is appropriate for some core wells located near the plume fringe where conditions are not expected to vary significantly or for which there is an extensive existing database of analyses. This subset of wells will be designated as secondary plume core wells. However, it should be noted that, because operation of the expanded recovery/treatment system has recently been initiated, data are needed more frequently to evaluate system operation. The sampling frequency proposed for all wells, including the secondary plume core wells, in Step 7 will continue to be quarterly for calendar year 2003.
- Sentinel (Bypass Detection) Wells: Because data from the wells included in this subunit will be used to monitor the effectiveness of the shallow remediation system and to determine whether the plume is being captured, the timeframe for decisions here is 90 days.
- Sentinel (Middle Road Tracking) Wells: These wells will be used to evaluate whether the contamination already downgradient of the groundwater remediation system will

be captured by the Middle Road extraction wells. The decision timeframe for these wells is 90 days.

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all three subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Have the source control goals been met?

Analytical results from plume core wells will be utilized for this decision. It has been determined that, in order to meet the OU III cleanup goals in the required timeframe (30 years), groundwater extraction should be continued until plume core wells show carbon tetrachloride concentrations below 50 micrograms per liter ($\mu\text{g/l}$). At that time, the source control measure could be terminated.

If the mean carbon tetrachloride concentration in groundwater in each plume core well, computed from measurements over the previous two years, is less than 50 $\mu\text{g/l}$ and the computed mean is consistent with professional judgment, **then** the source control goals for this remedial action have been achieved. If not, consider the need for continued remediation.

Decision 3

Has the plume been controlled?

This decision applies to the sentinel wells. If the source control goals have not been met, then it must be verified that the plume is not growing. Plume growth is defined as an increase in carbon tetrachloride concentration in sentinel wells to above 50 $\mu\text{g/l}$ (if currently less than 50 $\mu\text{g/l}$) or a significant increase in carbon tetrachloride concentration (if currently above 50 $\mu\text{g/l}$).

If the carbon tetrachloride concentration in each sentinel well is less than 50 µg/l, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 4

Is the system operating as planned?

This decision applies to the plume core and sentinel wells. If the system is performing as planned, actual carbon tetrachloride concentrations in plume core and sentinel wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation.

Note: If the majority and/or “key” wells, as defined by a subject matter expert, are performing as planned, then “the system” as a whole is considered to be properly operating.

Decision 5

Have asymptotic conditions been demonstrated?

This decision applies to the plume core wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in carbon tetrachloride concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

If, for each plume core well, the slope of mean concentrations for all contaminants of concern are not different from zero for three years, and if experts on BNL hydrogeology and hydrochemistry concur with the results of the statistical analysis, **then** petition for system shutdown. If not, then continue system operation.

Note: this assumes that system operation is already considered “optimal.”

Decision 6

Is an engineering evaluation needed to modify the Middle Road treatment system to ensure capture and remediation of the carbon tetrachloride plume?

This decision applies to the Sentinel (Middle Road tracking) wells. There are four wells (104-11, 105-23, 105-42, and 104-36) to be included in the Sentinel (Middle Road tracking) wells subunit. Well locations are shown on Figure 1. Three of the wells (104-11, 105-23, and 105-42) are located to confirm that any of the shallow carbon tetrachloride plume that is not recovered by the upgraded existing remediation system will be captured by the Middle Road remediation system. The fourth well, 104-36, is located as an outpost well. Carbon tetrachloride detected in well 104-36 may not be captured by the Middle Road remediation system, and, if carbon tetrachloride is detected in this well at a concentration above 50 µg/l, then the Middle Road remediation system may need to be modified to ensure capture of the shallow carbon tetrachloride plume.

If the carbon tetrachloride concentration in any Middle Road tracking well exceeds 50 µg/l, **then** consider an engineering evaluation to determine whether modifications to the Middle Road treatment system are warranted.

Step 6: Specify Acceptable Error Tolerances

Table 12.9.1 (see page 12.9-8) summarizes the decision and possible decision errors for this project.

Step 7: Optimize the Design

Number and Location of Wells

Because an additional extraction well will be constructed near Weaver Drive, 7 existing wells should be added to the program as plume core wells. These wells, shown on Figure 1, are 085-236, 085-237, 095-43, 095-47, 095-88, 095-277, and 095-279. Three existing wells (085-235, 095-45, and 095-89) should be added to the sampling program as secondary core wells.

Five existing wells should be added to the program as sentinel wells. These are wells 095-42, 095-53, 095-90, 095-92, and 095-280 (Figure 12.9.1).

Four wells should be added as Middle Road tracking wells. These are wells 104-11, 105-23, 105-42, and 104-36. Well locations are shown on Figure 12.9.1.

Due to its distance from the existing plume, well 085-186 should be removed from the program.

Parameters and Frequency

Because the contaminant of concern for this project is carbon tetrachloride and samples are currently analyzed for VOCs only, no modifications are proposed to analytical parameters.

Because operation of the expanded recovery/treatment system has recently been initiated, data are needed more frequently to evaluate system operation. The sampling frequency for all wells should therefore be quarterly for calendar year 2003. However, the sampling program will be reviewed in June 2003 as part of the annual Groundwater Monitoring/Remediation Systems Operations Report and it is likely that a reduction in sampling frequency will be proposed at that time for wells in specific subunits, as described in Step 4.

The proposed sampling program for the OU III Carbon Tetrachloride Source Control project includes 31 wells. A summary of the proposed sampling program is shown in Table 12.9.2. Well subunits are detailed in Table 12.1.2.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

There are no sampling program modifications for 2003 therefore, there is no change in sampling and analysis costs.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$39,680
FY2003	\$39,680
Difference	\$0

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   William Dorsch (631) 344-5186
                                         Vincent Racaniello (631) 344-5436

Table 12.9.1 Decisions, Potential Decision Errors and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Have source control goals been met?	See Step 3 for inputs.	(1) Determine source control goals have been met then they are not. (2) Fail to determine source control goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Is the system performing as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Have asymptotic conditions been demonstrated?	See Step 3 for inputs.	(1) Determine asymptotic conditions reached when they are not. (2) Determine asymptotic conditions not reached when they are.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation that is no longer effective.
Is an engineering evaluation needed to modify the Middle Road	See Step 3 for inputs.	(1) Determine an evaluation is needed when it is not. (2) Determine an evaluation is not needed when it is.	(1) Wasted resources, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.

treatment system to ensure capture and remediation of the carbon tetrachloride plume?			

Table 12.9.2 Proposed Modifications to the Carbon Tetrachloride Source Control Monitoring Wells			
Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
085-07	Quarterly	No Change	None
085-13	Quarterly	No Change	None
085-16	Quarterly	No Change	None
085-160	Quarterly	No Change	None
085-161	Quarterly	No Change	None
085-162	Quarterly	No Change	None
085-163	Quarterly	No Change	None
085-17	Quarterly	No Change	None
085-236	Quarterly	No Change	None
085-237	Quarterly	No Change	None
085-238	Quarterly	No Change	None
085-98	Quarterly	No Change	None
095-183	Quarterly	No Change	None
095-185	Quarterly	No Change	None
095-186	Quarterly	No Change	None
095-42	Quarterly	No Change	None
095-43	Quarterly	No Change	None
095-45	Quarterly	No Change	None
095-47	Quarterly	No Change	None
095-53	Quarterly	No Change	None
095-88	Quarterly	No Change	None
095-89	Quarterly	No Change	None
095-90	Quarterly	No Change	None
095-92	Quarterly	No Change	None
104-11	Quarterly	No Change	None
105-42	Quarterly	No Change	None
095-277	Quarterly	No Change	None
095-279	Quarterly	No Change	None
095-280	Quarterly	No Change	None
104-36	Quarterly	No Change	None

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SERVICES DIVISION

TITLE:
**OU III CARBON TETRACHLORIDE
SOURCE CONTROL
MONITORING WELL LOCATIONS**
2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT: HZ.: -	DATE: 11/20/02	PROJECT NO.: 07340
CHKD: WRD	APPD: VJR	REV.: 1	NOTES:
FIGURE NO.: 1			

OU III CENTRAL POST-ROD

DATE November 20, 2002

PROPOSED CHANGE

There will be no modifications to the OU III Central monitoring program for 2003.

DESCRIPTION AND TECHNICAL BASIS

The OU III Remedial Investigation identified several low-level (less than 100 micrograms per liter ($\mu\text{g/l}$)) source areas and non-point contaminant sources within the developed central areas of the BNL Site. These sources include spills within the Alternating Gradient Synchrotron (AGS) Complex and at the storage area for site maintenance equipment (Building 208) and other sources. Because these sources are not significant enough to warrant a dedicated monitoring program, they are monitored under the OU III Central project. In addition, this project includes sentinel wells for the Suffolk County Water Authority (SCWA) William Floyd Parkway wellfield, wells 109-03 and 109-04 near the BNL site boundary.

A Preliminary Site Investigation was conducted in May 2001 to evaluate groundwater quality in the vicinity of Building 830. The results of this investigation indicated the existence of a potential contaminant source in this area.

The monitoring well network for the OU III Central project consists of 22 wells that provide groundwater quality data in the vicinity of the source areas and at downgradient locations. Well locations are shown on Figure 12.10.1. The wells are sampled quarterly for analysis of VOCs and annually for analysis of gross alpha/beta, gamma spectroscopy, tritium, and strontium-90, as shown in Tables 12.1.1 and 12.1.2.

The contaminants of concern associated with the sources monitored by the OU III Central wells are VOCs. During calendar year 2000, 8 of the 22 wells contained at least one VOC at a concentration above its New York State groundwater standard. No radionuclides were detected at an activity above New York State groundwater standards in any of the OU III Central wells.

Groundwater flow in the central portion of the BNL Site is locally variable, due to BNL pumping and recharge sources in the area. In general, groundwater flow is toward the south or southeast.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- _____ Compliance
- _____ Support Compliance

_____	Surveillance
_____	
x _____	Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater beneath the BNL Site has been impacted by low levels of VOCs from historic operations at several isolated areas. Because active remediation of these commingled plumes is not being conducted, data are needed to verify that the contaminants are naturally degrading according to the attenuation model.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Are there potential impacts to the SCWA William Floyd Parkway wellfield from on-site contamination?
- Are performance objectives met?
- If not, are observed conditions consistent with the attenuation model?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- VOC analytical results in groundwater
- Location of existing wells relative to flow patterns (Figure 12.10.1)
- Regulatory drivers (OU III ROD)
- Action Levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data.

Step 4: Define the Study Boundaries

The project decision unit limits are defined by:

- Cornell Avenue (well 064-03) on the north
- Middle Road (wells 113-06 and 113-07) and Ashton Lane (wells 109-03 and 109-04) on the south
- HO Basin and RA V Basin on the east
- William Floyd Parkway on the west
- Upper Glacial and shallow Magothy aquifers.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Are there potential impacts to the SCWA William Floyd Parkway wellfield from on-site contamination?

For this project, particular attention will be paid to results from wells 109-03 and 109-04, which are located near the BNL site boundary and serve as sentinel wells for the SCWA William Floyd Parkway wellfield. Results from future sampling events will be evaluated in context with historic data to determine whether contamination from the BNL Site can potentially impact the wellfield.

If sample results from sentinel wells 109-03 and 109-04 indicate the potential for impacts to the SCWA William Floyd Parkway wellfield from on-site contamination and these results are confirmed by resampling, **then** the Groundwater Contingency Plan will be

implemented and notification will be made to the SCWA, the Suffolk County Department of Health Services, and the New York State Department of Environmental Conservation.

Decision 3

Are performance objectives met?

According to the Record of Decision for OU III, concentrations of individual VOCs will be reduced to below MCLs within 30 years. Portions of the plumes may attenuate to below MCLs before active remediation is instituted.

If, for all wells, the mean concentration of each VOC in groundwater, computed from the previous four consecutive sampling events, is less than the compound-specific MCL, and the computed mean is consistent with professional judgment, **then** petition for closure of the remedial action. Otherwise, continue attenuation monitoring.

Decision 4

If not, are observed conditions consistent with the attenuation model?

If performance objectives have not been met, **then** it must be determined whether VOC concentrations in groundwater are being reduced according to the attenuation model.

If the detected VOC concentrations are consistent with the attenuation model, groundwater model results and professional judgment, **then** continue attenuation monitoring. If not, consider refining the conceptual model and/or implementing supplements to bolster the attenuation process.

Step 6: Specify Acceptable Error Tolerances

Table 12.10.1 summarizes the decision and possible decision errors for this project.

Table 12.10.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Are performance objectives met?	See Step 3 for inputs.	(1) Data indicate that MCLs have not been met when they have. (2) Data indicate that MCLs have been met when they have not.	(1) Wasted resources conducting continued unnecessary monitoring. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.

If not, are observed conditions consistent with attenuation model?	See Step 3 for inputs.	(1) Data indicate that conditions are not consistent with model when they are. (2) Data indicate that conditions are consistent with model when they are not.	(1) Wasted resources conducting attenuation model refinements and introducing supplements. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.

Step 7: Optimize the Design

Number and Location of Wells

Because wells 072-03 and 072-04 are apparently located well west of the contaminant sources monitored by this program, sampling of these wells should be eliminated.

Because well 106-19 monitors the Magothy aquifer and the identified contamination is within the Upper Glacial aquifer, sampling of well 106-19 should be eliminated.

Because wells 105-25, 113-06 and 113-07 monitor the Middle Road remediation system, sampling of these wells should be eliminated from the OU III Central project and added to the Middle Road project.

Parameters and Frequency

Because the contaminants of concern for the groundwater plumes monitored under this project are VOCs, sampling for radiological parameters (gross alpha/beta, gamma spectroscopy, tritium, and strontium-90) should be eliminated for all wells except 109-03 and 109-04, which serve as sentinel wells for the Suffolk County Water Authority William Floyd Parkway wellfield.

A summary of the proposed OU III Central sampling program is shown in Table 12.10.2 below.

Table 12.10.2 Proposed Modifications to the OU III Central Sampling Program			
Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
064-03	Quarterly	No Change	None
065-02	Quarterly	No Change	None
065-05	Quarterly	No Change	None
066-07	Quarterly	No Change	None
066-08	Quarterly	No Change	None
066-09	Quarterly	No Change	None

075-01	Quarterly	No Change	None
075-02	Quarterly	No Change	None
076-28	Quarterly	No Change	None
076-314	Quarterly	No Change	None
076-373	Quarterly	No Change	None
083-01	Quarterly	No Change	None
083-02	Quarterly	No Change	None
084-04	Quarterly	No Change	None
084-05	Quarterly	No Change	None
096-07	Quarterly	No Change	None
105-05	Quarterly	No Change	None
105-06	Quarterly	No Change	None
109-03	Quarterly	No Change	None
109-04	Quarterly	No Change	None

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

There are no changes in sampling and analysis costs for 2003.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$28,631
FY2003	\$28,631.00
Difference	\$0

IMPLEMENTATION DATE   January 1, 2003

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BROOKHAVEN
NATIONAL LABORATORY
ENVIRONMENTAL
SERVICES DIVISION

TITLE: **OU III CENTRAL
POST-ROD
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE**

DWN: KCK	VT: HZ.: —	DATE: 11/25/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV.: 1	NOTES: —

FIGURE NO.:

1

OU III BUILDING 96 Post-ROD

DATE November 20, 2002

PROPOSED CHANGE

- Two new permanent monitoring wells will be installed upgradient (MW-A) and downgradient (MW-B) of the high concentration area after two additional direct push probeholes are installed to verify the concentrations.
- One additional permanent monitoring well (MW-C) will be installed southwest of well 095-159 at the GP-2 location to monitor potential westward spread of the contaminants.

DESCRIPTION AND TECHNICAL BASIS

Solvents were historically used at a former vehicle maintenance and drum storage area located immediately west of the Supply and Materiel area. While no spills were documented in this area, soil and groundwater samples collected during the Operable Unit (OU) III Remedial Investigation contained high concentrations of tetrachloroethylene (PCE) and 1,1,1-trichloroethane (TCA), especially in shallow groundwater. These results indicate that spillage has historically occurred in this area and a narrow plume (approximately 200 feet wide) has been defined flowing south from the area of Building 96.

The identified groundwater contamination was addressed by construction of a treatment system consisting of four, 2-screen remediation wells (RTW-1, RTW-2, RTW-3 and RTW-4). Well RTW-1 is located in the area where the highest concentrations of volatile organic compounds (VOCs) were detected. The remaining three wells (RTW-2, RTW-3 and RTW-4) are located further south (downgradient) in an east-west line to intercept the plume migrating south of RTW-1. Well locations are shown on Figure 12.11.1. Impacted groundwater is extracted through the well's lower screen, treated via air stripping and recharged through the well's upper screen. Operation of the system began during calendar year 2001.

The remediation wells were located to intercept the area of greatest contaminant concentrations. Groundwater flow maps indicate that existing contamination currently downgradient of the Building 96 remediation system will be intercepted by OU III extraction wells EW-9, EW-10 and EW-11, located approximately 1,500 feet downgradient of the Building 96 area, the Middle Road treatment system (currently being constructed) and the South Boundary treatment system. As a result, the Building 96 contamination is not expected to migrate off of the BNL site.

The monitoring well network for the OU III Building 96 program consists of 17 wells, all of which are screened in the shallow Upper Glacial aquifer. Two of the wells (085-97 and

085-293) are located upgradient of the former Building 96 source area. The remaining wells except 095-171 are located within the plume core and serve to define the lateral extent of the contamination approximately 300 feet downgradient of the former source area. Well 095-171 was constructed to monitor the plume perimeter downgradient of the source area. The screen zone and aquifer screened by each of these wells is summarized in the table on the next page. Well locations are shown on Figure 12.11.1. The wells are sampled quarterly for analysis of VOCs to monitor the plume configuration and the effectiveness of the remediation system. A monitoring schedule is provided in Table 12.1.1.

The most recent groundwater data indicate that the plume is shrinking and that the highest concentrations of VOCs are decreasing in response to operation of the remediation system.

TABLE 12.11.1 CURRENT OU III BUILDING 96 WELLS			
WELL	Decision Unit	Screen Zone *	Aquifer Screened
085-97	Plume Perimeter	15-35	Shallow Upper Glacial
085-293	Plume Core	45-55	Shallow Upper Glacial
095-84	Plume Perimeter	15-35	Shallow Upper Glacial
095-85	Plume Perimeter	90-100	Shallow Upper Glacial
095-159	Plume Perimeter	45-55	Shallow Upper Glacial
095-161	Plume Perimeter	45-55	Shallow Upper Glacial
095-162	Plume Core	45-55	Shallow Upper Glacial
095-163	Bypass Detection	45-55	Shallow Upper Glacial
095-164	Bypass Detection	25-30	Shallow Upper Glacial
095-165	Bypass Detection	45-55	Shallow Upper Glacial
095-166	Bypass Detection	45-55	Shallow Upper Glacial
095-167	Bypass Detection	45-55	Shallow Upper Glacial
095-168	Bypass Detection	45-55	Shallow Upper Glacial
095-169	Bypass Detection	45-55	Shallow Upper Glacial
095-170	Bypass Detection	45-55	Shallow Upper Glacial
095-171	Plume Perimeter	45-55	Shallow Upper Glacial
095-172	Plume Core	45-55	Shallow Upper Glacial

* Feet below ground surface

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

_____ Compliance
 _____ Support Compliance

	Surveillance
x	Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Remediation of the Building 96 VOC plume is currently being conducted utilizing four recirculation wells. Data are needed to verify that this system is reducing the identified contamination according to plan. The Building 96 remediation system is a source control action and is part of a comprehensive cleanup program to restore the Upper Glacial aquifer to MCLs within 30 years.

Step 2: Identify the Decisions

The decisions for the project are

1. Is the BNL Groundwater Contingency Plan triggered?
2. Have the source control goals been met?
3. If not, has the plume been controlled?
4. Is the system operating as planned?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume Core wells (Decisions 1, 2, 4, and 5)
- Plume Perimeter wells (Decisions 1 and 3)
- Bypass Detection wells (Decisions 1, 3, and 4)

The decision unit for each of the wells in the current monitoring network is shown in Table 12.11.1. The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater
- Location of existing wells relative to flow patterns (Figure 12.11.1)
- Evaluation of capture zone for extraction wells
- Action Levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data.

Step 4: Define the Study Boundaries

The decision unit limits for this project are the area being remediated in the vicinity of Building 96 as defined by a perimeter extending approximately 100 feet beyond the groundwater remediation wells. The vertical study limits are from the water table surface to approximately 70 feet below ground surface which is the zone containing total VOCs at concentrations above 50 ug/l. As described above, any deeper contamination will be intercepted by remediation systems further downgradient.

The potential risk to downgradient receptors from the Building 96 VOC plume was determined to be low based on the following factors:

- Public water hookups have been provided off site
- This contamination is not within the capture zone of BNL supply wells
- Travel time of approximately 10 years to the BNL site boundary
- Contamination that is not captured by the Building 96 treatment system will be intercepted by other OU III treatment systems before reaching the BNL site boundary.

The rate of source removal from the aquifer is relatively quick as the treatment system is projected to operate for less than three years. The rate of groundwater migration is relatively slow (less than 1 foot per day). Because of the projected rapid rate of treatment, data are required every three months to enable operational adjustments designed to achieve the goals within three years of operation.

Step 5: Develop the Decision Rules**Decision 1***Is the BNL Groundwater Contingency Plan triggered?*

Analytical results from wells in all three subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Have the source control goals been met?

The OU III Record of Decision requires that this VOC plume source area be remediated to prevent or reduce downgradient impacts. As this is a source control activity, setting specific cleanup goal concentrations is not necessary to ensure that the system is operated in an efficient manner. Rather, the removal of a significant portion of the contaminant mass is the appropriate decision metric for determination of shut-down criteria. A series of indices have been developed to aid in this decision. The first decision rule index is the cumulative mass removal of contamination. The second is the identification of a “rebound” in concentrations after treatment and the third is an interpretation/ evaluation of whether the remaining contamination is a significant risk to achieving the cleanup goals specified in the ROD.

- **If** data from plume core wells show that more than 50 percent of the VOC mass OR at least 57.5 pounds of VOCs have been removed from the aquifer beneath the former scrap yard AND there are no indications of a continuing source, **then** consider termination of full-time system operation and beginning of pulsed operation of the system. If not, then continue full-time operation of the system.
- **If** pulsing of the remediation system does not result in significant rebound in contaminant concentrations AND model predictions indicate that any remaining contamination will not prevent achievement of cleanup objectives, **then** consider termination of system operation. If not, then continue operation of the system.

Decision 3

If not, has the plume been controlled?

This decision applies to the plume perimeter and bypass detection wells. If the source control goals have not been met, then it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume fringe or bypass detection wells to above 50 ug/l (if currently less than 50 ug/l) or a significant increase in total VOC concentration (if currently above 50 ug/l).

- If the total VOC concentration in each plume perimeter and bypass detection well is less than 50 ug/l, then continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 4

Is the system operating as planned?

This decision applies to the plume core and bypass detection wells. **If** the system is performing as planned, **then** actual total VOC concentrations in plume core and bypass

detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

- If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), then continue to operate. If not, then consider operational adjustments and/or engineering evaluation.

Note: if the majority and/or "key" wells, as defined by a subject matter expert, are performing as planned, then "the system" as a whole is considered to be properly operating.

Step 6: Specify Acceptable Error Tolerances

Table 12.11.2 summarizes the decision and possible decision errors for this project.

There are no potential receptors immediately downgradient of the Building 96 area and groundwater travel time to the site boundary is approximately 10 years. In addition, groundwater remediation was implemented in this area during calendar year 2001 and other remediation systems are in place (OU III Middle Road) or are being constructed downgradient of the Building 96 area.

Due to these factors, it is very unlikely that decision error will result in adverse consequences to human health. The consequences of decision error relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust and BNL credibility, and potentially wasted resources.

Step 7: Optimize the Design

Number and Location of Wells

Two new permanent monitoring wells will be installed upgradient (MW-A) and down gradient (MW-B) of the high concentration area after two additional direct push probeholes are installed to verify the concentrations.

One additional permanent monitoring well (MW-C) will be installed southwest of well 095-159 at the GP-2 location to monitor potential westward spread of the contaminants.

TABLE 12.11.2 DECISIONS, POTENTIAL DECISION ERRORS, AND POTENTIAL CONSEQUENCES			
DECISION	INPUTS	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Have cleanup goals been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Is the system performing as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Have asymptotic conditions been demonstrated?	See Step 3 for inputs.	(1) Determine asymptotic conditions reached when they are not. (2) Determine asymptotic conditions not reached when they are.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation that is no longer effective.

Parameters and Frequency

Due to the utilization of a relatively new remediation technology and the relatively short period of operation for the remediation system, no modifications to the sampling frequency or analytical parameters are recommended.

A summary of the revised sampling program for this project is provided in Table 12.11.3.

TABLE 12.11.3 PROPOSED MODIFICATIONS TO THE OU III BUILDING 96 PROJECT					
WELL	Proposed Sampling Frequency *	Proposed Analytical Parameters	Well	Proposed Sampling Frequency *	Proposed Analytical Parameters
085-97	Quarterly	VOCs	095-166	Quarterly	VOCs
085-293	Quarterly	VOCs	095-167	Quarterly	VOCs
095-84	Quarterly	VOCs	095-168	Quarterly	VOCs
095-85	Quarterly	VOCs	095-169	Quarterly	VOCs
095-159	Quarterly	VOCs	095-170	Quarterly	VOCs
095-161	Quarterly	VOCs	095-171	Quarterly	VOCs
095-162	Quarterly	VOCs	095-172	Quarterly	VOCs
095-163	Quarterly	VOCs	MW-A	Quarterly	VOCs
095-164	Annually	VOCs	MW-B	Quarterly	VOCs
095-165	Quarterly	VOCs	MW-C	Quarterly	VOCs

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications described in Step 7 will result in an increase in sampling and analysis cost of \$3,600 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$22,800
FY2003	\$26,400
Difference	\$3,600

IMPLEMENTATION DATE   January 1, 2003

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BROOKHAVEN
NATIONAL LABORATORY

ENVIRONMENTAL
SERVICES DIVISION

TITLE: OU III BUILDING 96
SOURCE CONTROL
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT: HZ: -	DATE: 11/21/02	PROJECT NO.: 07340
CHKD: WRD	APPD: VJR	REV.: 1	NOTES:
FIGURE NO.: 1			

OU III SOUTH BOUNDARY PUMP AND TREAT SYSTEM

DATE November 20, 2002

PROPOSED CHANGE

One additional downgradient (bypass detection) monitoring well be installed on the south side of the LIE downgradient of EW-4 to verify high levels of contamination in this vicinity are being captured. The well will be installed during the fall of 2002.

DESCRIPTION AND TECHNICAL BASIS

The Operable Unit (OU) III South Boundary pump and treat system was designed to capture contamination consisting of volatile organic compounds (VOCs) in the Upper Glacial aquifer. This system is one of eight groundwater remediation systems planned or in operation. These systems, working together, are designed to remediate the OU III VOC plume. Some VOC contamination currently existing in the upper portion of the Magothy aquifer is being further characterized, and a decision on the strategy for achieving cleanup goals will be made after completion of the additional characterization.

The OU III South Boundary groundwater extraction and treatment system includes seven extraction wells. Extracted groundwater is treated via air stripping and recharged upgradient of the plume. The system has been in operation since 1977. Shallow groundwater flow in this area is toward the south.

The monitoring network for the OU III South Boundary system includes 40 wells. Well locations are shown in Figure 12.12.1.

Currently, the wells are sampled quarterly, semi-annually or annually for analysis of VOCs, tritium, gross alpha, gross beta, gamma spectroscopy and strontium-90 as shown in Tables 12.1.1 and 12.1.2. During calendar year 2000, 16 of the 40 wells contained concentrations of individual VOCs greater than New York State groundwater standards. No radionuclides were detected at an activity above New York State groundwater standards in any well during calendar year 2000.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

VOC plume that could represent a potential risk to human health has been defined on the BNL Site. In response, capture and remediation of the plume was implemented in the fall of 1997. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decisions

The decisions for the project are:

1. Is the BNL Groundwater Contingency Plan triggered?
2. Have the cleanup goals been met?
3. If not, has the plume been controlled?
4. Is the system operating as planned?
5. Have asymptotic conditions been demonstrated?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume Core wells (Decisions 1, 2, 4, and 5)
- Perimeter wells, used to define the extent of the plume (Decisions 1 and 3)
- Bypass Detection wells (Decisions 1, 3, and 4)

The wells included in each subunit are shown in Table 12.1.2. The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater
- Location of existing wells relative to flow patterns
- Evaluation of capture zone for extraction wells
- Action Levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data.

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Middle Road to the north
- Long Island Expressway to the south
- well 122-33 to the east
- wells 121-06, 121-07, and 121-08 to the west
- Upper Glacial and upper Magothy aquifers.

Separate decisions will be made in the three subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire study system. The temporal boundaries of the study area vary, based on the decision.

- *Plume Core:* Because the rate of water quality improvement in this area is relatively slow and historic results indicate that the plume is being controlled by the treatment system, the timeframe for decisions for this subunit is 180 days.
- *Perimeter:* Because the wells included in this subunit define the plume horizontally and vertically, which is used to determine whether the plume is being captured. Since historic results indicate that the plume is being controlled by the treatment system, the timeframe for decisions here is 180 days.
- *Bypass Detection Area:* Because the wells in this area indicate whether the plume capture performance objective is being met, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all three subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Have the cleanup goals been met?

Analytical results from plume core wells will be utilized for this decision. It has been determined that, in order to meet cleanup goals in the required timeframe (30 years), groundwater extraction should be continued until plume core wells show total VOC concentrations below 50 micrograms per liter (ug/l). At that time, the project could be reclassified as Monitored Natural Attenuation.

If the mean concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous two years, is less than the established cleanup goal for that parameter and the computed mean is consistent with

professional judgment, **then** the cleanup goals for this remedial action have been achieved. If not, consider the need for continued remediation.

Decision 3

If not, has the plume been controlled?

This decision applies to the perimeter and bypass detection wells.

If the cleanup goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume fringe or bypass detection wells to above 50 µg/l (if currently less than 50 µg/l) or a significant increase in total VOC concentration (if currently above 50 µg/l).

If the trend in each plume fringe and bypass detection well has a negative slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 50 µg/l, **then** continue to operate the system. **If not, then** consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 4

Is the system operating as planned?

This decision applies to the plume core and bypass detection wells.

If the system is performing as planned, **then** actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation.

Note: If the majority and/or “key” wells, as defined by a subject matter expert, are performing as planned, then “the system” as a whole is considered to be properly operating.

Decision 5

Have asymptotic conditions been demonstrated?

This decision applies to the plume core area wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the

system may be appropriate. To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

If, for each plume core well, the slope of mean concentrations for all contaminants of concern are not different from zero for three years, and if subject matter experts on BNL hydrogeology and hydrochemistry concur with the results of the statistical analysis, **then** petition for system shutdown. If not, then continue system operation.

Note: this assumes that system operation is already considered “optimal.”

Step 6: Specify Acceptable Error Tolerances

Table 12.12.1 summarizes the decision and possible decision errors for this project.

Table 12.12.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Have cleanup goals been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Is the system performing as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Have asymptotic conditions been demonstrated?	See Step 3 for inputs.	(1) Determine asymptotic conditions reached when they are not. (2) Determine asymptotic conditions not reached when they are.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Location of Wells

Review of the existing well network identified a potential data gap in the vicinity of EW-4 with respect to the bypass detection area. It is therefore recommended that an additional well be added to the monitoring program as a bypass detection area well.

Parameters and Frequency

As described in Step 4 above, decisions will be made for the decision subunits on a timeframe of either 90 or 180 days. The sampling frequency for wells in the plume core and perimeter areas should therefore remain semi-annually and the sampling frequency for bypass detection area wells should continue at a quarterly frequency. Based on the historic database and slow rate of change in VOC concentrations for the plume core wells, further reduction in sampling frequency to annually may be recommended in the near future. Monitoring schedule details are provided in Table 12.12.2.

Table 12.12.2 Proposed Modifications to the South Boundary Monitoring Wells			
Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
000-280	Annually	No Change	None
121-06	Annually	No Change	None
121-09	Annually	No Change	None
121-12	Annually	No Change	None
121-18	Annually	No Change	None
121-21	Annually	No Change	None
122-10	Annually	No Change	None
122-15	Annually	No Change	None
122-18	Annually	No Change	None
114-06	Semi-annually	No Change	None
114-07	Semi-annually	No Change	None
121-10	Quarterly	No Change	None
121-11	Semi-annually	No Change	None
121-13	Semi-annually	No Change	None
121-14	Semi-annually	No Change	None
121-20	Semi-annually	No Change	None
121-23	Semi-annually	No Change	None
122-04	Semi-annually	No Change	None
122-05	Semi-annually	No Change	None
122-16	Semi-annually	No Change	None
122-17	Semi-annually	No Change	None
122-19	Semi-annually	No Change	None
122-20	Semi-annually	No Change	None
122-21	Semi-annually	No Change	None
122-22	Semi-annually	No Change	None
122-24	Quarterly	No Change	None
122-25	Quarterly	No Change	None
122-31	Semi-annually	No Change	None
122-32	Semi-annually	No Change	None
122-33	Semi-annually	No Change	None
122-34	Quarterly	No Change	None
122-35	Quarterly	No Change	None
121-07	Semi-annually	No Change	None
121-08	Semi-annually	No Change	None
121-19	Semi-annually	No Change	None
121-22	Semi-annually	No Change	None
122-02	Semi-annually	No Change	None
122-09	Semi-annually	No Change	None
New-1	Semi-annually	No Change	None

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications described in Step 7 will result in an increase in sampling and analysis costs of \$864 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$28,800
FY2003	\$29,664
Difference	\$864

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   William Dorsch (631) 344-5186
Vincent Racionello, (631) 344-5436

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BROOKHAVEN
NATIONAL LABORATORY
ENVIRONMENTAL
SERVICES DIVISION

TITLE: **OU III SOUTH BOUNDARY
PUMP AND TREAT SYSTEM
MONITORING WELL LOCATIONS**
2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT: HZ:	DATE: 11/20/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV: 1	NOTES: -
FIGURE NO.: 1			

OU III SOUTH BOUNDARY RADIONUCLIDE MONITORING

DATE November 20, 2002

PROPOSED CHANGE

There are no modifications to the OU III South Boundary radiological monitoring program in 2003.

DESCRIPTION AND TECHNICAL BASIS

As part of Data Quality Objective analysis for the OU III South Boundary and Western South Boundary pump and treat systems, it was recommended that analysis for radionuclides be eliminated from these programs. However, in order to confirm that groundwater impacted by radionuclides is not flowing off site, periodic analysis for radionuclides at the BNL southern property boundary may be warranted.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☒ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Data are needed to evaluate whether groundwater impacted by radionuclides is migrating off site.

Step 2: Identify the Decision

The decision for the project is:

Is groundwater impacted by radionuclides migrating off site (that is, Is the Groundwater Contingency Plan triggered)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Analytical results for radionuclides in groundwater
- Location of existing wells relative to flow patterns
- Analytical methods and detection limits as described in the BNL Environmental Monitoring Plan
- Action levels
- Variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Middle Road to the north
- the BNL site boundary to the south
- wells 121-31 and 121-32 to the east
- William Floyd Parkway to the west
- Upper Glacial and upper Magothy aquifers.

Step 5: Develop the Decision Rules

Decision 1

Is groundwater impacted by radionuclides migrating off-site (that is, is the Groundwater Contingency Plan triggered)?

The sample results will be evaluated in context with historical data. As part of that evaluation, circumstances that would require implementation of the Groundwater Contingency Plan would be determined for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, including detection of previously undetected contaminants and detection of contaminants in wells where those contaminants have not previously been detected.

If radionuclides are detected in any well at unusually high concentrations (relative to the historical baseline) and the results are confirmed by resampling, **then** implement actions as prescribed in the BNL Groundwater Contingency Plan.

Step 6: Specify Acceptable Error Tolerances

Table 12.13.1 summarizes the decision and possible decision errors for this project.

Table 12.13.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is groundwater impacted by radionuclides migrating off-site?	See Step 3 for inputs.	(1) Data indicate that groundwater impacted by radionuclides is flowing off-site when that is not the case. (2) Data indicate that there is not groundwater impacted by radionuclides flowing off-site when there is.	(1) Investigation and/or remediation of groundwater contamination may be undertaken by BNL when it is not warranted. (2) Delays in addressing contamination, possible actions by regulatory agencies.

Step 7: Optimize the Design**Number and Location of Wells**

Since analysis of radionuclides was eliminated from the Operable Unit (OU) III South Boundary and Western South Boundary projects, but such analysis may be warranted to confirm that groundwater impacted by radionuclides is not flowing off-site, it is recommended that on-site wells within the OU III South Boundary and Western South Boundary projects be sampled for radionuclide analysis. The wells to be sampled are summarized in Table 12.13.2. Well locations are shown on Figure 12.13.1.

Parameters and Frequency

The radionuclide samples should be analyzed for tritium, gamma spectroscopy and strontium-90. Since gross alpha and gross beta are used for screening purposes only, analysis for these parameters is not warranted.

Since results from historic samples indicate that there is currently little potential for groundwater impacted by radionuclides to flow off-site along the western BNL site boundary, sampling for radionuclides should be conducted annually. Such sampling should be conducted in conjunction with the current monitoring programs for the OU III South Boundary and Western South Boundary projects to eliminate additional costs for sample collection. The monitoring schedule is provided in Table 12.1.1.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

There were no modifications to this program for 2003 therefore, the sampling and analysis costs will remain the same.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$8,576
FY2003	\$8,576
Difference	\$0

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   William Dorsch (631) 344-5186

Table 12.13.2 Proposed Modifications to the South Boundary Radionuclide Monitoring Wells

Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
000-280	Annually	No Change	None
121-06	Annually	No Change	None
121-09	Annually	No Change	None
121-12	Annually	No Change	None
121-18	Annually	No Change	None
121-21	Annually	No Change	None
122-10	Annually	No Change	None
122-15	Annually	No Change	None
122-18	Annually	No Change	None
114-06	Annually	No Change	None
114-07	Annually	No Change	None
121-10	Annually	No Change	None
121-11	Annually	No Change	None
121-13	Annually	No Change	None
121-14	Annually	No Change	None
121-20	Annually	No Change	None
121-23	Annually	No Change	None
122-04	Annually	No Change	None
122-05	Annually	No Change	None
122-16	Annually	No Change	None
122-17	Annually	No Change	None
122-19	Annually	No Change	None
122-20	Annually	No Change	None
122-21	Annually	No Change	None
122-22	Annually	No Change	None
122-24	Annually	No Change	None
122-25	Annually	No Change	None
122-31	Annually	No Change	None
122-32	Annually	No Change	None
122-33	Annually	No Change	None
122-34	Annually	No Change	None
122-35	Annually	No Change	None
121-07	Annually	No Change	None
121-08	Annually	No Change	None
121-19	Annually	No Change	None
121-22	Annually	No Change	None
122-02	Annually	No Change	None
122-09	Annually	No Change	None
New-1	Annually	No Change	None
124-02	Annually	No Change	None
126-01	Annually	No Change	None
130-02	Annually	No Change	None
130-03	Annually	No Change	None
130-04	Annually	No Change	None
119-03	Annually	No Change	None
126-11	Annually	No Change	None
126-15	Annually	No Change	None
<i>continued</i>			

Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
121-42	Annually	No Change	None
127-04	Annually	No Change	None
126-13	Annually	No Change	None
126-14	Annually	No Change	None
125-01	Annually	No Change	None
127-06	Annually	No Change	None
127-07	Annually	No Change	None
126-16	Annually	No Change	None
130-08	Annually	No Change	None

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OU III MIDDLE ROAD PUMP AND TREAT SYSTEM

DATE November 20, 2002

PROPOSED CHANGE

No modifications to the sampling program for this project are proposed.

DESCRIPTION AND TECHNICAL BASIS

The Operable Unit (OU) III Middle Road pump and treat system was designed to capture contamination consisting of volatile organic compounds (VOCs) in the Upper Glacial aquifer upgradient of the BNL south property boundary. This system is one of eight groundwater remediation systems planned or in operation. These systems, working together, are designed to remediate the OU III VOC plume.

The OU III Middle Road groundwater extraction and treatment system includes six extraction wells. Extracted groundwater is treated via air stripping and recharged upgradient of the plume. The system has been in operation since the fall of 2001. Shallow groundwater flow in this area is toward the south.

As described in the Operation and Maintenance Manual for the OU III Middle Road project, the monitoring network includes 27 wells. Twenty-six of these wells have already been constructed. The remaining well will be constructed (and also sampled) as part of the OU III Carbon Tetrachloride Removal Action project. Six of the wells in the OU III Middle Road project are also sampled as part of the OU III High Flux Beam Reactor (HFBR) project, six other wells are sampled as part of the OU I/IV project, and one other well is also sampled as part of the Chemical/Animal Holes project. Well locations are shown on Figure 12.14.1.

Once system startup has been completed, sampling of the wells will be conducted quarterly as shown in Table 12.1.1. Samples will be analyzed for VOCs.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health has been defined on the BNL site. In response, capture and remediation of the plume was implemented in the fall of 2001. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Have the cleanup goals been met?
- If not, has the plume been controlled?
- Is the system operating as planned?
- Have asymptotic conditions been demonstrated?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume Core wells (Decisions 1, 2, 4, and 5)
- Perimeter wells, used to define the extent of the plume (Decisions 1 and 3)
- Bypass Detection wells (Decisions 1, 3, and 4)

The wells included in each subunit are shown in Table 12.1.2.

The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater
- Location of existing wells relative to flow patterns
- Evaluation of capture zone for extraction wells

- Action Levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Princeton Avenue to the north
- Approximately 500 feet south of Middle Road (wells 113-16, 113-17, 113-18, 113-19, and 113-20) to the south
- Well 122-33 to the east
- Well 113-08 to the west
- Upper Glacial and upper Magothy aquifers

Separate decisions will be made in the three subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire study system. As described below, the temporal boundaries of the study area are currently the same for each decision subunit. However, as more data are collected, the timeframe for decisions in a subunit may be modified. Therefore, the subunits have been described separately.

- Plume Core: Plume core wells will be used to provide data for measuring the performance of the system. Because the system is newly operational, data are needed on a relatively frequent basis. Therefore, the timeframe for decisions for this subunit is 90 days.
- Perimeter: The wells included in this subunit define the plume horizontally and vertically, which is used to determine whether the plume is being captured. Because the system is newly operational, the timeframe for decisions here is 90 days.
- Bypass Detection Area: Because the wells in this area indicate whether the plume capture performance objective is being met, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all three subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Have the cleanup goals been met?

Analytical results from plume core wells will be utilized for this decision. It has been determined that, in order to meet cleanup goals in the required timeframe (30 years), groundwater extraction should be continued until plume core wells show total VOC concentrations below 50 micrograms per liter ($\mu\text{g/l}$). At that time, the project could be reclassified as Monitored Natural Attenuation.

If the mean concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous two years, is less than the established cleanup goal for that parameter and the computed mean is consistent with professional judgment, **then** the cleanup goals for this remedial action have been achieved. If not, consider the need for continued remediation.

Decision 3

If not, has the plume been controlled?

This decision applies to the perimeter and bypass detection wells. If the cleanup goals have not been met, then it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in perimeter or bypass detection wells to above 50 $\mu\text{g/l}$ (if currently less than 50 $\mu\text{g/l}$) or a significant increase in total VOC concentration (if currently above 50 $\mu\text{g/l}$).

If the trend in each perimeter and bypass detection well has a negative slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 50 $\mu\text{g/l}$, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 4

Is the system operating as planned?

This decision applies to the plume core and bypass detection wells. If the system is performing as planned, then actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation.

Note: If the majority and/or “key” wells, as defined by a subject matter expert, are performing as planned, then “the system” as a whole is considered to be properly operating.

Decision 5

Have asymptotic conditions been demonstrated?

This decision applies to the plume core area wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

If, for each plume core well, the slope of mean concentrations for all contaminants of concern is not different from zero for three years, and if subject matter experts on BNL hydrogeology and hydrochemistry concur with the results of the statistical analysis, **then** petition for system shutdown. If not, then continue system operation.

Note: this assumes that system operation is already considered “optimal.”

Step 6: Specify Acceptable Error Tolerances

Table 12.14.1 summarizes the decision and possible decision errors for this project.

Table 12.14.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Have cleanup goals been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Is the system performing as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Have asymptotic conditions been demonstrated?	See Step 3 for inputs.	(1) Determine asymptotic conditions reached when they are not. (2) Determine asymptotic conditions not reached when they are.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Location of Wells

The number and locations of wells for this program are considered adequate. Therefore, no modifications are recommended at this time.

Parameters and Frequency

As described in Step 4 above, decisions will be made for the decision subunits on a timeframe of 90 days. The sampling frequency for all wells should therefore be quarterly. All samples will be analyzed for VOCs only.

A summary of the proposed sampling program is shown in Table 12.14.2.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

There are no cost changes for the OU III Middle Road program in 2003. This cost accounts for the 14 OU III Middle Road wells that are also sampled as part of other projects. It is assumed that sampling of wells that overlap multiple projects will be done concurrently. Therefore, sampling and, where appropriate, analytical costs for overlapping wells have not been incorporated into this cost analysis, but rather have been included in the costs for the other projects.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$31,152
FY2003	\$31,152
Difference	\$0

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   William Dorsch (631) 344-5186
Vincent Racionello (631) 344-5436

Table 12.14.2 Proposed Modifications to the Middle Road Project Monitoring Wells			
Well ID	Current Sampling Frequency	Proposed Frequency Changes	Affected Parameters
105-52	Quarterly	No Change	None
105-53	Quarterly	No Change	None
105-54	Quarterly	No Change	None
113-16	Quarterly	No Change	None
113-17	Quarterly	No Change	None
113-18	Quarterly	No Change	None
113-19	Quarterly	No Change	None
113-20	Quarterly	No Change	None
113-21	Quarterly	No Change	None
113-22	Quarterly	No Change	None
114-12	Quarterly	No Change	None
105-23	Quarterly	No Change	None
105-25	Quarterly	No Change	None
105-44	Quarterly	No Change	None
113-06	Quarterly	No Change	None
113-07	Quarterly	No Change	None
113-08	Quarterly	No Change	None
113-09	Quarterly	No Change	None
113-11	Quarterly	No Change	None
106-53	Quarterly	No Change	None
106-54	Quarterly	No Change	None
106-55	Quarterly	No Change	None
106-56	Quarterly	No Change	None
106-58	Quarterly	No Change	None
106-59	Quarterly	No Change	None
106-62	Quarterly	No Change	None

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ENVIRONMENTAL
SERVICES DIVISION

TITLE:

OU III MIDDLE ROAD
PUMP AND TREAT SYSTEM
MONITORING WELL LOCATIONS

2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT:HZ.: -	DATE: 11/25/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV.: 1	NOTES: -

FIGURE NO.:

1

OU III WESTERN SOUTH BOUNDARY PUMP AND TREAT SYSTEM

DATE November 20, 2002

PROPOSED CHANGE

No modifications to the sampling program for this project are proposed.

DESCRIPTION AND TECHNICAL BASIS

The Operable Unit (OU) III Western South Boundary pump and treat system was designed to capture the higher concentrations of volatile organic compounds (VOCs) in the Upper Glacial aquifer along the western portion of the BNL south property boundary. This system will capture and remediate a portion of the OU III VOC plume to reduce future off-site migration of the contamination and discharge of the VOC plume to the Carmans River.

Construction of the OU III Western South Boundary groundwater extraction and treatment system was completed in March 2002. The system includes two extraction wells located along the BNL south property boundary. Extracted groundwater is treated via air stripping and recharged at the western end of Middle Road upgradient and cross-gradient of the plume. Groundwater flow in this area is toward the south.

The monitoring network for the OU III Western South Boundary program includes 17 wells. Well locations are shown on Figure 12.15.1. Groundwater samples are collected and analyzed for VOCs on a quarterly basis as shown in Tables 12.1.1 and 12.1.2.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health or the environment (off-site sensitive receptor, the Carmans River) has been defined on the BNL site. In

response, capture and remediation of the higher concentrations of VOCs is being implemented along the western site boundary. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decision

The decisions for the project are:

1. Is the BNL Groundwater Contingency Plan triggered?
2. Is the system operating as planned?
3. Have asymptotic conditions been demonstrated?

Step 3: Identify Inputs to the Decision

The project was divided into four decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume Core wells (Decisions 1, 2, and 3)
- Perimeter wells, used to define the extent of the plume (Decision 1)
- Bypass Detection wells (Decisions 1 and 2)
- Perimeter (Recharge Basin) wells (Decisions 1 and 2)

The wells included in each subunit are shown in Table 12.1.2. The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater
- Location of existing wells relative to flow patterns
- Evaluation of capture zone for extraction wells
- Action Levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Middle Road to the north

- Long Island Expressway eastbound service road and wells 127-07, 126-16, and 130-08 to the south
- Unpaved north-south access road and wells 121-06, 121-07, and 121-08 to the east
- Western South Boundary Recharge Basin and wells 119-03, 125-01, and 125-02 to the west
- Upper Glacial and upper Magothy aquifers

Separate decisions will be made for the four subunits described in Step 3. As described below, the temporal boundaries of the study area are currently the same for each decision subunit. However, as more data are collected, the timeframe for decisions in a subunit may be modified. Therefore, the subunits have been described separately.

- Plume Core: Plume core wells will be used to provide data for measuring the performance of the system. Because the system will be newly operational, data are needed on a relatively frequent basis. Therefore, the timeframe for decisions for this subunit is 90 days.
- Perimeter: The wells included in this subunit will also be used to provide data for measuring the performance of the system. Because the system will be newly operational, the timeframe for decisions here is 90 days.
- Bypass Detection Area: The wells in this area will provide data for measuring the system performance and will also indicate water quality that will eventually discharge to the Carmans River. Therefore, the decision timeframe for this area is 90 days.
- Perimeter (Recharge Basin): Because the wells around the recharge basin provide information regarding system performance by evaluating the quality of treated water being discharged into the recharge basin, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all four subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Is the system operating as planned?

This decision applies to the plume core, bypass detection and recharge basin wells. If the system is performing as planned, then actual total VOC concentrations in plume core, bypass detection and recharge basin wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need to evaluate this discrepancy.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation.

Note: if the majority and/or “key” wells, as defined by a subject matter expert, are performing as planned, then “the system” as a whole is considered to be properly operating.

Decision 3

Have asymptotic conditions been demonstrated?

This decision applies to the plume core area wells. When no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

If, for each plume core well, the slope of mean concentrations for all contaminants of concern are not different from zero for three years, and if subject matter experts on BNL hydrogeology and hydrochemistry concur with the results of the statistical analysis, **then** petition for system shutdown. If not, then continue system operation.

Note: this assumes that system operation is already considered “optimal.”

Step 6: Specify Acceptable Error Tolerances

Table 12.15.1 summarizes the decision and possible decision errors for this project.

Table 12.15.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Is the system performing as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Have asymptotic conditions been demonstrated?	See Step 3 for inputs.	(1) Determine asymptotic conditions reached when they are not. (2) Determine asymptotic conditions not reached when they are.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Location of Wells

The number and locations of wells for this program are considered adequate.

Parameters and Frequency

Because the contaminants of concern for this project are VOCs, samples collected from the 16 wells included in the program will be analyzed for VOCs only.

As described in Step 4 above, decisions will be made for the four decision subunits on a time frame of 90 days. The sampling frequency for all wells is quarterly (see Table 12.1.1).

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

There was an increase of \$4,546 in sampling and analysis costs for the 2003 program.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$16,000
FY2003	\$20,546
Difference	\$4,546

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   William Dorsch (631) 344-5186
Thomas Burke (631) 344-3130

Table 12.15.2 Proposed Modifications to the Western South Boundary Monitoring Wells			
Well ID	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
124-02	Quarterly	No Changes	None
126-01	Quarterly	No Changes	None
130-02	Quarterly	No Changes	None
130-03	Quarterly	No Changes	None
130-04	Quarterly	No Changes	None
119-03	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
126-11	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
126-15	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
121-42	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
127-04	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
126-13	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
126-14	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
125-01	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
127-06	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
127-07	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
126-16	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
130-08	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90
124-02	None	Quarterly	VOCs
	None	Annually	Tritium, Gamma Spec, Sr-90

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LEGEND

14 MONITORING WELL ID

2001 EXTENT OF TVOC PLUME
BASED ON 5 µG/L ISOCONTOUR
(DASHED WHERE INFERRED)

32 BNL GRID NUMBER

EW-5 BNL REMEDIATION WELL
UVB-1

267 PLUME CORE

267 PLUME PERIMETER

267 BYPASS DETECTION

267 BACKGROUND

SCALE
0 250 500 FEET

BROOKHAVEN
NATIONAL LABORATORY

ENVIRONMENTAL
SERVICES DIVISION

TITLE:
**OU III WESTERN SOUTH BOUNDARY
PUMP AND TREAT SYSTEM
MONITORING WELL LOCATIONS**

2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT.HZ.: —	DATE: 11/25/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV.: 1	NOTES: —
FIGURE NO.: 1			

OU III OFF SITE POST-ROD

DATE November 20, 2002

PROPOSED CHANGE

Since the expected travel time for the volatile organic compound (VOC) plume to wells 800-21, 800-22, 800-23, 800-51, 800-52, and 800-53 is greater than 10 years, the sampling frequency for these wells can be reduced to annually. However, because these two well clusters are located between the plume and a sensitive resource (the Carmans River), sampling of the wells should be reduced to semi-annually to ensure that the VOC plume will not impact the Carmans River. If any VOC is detected in any of these wells at a concentration above its New York State groundwater standard, then the sampling frequency for each well in that cluster will be increased to quarterly.

Because the contaminants of concern for the groundwater plumes monitored under this project are VOCs, sampling for radiological parameters (gross alpha/beta, gamma spectroscopy, tritium, and strontium-90) should be eliminated.

DESCRIPTION AND TECHNICAL BASIS

The sources for the plumes monitored by the Operable Unit (OU) III off-site program are located within the developed central areas of the BNL Site. Due to the proximity of the plume source areas and variability in groundwater flow direction in the vicinity of the source areas, the plumes are commingled south of the BNL site boundary. Groundwater flow south of the BNL site boundary is toward the south.

The monitoring well network for the OU III Off-site project consists of 20 wells that provide groundwater quality data south of the western portion of the BNL site boundary. The screen zone and aquifer screened by each of the wells currently sampled are summarized in Table 12.16.1. Well locations are shown in Figure 12.16.1. Wells are sampled quarterly for analysis of VOCs and annually for analysis of gross alpha/beta, gamma spectroscopy, tritium, and strontium-90, as shown in Tables 12.1.1 and 12.1.2.

Some of the wells in this program were constructed south of the leading edge of the plume to act as sentinel wells. The locations of the sentinel wells were selected using the BNL Regional Groundwater Flow Model. In addition, it should be noted that many of the wells included in this program will be incorporated into one or more of several active remediation programs that are currently planned or being designed. A Data Quality Objective summary will be prepared for each of these future projects when system operation has been initiated.

The contaminants of concern associated with the sources monitored by the OU III off-site wells are VOCs. During calendar year 2000, only two wells (000-104 and 000-131) contained VOCs at concentrations above New York State groundwater standards. No

radionuclides were detected at an activity above New York State groundwater standards in any of the OU III off-site wells.

Table 12.16.1 Current OU III Off-Site Wells		
Well	Screen Zone *	Aquifer Screened
000-97	284-304	Magothy
000-98	190-210	Deep Upper Glacial
000-99	83-93	Shallow Upper Glacial
000-101	185-205	Deep Upper Glacial
000-102	305-325	Magothy
000-104	195-215	Deep Upper Glacial
000-105	275-295	Magothy
000-107	195-215	Deep Upper Glacial
000-131	220-230	Deep Upper Glacial
800-21	202-222	Magothy
800-22	105-125	Deep Upper Glacial
800-23	35-45	Shallow Upper Glacial
800-40	166-186	Deep Upper Glacial
800-41	203-223	Magothy
800-43	147-167	Mid Upper Glacial
800-44	202-222	Deep Upper Glacial
800-50	195-215	Magothy
800-51	70-80	Shallow Upper Glacial
800-52	140-160	Deep Upper Glacial
800-53	190-210	Mid Upper Glacial

* Feet below ground surface

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater south of the BNL site boundary has been impacted by VOCs at concentrations exceeding New York State groundwater standards. Because active remediation of these commingled plumes is currently being planned or designed, data are needed to verify that the contaminants are naturally degrading in the interim and to determine the nature and extent of the VOC plumes for system design.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Have performance objectives been met?
- If not, are observed conditions consistent with the attenuation model?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- VOC analytical results in groundwater
- Location of existing wells relative to flow patterns
- Action Levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

The project decision unit limits are defined by:

- Carleton Drive on the north
- Wells 800-21, 800-22, and 800-23, and Flower Hill Drive on the south
- Boxwood Drive (well 000-107) on the east
- Carmans River (wells 800-21, 800-22, and 800-23) and Westend Avenue (wells 800-51, 800-52, and 800-53) on the west
- Upper Glacial and upper Magothy aquifers

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Are performance objectives met?

According to the Record of Decision for OU III, concentrations of individual VOCs will be reduced to below MCLs within 30 years. Portions of the plume may attenuate to below MCLs before active remediation is instituted.

If, for all wells, the mean concentration of each VOC in groundwater, computed from the previous four consecutive sampling events, is less than the compound-specific MCL, and the computed mean is consistent with professional judgment, **then** petition for closure of the remedial action. Otherwise, continue attenuation monitoring.

Decision 3

If not, are observed conditions consistent with the attenuation model?

If performance objectives have not been met, **then** it must be determined whether VOC concentrations in groundwater are being reduced according to the attenuation model.

If the detected VOC concentrations are consistent with the attenuation model, groundwater model results and professional judgment, **then** continue attenuation monitoring. If not, consider refining the conceptual model and/or implementing supplements to bolster the attenuation process.

Step 6: Specify Acceptable Error Tolerances

Table 12.16.2 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Are performance objectives met?	See Step 3 for inputs.	(1) Data indicate that MCLs have not been met when they have. (2) Data indicate that MCLs have been met when they have not.	(1) Wasted resources conducting continued unnecessary monitoring. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.
If not, are observed conditions consistent with attenuation model?	See Step 3 for inputs.	(1) Data indicate that conditions are not consistent with model when they are. (2) Data indicate that conditions are consistent with model when they are not.	(1) Wasted resources conducting attenuation model refinements and introducing supplements. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.

Step 7: Optimize the Design

Number and Location of Wells

Because the expected travel time for the VOC plume to wells 800-21, 800-22, 800-23, 800-51, 800-52, and 800-53 is greater than 10 years, the sampling frequency for these wells can be reduced to annually. However, since these two well clusters are located between the plume and a sensitive resource (the Carmans River), sampling of the wells should be reduced to semi-annually to ensure that the VOC plume will not impact the Carmans River. If any VOC is detected in any of these wells at a concentration above its New York State groundwater standard, then the sampling frequency for each well in that cluster will be increased to quarterly.

Parameters and Frequency

Since the contaminants of concern for the groundwater plumes monitored under this project are VOCs, sampling for radiological parameters (gross alpha/beta, gamma spectroscopy, tritium, and strontium-90) should be eliminated. A summary of the proposed modifications to the OU III off-site sampling programs is provided in Table 12-16.3.

12.16.3 Proposed Modifications to the OU III Off-Site Monitoring Wells			
Well	Current Sampling Frequency	Proposed Sampling Frequency	Proposed Analytical Parameters
000-97	Quarterly	Quarterly	VOCs
000-98	Quarterly	Quarterly	VOCs
000-99	Quarterly	Quarterly	VOCs
000-101	Quarterly	Quarterly	VOCs
000-102	Quarterly	Quarterly	VOCs
000-104	Quarterly	Quarterly	VOCs
000-105	Quarterly	Quarterly	VOCs
000-107	Quarterly	Quarterly	VOCs
000-131	Quarterly	Quarterly	VOCs
800-21	Quarterly	Semi-annually	VOCs
800-22	Quarterly	Semi-annually	VOCs
800-23	Quarterly	Semi-annually	VOCs
800-40	Quarterly	Quarterly	VOCs
800-41	Quarterly	Quarterly	VOCs
800-43	Quarterly	Quarterly	VOCs
800-44	Quarterly	Quarterly	VOCs
800-50	Quarterly	Quarterly	VOCs
800-51	Quarterly	Semi-annually	VOCs
800-52	Quarterly	Semi-annually	VOCs
800-53	Quarterly	Semi-annually	VOCs

+ Wells are currently sampled quarterly for analysis of VOCs and annually for analysis of gross alpha/beta, gamma spectroscopy, tritium and strontium-90.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications described in Step 7 will result in a decrease in sampling and analysis cost of \$8,999 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$30,759
FY2003	\$21,760
Difference	– \$8,999

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   William Dorsch (631) 344-5186
                                          Vincent Racaniello (631) 344-5436

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LEGEND

03

MONITORING WELL

5

2001 EXTENT OF TVOC
PLUME BASED
ON 5 µG/L ISOCONTOUR

32

BNL GRID NUMBER

BNL RECHARGE BASIN

RAV

SCALE

0 1000 FEET

BROOKHAVEN
NATIONAL LABORATORY

ENVIRONMENTAL
SERVICES DIVISION

TITLE:

OU III OFFSITE
POST-ROD
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE

DWN:

KCK

VT: HZ.:

-

DATE:

11/25/02

PROJECT NO.:

07176

CHKD:

WRD

APPD:

WRD

REV.:

1

NOTES:

-

FIGURE NO.:

1

OU III INDUSTRIAL PARK POST-ROD

DATE November 20, 2002

PROPOSED CHANGES

- Review of the existing well network identified potential data gaps in the bypass detection well subunit. Therefore, an additional well will be installed at the 000-276 location and screened within the deep Upper Glacial horizon at elevations equivalent to the UVB extraction well screen depths.
- A second additional bypass monitoring well will be installed along Carleton Drive approximately 200 feet west of existing well 000-273. Installation of a second bypass monitoring well at this location will provide adequate downgradient bypass monitoring of the area where the highest concentrations are observed (between UVB-1 and UVB-2). Therefore, this well will be screened in the deep horizon at elevations similar to UVB extraction well screens. The addition of these wells will help support the exit strategy for this system.
- In addition, a plume bypass well being installed under the OU III South Boundary Program will also be integrated into the Industrial Park Program as a plume core well. This well will serve the purpose of defining the trailing edge of the plume core.

DESCRIPTION AND TECHNICAL BASIS

The sources for the VOC plumes addressed by the Operable Unit (OU) III Industrial Park program are located within the developed central areas of the BNL Site. Due to the proximity of the plume source areas and variability in groundwater flow direction in the vicinity of the source areas, the plumes are commingled south of the BNL site boundary. Groundwater flow south of the BNL site boundary is toward the south, with a slight south-southwesterly component in the southwestern portion of the project area.

A portion of the commingled VOC plume migrated beyond the BNL site boundary prior to construction and operation of the OU III South Boundary groundwater extraction and treatment system. In response, the seven in-well air stripping treatment wells that comprise the OU III Industrial Park System were constructed within the Parr Industrial Park, located south of the west-central portion of the BNL southern site boundary. This system was constructed to provide hydraulic control to prevent further downgradient migration of the VOC plume and to remediate the portion of the plume with a concentration of total VOCs above 50 micrograms per liter ($\mu\text{g/l}$) in the deep Upper Glacial aquifer. The system has been operated since December 1999.

The monitoring well network for the OU III Industrial Park project consists of 42 wells, plus the seven recirculation wells. These wells monitor the VOC plume in the vicinity of the Parr Industrial Park as well as the effectiveness of the seven in-well groundwater treatment systems. Additional characterization of groundwater contamination within the shallow Magothy aquifer is planned. If warranted, remediation systems will be designed

and constructed to address Magothy contamination at a future date. The contaminants of concern associated with the OU III Industrial Park are VOCs.

Well locations are shown on Figure 12.17.1. The wells are currently sampled quarterly for analysis of VOCs with the exception of shallow wells 000-254, 000-257, 000-260, 000-263, 000-266, and 000-269, which are sampled annually for VOC analysis. The monitoring schedule is provided in Table 12.1.1.

During calendar year 2001, 19 of the 39 wells contained concentrations of individual chlorinated VOCs greater than New York State groundwater standards, including tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, 1,1-dichloroethene, methylene chloride, carbon tetrachloride, chloroform, 1,1,2,2-tetrachloroethane and 1,1,1-trichloroethane.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health or the environment has been defined south of the BNL site. In response, remediation of the plume has been conducted since September 1999. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decision

The decisions for the project are:

1. Is the BNL Groundwater Contingency Plan triggered?
2. Have the cleanup goals been met?
3. If not, has the plume been controlled?
4. Is the system operating as planned?
5. Have asymptotic conditions been demonstrated?

Step 3: Identify Inputs to the Decision

The project was divided into four decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume Core wells (Decisions 1, 2, 4, and 5)
- Plume Perimeter wells, used to define the extent of the plume (Decisions 1 and 3)
- Bypass Detection wells (Decisions 1, 3, and 4)
- Magothy (Decision 1 and planning for future Magothy restoration)

The wells included in each subunit are shown in Table 12.1.2. The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater
- Location of existing wells relative to flow patterns (Figure 12.17.1)
- Evaluation of capture zone for extraction wells
- Action Levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Long Island Expressway to the north
- Carleton Drive to the south
- Boxwood Drive (well 000-272) to the east
- Lockwood Drive (well 000-245) to the west
- The Upper Glacial aquifer.

Separate decisions will be made in the four subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire system. The temporal boundaries of the study area vary, based on the decision.

Plume Core: Because the remediation technology is relatively new and has been in operation for a relatively short time, the timeframe for decisions for this subunit is 90 days.

Plume Perimeter: Because the wells in this subunit define the plume horizontally and vertically, which is used to determine whether the plume is being captured, the timeframe for decisions here is 90 days. Shallow wells located above the plume core have been monitored since 1999 and remain clean. These monitoring wells are for verifying that the shallow zone remains clean. This has been demonstrated with three years of data. The probability of the shallow zone becoming contaminated is low because the treated effluent is monitored before return to the aquifer and operational adjustments are made as required to ensure adequate treatment. Therefore, the shallow zone decision time frame is not less than 365 days.

Bypass Detection Area: Because the wells in this area indicate whether the plume capture performance objective is being met, the decision timeframe for this area is 90 days.

Magothy: Because high VOC concentrations have been observed in Magothy wells (000-130, 000-259, and 000-250), the decision timeframe for these wells is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Have the cleanup goals been met?

It is anticipated that approximately 7 to 10 years of active groundwater treatment will reduce the TVOC concentrations in the plume core to less than 50 µg/l. If this occurs, it is reasonable to expect (based on model projections) that MNA of the remaining contamination in the plume core will be reduced further to meet the cleanup goals of restoring the Upper Glacial aquifer to MCLs within 30 years. A series of indices have been developed to aid in this decision. The first index is to determine whether the mean total VOC concentration in all plume core wells has been reduced to less than 50 µg/l within 7 to 10 years after active remediation begins. This index will allow monitored natural attenuation (MNA) to thereafter reduce the individual VOC concentrations to MCLs within the required 30-year timeframe.

The second index is to determine whether the total VOC concentration in each plume core well has been reduced to less than 50 µg/l in less than 7 to 10 years of active remediation.

If the total VOC concentration in each plume core well has been reduced to less than 50 µg/l in less than 7 to 10 years of active remediation, **then** proceed with pulsed operation of the system (see Index 3). **If** not and treatment has occurred for less than 7 to 10 years, **then** continue treatment. **If** not and treatment has occurred for at least 7 to 10 years, **then** perform an engineering evaluation to predict the fate of the remaining contamination and determine whether MCLs will be met by 2030.

The third index is to determine whether there is significant concentration rebound after system pulsing. **If** yes, and system has operated for less than 7 to 10 years, **then** continue operation. **If** yes and system has operated for more than 7 to 10 years, an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted (see Decision 5 to help with this decision). **If** no significant rebound is observed within a one-year time period, **then** petition for system shutdown and continue with MNA.

If the mean concentration of total VOCs in groundwater, calculated from analytical results from all plume core wells for the most recent sampling event, is less than 50 µg/l (Index 1), AND if the mean concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous two years, is less than 50 µg/l (Index 2), AND pulsing of the remediation system has not resulted in significant rebound of contaminant concentrations (Index 3), **then** petition for system shutdown and continue with MNA until MCLs are met. If not, consider the need for continued remediation.

Decision 3

If not, has the plume been controlled?

This decision applies to the plume fringe and bypass detection wells.

If the cleanup goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume fringe or bypass detection wells to above 50 µg/l (if currently less than 50 µg/l) or a significant increase in total VOC concentration (if currently above 50 µg/l).

If the trend in each plume perimeter and bypass detection well has a negative or zero slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 50 µg/l, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 4

Is the system operating as planned?

This decision applies to the plume core and bypass detection wells.

If the system is performing as planned, **then** actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation.

Note: If the majority and/or “key” wells, as defined by a subject matter expert, are performing as planned, then “the system” as a whole is considered to be properly operating.

Decision 5

Have asymptotic conditions been demonstrated?

This decision applies to the plume core area wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

If, for each plume core well, the slope of mean concentrations for all contaminants of concern is not different from zero for a minimum of one year, and if subject matter experts on BNL hydrogeology and hydrochemistry concur with the results of the

statistical analysis, **then** petition for system shutdown. If not, then continue system operation.

Note: This assumes that system operation is already considered “optimal.”

Step 6: Specify Acceptable Error Tolerances

Table 12.17.1 summarizes the decision and possible decision errors for this project.

Table 12.17.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based On Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Have cleanup goals been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Is the system performing as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Have asymptotic conditions been demonstrated?	See Step 3 for inputs.	(1) Determine asymptotic conditions reached when they are not. (2) Determine asymptotic conditions not reached when they are.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Location of Wells

Review of the existing well network identified potential data gaps in the bypass detection well subunit. Therefore, an additional well will be installed at the 000-276 location and

screened within the deep horizon at elevations equivalent to the UVB extraction well screen depths.

A second additional bypass monitoring well will be installed along Carleton Drive approximately 200 feet west of existing well 000-273. Installation of a second bypass monitoring well at this location will provide adequate downgradient bypass monitoring of the area where the highest concentrations are observed (between UVB-1 and UVB-2). Therefore, this well will be screened in the deep horizon at elevations similar to UVB extraction well screens. The addition of these wells will help support the exit strategy for this system.

In addition, a plume bypass well being installed under the OU III South Boundary Program will be integrated into the Industrial Park Program as a plume core well. This well will serve the purpose of defining the trailing edge of the plume core.

Parameters and Frequency

No modifications to the analytical parameters or sampling frequency are recommended. A summary of the revised sampling program for this project is provided in Table 12.17.2 on the following page.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications described in Step 7 will result in an increase in sampling and analysis cost of \$2,400 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$51,600
FY2003	\$54,000
Difference	\$2,400

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

Table 12.17.2 Proposed Modifications to the Industrial Park Project Monitoring Wells

Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
000-112	Quarterly	No Change	None
000-114	Quarterly	No Change	None
000-130	Quarterly	No Change	None
000-245	Quarterly	No Change	None
000-246	Quarterly	No Change	None
000-247	Quarterly	No Change	None
000-248	Quarterly	No Change	None
000-249	Quarterly	No Change	None
000-250	Quarterly	No Change	None
000-251	Quarterly	No Change	None
000-252	Quarterly	No Change	None
000-253	Quarterly	No Change	None
000-254	Annually	No Change	None
000-255	Quarterly	No Change	None
000-256	Quarterly	No Change	None
000-257	Annually	No Change	None
000-258	Quarterly	No Change	None
000-259	Quarterly	No Change	None
000-260	Annually	No Change	None
000-261	Quarterly	No Change	None
000-262	Quarterly	No Change	None
000-263	Annually	No Change	None
000-264	Quarterly	No Change	None
000-265	Quarterly	No Change	None
000-266	Annually	No Change	None
000-267	Quarterly	No Change	None
000-268	Quarterly	No Change	None
000-269	Annually	No Change	None
000-270	Quarterly	No Change	None
000-271	Quarterly	No Change	None
000-272	Quarterly	No Change	None
000-273	Quarterly	No Change	None
000-274	Quarterly	No Change	None
000-275	Quarterly	No Change	None
000-276	Quarterly	No Change	None
000-277	Quarterly	No Change	None
000-278	Quarterly	No Change	None
000-279	Quarterly	No Change	None
000-280	Quarterly	No Change	None
New-1	None	Quarterly	VOCs
	None	1 st Round Only	Tritium, Gamma Spec, Sr-90
New-2	None	Quarterly	VOCs
	None	1 st Round Only	Tritium, Gamma Spec, Sr-90
New-3	None	Quarterly	VOCs
	None	1 st Round Only	Tritium, Gamma Spec, Sr-90

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ENVIRONMENTAL
SERVICES DIVISION

TITLE: OU III INDUSTRIAL PARK
PUMP AND TREAT SYSTEM
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT:HZ.: -	DATE: 11/19/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV.: 1	NOTES: -
FIGURE NO.: 1			

OU IV AOC 5/SHUTDOWN DEMONSTRATION PHASE

DATE November 20, 2002

PROPOSED CHANGE

No modifications to the sampling program for this project are proposed.

DESCRIPTION AND TECHNICAL BASIS

The Operable Unit (OU) IV Area of Concern (AOC) 5 project monitors a 1977 spill of fuel oil and mineral spirits that occurred at the BNL Central Steam Facility (CSF), as well as other minor historic spills that occurred in the vicinity of the CSF. An air sparge/soil vapor extraction (AS/SVE) system has been operated since November 1997 to address these contaminant sources. Groundwater sample results show that the system has been effective at reducing contaminant levels. In fact, a request to shut down the remediation system was submitted to the regulators in December 2000, and approved. However, groundwater sample results from the October 2000 sampling event showed exceedances of New York State groundwater standards for volatile organic compounds (VOCs) in two wells (076-04 and 076-06). In response, a portion of the remediation system was restarted and additional remediation using Oxygen Release Compound® (ORC) was implemented in early calendar year 2001.

This project is nearing the end of the treatment phase, and is shifting to demonstrating that cleanup objectives have been met and that significant rebound in VOC concentrations is not occurring. Remediation goals for this project are 5 micrograms per liter ($\mu\text{g/l}$) for each contaminant, unless asymptotic conditions are reached at some higher level. A portion of the plume migrated past the treatment area before remediation was implemented. These contaminants will be addressed by downgradient remediation systems that are currently in operation, being constructed, or planned.

The groundwater flow direction is generally to the south, although it may vary due to effects from several recharge basins in the area.

The monitoring well network for the OU IV AOC 5 project consists of 21 wells. Due to the variable groundwater flow direction, the BNL Regional Groundwater Flow Model was used to select locations for some wells. Well locations are shown on Figure 12.18.1. The wells are sampled quarterly for analysis of VOCs and semi-volatile organic compounds (SVOCs) as shown in Tables 12.1.1 and 12.1.2.

During calendar year 2000, 8 of the 21 wells (076-04, 076-05, 076-06, 076-09, 076-23, 076-180, 076-182, and 076-185) contained concentrations of individual VOCs greater than New York State groundwater standards. However, only well 076-04 contained total VOCs above $50 \mu\text{g/l}$ and exceedances for more than one compound. The other exceedances were for one VOC during one quarter in wells located outside the area influenced by the AS/SVE system. The only SVOC detected at a concentration above New York State groundwater standards was bis (2-ethylhexyl) phthalate, a common laboratory contaminant. The only other SVOC detected in any well was 2-methylnaphthalene, which was detected in two wells at concentrations less than the above-cited New York State groundwater standard.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

_____	Compliance
_____	Support Compliance
_____	Surveillance
_____x	Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health has been defined in the central portion of the BNL Site. In response, remediation of the plume has been conducted since November 1997. Data are needed to verify that cleanup objectives have been met.

Step 2: Identify the Decision

The decisions for the project are:

1. Is the BNL Groundwater Contingency Plan triggered?
2. Have the cleanup goals been met?
3. Are additional enhancements (that is, ORC) necessary or is further operation of the AS/SVE system required?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs and SVOCs in groundwater
- Location of existing wells relative to flow patterns
- OU IV Operation and Maintenance Manual
- June 2002 Petition to for closure for the OU IV Air Sparge/Soil Vapor Extraction Remediation System
- Action Levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries As currently defined, the spatial boundaries of the study area are defined by:

- Cornell Avenue (well 076-02) to the north
- Brookhaven Avenue to the south
- Seventh Street (wells 076-23 and 076-18) to the west
- North Sixth Street and well 076-06 to the east
- The shallow and mid-depth portions of the Upper Glacial aquifer.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Have the cleanup goals been met?

Quarterly groundwater monitoring will continue. **If** no significant rebound of contaminant concentrations occurs in groundwater after a 6-month period of quarterly monitoring, **then** a petition for closure and termination of formal post-closure monitoring will be submitted in accordance with the Operation and Maintenance Manual.

Decision 3

Are additional enhancements (that is, ORC) necessary or is further operation of the AS/SVE system required?

If significant rebound in contaminant concentrations does occur, **then** consider implementing additional enhancements and/or restarting the AS/SVE system.

Step 6: Specify Acceptable Error Tolerances

Table 12.18.1 summarizes the decision and possible decision errors for this project.

Table 12.18.1 Decisions, Potential Decision Errors and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Have cleanup goals been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Are additional enhancements necessary or is further operation of the AS/SVE system required?	See Step 3 for inputs.	(1) Determine enhancements or system restart is not required when it is. (2) Determine enhancements or system restart is required when it is not.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments or system restart.

Step 7: Optimize the Design**Number and Location of Wells**

The existing well network for this project is considered adequate. Therefore, no modifications to the number and locations of wells are recommended.

Parameters and Frequency

Because a fuel oil spill is a source of the groundwater contaminant plume, sampling for VOCs and SVOCs is warranted. Therefore, no modifications to the analytical parameters are recommended.

Because the purpose of the current sampling program is to evaluate whether rebound in contaminant concentrations is occurring, quarterly sampling is warranted. Therefore, no modifications to the sampling frequency are recommended (see Table 12.18.2). If no significant rebound of contaminant concentrations occurs in groundwater after a 6-month period of quarterly monitoring, a petition for closure and termination of formal post-closure monitoring will be submitted in accordance with the Operation and Maintenance Manual.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Because no modifications to the sampling program are recommended, there is no annual change in sampling and analysis cost.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$48,552
FY2003	\$48,552
Difference	\$0

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   William Dorsch   (631) 344-5186
Vincent Racaniello (631) 344-5436

Table 12.18.2 Proposed Modifications to the AOC 5 AS/SVE Project Monitoring Wells			
Well ID	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
076-02	Quarterly	No Change	None
076-04	Monthly	No Change	None
076-05	Quarterly	No Change	None
076-06	Quarterly	No Change	None
076-08	Quarterly	No Change	None
076-178	Quarterly	No Change	None
076-179	Quarterly	No Change	None
076-180	Quarterly	No Change	None
076-185	Quarterly	No Change	None
076-186	Quarterly	No Change	None
076-18	Quarterly	No Change	None
076-19	Quarterly	No Change	None
076-21	Quarterly	No Change	None
076-23	Quarterly	No Change	None
076-380	Annually	No Change	None
076-07	Quarterly	No Change	None
076-09	Quarterly	No Change	None
076-181	Quarterly	No Change	None
076-182	Quarterly	No Change	None
076-183	Quarterly	No Change	None
076-184	Quarterly	No Change	None
076-22	Quarterly	No Change	None

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OU IV AOC 6 Post-ROD**DATE** November 20, 2002**PROPOSED CHANGE**

The addition of recharge water from the OU III Middle Road groundwater remediation system to the RA V recharge basin has resulted in a more westerly component to groundwater flow in the OU IV area. An additional monitoring well will be installed in 2002 to monitor for the potential westerly migration of the plume.

DESCRIPTION AND TECHNICAL BASIS

The Operable Unit (OU) IV Area of Concern (AOC) 6 project monitors a strontium-90 plume emanating from contaminated soil within an area known as the Building 650 Sump Outfall Area. This area is a natural depression at the terminus of a discharge pipe from Building 650. The pipe conveyed discharges from decontamination of radioactively contaminated clothing and equipment that was conducted on an outdoor pad at Building 650 beginning in 1959. Impacted soil within the sump outfall area was excavated during calendar year 2002. Groundwater flow in this area is toward the south-southwest.

The monitoring well network for the OU IV AOC 6 project consists of 30 wells. The wells are located to monitor groundwater downgradient of the decontamination pad and Building 650 Sump Outfall Area. Some wells were constructed south of the leading edge of the plume to act as sentinel wells. Well locations are shown on Figure 12.19.1. In accordance with the Record of Decision (ROD) for OU IV, the wells are sampled semi-annually for analysis of strontium-90, gross alpha/beta, gamma spectroscopy and tritium. A schedule is provided in Table 12.1.1. The 5-year review for this project was conducted in calendar year 2002.

During calendar year 2000, five wells contained strontium-90 at an activity above New York State groundwater standards. No other radionuclides were detected at activities above New York State groundwater standards in any of the OU IV AOC 6 wells. The extent of the strontium-90 plume, as defined by calendar year 2001 data, is shown on Figure 12.19.1. In general, strontium-90 activity trends are stable or increasing for the wells within the plume, and stable to slightly increasing in wells downgradient of the plume.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater in the vicinity of Building 650 and the Building 650 Sump Outfall Area, and downgradient of these areas has been impacted by strontium-90 at activities exceeding New York State groundwater standards. Data are needed to define the extent of the strontium-90 plume.

Step 2: Identify the Decision

The decisions for the project are:

1. Is the BNL Groundwater Contingency Plan triggered?
2. Are performance objectives met?
3. If not, are observed conditions consistent with the attenuation model?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include

- Direction and velocity of groundwater flow
- Radionuclide analytical results in groundwater
- Location of existing wells relative to flow patterns
- Action Levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL Environmental Monitoring Plan
- Variability of data.

Step 4: Define the Study Boundaries

The project decision unit limits are defined by:

- HO Basin (well 066-190) on the north
- Brookhaven Avenue on the south

- Railroad Street (wells 076-373 and 076-317) on the west
- HO Basin and RA V Basin on the east
- shallow and mid-depth Upper Glacial aquifer.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Are performance objectives met?

The performance objectives for this project are strontium-90 activities below New York State groundwater standards.

If, for all wells, the mean strontium-90 activity in groundwater, computed from the previous four consecutive sampling events, is less than the New York State groundwater standard, and the computed mean is consistent with professional judgment, **then** petition for cessation of monitoring. Otherwise, continue monitoring.

Decision 3

If not, are observed conditions consistent with the attenuation model?

If performance objectives have not been met, **then** it must be determined whether strontium-90 activities in groundwater are consistent with the attenuation model (that is, results are on track to attenuate to less than MCLs within 30 years).

If the detected strontium-90 activities are consistent with the attenuation model, groundwater model results and professional judgment, **then** continue monitoring. If not, consider refining the conceptual model and/or conducting an evaluation to determine

whether outside factors (such as additional contaminant sources) are affecting the results. As part of this decision, the following subrules apply

- **If** the gross alpha activity exceeds 5 picoCuries per liter (pCi/l) and the results are not explained by the gamma spectroscopy results, **then** isotopic alpha analyses will be performed to determine which radionuclides are present.
- **If** the gross beta activity results exceed 16 pCi/l and the results are not explained by the strontium-90 or gamma spectroscopy results, **then** isotopic analyses will be performed to determine which radionuclides are present.
- **If** the gamma spectroscopy results show positive results for radionuclides which have specific isotopic analyses, **then** the original groundwater sample will be analyzed for the specific radionuclide to confirm the activity.

Step 6: Specify Acceptable Error Tolerances

Table 12.19.1 summarizes the decision and possible decision errors for this project.

Table 12.19.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Are performance objectives met?	See Step 3 for inputs.	(1) Data indicate that performance objectives have not been met when they have. (2) Data indicate that performance objectives have been met when they have not.	(1) Wasted resources conducting continued unnecessary monitoring. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.
If not, are observed conditions consistent with attenuation model?	See Step 3 for inputs.	(1) Data indicate that conditions are not consistent with model when they are. (2) Data indicate that conditions are consistent with model when they are not.	(1) Wasted resources conducting attenuation model refinements and introducing supplements. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.

Step 7: Optimize the Design

Number and Location of Wells

Based on review of the existing monitoring network and strontium-90 plume configuration, it is recommended that one additional monitoring well be constructed to define the western perimeter of the plume.

Parameters and Frequency

The wells are sampled semi-annually for analysis of strontium-90, gross alpha/beta, gamma spectroscopy and tritium. Because these parameters are specified in the OU IV ROD, no modifications to the analytical parameters are recommended.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications described in Step 7 will result in an increase in sampling and analysis cost of \$2,440.00 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$28,392
FY2003	\$30,832
Difference	\$2,440

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   William Dorsch (631) 344-5186
Michael Hauptmann (631) 344-4202

Table 1219.2 Proposed Modifications to the AOC 6 Project Monitoring Wells			
Well ID	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
076-05	Semi-annually	No Change	None
076-07	Semi-annually	No Change	None
076-09	Semi-annually	No Change	None
076-181	Semi-annually	No Change	None
076-182	Semi-annually	No Change	None
076-183	Semi-annually	No Change	None
076-184	Semi-annually	No Change	None
076-22	Semi-annually	No Change	None
076-24	Semi-annually	No Change	None
066-17	Semi-annually	No Change	None
066-18	Semi-annually	No Change	None
066-189	Semi-annually	No Change	None
066-190	Semi-annually	No Change	None
076-13	Semi-annually	No Change	None
076-167	Semi-annually	No Change	None
076-168	Semi-annually	No Change	None
076-169	Semi-annually	No Change	None
076-20	Semi-annually	No Change	None
076-25	Semi-annually	No Change	None
076-26	Semi-annually	No Change	None
076-262	Semi-annually	No Change	None
076-263	Semi-annually	No Change	None
076-264	Semi-annually	No Change	None
076-265	Semi-annually	No Change	None
076-27	Semi-annually	No Change	None
076-28	Semi-annually	No Change	None
076-314	Semi-annually	No Change	None
076-317	Semi-annually	No Change	None
076-373	Semi-annually	No Change	None
076-10	Semi-annually	No Change	None
New-1	Semi-annually	No Change	None

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NATIONAL LABORATORY
ENVIRONMENTAL
SERVICES DIVISION

TITLE: OU IV AOC 6
POST-ROD
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT: HZ.: —	DATE: 11/25/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV.: 1	NOTES: —
FIGURE NO.: 1			

GROUNDWATER MONITORING FOR OU V

DATE November 21, 2002

PROPOSED CHANGE

No modifications to the sampling program for this project are proposed.

DESCRIPTION AND TECHNICAL BASIS

Historically, the BNL sewage treatment plant (STP) received discharges of contaminants from routine operations at the facility. Releases of contaminants, in particular VOCs, metals and radionuclides, to groundwater occurred via the STP sand filter beds and discharges to the Peconic River. In addition, trace levels of pesticides have occasionally been detected in some wells. Public water was provided by BNL in 1997 to off-site residences downgradient of the plume. The Operable Unit (OU) V project monitors the identified groundwater contamination in the area of the STP, eastern site boundary and off-site. Groundwater flow in the vicinity of the STP is toward the southeast and toward the south-southeast in the vicinity of the southeastern BNL site boundary.

The monitoring well network for the OU V project consists of 34 wells designed to monitor the attenuation of the contaminants, including sentinel wells constructed downgradient of the off-site VOC plume. The BNL Regional Groundwater Model was utilized for placement of the sentinel wells. Well locations are shown on Figure 1. The wells are sampled semi-annually for analysis of VOCs, pesticides, PCBs, water quality parameters, metals, tritium, gross alpha, gross beta and gamma spectroscopy (Table 12.1.1 and 12.1.2).

During calendar year 2000, individual VOCs were detected in three wells at concentrations above New York State groundwater standards. No pesticides or PCBs were detected in any of the OU V wells in calendar year 2000. The metals of concern identified during the OU V Remedial Investigation, mercury and hexavalent chromium, were not detected in any sample during calendar year 2000. The only metals that exceeded New York State groundwater standards in the OU V wells were aluminum, iron, manganese and sodium. During calendar year 2000, 17 wells contained one or more of these four metals at concentrations above New York State groundwater standards. Tritium was detected in several wells near the site boundary and off-site, although the detected activities were all well below the New York State groundwater standard.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☒ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater downgradient of the BNL STP and off-site has been impacted by contaminants at concentrations exceeding New York State groundwater standards. Data are needed to confirm that these contaminants are attenuating according to plan and that performance objectives are achieved.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Are performance objectives met?
- Is the extent of the plume still defined by the existing monitoring well network?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume Core wells (Decisions 1 and 2)
- Sentinel wells, used to define the extent of the plume (Decisions 1 and 3)
- Background wells (Decision 1)

The wells included in each subunit are shown in Table x-2.

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- analytical results for VOCs, pesticides, PCBs, metals, water quality parameters and tritium in groundwater
- Location of existing wells relative to flow patterns
- Action Levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL Environmental Monitoring Plan
- Variability of data.

Step 4: Define the Study Boundaries

The project decision unit limits are defined by:

- the BNL STP to the north and west
- Country Club Drive on the south
- Chichester Avenue/Wading River Road on the east
- the Upper Glacial and upper Magothy aquifers.

Separate decisions will be made for the three subunits described in Step 3. As described below, the temporal boundaries of the study area are currently the same for each decision subunit. The temporal boundaries will remain the same until the project's first 5-year review. At that time, the timeframe for decisions in a subunit may be modified. Therefore, the subunits have been described separately.

- Plume Core: plume core wells will be used to provide data for measuring the attenuation of the contaminants and evaluating whether performance objectives (cleanup goals) have been met. The timeframe for decisions for this subunit is 180 days.
- Sentinel: the wells included in this subunit will be used to provide data to evaluate whether the existing well network can be used to define the plume, thereby ensuring potential downgradient receptors are protected. The timeframe for decisions here is 180 days.
- Background: the wells in this area will provide data for evaluating contamination from upgradient sources that may be entering project area. The decision timeframe for this area is 180 days.

Step 5: Develop the Decision Rules

Decision 1

1. Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results from all wells will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

2. *Are performance objectives met?*

The performance objectives for this project are to attain drinking water standards in groundwater in the Upper Glacial aquifer within 30 years. Sample results from plume core wells will be evaluated to determine whether these objectives have been met.

If, for all plume core wells, the mean concentration for each individual VOC in groundwater, computed from the previous four consecutive sampling events, is less than the New York State groundwater standard for that compound, and the computed mean is consistent with professional judgment, **then** petition for cessation of monitoring. Otherwise, continue monitoring.

3. *Is the extent of the plume still defined by the existing monitoring well network?*

In order to ensure that potential downgradient receptors are protected, the plume must be able to be defined by the existing monitoring well network. Sample results from sentinel wells will be compared to New York State groundwater standards to evaluate the extent of the plume.

If evaluation of VOC results, in conjunction with historic analytical results and trends, groundwater model predictions, site conceptual model and professional judgment, indicates that the plume can still be defined by the existing monitoring well network, **then** continue monitoring. If not, consider recategorizing some wells into a different decision subunit and conducting an evaluation of whether additional sentinel wells are required.

Step 6: Specify Acceptable Error Tolerances

Table 12.20.1 Decisions, Potential Errors, and Potential Consequences			
DECISION	INPUTS	POTENTIAL ERRORS BASED ON DATA	POTENTIAL CONSEQUENCES
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Are performance objectives met?	See Step 3 for inputs.	(1) Data indicate that performance objectives have not been met when they have. (2) Data indicate that performance objectives have been met when they have not.	(1) Wasted resources conducting continued unnecessary monitoring. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.

Is the extent of the plume still defined by the existing monitoring well network?	See Step 3 for inputs.	(1) Data indicate the plume is not defined by existing wells when it is. (2) Data indicate the plume is defined by existing wells when it is not.	(1) Wasted resources evaluating, possibly constructing and sampling additional wells. (2) Potential bypass of contaminants and potential risk to downgradient receptors.

Step 7: Optimize the Design

Number and Location of Wells

The existing well network for this project is considered adequate (Figure 12.20.1). Therefore, no modifications to the number and locations of wells are recommended.

Parameters and Frequency

The analytical parameters and sampling frequency currently conducted for this project are considered adequate. Therefore, no modifications are recommended at this time.

A summary of the proposed sampling program is provided in Table 12.20.2.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Since no modifications to the sampling program are recommended, there is no change in annual sampling and analysis cost.

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Douglas Paquette (631) 344-7046

Table 12.20.2 Proposed Modification to the OUV Monitoring Wells

WELL	CURRENT SAMPLING FREQUENCY	PROPOSED SAMPLING FREQUENCY CHANGES	AFFECTED PARAMETERS
000-122	Semi-annually	No Change	None
000-123	Semi-annually	No Change	None
000-141	Semi-annually	No Change	None
000-142	Semi-annually	No Change	None
000-143	Semi-annually	No Change	None
000-144	Semi-annually	No Change	None
000-145	Semi-annually	No Change	None
000-146	Semi-annually	No Change	None
000-147	Semi-annually	No Change	None
037-02	Semi-annually	No Change	None
037-03	Semi-annually	No Change	None
037-04	Semi-annually	No Change	None
041-01	Semi-annually	No Change	None
041-02	Semi-annually	No Change	None
041-03	Semi-annually	No Change	None
049-05	Semi-annually	No Change	None
049-06	Semi-annually	No Change	None
050-01	Semi-annually	No Change	None
050-02	Semi-annually	No Change	None
061-03	Semi-annually	No Change	None
061-04	Semi-annually	No Change	None
061-05	Semi-annually	No Change	None
600-15	Semi-annually	No Change	None
600-16	Semi-annually	No Change	None
600-18	Semi-annually	No Change	None
600-19	Semi-annually	No Change	None
600-20	Semi-annually	No Change	None
600-21	Semi-annually	No Change	None
600-22	Semi-annually	No Change	None
600-23	Semi-annually	No Change	None
600-24	Semi-annually	No Change	None
600-25	Semi-annually	No Change	None
600-26	Semi-annually	No Change	None
600-27	Semi-annually	No Change	None

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TITLE:
**OU V POST ROD
MONITORING WELL LOCATIONS**
2003 DATA QUALITY OBJECTIVES UPDATE

DWN: KCK	VT.HZ.: —	DATE: 11/25/02	PROJECT NO.: 07176
CHKD: WRD	APPD: WRD	REV.: —	NOTES: —

FIGURE NO.:
1

OU VI ETHYLENE DIBROMIDE POST-ROD/PRE-DESIGN

DATE November 20, 2002

PROPOSED CHANGE

The EDB Monitoring Program will be enhanced with additional wells in 2003 to more precisely monitor the high concentration area of the EDB plume and enhance the sentinel well network downgradient of the plume leading edge. No additional modifications to the monitoring program are warranted at this time.

DESCRIPTION AND TECHNICAL BASIS

The monitoring well network for the OU VI EDB Project consists of 27 wells. Three wells (058-02, 089-13 and 089-14) are located on-site upgradient of the current EDB plume in the former source area. Five wells (000-180, 000-285, 800-24, 800-25, and 800-54) serve as sentinel wells in the area downgradient and east of the plume. The remaining 19 wells define the off-site EDB plume in the horizontal and vertical dimensions. Well locations are shown on Figure 12.21.1. The wells are sampled quarterly for analysis of VOCs and EDB, and annually for analysis of tritium and gross alpha/beta. Table 12.1.1 shows the monitoring schedule for 2003. Until the middle of calendar year 2001, samples were also analyzed for bromide ion, total organic carbon (TOC), carbon dioxide, ethane, and ethane to evaluate natural degradation of the EDB. However, because active remediation of the plume will be implemented during calendar year 2003, analysis for these degradation indicator parameters was discontinued in mid-2001.

The contaminant of concern associated with the OU VI plume is EDB. During calendar year 2000, EDB concentrations exceeding the New York State groundwater standard were not detected in any on-site well, indicating that the plume has migrated completely off site. No exceedances of New York State groundwater standards for VOCs or tritium were detected in any of the wells during calendar year 2000.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

There is an existing plume of groundwater contaminated by EDB that has migrated south of the BNL Site boundary. In response, a groundwater remediation system is currently being designed. Data are needed to confirm the vertical and horizontal extent of the EDB plume so that the design of the remediation system can be optimized

Step 2: Identify the Decision)

The decision for the project is

- Is the design of the planned remediation system adequate to intercept and treat the existing contamination to prevent impacts to potential downgradient receptors?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- EDB analytical results in groundwater
- Location of existing wells relative to flow patterns (Figure 12.21.1)
- Regulatory drivers (OU I ROD)
- Action Levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data
- Status of potential downgradient receptors

Step 4: Define the Study Boundaries

The horizontal extent of the study area is the existing EDB plume and surrounding wells at, and south of, the southern BNL site boundary. These limits are defined by well 100-12 to the north, wells 800-24, 800-25 and 800-54 to the south, wells 000-285 and 000-180 to the east, and wells 099-06, 000-117, and 800-54 to the west. The vertical extent of the study area is the saturated thickness of the Upper Glacial aquifer.

Because the contaminant plume has already passed the southern BNL site boundary, tracking the plume configuration over time is of critical importance. In addition, the

remediation system design will depend on the plume configuration. The timeframe to consider analytical results is therefore 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the design of the planned remediation system adequate to intercept and treat the existing contamination to prevent impacts to potential downgradient receptors?

If evaluation of EDB results, in conjunction with historic analytical results and trends, groundwater model predictions, site conceptual model and professional judgment, indicates that the planned remediation system will not be effective in capturing the existing EDB plume, **then** consider modifications to the remediation system.

Step 6: Specify Acceptable Error Tolerances

Table 12.21.1 summarizes the decision and possible decision errors for this project.

Table 12.21.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the design of the planned remediation system adequate to intercept and treat the existing contamination to prevent impacts to potential downgradient receptors?	See Step 3 for inputs.	(1) Data indicate the system will not be effective when it will be. (2) Data indicate the system will be effective when it will not be effective.	(1) Wasted resources conducting technical evaluations and possible system modifications. (2) Potential bypass of contaminants and potential risk to downgradient receptors.

Step 7: Optimize the Design

Number and Location of Wells

The EDB Monitoring Program will be enhanced with additional wells in 2003 to more precisely monitor the high concentration area of the EDB plume and enhance the sentinel well network downgradient of the plume edge.

Parameters and Frequency

The analytical parameters and sampling frequency currently conducted for this project are considered adequate. Therefore, no modifications are recommended at this time. A summary of sampling parameters and frequency is provided in Table 12.21.2.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Since no modifications to the sampling program are recommended, there is no change in annual sampling and analysis cost.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$43,569
FY2003	\$43,569
Difference	\$0

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   William Dorsch (631) 344-5186
Michael Hauptmann (631) 344-4202

Table 12.21.2 Proposed Modifications to the Ethylene Dibromide Pre-Design Monitoring Wells			
Well ID	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
000-110	Quarterly	No Change	None
000-173	Quarterly	No Change	None
000-174	Quarterly	No Change	None
000-175	Quarterly	No Change	None
000-176	Quarterly	No Change	None
000-177	Quarterly	No Change	None
000-178	Quarterly	No Change	None
000-179	Quarterly	No Change	None
000-180	Quarterly	No Change	None
000-181	Quarterly	No Change	None
000-201	Quarterly	No Change	None
000-209	Quarterly	No Change	None
058-02	Quarterly	No Change	None
089-13	Quarterly	No Change	None
089-14	Quarterly	No Change	None
099-06	Quarterly	No Change	None
099-10	Quarterly	No Change	None
099-11	Quarterly	No Change	None
100-12	Quarterly	No Change	None
100-13	Quarterly	No Change	None
100-14	Quarterly	No Change	None
800-24	Quarterly	No Change	None
800-25	Quarterly	No Change	None
800-54	Quarterly	No Change	None
000-283	Quarterly	No Change	None
000-284	Quarterly	No Change	None
000-285	Quarterly	No Change	None

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ENVIRONMENTAL
SERVICES DIVISION

TITLE:

OU VI ETHYLENE DIBROMIDE
PRE-DESIGN
MONITORING WELL NETWORK
2003 DATA QUALITY OBJECTIVES UPDATE

DWN:
KCK

VT: HZ.:
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DATE:
11/25/02

PROJECT NO.:
07176

CHKD:
MFG

APPD:
MGH

REV.:
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NOTES:
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FIGURE NO.:

1

SITE BACKGROUND

DATE November 20, 2002

PROPOSED CHANGE

There are no proposed modifications to this program in 2003.

DESCRIPTION AND TECHNICAL BASIS

Background water quality at BNL has been monitored since 1996. The current program includes 10 wells located in the northwestern portion of the BNL property (017-01, 017-03, 017-04, 018-01, 018-02, 018-04, 018-05, 034-02, 034-03, and 063-09) and three wells off-site to the north (000-118, 000-119 and 000-120). Well locations are shown on Figure 12.22.1

Samples are collected semi-annually and analyzed for the contaminants of concern identified for groundwater characterization work conducted for the various remedial investigations and removal actions at BNL, including VOCs, metals, and leachate parameters. Analytical results are reviewed to determine whether contaminants from off-site, upgradient sources are being transported onto the BNL facility. Historically, low levels of VOCs (less than New York State groundwater standards) have been detected in the deeper portion of the Upper Glacial aquifer and in the Magothy aquifer. During calendar year 2000, aluminum, iron, manganese, and sodium were detected at concentrations exceeding New York State groundwater standards in some Site Background wells.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☒ Surveillance
- ☒ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

During calendar year 2000, groundwater flow in the northwestern portion of the BNL facility within the shallow and deep portions of the Upper Glacial aquifer was toward the east to south-southeast and groundwater flow within the Magothy aquifer was toward the east-southeast. This is consistent with historic groundwater flow patterns at the BNL

facility. Site Background wells are positioned to detect contamination migrating onto the BNL Site.

Problem Statement: Data are needed to evaluate whether off-site, upgradient sources of groundwater contamination are impacting the BNL facility and to establish baseline/background levels of naturally-occurring constituents, including metals and radionuclides, that are unimpacted by BNL activities.

Step 2: Identify the Decision

The decision for the project is:

- Is groundwater quality at BNL being impacted by off-site, upgradient source(s) of contamination (that is, is the Groundwater contingency Plan triggered)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Location of existing wells relative to flow patterns (Figure 12.22.1)
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

The study boundaries for the Site Background program are the northwestern (upgradient) portion of the BNL facility and nearby off-site areas within the Upper Glacial and shallow Magothy aquifers.

Step 5: Develop the Decision Rules

Decision 1

The sample results will be evaluated in context with historical data. As part of that evaluation, circumstances that would require implementation of the Groundwater Contingency Plan would be determined for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, including detection of previously undetected contaminants and detection of contaminants in wells where those contaminants have not previously been detected.

If contaminants are detected in any well at unusually high concentrations (relative to the historical baseline) and the results are confirmed by resampling, **then** implement actions as prescribed in the BNL Groundwater Contingency Plan.

Step 6: Specify Acceptable Error Tolerances

Table 12.22.1 summarizes the decision and possible decision errors for this project.

Table 12.22.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is groundwater quality at BNL being impacted by off-site, upgradient source(s) of contamination ?	See Step 3 for inputs.	(1) Data indicate the existence of an upgradient source when one does not exist (data indicate detected contamination is from an off-site source when it is not). (2) Data indicate that there is not an upgradient source when one does exist (data indicate detected contamination is from an on-site source when it is not).	(1) On-site contaminant source(s) will not be investigated and/or remediated and may continue to degrade groundwater quality. (2) Investigation and/or remediation of groundwater contamination may be undertaken by BNL when it is not warranted.

Because the wells included in the Site Background program are located in the upgradient portion of the BNL facility, travel time for contamination detected in these wells to the nearest potential receptor (on-site potable supply wells) is on the order of 10 years. It is therefore unlikely that decision error will result in adverse consequences to human health. The consequences of decision error relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust and BNL credibility, and wasted resources.

Step 7: Optimize the Design

Number and Location of Wells

The number and location of wells for this program are considered adequate.

Parameters and Frequency

The analytical parameters and sampling frequency currently conducted for this project are considered adequate. Therefore, no modifications are recommended at this time.

A summary of the proposed modifications to the Site Background sampling program is provided in Table 12.22.2.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Because no modifications to the sampling program are recommended, there is no change in annual sampling and analysis cost.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$3,200
FY2003	\$3,200
Difference	\$0

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   Drew Bennett (631) 344-5517
William Dorsch (631) 344-5186

Table 12.22.2 Proposed Modifications to the Site Background Monitoring Wells			
Well ID	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
017-01	Annually	No Change	None
017-03	Annually	No Change	None
017-04	Annually	No Change	None
018-01	Annually	No Change	None
018-02	Annually	No Change	None
018-04	Annually	No Change	None
018-05	Annually	No Change	None
034-02	Annually	No Change	None
034-03	Annually	No Change	None
063-09	Annually	No Change	None

* as part of Site Background program; some wells may be sampled as part of other programs.

+ Site Background wells are currently sampled for analysis of VOCs, metals, leachate parameters, gross alpha, gross beta, gamma spectroscopy, tritium and strontium-90.

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ENVIRONMENTAL
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TITLE:

SITE BACKGROUND
MONITORING WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
KCK	-	11/25/02	07176
CHKD:	APPD:	REV.:	NOTES:
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FIGURE NO.:

1

GROUNDWATER ELEVATION MONITORING

DATE November 20, 2002

PROPOSED CHANGE

No modifications to the sampling program for this project are proposed.

DESCRIPTION AND TECHNICAL BASIS

The purpose of the groundwater elevation monitoring program is to characterize the groundwater flow direction and rate across the BNL site and off the site in multiple aquifers of interest to the groundwater protection and cleanup programs. The aquifers or sub-aquifers are:

- *Shallow Upper Glacial aquifer:* This portion of the aquifer is first to be impacted by any BNL releases and is currently contaminated in portions of the site. Groundwater flow direction and rate vary depending on the discharge area (Peconic River, Carmans River, or Moriches Bay) as well as BNL water supply well and groundwater remediation well pumping and recharge basin operations.
- *Deep Upper Glacial aquifer:* This portion of the aquifer is utilized by BNL's water supply wells and is also contaminated in certain areas on and off site. The deep Upper Glacial aquifer is also the target of numerous groundwater remediation systems. Groundwater flow direction and rate vary depending on the discharge area (Peconic River, Carmans River, or Moriches Bay) as well as BNL water supply well and groundwater remediation well pumping and, to a lesser extent, recharge basin operations.
- *Upper Magothy aquifer:* This aquifer is contaminated in isolated off-site areas and is currently the focus of a comprehensive characterization study. This aquifer is also utilized by the Suffolk County Water Authority for off-site community water supply purposes (BNL's plumes are currently not an immediate threat to these wells). This aquifer tends to have different flow patterns and rates (i.e., more east-southeast and slower) than the Upper Glacial aquifer.

Synoptic groundwater elevation measurements are currently collected from approximately 850 wells on a quarterly basis. Measured wells are screened at various depths within the Upper Glacial aquifer and the upper portion of the Magothy aquifer. Most of the wells included in the groundwater elevation monitoring program are located on site, although off-site wells constructed by BNL and by the United States Geological Survey are also measured. In addition, because wells in some areas are more closely spaced than necessary for the groundwater elevation monitoring program, only a representative number of wells are monitored and not all existing wells are included in the program.

The resulting groundwater elevation data are used to develop groundwater elevation contour maps. The information contained on these maps is utilized to evaluate horizontal groundwater flow directions and rates throughout the BNL site, as well as to determine vertical gradients within and between the Upper Glacial and Magothy aquifers. These data are used to confirm that monitoring and extraction wells are located properly and to confirm that existing remediation systems are effective at capturing the targeted contamination, and that monitoring of operational and engineered controls for groundwater protection is capable of rapidly detecting an unexpected release of contamination.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

☐	Compliance
☐	Support Compliance
☒	Surveillance
☒	Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

To monitor groundwater quality and the effectiveness of groundwater protection and cleanup activities, comprehensive groundwater flow information is required. Groundwater level information is required to generate groundwater flow information. Data are needed to evaluate groundwater flow directions and rates, and horizontal and vertical gradients in multiple aquifer segments across the BNL site and off site.

Step 2: Identify the Decision

This project generates comprehensive and regional data inputs for decisions to be made in various groundwater remediation and groundwater protection projects. These decisions are not discussed here. The decisions related to this project are:

- Are the groundwater flow direction and rate data developed for this project of sufficient level of detail and confidence to support other projects?
- Is the groundwater flow system approaching a steady state condition that could justify changes in monitoring?

Step 3: Identify Inputs to the Decision

The groundwater flow inputs generated by this project that are necessary for decisions in other projects include:

- Quarterly depth to water measurements in selected wells, measured to the nearest 0.01 foot
- Measuring point elevations for measured wells, measured to the nearest 0.01 foot
- Locations of measured wells

Step 4: Define the Study Boundaries

Because wells located throughout the BNL site and off site are included in this program, the study boundaries are the groundwater watershed areas for the Upper Glacial and upper Magothy aquifers in the vicinity of the BNL site.

Step 5: Develop the Decision Rules

Decision 1

Are the groundwater flow direction and rate data developed for this project of sufficient level of detail and confidence to support other projects?

These decision rules should be applied for each of the three aquifer segment or layers of interest. The data generated for each measurement round will be reviewed by experts on BNL hydrogeology with respect to historic data and pumping and recharge rates for supply wells and existing remediation systems.

If data generated for each measurement round for each of the three aquifer segments of interest are considered adequate as input for decisions to be made for other projects, **then** utilize the data for project-specific decisions. Otherwise, consider modifying the suite of wells that are measured to address the identified data gap(s).

Decision 2

Is the groundwater flow system approaching a steady state condition that could justify changes in elevation monitoring?

If, for any of the three aquifer segments of interest, significant change in groundwater flow direction or gradient is observed during any four consecutive measuring periods, **then** continue with the existing monitoring program for that aquifer segment.

If significant change in groundwater flow direction or gradient is not observed in one or more of the three aquifer segments of interest during any four consecutive measuring periods, **then** apply expert judgment to consider reducing monitoring frequency or the number of measured wells for that aquifer segment(s).

Step 6: Specify Acceptable Error Tolerances

Table 12.23.1 summarizes the decision and possible decision errors for this project.

Table 12.23.1 Decisions, Potential Decision Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Are the groundwater flow direction and rate data developed for this project of sufficient level of detail and confidence to support other projects?	See Step 3 for inputs.	(1) Data indicate data are sufficient when they are not. (2) Data indicate data are not sufficient when they are.	(1) Potential for decision or monitoring errors in other projects due to inadequate data. (2) Wasted resources considering/ implementing operational or monitoring adjustments in other projects.
Is the groundwater flow system approaching a steady state condition that could justify changes in elevation monitoring?	See Step 3 for inputs.	(1) Data indicate that the groundwater system is approaching a steady state condition when it is not. (2) Data indicate that the groundwater system is not approaching a steady state condition when it is.	(1) Potential for variations in groundwater flow direction to be missed due to decreased monitoring frequency, loss of stakeholder trust. (2) Wasted resources conducting unnecessary water level monitoring.

Step 7: Optimize the Design

Number and Location of Wells

Groundwater data have been reviewed and are considered to be sufficient to support the decisions to be made in other projects. The number and locations of wells currently measured are considered adequate. Therefore, no modifications to the program are recommended.

Frequency

Because data indicate that the groundwater flow system is not currently considered be in a steady state condition, the frequency of measurement is recommended to remain at quarterly.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Because no modifications to the sampling program are recommended, there is no annual change in sampling and analysis cost.

TOTAL COST FOR MONITORING PROGRAM

FY2002	\$48,000
FY2003	\$48,000
Difference	\$0

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   William Dorsch (631) 344-5186

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ENVIRONMENTAL
SERVICES DIVISION

TITLE:
GROUNDWATER ELEVATION MONITORING
WELL LOCATIONS
2003 DATA QUALITY OBJECTIVES UPDATE

DWN:	VT:HZ.:	DATE:	PROJECT NO.:
KCK	-	11/26/02	07176
CHKD:	APPD:	REV.:	NOTES:
WRD	WRD	1	-

FIGURE NO.:

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Table 12.24.1 Environmental Surveillance Facility Groundwater Monitoring Schedule CY 2003

PROJECT	SAMPLE EVENT	START DATE	END DATE	# OF WELLS	VALIDATE DATA
Alternating Gradient Synchrotron Facility	1st Qtr.	01/01/2003	02/15/2003	21	No (a)
	2nd Qtr.	04/01/2003	05/15/2003	55	No (a)
	3rd Qtr.	07/01/2003	08/15/2003	21	No (a)
	4th Qtr.	10/01/2003	11/15/2003	55	No (a)
Brookhaven LINAC Isotope Producer	1st Qtr.	01/01/2003	02/15/2003	7	No (a)
	2nd Qtr.	04/01/2003	05/15/2003	5	No (a)
	3rd Qtr.	07/01/2003	08/15/2003	7	No (a)
	4th Qtr.	10/01/2003	11/15/2003	5	No (a)
Relativistic Heavy Ion Collider	1st Qtr.	02/01/2003	02/28/2003	13	No (a)
	3rd Qtr.	08/01/2003	08/31/2003	13	No (a)
New Waste Management Facility	1st Qtr.	02/01/2003	02/26/2003	8	No (a)
	2nd Qtr.	05/01/2003	05/31/2003	8	No (a)
	3rd Qtr.	08/01/2003	08/31/2003	8	No (a)
	4th Qtr.	11/01/2003	11/30/2003	8	No (a)
Brookhaven Medical Research Reactor	1st Qtr.	03/01/2003	03/31/2003	4	No (a)
	3rd Qtr.	09/01/2003	9/31/03	4	No (a)
Sewage Treatment Plant	2nd Qtr.	06/01/2003	06/30/2003	9	No (a)
	4th Qtr.	12/01/2003	12/31/2003	6	No (a)
Motor Pool	1st Qtr.	03/01/2003	03/31/2003	3	No (a)
	3rd Qtr.	09/01/2003	09/30/2003	7	No (a)
Service Station	1st Qtr.	03/01/2003	03/31/2003	5	No (a)
	3rd Qtr.	09/01/2003	9/31/2003	5	No (a)
Major Petroleum Facility (c)	2nd Qtr.	04/01/2003	04/30/2003	8	Yes (a, b)
	4th Qtr.	10/01/2003	10/31/2003	8	Yes (a, b)

(a) Results from BNL ASL are checked for completeness and accuracy by ASL supervisors.

(b) Results from contractor laboratories are verified or validated using standardized EPA methods.

(c) Monthly floating produce measurements are performed.

Table 12.24.2 ES Facility Groundwater Monitoring Program Analytical Breakdown CY 2003

Well ID	Area	Sub Area	Decision Subunit	EPA 524-2 VOCs	EPA 625 Semi-VOCs	EPA 608 Pest/PCBs	Sulfate/Chloride/Nitrate	Metals	EPA 900 Gross Alpha/Beta	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Floating Product	Frequency (events/year)
064-02	BLIP		Upgradient											a
054-61	BLIP		Upgradient						X(b)	X				2
064-46	BLIP		Downgradient						X(b)	X				2
064-47	BLIP		Downgradient						X(b)	X				4
064-48	BLIP		Downgradient						X(b)	X				4
064-49	BLIP		Downgradient						X(b)	X				4
064-50	BLIP		Downgradient						X(b)	X				4
064-67	BLIP		Downgradient						X(b)	X				4
054-08	AGS	Bkgd. Booster/BAF	Upgradient								X			2
AGS-44	AGS	BAF	Downgradient								X			2
064-51	AGS	Booster Beam Stop	Downgradient								X			2
065-52	AGS	Booster Beam Stop	Downgradient								X			2
064-03	AGS	Bldg. 914	Downgradient								X			2
064-53	AGS	Bldg. 914	Downgradient								X			2
064-54	AGS	Bldg. 914	Downgradient								X			2
054-62	AGS	Bkgd. J-10 Beam Stop	Upgradient								X			2
054-63	AGS	J-10 Beam Stop	Downgradient								X			2
054-64	AGS	J-10 Beam Stop	Downgradient								X			2
054-65	AGS	Bkgd. g-2 Stop/Plume	Upgradient								X			4
054-66	AGS	g-2 Beam Stop	Downgradient								X			2
054-67	AGS	g-2 Beam Stop	Downgradient								X			2
054-68	AGS	g-2 Beam Stop	Downgradient								X			2
054-125	AGS	g-2 Beam Stop	Downgradient								X			2
054-07	AGS	g-2 Tritium Plume	Downgradient						X(b)	X				12
054-124	AGS	g-2 Tritium Plume	Downgradient						X(b)	X				4
054-184	AGS	g-2 Tritium Plume	Downgradient						X(b)	X				4
054-185	AGS	g-2 Tritium Plume	Downgradient						X(b)	X				4
064-95	AGS	g-2 Tritium Plume	Downgradient						X(b)	X				4
054-126	AGS	g-2 Tritium Plume	Downgradient								X			4
065-122	AGS	g-2 Tritium Plume	Downgradient								X			4
065-123	AGS	g-2 Tritium Plume	Downgradient								X			4
065-124	AGS	g-2 Tritium Plume	Downgradient								X			4
065-125	AGS	g-2 Tritium Plume	Downgradient								X			4
065-126	AGS	g-2 Tritium Plume	Downgradient								X			4
065-194	AGS	g-2 Tritium Plume	Downgradient								X			4

Table 12.24.2 ES Facility Groundwater Monitoring Program Analytical Breakdown CY 2003

Well ID	Area	Sub Area	Decision Subunit	EPA 524.2 VOCs	EPA 625 Semi-VOCs	EPA 608 Pest/PCBs	Sulfate/Chloride/Nitrate	Metals	EPA 900 Gross Alpha/Beta	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Floating Product	Frequency (events/year)
065-195	AGS	g-2 Tritium Plume	Downgradient								X			4
055-31	AGS	g-2 Tritium Plume	Downgradient								X			4
065-321	AGS	g-2 Tritium Plume	Downgradient								X			4
065-322	AGS	g-2 Tritium Plume	Downgradient								X			4
065-323	AGS	g-2 Tritium Plume	Downgradient								X			4
065-324	AGS	g-2 Tritium Plume	Downgradient								X			4
065-02	AGS	g-2 Tritium Plume	Downgradient								X			4
065-173	AGS	g-2 Tritium Plume	Downgradient								X			4
054-127	AGS	Fm. U-Line Target	Upgradient								X			2
054-128	AGS	Fm. U-Line Target	Downgradient								X			2
054-129	AGS	Fm. U-Line Target	Downgradient								X			2
054-130	AGS	Fm. U-Line Target	Downgradient								X			2
054-168	AGS	Fm. U-Line Stop	Downgradient								X			2
054-169	AGS	Fm. U-Line Stop	Downgradient								X			2
054-69	AGS	Bkgd/Bldg 912	Upgradient								X			2
055-14	AGS	Bkgd/Bldg 912	Upgradient								X			2
065-120	AGS	Bldg 912	Downgradient								X			2
065-121	AGS	Bldg 912	Downgradient								X			2
055-15	AGS	Bldg 912	Downgradient								X			2
055-16	AGS	Bldg 912	Downgradient								X			2
065-192	AGS	Bldg 912	Downgradient								X			2
065-193	AGS	Bldg 912	Downgradient								X			2
055-29	AGS	Bldg 912	Downgradient								X			2
055-30	AGS	Bldg 912	Downgradient								X			2
055-32	AGS	Bldg 912	Downgradient								X			2
064-55	AGS	E-20 Catcher	Downgradient								X			2
064-56	AGS	E-20 Catcher	Downgradient								X			2
064-80	AGS	E-20 Catcher	Downgradient								X			2
025-01	RHIC	Beam Stop Area	Upgradient								X			2
025-03	RHIC	Beam Stop Area	Downgradient								X			2
025-04	RHIC	Beam Stop Area	Downgradient								X			2
025-05	RHIC	Beam Stop Area	Downgradient								X			2
025-06	RHIC	Beam Stop Area	Downgradient								X			2
025-07	RHIC	Beam Stop Area	Downgradient								X			2
025-08	RHIC	Beam Stop Area	Downgradient								X			2

Table 12.24.2 ES Facility Groundwater Monitoring Program Analytical Breakdown CY 2003

Well ID	Area	Sub Area	Decision Subunit	EPA 524.2 VOCs	EPA 625 Semi-VOCs	EPA 608 Pes/PCBs	Sulfate/Chloride/Nitrate	Metals	EPA 900 Gross Alpha/Beta	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Floating Product	Frequency (events/year)
034-05	RHIC	Collimator Area	Downgradient							X				2
034-06	RHIC	Collimator Area	Downgradient							X				2
043-01	RHIC	Collimator Area	Downgradient							X				2
043-02	RHIC	Collimator Area	Downgradient							X				2
044-13	RHIC	Collimator Area	Downgradient							X				2
044-14	RHIC	Collimator Area	Downgradient							X				2
044-29	RHIC	W-Line Stop	Downgradient							X				2
063-01	WTP		Upgradient											0
063-02	WTP		Upgradient											0
063-03	WTP		Downgradient											0
073-01	WTP		Downgradient											0
073-02	WTP		Downgradient											0
046-01	SG Range		Upgradient											0
046-02	SG Range		Downgradient											0
046-03	SG Range		Downgradient											0
039-91	LF Range		Downgradient											0
039-92	LF Range		Downgradient											0
084-12	BMRR		Downgradient					X(b)	X(b)	X	X(c)			2
084-13	BMRR		Downgradient					X(b)	X(b)	X	X(c)			2
084-27	BMRR		Downgradient					X(b)	X(b)	X	X(c)			2
084-28	BMRR		Upgradient					X(b)	X(b)	X	X(c)			2
102-05	Motor Pool	Gasoline USTs	Downgradient	X	X(b)							X		2
102-06	Motor Pool	Gasoline USTs	Downgradient	X	X(b)							X		2
102-08	Motor Pool	Bldg 326	Upgradient											(a)
102-10	Motor Pool	Bldg 326/USTs	Downgradient	X	X(b)							X		2
102-11	Motor Pool	Bldg 326	Downgradient	X								X		1
102-12	Motor Pool	Bldg 326	Downgradient	X								X		1
102-13	Motor Pool	Bldg 326	Downgradient	X								X		1
085-16	Gas Station	Pump Island	Downgradient	X	X(b)							X		2
085-17	Gas Station	Pump Island	Downgradient	X	X(b)							X		2
085-235	Gas Station	Gasoline USTs	Downgradient	X	X(b)							X		2
085-236	Gas Station	Gasoline USTs	Downgradient	X	X(b)							X		2
085-237	Gas Station	Gasoline USTs	Downgradient	X	X(b)							X		2
055-03	WMF	Bkgd.	Upgradient	X			X	X	X	X	X			4 (e)
055-10	WMF	Bkgd.	Upgradient	X			X	X	X	X	X			4 (e)

Table 12.24.2 ES Facility Groundwater Monitoring Program Analytical Breakdown CY 2003

Well ID	Area	Sub Area	Decision Subunit	EPA 524.2 VOCs	EPA 625 Semi-VOCs	EPA 608 Pes/PCBs	Sulfate/Chloride/Nitrate	Metals	EPA 900 Gross Alpha/Beta	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Floating Product	Frequency (events/year)
056-21	WMF	RCRA Bldg.	Downgradient	X			X	X	X	X	X			4 (e)
056-22	WMF	Rad. Bldg.	Downgradient	X			X	X	X	X	X			4 (e)
056-23	WMF	Rad. Bldg.	Downgradient	X			X	X	X	X	X			4 (e)
066-07	WMF	Bkgd	Upgradient	X			X	X	X	X	X			4 (e)
066-83	WMF	Mixed Waste Bldg.	Downgradient	X			X	X	X	X	X			4 (e)
066-84	WMF	Bkgd.	Upgradient	X			X	X	X	X	X			4 (e)
084-36	BIO	Greenhouses	Downgradient											0
084-37	BIO	Greenhouses	Downgradient											0
076-16	MPF		Downgradient	X	X							X(d)		2
076-17	MPF		Downgradient	X	X							X(d)		2
076-18	MPF		Downgradient	X	X							X(d)		2
076-19	MPF		Downgradient	X	X							X(d)		2
076-25	MPF		Upgradient	X	X							X(d)		2
076-378	MPF		Downgradient	X	X							X(d)		2
076-379	MPF		Downgradient	X	X							X(d)		2
076-380	MPF		Downgradient	X	X							X(d)		2
038-02	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		2
038-03	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		2
039-07	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		2
039-08	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		2
039-86	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		2
039-87	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		2
039-88	STP	Holding Ponds	Downgradient	X					X	X	X			1
039-89	STP	Holding Ponds	Downgradient	X					X	X	X			1
039-90	STP	Holding Ponds	Downgradient	X					X	X	X			1

a: Sampling of this well is optional.

b: Samples collected annually.

c: Sr-90 samples to be collected only if elevated gross beta values are observed.

d: Floating product determination measurements to be collected monthly.

e: Reduce to semiannual and eliminate metals and anions analyses upon NYSDEC approval.

GROUNDWATER MONITORING AT THE ALTERNATING GRADIENT SYNCHROTRON COMPLEX**DATE** November 19, 2002**PROPOSED CHANGES**

The primary change for the next calendar year is the reduction in gamma spectroscopy analyses to determine the presence and concentration of sodium-22. Most groundwater samples will only be analyzed for tritium, which is the primary contaminant of concern associated with releases from activated soil shielding (see Tables 12.24.1 and 12.24.2). Although sodium-22 is also produced in activated soil shielding, the levels detected in groundwater are usually well below drinking water standards and, compared to tritium, this radionuclide is less leachable and has a much shorter half-life. Samples will only be tested for sodium-22 on an annual basis for select wells located immediately downgradient of the g-2/VQ12 soil activation area. During 2002, five wells located immediately downgradient of the g-2/VQ12 source area were sampled monthly in support of the ongoing Engineering Evaluation/Cost Assessment. During 2003, the sampling frequency for four of the wells will be reduced to quarterly. Sampling frequency will continue to be monthly for well 054-07 which has the highest tritium concentrations. During 2002, one new well was installed at the new Booster Applications Facility and three new wells were installed to help monitor the g-2/VQ12 tritium plume east of Building 912. These wells will be fully incorporated into the routine surveillance program for 2003. Samples for VOC analysis will continue to be collected from select wells on an annual basis, and provided to the Environmental Restoration program to support the ongoing evaluation of historical solvent releases in the AGS area.

DESCRIPTION AND TECHNICAL BASIS

Since 1999, BNL has installed approximately 50 permanent monitoring wells and numerous temporary wells to evaluate the potential impact of activated soil shielding located near the AGS's beam stop and target areas. Groundwater monitoring results indicated that groundwater quality had been impacted by tritium originating from operations at the g-2/VQ12 magnet area, former U-Line beam stop and the former E-20 catcher. In these areas, rainwater was able to infiltrate activated soil shielding, and leach tritium into the groundwater. Tritium concentrations were found to exceed the 20,000 pCi/L drinking water standard in these three locations. Once identified, BNL took corrective actions (e.g., installation of impermeable caps) to prevent additional contamination from entering the aquifer system. Following these corrective actions, tritium concentrations in the former U-Line beam stop and the former E-20 catcher areas dropped to well below the 20,000 pCi/L standard. However, high levels of tritium (up to 3,000,000 pCi/L) continue to be detected in wells located downgradient of the g-2/VQ12 source area. Monitoring at other potential soil activation areas such as the J-10 Beam Stop, Booster Beam Stop, Building 914 Transfer Tunnel, and Building 912 continue to

demonstrate that groundwater has not been significantly impacted, and that existing engineered controls are working effectively.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

x	Compliance
	Support Compliance
x	Surveillance
x	Restoration

DATA QUALITY OBJECTIVE ANALYSIS**Step 1: State the Problem**

Secondary particles are created near beam loss points, beam targets and beam stops. These particles have the potential to escape into the soils surrounding the accelerator tunnels or into the soils underlying target and beam stop areas in the experimental hall areas. Although considerable effort is taken to design appropriate shielding and other engineering controls into these systems, many secondary particles will still interact with soils surrounding the tunnels and underlying floors. The types of radionuclides created from this interaction include tritium, beryllium-7, carbon-11, nitrogen-13, oxygen-15, and sodium-22. Once present in the soils, these radionuclides can be leached downward into groundwater by means of rainwater percolation. These leaching processes are usually quite slow and, therefore, only radionuclides with long half-lives such as tritium ($t_{1/2} = 12.3$ years) and sodium-22 ($t_{1/2} = 2.6$ years) are likely to be detected in the groundwater below the AGS. BNL has been taking steps to either reduce the amount of radioactivity produced in soils (by means of additional shielding or modifying operating procedures) or to prevent the leaching of these materials to groundwater by the construction of impermeable caps. Another potential source of groundwater contamination is the inadvertent release of activated water from the AGS's primary cooling water systems. To reduce this threat, the piping systems have been modified to reduce the volume of water that can be exposed to beam line losses, and piping containing high levels of tritiated water are located inside facility structures where they can be visibly inspected.

The collection of groundwater samples from wells located downgradient of the soil activation areas is required to demonstrate that the operational and engineered controls are effective in protecting groundwater quality. These controls include

- Limiting the amount of soil activation by use of internal shielding material and beam focusing
- Primary cooling water management
- Installation and maintenance of impermeable caps (geomembrane, gunnite, etc.)
- Storm water management.

Although groundwater quality in the AGS area has been impacted by the historical releases of volatile organic compounds (namely 1,1,1-trichloroethane), this monitoring program is focused on the evaluation of potential impacts that may result from current activities, namely soil activation. However, this program does support the Environmental

Restoration program's continual evaluation of historical VOC contamination in this area by occasionally providing samples for VOC analysis.

Step 2: Identify the Decision

The decision for this monitoring program is:

Are the operational and engineered controls employed at the AGS complex effective at preventing the release of tritium and sodium-22 to groundwater at concentrations that exceed drinking water standards at the point of assessment (i.e., the closest downgradient well(s) located downgradient of each identified soil activation area)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the AGS
- Modeled estimates on the amount of soil activation at each beam stop and target area
- Direction and velocity of groundwater flow
- Tritium and sodium-22 concentrations in groundwater, with tritium being the primary contaminant of concern
- Locations of background and downgradient wells relative to each identified soil activation area
- Regulatory requirements (DOE Order 5400.1, Interagency Agreement – AOC 16T)
- Action levels (as described in the Groundwater Contingency Plan)
- Analytical methods and detection limits
  - Tritium – EPA Method 906
  - Gamma Spectroscopy – EPA Method 901

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the AGS complex, and the nearest practicable monitoring points (i.e., “points of assessment”) located near each of the identified soil activation areas. The period for which decisions are made varies between 90 days and 180 days. These time frames are based upon the following:

- The time required for tritium and sodium-22 to migrate through the vadose zone and reach the groundwater table (by means of rainwater leachate) is likely to be on the order of 30 to 60 days.
- Once the radionuclides have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, which is typically located 100 feet from the source) is on the order of 130 days.
- Decision periods of 90 days are acceptable for areas where historical monitoring has demonstrated that groundwater quality has already been significantly impacted (e.g., the g-2/VQ12 area). A decision period of 90 days is required to evaluate the effectiveness of new engineered or operational controls have just been implemented in these areas.
- Decision periods of 180 days are acceptable for areas where monitoring has demonstrated that current engineered and operational controls are effective (e.g., J-10 Beam Stop, Booster Beam Stop, Building 914 Transfer Tunnel, Former U-Line Target, former E-20 Catcher, and portions of Building 912).

Step 5: Develop the Decision Rules

Are the engineered and operational controls effective at preventing or reducing the leaching of radionuclides from activated soils to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response:

If for any monitoring well:

- The tritium or sodium-22 concentrations exceed the applicable drinking water standards (and this result is confirmed by re-sampling), indicating a new release resulting from a failure in an engineered control or release from a previously unidentified source, OR
- Tritium or sodium-22 concentrations indicate an unexpected release rate from an existing groundwater contaminant source (and this result is confirmed by re-sampling), or previously unknown source (and this result is confirmed by re-sampling), OR

- If tritium or sodium-22 concentrations increase by greater than ten times the established baseline concentration for an existing plume

then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response:

If for any monitoring well:

- The tritium or sodium-22 concentrations are greater than 50% but less than 100% of the applicable drinking water standards (and this result is confirmed by re-sampling), indicating a new release resulting in a failure in an engineered control or release from a previously unidentified source; OR
- If tritium or sodium-22 concentrations increase by greater than five times but less than ten times the established baseline concentration for an existing plume.

then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.25.1 Decisions, Potential Errors, and Potential Consequences			
Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching of tritium and sodium-22 from activated soil shielding to the groundwater.	See Step 3 for inputs	Data indicate controls are effective when they are not. Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	A discrete slug of contamination potentially up to 100 feet long and 20 feet wide could exist and not be detected.* Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

*Assumes results from one sample period were inaccurate.

There are no potential receptors (i.e., potable water supply wells) located immediately downgradient of the AGS Complex, and groundwater travel time to the nearest potential downgradient receptor (Potable Well 10) is greater than two years. Operations of potable Well 10 have been significantly reduced since 1999, thereby reducing the likelihood that a plume from the AGS area will be captured by this well. Due to these factors, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with (short-term) decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial action under CERCLA or other regulatory program.

Step 7: Optimize the Design

Number and Location of Wells

The wells located around the AGS are biased toward detecting contamination originating from activated soils associated with current and former beam stop and target areas (Figure 12.25.1). The wells are located as close as possible to these potential source areas to allow for early detection of contaminant releases. The current approved monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. The extensive improvements to the AGS groundwater-monitoring program made since 1999 allow for the timely evaluation of potential impacts. Several additional wells may be installed during 2003 to support ongoing characterization efforts of the Engineering Evaluation/Cost Assessment for the g-2/VQ12 tritium plume (Figure 12.25.2).

Parameters and Frequency

Groundwater quality in the AGS complex is routinely evaluated using as many as 55 monitoring wells. Approximately three years of analytical data are available to assess potential impacts from activated soil shielding areas. Tritium and sodium-22 have been detected in groundwater downgradient of several activated soil shielding areas. Whereas tritium has been found to exceed drinking water standards in these areas, sodium-22 is usually detected at very low concentrations. Because tritium is easily leached from activated soils, is highly mobile in groundwater, and has a longer half-life (12.3 years as opposed to 2.6 for sodium-22), the primary focus of the monitoring program is the detection of tritium.

- In 1999, groundwater monitoring identified the presence of activated soil shielding near the g-2/VQ12 magnet area. Tritium and sodium-22 concentrations in wells installed downgradient of this area were as high as 1.8 million pCi/L and 60 pCi/L, respectively. (The drinking water standards for tritium and sodium-22 are 20,000 pCi/L and 400 pCi/L, respectively.) As a result of these findings, an impermeable cap was constructed over the area to prevent rainwater infiltration of the activated soils. During 2002, high levels (>3,000,000 pCi/L) of tritium continued to be detected in wells located immediately downgradient of the source area. As part of the continued effort to evaluate the effectiveness of the cap and to monitor the tritium plume, groundwater samples will continue to be collected on a quarterly basis during 2003. Some wells (e.g., 054-07) located directly downgradient of the source area may be monitored on a monthly basis. Samples will be analyzed primarily for tritium. Samples from select wells immediately downgradient of the g-2/VQ12 source area will be analyzed for sodium-22 (by gamma spectroscopy).
- During 1999 and 2000, elevated levels of tritium and sodium-22 were detected downgradient of two inactive accelerator beam stop areas. Tritium and sodium-22 concentrations up to 40,400 pCi/L and 704 pCi/L respectively, were detected in wells located downgradient of the former E-20 Catcher, and tritium was detected up to 70,000 pCi/L in wells located downgradient of the former U-Line Beam Stop. As a result of these findings, impermeable caps were constructed over these areas to

prevent rainwater infiltration of the activated soils. To evaluate the effectiveness of these caps, groundwater samples were initially collected on a quarterly basis, and then reduced to semiannually in 2002 following noticeable reductions in contaminant concentrations. Samples collected during 2002 continue to indicate that the tritium and sodium-22 concentrations in groundwater are well below drinking water standards. As a result, the sampling frequency will continue to be semiannual, and samples will be analyzed for tritium.

- Monitoring results since 1999 have demonstrated that engineered and operational controls have been effective in protecting groundwater quality at the J-10 Beam Stop, Booster Beam Stop, Building 914 Transfer Tunnel, former U-Line Target, and Building 912 areas. Tritium concentrations in these areas have ranged from non-detectable to generally less than 2,000 pCi/L, whereas sodium-22 concentrations have ranged from non-detectable to less than 25 pCi/L. These wells will continue to be sampled semiannually. Several wells that are used to monitor Building 912 will be monitored on a quarterly basis as part of the g-2/VQ12 tritium plume monitoring program, and samples will be analyzed for tritium. A new monitoring program, consisting of two monitoring wells, has been established for the newly constructed Booster Applications Facility. These wells will be monitored semiannually, and samples will be analyzed for tritium.

Table 12.25.2 Comparison of CY 2002 and CY 2003 Monitoring Programs

WELL	CY2002 SAMPLING FREQUENCY	CY2003 SAMPLING FREQUENCY	AFFECTED PARAMETERS
054-08	Semiannual	No Change	No gamma analysis
AGS-44	New Well	Semiannual	Tritium
064-51	Semiannual	No Change	No gamma analysis
065-52	Semiannual	No Change	No gamma analysis
064-03	Semiannual	No Change	No gamma analysis
064-53	Semiannual	No Change	No gamma analysis
064-54	Semiannual	No Change	No gamma analysis
054-62	Semiannual	No Change	No gamma analysis
054-63	Semiannual	No Change	No gamma analysis
054-64	Semiannual	No Change	No gamma analysis
054-65	Quarterly	No Change	No gamma analysis
054-66	Semiannual	No Change	No gamma analysis
054-67	Semiannual	No Change	No gamma analysis
054-68	Semiannual	No Change	No gamma analysis
054-125	Semiannual	No Change	No gamma analysis
054-07	Quarterly	No Change	None
054-124	Quarterly	No Change	None
054-184	Quarterly	No Change	None
054-185	Quarterly	No Change	None

064-95	Quarterly	No Change	None
054-126	Quarterly	No Change	No gamma analysis
065-122	Quarterly	No Change	No gamma analysis
065-123	Quarterly	No Change	No gamma analysis
065-124	Quarterly	No Change	No gamma analysis
065-125	Quarterly	No Change	No gamma analysis
065-126	Quarterly	No Change	No gamma analysis
065-194	Quarterly	No Change	No gamma analysis
065-195	Quarterly	No Change	No gamma analysis
055-31	Quarterly	No Change	No gamma analysis
065-321	Quarterly	No Change	No gamma analysis
065-322	Quarterly	No Change	No gamma analysis
065-323	Quarterly	No Change	No gamma analysis
065-324	Quarterly	No Change	No gamma analysis

WELL	CY2002 SAMPLING FREQUENCY	CY2003 SAMPLING FREQUENCY	AFFECTED PARAMETERS
065-02	Quarterly	No Change	No gamma analysis
065-173	Quarterly	No Change	No gamma analysis
054-127	Semiannual	No Change	No gamma analysis
054-128	Semiannual	No Change	No gamma analysis
054-129	Semiannual	No Change	No gamma analysis
054-130	Semiannual	No Change	No gamma analysis
054-168	Semiannual	No Change	No gamma analysis
054-169	Semiannual	No Change	No gamma analysis
054-69	Semiannual	No Change	No gamma analysis
055-14	Semiannual	No Change	No gamma analysis
065-120	Semiannual	No Change	No gamma analysis
065-121	Semiannual	No Change	No gamma analysis
055-15	Semiannual	No Change	No gamma analysis
055-16	Semiannual	No Change	No gamma analysis
065-192	Semiannual	No Change	No gamma analysis
065-193	Semiannual	No Change	No gamma analysis
055-29	Semiannual	No Change	No gamma analysis
055-30	Semiannual	No Change	No gamma analysis
055-32	Semiannual	No Change	No gamma analysis
064-55	Semiannual	No Change	No gamma analysis
064-56	Semiannual	No Change	No gamma analysis
064-80	Semiannual	No Change	No gamma analysis

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Compared to CY2002, the changes described above will result in an overall cost reduction of \$3,200.

TOTAL COST FOR MONITORING PROGRAM

\$65,200

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Douglas Paquette (631) 344-7046

Figure 1

Environmental Surveillance
Monitoring Well Locations
AGS and BLIP Facility Area

LEGEND

- Monitoring well
- Potable Supply Well
- Buildings, Facilities
- Recharge Basins
- AGS Facilities
- AGS Ring
- June 2000 Groundwater Table (ft AMSL)
- Tritium Concentration > Drinking Water Standards

SCALE

Meters

\\OERNT\GIS\GW_PROJECTS\OU 3\G-2\G-2 WINTER RESULTS.DWG

BROOKHAVEN
NATIONAL LABORATORY

ENVIRONMENTAL
SERVICES DIVISION

g-2 MONITORING WELL AND
GEOPROBE TRITIUM RESULTS
FOURTH QUARTER 2001

DWN: KCK	VT.HZ.: -	DATE: 07/16/02	PROJECT NO.: 07176
CHKD: DEP	APPD: DBB	REV.: 1	NOTES: DRAFT
FIGURE NO.:		12.25.2	

GROUNDWATER MONITORING AT THE BROOKHAVEN LINAC ISOTOPE PRODUCER (BLIP)**DATE** November 20, 2002**PROPOSED CHANGE**

The BLIP monitoring wells will continue to be sampled on a quarterly basis. Samples will be analyzed for tritium quarterly; however, the frequency of analyses for sodium-22 will be reduced from semiannually to annually.

DESCRIPTION AND TECHNICAL BASIS

Following the 1998 discovery of tritium in groundwater downgradient of the BLIP facility, BNL installed seven monitoring wells to evaluate the effectiveness of a new impermeable cap and operational controls designed to prevent the additional leaching of contaminants to the groundwater. Groundwater monitoring results for CY 1999 and the first half of CY 2000 indicated that tritium concentrations had fallen to levels of less than one-quarter of the drinking water standard. Alternatives for long-term control of the activated soils were evaluated as part of the CERCLA program. The selected alternative was the injection of colloidal silica grout to reduce the permeability of the activated soil surrounding the BLIP target. Following the May-June 2000 injection of colloidal silica grout, an increase in tritium concentrations was observed in downgradient wells. Tritium concentrations increased to 60,800 pCi/L, three times the drinking water standard. Sodium-22 concentrations increased to nearly 275 pCi/L, but well below the drinking water standard of 400 pCi/L. This increase was the result of a one-time release of contaminated pore water that was displaced by the silica grout. Tritium concentrations decrease to below drinking water standards by the end of 2002. Monitoring at this facility will remain on a quarterly schedule for at least one more year (see Tables 12.24.1 and 12.24.2).

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☒ Compliance
- ☐ Support Compliance
- ☒ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Secondary particles created at the BLIP target vessel have activated some of the soils the surround portions of the vessel. The types of radionuclides created from this interaction include tritium, beryllium-7, carbon-11, nitrogen-13, oxygen-15, and sodium-22. Once present in the soils, these radionuclides can be leached downward into groundwater by means of rainwater percolation. These leaching processes are usually quite slow and, therefore, only radionuclides with long half-lives such as tritium ($t_{1/2} = 12.3$ years) and sodium-22 ($t_{1/2} = 2.6$ years) are likely to be detected in the groundwater below the BLIP. BNL has been taking steps to prevent the leaching of these materials to groundwater by improving rainwater management. Rainwater management initiatives included the reconnection of the building's rain gutters, sealing paved areas, and the construction of impermeable cap. In conjunction with the Environmental Restoration program, colloidal silica grout was injected into the activated soil area to reduce the permeability of the soils. Another potential source of groundwater contamination is the inadvertent release of activated water from the BLIP's primary cooling water system. These water systems are located inside the BLIP building, and can be visually inspected.

The collection of groundwater samples from wells located downgradient of BLIP is required to demonstrate that the operational and engineered controls are effective in protecting groundwater quality. These controls include:

- Limiting the amount of soil activation by use of internal shielding material and beam focusing
- Primary cooling water management
- Reduced the permeability of the activated soils using colloidal silica grout
- Installation and maintenance of impermeable caps (geomembrane, gunnite, etc.)
- Storm water management.

Step 2: Identify the Decision

The decision for this monitoring program is:

- Are the operational and engineered controls employed at BLIP effective at preventing additional releases of tritium and sodium-22 to groundwater at concentrations that exceed drinking water standards at the point of assessment (i.e., the closest downgradient well(s))?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at BLIP
- Modeled estimates on the amount of soil activation near the target vessel.
- Direction and velocity of groundwater flow
- Tritium and sodium-22 concentrations in groundwater. Tritium is the primary contaminant of concern because it is highly leachable, is highly mobile in the aquifer, and has a half-life of 12.6 years
- Locations of background and downgradient wells relative to the soil activation area

- Regulatory requirements (DOE Order 5400.1, Interagency Agreement AOC 16K)
- Action levels (as described in the Groundwater Protection Contingency Plan)
- Analytical methods and detection limits:
  - Tritium – EPA Method 906
  - Gamma spectroscopy – EPA Method 901

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of BLIP. The period for which decisions are made is 90 days. This time frame is based upon the following:

- The time required for tritium and sodium-22 to migrate through the vadose zone and reach the groundwater table (by means of rainwater leachate) is likely to be on the order of 30 to 60 days.
- Once the radionuclides have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessments, which are located approximately 50 feet from the source) is on the order of 75 days.
- A decision period of 90 days is required to evaluate the effectiveness of the engineered and operational controls.

Step 5: Develop the Decision Rules

Are the engineered and operational controls effective at preventing or reducing the leaching of radionuclides from activated soils to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response:

If for any monitoring well:

- If tritium concentrations increase by greater than ten times the previous year baseline concentration for the existing plume (and this result is confirmed by re-sampling) OR
- Tritium or other radionuclide concentrations indicate a release from a previously unknown source (and this result is confirmed by re-sampling).

Then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response:

If for any monitoring well:

- If tritium concentrations increase by greater than five times but less than ten times the previous years baseline concentration for the existing plume (and this result is confirmed by re-sampling).

Then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.26.1 Decisions, Potential Errors, and Potential Consequences			
Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching of tritium and sodium-22 from activated soil shielding to the groundwater.	See Step 3 for inputs	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 100 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

*Assumes results from one sample period were inaccurate.

There are no potential receptors (i.e., potable water supply wells) located immediately downgradient of BLIP, and groundwater travel time to the nearest potential downgradient receptor (Potable Well 4) is greater than five years. Due to these factors, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require additional remedial actions.

Step 7: Optimize the Design

Number and Location of Wells

The wells located near the BLIP are biased toward detecting contamination originating from activated soils adjacent to the target vessel and to evaluate potential contamination that could originate from upgradient sources such as the LINAC (Figure 12.26.1). The downgradient wells are located as close as possible to the BLIP building to allow for early detection of contaminant

releases. The current monitoring well network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years and the relatively small size of the potential source, no refinements are recommended.

Parameters and Frequency

Groundwater quality at BLIP is routinely evaluated using five to eight monitoring wells. Most of these wells were installed during 1999 and 2000. Because tritium is easily leached from activated soils, is highly mobile in groundwater, and has a longer half-life (12.3 years as opposed to 2.6 for sodium-22), the primary focus of the monitoring program is the detection of tritium. Due to retardation of sodium-22 migration in the aquifer, tritium would be the first radionuclide detected in the monitoring well network should the established engineered controls fail. Sampling frequency for sodium-22 could increase if there were a significant increase in tritium concentrations.

In 1998, tritium and sodium-22 concentrations were detected as high as 54,000 pCi/L and 151 pCi/L, respectively. (The drinking water standards for tritium and sodium-22 are 20,000 pCi/L and 400 pCi/L, respectively.) Monitoring results from 1999 and the first half of 2000 indicated that the engineering and operational controls implemented at BLIP were highly effective at preventing additional leaching of tritium and sodium-22 from the soils surrounding the BLIP target vessel. During this time period, tritium and sodium-22 concentrations in wells located directly downgradient of BLIP (within 50 feet) were generally less than one-quarter of the drinking water standards. Following the injection of the colloidal silica grout in May-June 2000, a slight increase in tritium (<2,000 pCi/L increased to 5,700 pCi/L) and sodium-22 (<5 pCi/L increased to 57 pCi/L) concentrations were detected in wells located immediately downgradient of BLIP. By October 2000, tritium concentrations increased to 56,000 pCi/L. This increase was likely due to a one-time release of contaminated pore water that was displaced by the silica grout.

To evaluate the effectiveness of the operational controls, the impermeable cap and the silica grout, groundwater samples will continue to be collected on a quarterly basis for at least one more year, with the sampling frequency being reduced to semiannually starting in 2004. Samples will be analyzed quarterly for tritium and semiannually for sodium-22 (by gamma spectroscopy).

Table 12.26.2 Comparison of CY2002 and CY2003 Monitoring Programs

WELL	CY2002 SAMPLING FREQUENC Y	CY2003 SAMPLING FREQUENC Y	AFFECTED PARAMETERS
064-02	Quarterly	No Change	Reduce to annual gamma analysis
054-61	Quarterly	No Change	Reduce to annual gamma analysis
064-46	Quarterly	No Change	Reduce to annual gamma analysis
064-47	Quarterly	No Change	Reduce to annual gamma analysis
064-48	Quarterly	No Change	Reduce to annual gamma analysis

064-49	Quarterly	No Change	Reduce to annual gamma analysis
064-50	Quarterly	No Change	Reduce to annual gamma analysis
064-67	Quarterly	No Change	Reduce to annual gamma analysis

Compared to the previous year, the changes described above will result in an overall cost **decrease** of \$400.

TOTAL COST FOR MONITORING PROGRAM

\$10,700

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Douglas Paquette (631) 344-7046

Figure 1

Environmental Surveillance
Monitoring Well Locations
BLIP Facility Area

LEGEND

- Monitoring Well
- Wooded Areas
- Buildings, Facilities

June 2000 Groundwater
Elevation (ft AMSL)

SCALE

GROUNDWATER MONITORING AT THE RELATIVISTIC HEAVY ION COLLIDER (RHIC)**DATE** November 20, 2002**PROPOSED CHANGE**

No changes. Sampling frequency for RHIC area monitoring wells will continue to be semi-annually. However, samples will be analyzed only for tritium.

DESCRIPTION AND TECHNICAL BASIS

During 1999 and 2000, BNL installed 13 monitoring wells to collect pre-operational (baseline) water quality data and to establish a long-term monitoring program. The wells were positioned to evaluate the effectiveness of current engineered (caps) and operational controls designed to protect groundwater quality near activated soil shielding at the RHIC's beam stops and collimator areas. Prior to RHIC becoming operational in July 2000, sufficient pre-operational data on groundwater quality had been collected. Starting in 2001, the sampling frequency was reduced from quarterly to semiannually. Starting in 2002, groundwater samples were analyzed only for tritium, the primary contaminant of concern. For 2003, RHIC monitoring wells will continue to be monitored semiannually and analyzed only for tritium (see Tables 12.24.1 and 12.24.2).

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☒ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS**Step 1: State the Problem**

Secondary particles are created near the RHIC's beam stops and collimators. These particles have the potential to escape into the soils surrounding the accelerator tunnel. Although considerable effort is taken to design appropriate shielding and other engineering controls into these systems, many secondary particles will still interact with soils surrounding the tunnels and underlying floors. The types of radionuclides created from this interaction include tritium, beryllium-7, carbon-11, nitrogen-13, oxygen-15, and sodium-22. Once present in the soils, these radionuclides can be leached downward into groundwater by means of rainwater percolation. These leaching processes are usually

quite slow and, therefore, only radionuclides with long half-lives such as tritium ($t_{1/2} = 12.3$ years) and sodium-22 ($t_{1/2} = 2.6$ years) are likely to be detected in the groundwater below the RHIC. BNL has been taking steps to either reduce the amount of radioactivity produced in soils (by means of additional shielding or modifying operating procedures) or to prevent the leaching of these materials to groundwater by the construction of impermeable caps.

The collection of groundwater samples from wells located downgradient of the soil activation areas is required to demonstrate that the operational and engineered controls are effective in protecting groundwater quality. These controls include

- Limiting the amount of soil activation by use of internal shielding material and beam focusing
- Installation and maintenance of impermeable geomembrane caps over each potential soil activation area (e.g., three beam stops and two collimators)
- Storm water management.

Step 2: Identify the Decision

- Are the operational and engineered controls employed at RHIC effective at preventing the release of tritium and sodium-22 to groundwater at concentrations that exceed drinking water standards at the point of assessment (i.e., the closest downgradient well(s) located near each of the identified soil activation areas)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the RHIC
- Modeled estimates on the amount of soil activation at each beam stop and collimator.
- Direction and velocity of groundwater flow
- Tritium and sodium-22 concentrations in groundwater. Tritium is the primary contaminant of concern because it is highly leachable, is highly mobile in the aquifer, and has a half-life of 12.6 years
- Locations of background and downgradient wells relative to each identified soil activation area
- Regulatory requirements (DOE Order 5400.1)
- Action levels (as described in the Groundwater Protection Contingency Plan)
- Analytical methods and detection limits:
  - Tritium – EPA Method 906

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the beam stop and collimator areas within RHIC facility, and the nearest practicable monitoring points (i.e., “points of assessment”) located near each of the identified soil activation areas. The period for which decisions are made is 180 days. These time frames are based upon the following:

- The time required for tritium and sodium-22 to migrate through the vadose zone and reach the groundwater table (by means of rainwater leachate) is likely to be on the order of 30 to 60 days.
- Once the radionuclides have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, which is typically located 100 to 200 feet from the source) is on the order of 130 to 260 days.
- Decision periods of 180 days are acceptable for areas where monitoring has demonstrated that current engineered and operational controls are effective.

Step 5: Develop the Decision Rules

Are the engineered and operational controls effective at preventing or reducing the leaching of radionuclides from activated soils to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response:

If for any monitoring well:

- The tritium concentrations exceed the applicable drinking water standard (and this result is confirmed by re-sampling). Indicates a significant failure of existing operational or engineered controls.

Then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response:

If for any monitoring well:

- The tritium concentrations are greater than 50% but less than 100% of the applicable drinking water standard (and this result is confirmed by re-sampling). Indicates a potential failure of existing operational or engineered controls.

Then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 3 response. (Note: Initiation of preliminary investigations or other actions may occur if concentrations are less than 50% of the drinking water standards.)

Step 6: Specify Acceptable Error Tolerances

Table 12.27.1 Decisions, Potential Errors, and Potential Consequences			
Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching of tritium and sodium-22 from activated soil shielding to the groundwater.	See Step 3 for inputs	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 100 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

*Assumes results from one sample period were inaccurate.

There are no potential receptors (i.e., potable water supply wells) located immediately downgradient of the RHIC beam stop and collimator areas, and groundwater travel time to the nearest potential downgradient receptor (Potable Well 10) is greater than five years. Due to these factors, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial action under CERCLA or other regulations.

Step 7: Optimize the Design

Number and Location of Wells

The wells located at the RHIC are biased toward detecting contamination originating from activated soils associated with the facility's beam stops and collimators (Figure 12.27.1). The wells are located as close as possible to these potential source areas to allow for early detection of contaminant releases. The current approved monitoring network is considered adequate for

meeting the acceptable risk levels of stakeholders. No additional wells are recommended for this program.

Parameters and Frequency

Groundwater quality in the RHIC beam stop and collimator areas is routinely evaluated using up to 14 monitoring wells. Most of these wells were installed during 1999 and 2000. As many as six quarters of analytical data are available to assess pre-operational groundwater quality and six quarters of data following RHIC startup. Because tritium is easily leached from activated soils, is highly mobile in groundwater, and has a longer half-life (12.3 years as opposed to 2.6 for sodium-22), the primary focus of the monitoring program is the detection of tritium. Due to retardation of sodium-22 migration in the aquifer, tritium would be the first radionuclide detected in the monitoring well network should the established engineered controls fail.

To evaluate the long-term effectiveness of the impermeable caps installed over the beam stop and collimator areas, groundwater samples will be collected on a semiannual (180 day) basis. Samples will be analyzed only for tritium. Should tritium be detected in any of the wells, samples could also be collected to test for the presence of sodium-22.

Table 12.27.2 Comparison of CY2002 and CY 2003 Sampling Programs

WELL	CY2002 SAMPLING FREQUENC Y	CY2003 SAMPLING FREQUENC Y	AFFECTED PARAMETERS
025-01	Semiannual	No Change	None
025-03	Semiannual	No Change	None
025-04	Semiannual	No Change	None
025-05	Semiannual	No Change	None
025-06	Semiannual	No Change	None
025-07	Semiannual	No Change	None
025-08	Semiannual	No Change	None
034-05	Semiannual	No Change	None
034-06	Semiannual	No Change	None
043-01	Semiannual	No Change	None
043-02	Semiannual	No Change	None
044-13	Semiannual	No Change	None
044-14	Semiannual	No Change	None
044-29	Semiannual	No Change	None

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

No changes are recommended. Based upon new sampling and analysis rates there will be an overall cost reduction of \$300 compared to CY02.

TOTAL COST FOR MONITORING PROGRAM

\$9,600

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Douglas Paquette (631) 344-7046

Figure 1
Environmental Surveillance
Monitoring Well And Surface
Water Sampling Locations
RHIC Facility Area

LEGEND

Surface Water
Collection Points

Monitoring well

Buildings, Facilities

Recharge Basins

Site Boundary

June 2000 Groundwater
Elevation (ft AMSL)

SCALE

MONITORING AT THE WASTE MANAGEMENT FACILITY (WMF)

DATE November 20, 2002

PROPOSED CHANGE

Following NYSDEC approval of BNL's proposed modification of the RCRA Part B Permit, the sampling frequency for the eight WMF wells will be reduced from quarterly to semiannually (Tables 12.24.1 and 12.24.2). Furthermore, the groundwater samples will be analyzed only for chemical and radiological constituents that are likely to be stored at the WMF, and have the potential to impact groundwater quality following an accidental spill or leak. Therefore, samples will be analyzed for only for VOCs (for common degreasing solvents using EPA Method 524.2) and radionuclides (specifically for tritium and gamma emitting radionuclides, and gross alpha/beta analyses for unspecified radionuclides). Monitoring of groundwater flow directions in the WMF area will be conducted as part of BNL's quarterly site wide synoptic water level measurement project.

DESCRIPTION AND TECHNICAL BASIS

The Waste Management Facility is designed to safely handle, repack, and temporarily store BNL-derived wastes prior to shipment to an off-site disposal or treatment facility. The WMF has been designed as a state-of-the-art facility, with administrative and engineered controls that meet all applicable federal, state, and local environmental protection requirements. Moreover, institutional controls such as spill prevention plans, operations management plans, maintenance, and personnel training ensure that the facility is operated in a manner that is protective of the environment and human health.

The WMF is a complex consisting of four buildings: the Operations Building (Bldg. 860), Reclamation Building (Bldg. 865), RCRA Waste Building (Bldg. 855), and the Mixed Waste Building (Bldg. 870). In addition to administrative/operational controls (procedures, contingency plans, etc.), these buildings and the outlying paved areas have been engineered to ensure that any spills and leaks would be contained and detected prior to a release to the environment. Outdoor storage of hazardous or mixed waste only occurs within secondary containment. Sealed floors and isolated drainage areas mitigate potential accidental releases of liquid wastes in the Reclamation Building, the RCRA Building, and the Mixed Waste Building. All storage area floors are pitched inward to ensure that any spills would remain inside the building. For added protection, sealed concrete floors in liquid waste handling and storage areas are underlain by 20 mil. high density polyethylene (HDPE) tertiary containment membranes with monitoring access pipes used to determine whether there has been any leakage through the concrete from the storage cells. Spills in paved areas would be mitigated by concrete curbs and isolated drainage. (Note: the drain at the east roadway exit from the yard that is adjacent to the Reclamation Building, and the drain located to the northeast of the Reclamation Building do not have isolation valves, but do lead to the stormwater system that discharges to the Recharge Basin HO—SPDES Outfall 003. This

outfall is routinely monitored under the SPDES permit.) There are no RCRA-regulated above or belowground tanks in the WMF. However, all above and belowground storage tanks that are used to store non-RCRA regulated waste were designed, installed, and maintained in conformance with Article 12 of the Suffolk County Sanitary Code.

The WMF is located within two years of groundwater travel to BNL Potable Supply Wells 11 and 12, which are located south of East Fifth Avenue and just north of the WMF site. Because of the close proximity of the WMF to Potable Wells 11 and 12, it is imperative that the engineering and institutional controls discussed above are effective in ensuring that waste handling operations at the WMF do not degrade the quality of the soils and groundwater in this area. This Groundwater Monitoring Plan for the WMF supplements the WMF engineered and administrative controls by providing additional means of detecting potential contaminant releases from the WMF. The groundwater monitoring requirements are defined in the facility's RCRA Part B Permit. In 2002, BNL petitioned the NYSDEC to modify the groundwater monitoring program. Approval of the proposed changes is pending.

Since 1997, the eight WMF monitoring wells have been sampled on a quarterly basis, and samples have been analyzed for a wide variety of organic, inorganic, and radiological constituents. Monitoring results indicate that WMF operations have not impacted groundwater quality. Based on the low probability of an undetected release of either chemical or radiological contaminants from the WMF, semiannual monitoring should provide sufficient data to adequately assess groundwater quality in the WMF area. The rate of potential contaminant migration through the unsaturated soil underlying the facility depends on physical properties and volume of the released contaminant, the amount of organic carbon in the soils, and precipitation and infiltration rates. The adequacy of the proposed semiannual groundwater monitoring program is based in part on the assumption that a low volume contaminant release would be leached into the aquifer at a slow rate, and would not result in a rapid increase in concentration between sample collection periods. Secondly, since the supply wells pump large volumes of water over a large area, considerable mixing of contaminated and uncontaminated water would result in dilution of the contaminant(s).

In accordance with the BNL Groundwater Protection Contingency Plan, the monitoring program would be reevaluated immediately if a significant contaminant release to the environment were to occur in the WMF area, or if the monitoring wells within the WMF were to indicate that contaminants have been released from the facility as the result of a previously undetected spill or leak.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☒ Compliance
- ☐ Support Compliance
- ☐ Surveillance

Restoration

DATA QUALITY OBJECTIVE ANALYSIS**Step 1: State the Problem**

The WMF is designed to safely handle, repackage, and temporarily store BNL-derived wastes prior to shipment to an off-site disposal or treatment facility. The WMF has been designed as a state-of-the-art facility, with administrative and engineered controls that meet all applicable federal, state, and local environmental protection requirements. Moreover, institutional controls such as spill prevention plans, operations management plans, maintenance, and personnel training ensure that the facility is operated in a manner that is protective of the environment and human health.

The WMF is located adjacent to BNL Potable Supply Wells 11 and 12. Because of the close proximity of these supply wells, it is imperative that the engineering and institutional controls discussed below are effective in ensuring that waste handling operations at the WMF do not degrade the quality of the soils and groundwater in this area. The collection of groundwater samples from wells located at the WMF is required to demonstrate that current operational and engineered controls are effective in protecting groundwater quality by means of spill prevention and early detection. These controls include:

- Outdoor storage of hazardous or mixed waste only occurs within secondary containment.
- Potential accidental releases of liquid wastes in the Reclamation Building, the RCRA Building, and the Mixed Waste Building are mitigated by sealed floors and isolated drainage areas. All storage area floors are pitched inward to ensure that any spills would remain inside the building. For added protection, sealed concrete floors in liquid waste handling and storage areas are underlain by high density polyethylene (HDPE) tertiary containment membranes with monitoring access pipes used to determine whether there has been any leakage through the concrete from the storage cells.
- Spills in paved areas would be mitigated by concrete curbs and isolated drainage
- All liquid waste storage tanks were designed, installed and maintained in conformance with Article 12 of the Suffolk County Sanitary Code.

Step 2: Identify the Decision

The decision for this monitoring program is:

- Are the operations of the WMF impacting groundwater quality? If so, do concentrations exceed drinking water standards at the point of assessment (i.e., the closest downgradient wells)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the WMF
- Direction and velocity of groundwater flow
- Contaminant concentrations in groundwater
- Locations of background and downgradient wells relative to known or potential source areas
- Regulatory requirements (NYSDEC Permit)
- Action levels – detection volatile organic compounds or radionuclides at concentrations exceeding levels outlined in the Groundwater Contingency Plan
- Analytical methods and detection limits:
  - Volatile Organic Compounds (EPA Method 625)
  - Tritium (EPA Method 906)
  - Gamma Spectroscopy (EPA Method 901)
  - Gross Alpha/Beta (EPA Method 900)

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area immediately downgradient of the WMF. A decision period of 180 days is sufficient to provide a secondary means of verifying that the operational and engineered controls in place at the WMF are effective. This time frame is based upon the following considerations:

- As described above, the WMF has a number of engineered and operational controls that are designed to prevent release of contaminants to the environment. A more frequent monitoring program can be implemented if a leak is found or suspected.
- The time required for small volumes of contaminants to migrate through the vadose zone and reach the groundwater table is likely to be 90 days or more. It is important to note that some waste materials that are stored at the WMF are not readily mobile in soils.
- Once contaminants have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, which is typically located within 50 to 100 feet of a storage building) is on the order of 130 days.

Step 5: Develop the Decision Rules

Are the operational and engineered controls effective at preventing the release of contaminants to groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response:

If for any monitoring well:

- The contaminant concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling). The contaminant has not been detected in an upgradient well and suggests a release from a WMF activity, OR
- The contaminant concentrations are significant enough to immediately threaten the quality of water pumped from nearby drinking water supply wells 11 and 12, OR
- Contaminant concentrations indicate the presence of a previously unidentified source (including potential upgradient sources) and this result is confirmed by re-sampling,

Then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response:

If for any monitoring well:

- The contaminant concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling), and the contaminant has not been detected in an upgradient well and is not associated with a known upgradient source,

then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.28.1 Decisions, Potential Errors, and Potential Consequences			
Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the release of contaminants to soils and groundwater.	See Step 3 for inputs	Data indicate controls are effective when they are not. Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	A discrete slug of contamination potentially up to 200 feet long could exist and not be detected.* Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and all operational and engineered controls (i.e., inventory resolution, leak detection, secondary containment) were to fail.

BNL potable water supply wells 11 and 12 are located immediately adjacent to the WMF. Although it is possible that a decision error could result in adverse consequences to human health, the WMF is designed and operated in a manner that eliminates or limits any potential contaminant release to the environment. In addition to the groundwater monitoring program, the supply wells are also routinely monitored for the contaminants of concern in accordance with SDWA requirements. Because these supply wells draw water from a large area (i.e., zone of contribution), it is likely that low-level contamination would undergo considerable dilution before entering the water distribution system. Moreover, water pumped from the supply wells is treated with carbon filters prior to distribution. These wells are currently supplying only 15 percent of the water demand for the site. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions under applicable NYS regulations.

Step 7: Optimize the Design

Number and Location of Wells

The wells are located as close as possible to potential WMF source areas to allow for early detection of contaminant releases (Figure 12.28.1). Four of the monitoring wells are positioned between waste storage facilities and the potable supply wells. The four remaining wells are positioned to detect potential contamination from upgradient sources (e.g., Building 830 and the AGS research complex). Because the monitoring well network is designed to act as a secondary means of verifying proper facility operation, the current approved monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders.

Parameters & Frequency

Groundwater quality at the WMF area is evaluated using eight monitoring wells. Analysis of quarterly monitoring results since 1997 indicates WMF operations have not impacted groundwater quality.

Following NYSDEC approval of the proposed changes to the RCRA Part B Permit, well sampling frequency will be reduced from a quarterly to semiannual basis, and samples will only be analyzed for volatile organic compounds and radioactivity.

Table 12.28.2 Comparison of CY2002 and CY 2003 Sampling Programs			
Well ID	CY2002 Sampling Frequency	CY2003 Sampling Frequency	Affected Parameters
055-03	Quarterly	Semiannual*	Eliminate metals and anions
055-10	Quarterly	Semiannual*	Eliminate metals and anions
056-21	Quarterly	Semiannual*	Eliminate metals and anions
056-22	Quarterly	Semiannual*	Eliminate metals and anions
056-23	Quarterly	Semiannual*	Eliminate metals and anions
066-07	Quarterly	Semiannual*	Eliminate metals and anions
066-83	Quarterly	Semiannual*	Eliminate metals and anions
066-84	Quarterly	Semiannual*	Eliminate metals and anions

* Reduce to semiannual sampling upon NYSDEC approval of proposed RCRA Part B modification.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

When approved by the NYSDEC, the proposed changes will result in an annual cost reduction of approximately \$13,500.

TOTAL COST FOR MONITORING PROGRAM

The modified groundwater sampling and analysis program will cost approximately \$12,000. If NYSDEC approval is not obtained, sampling and analysis costs for CY03 will be \$29,950.

IMPLEMENTATION DATE   January 1, 2003 – Assuming that NYSDEC approval is received in December 2002.

POINT OF CONTACT   Douglas Paquette (631) 344-7046

Figure 1

Environmental Surveillance
Monitoring Well Locations
Waste Management Facility Area

LEGEND

- Monitoring well
- Potable Supply Well
- Buildings, Facilities
- Recharge Basins
- N June 2001 Groundwater Elevation (ft AMSL)
- General Direction of Groundwater Flow

SCALE

GROUNDWATER MONITORING AT THE BNL MEDICAL RESEARCH REACTOR (BMRR) FACILITY

DATE November 21, 2002

PROPOSED CHANGE

No changes are proposed for 2003. Sampling frequency will remain at semiannual. Samples will be collected for tritium analysis on a semiannual basis, and annually for gross alpha/gross beta and gamma spectroscopy (Tables 12.24.1 and 12.24.2).

DESCRIPTION AND TECHNICAL BASIS

Groundwater data collected since 1997 indicates that tritium concentrations remain below the drinking water standard of 20,000 pCi/L. Although tritium concentrations have not declined to non-detectable levels following the implementation of new operational and engineered controls in 1997, tritium concentrations have declined from a maximum of 17,100 pCi/L in 1999 to <5,000 pCi/L during 2002. No other potential BMRR related radionuclides have been detected in groundwater to date. It is expected that residual tritium remains in the vadose zone below the facility, and that some amount will migrate to the water table by natural processes (i.e., water table fluctuation) over many years.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

☐	Compliance
☐	Support Compliance
☒	Surveillance
☐	Restoration

DATA QUALITY OBJECTIVE ANALYSIS**Step 1: State the Problem**

In 1997, tritium was detected at concentrations up to 11,800 pCi/L in several monitoring wells located directly downgradient of the BMRR facility. The drinking water standard for tritium is 20,000 pCi/L. Review of systems and operations within the BMRR facility identified two potential sources for the tritium detected in groundwater: (1) spills that occurred during the transfer of radioactive liquids to a former aboveground storage tank, and (2) a floor drain system and associated sump that had received primary cooling water on several occasions. Primary coolant contained tritium at a concentration up to 465 uCi/L. Although small volume releases did occur while transferring liquids to the outdoor storage tank on several occasions, the most likely source for the tritium detected in groundwater is the floor drain system and associated unlined 150-gallon capacity, SU-

2 sump located in the basement of the BMRR. Historical records indicated 16 spills or discharges totaling nearly 800 gallons of primary water to the floor drains or directly to the SU-2 sump. The last such discharge occurred in January 1987. Although most of the primary water that was discharged was properly disposed, qualitative leak-rate testing conducted in 1997 indicated that the sump and/or floor drain piping system was not entirely leak tight, and some amount of radioactive water may have leaked to the underlying soils. Furthermore, until 1997, secondary (non-radioactive) coolant water was routinely discharged to the SU-2 sump and floor drain system. Leakage of secondary water could have provided sufficient water volume to drive the tritium through the unsaturated zone and into the groundwater beneath the reactor building.

To prevent future release of radioactive materials to the soils and groundwater below the BMRR, the floor drain system was abandoned in 1997. BNL also sealed the SU-2 sump, and a plastic container was installed in the sump pit. A liquid sensor installed in the sump is used to detect the presence of any liquids outside the plastic container.

The sampling network includes upgradient Well 084-28 and downgradient Wells 084-12, 084-13, and 084-27. Samples collected from these wells have been analyzed for tritium, gross alpha, gross beta, and gamma spectroscopy. Occasionally tests have also been performed for strontium-90 when elevated gross beta levels were detected. The varying rate of recharge to groundwater over time from the OU III recharge basin and historical operation of water supply well 105 (which stopped operating in 2000, and was abandoned in 2002) resulted in some transient flow conditions in the BMRR area. However, the predominant direction of groundwater flow in the area remains to the south-southeast.

Groundwater data are required to demonstrate that the operational and engineered controls are effective in protecting groundwater quality. These controls include

- closed floor drain system
- improved primary cooling water management.

Data are not collected to monitor historical releases (that is, an existing plume) as current information indicates that the drinking water standard for tritium of 20,000 pCi/L was never exceeded. The highest tritium levels (approximately 18,000 pCi/L) were detected in temporary wells installed within 50 feet of the BMRR. In addition, the BMRR facility has been designated for decommissioning and demolition. Issues related to the decommissioning and demolition are not addressed in this DQO. Current plans call for the removal of any remaining fuel and activated primary water by the end of 2003.

Based on an average groundwater flow velocity of 0.75 feet per day, the travel time from the point contaminants may enter the soils below the reactor building, migrate through the vadose zone and travel to the monitoring wells is likely to be greater than 100 days. Monitoring conducted during 2002 indicates that tritium concentrations have dropped to <5,000 pCi/L. No other reactor related radionuclides have been detected in groundwater downgradient of the BMRR.

Step 2: Identify the Decision

The decision for the project is

- Are the controls effective at eliminating further discharges to soils and groundwater below the BMRR (i.e., are performance objectives met)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Maintenance of reactor structure and future D&D activities
- Direction and velocity of groundwater flow
- Tritium, gross alpha, gross beta, and strontium-90 concentrations in groundwater with time from historical sampling
- Current location of background (1) and downgradient monitoring (3) wells (map included as Figure 7)
- Regulatory Driver (DOE Order 5400.1)
- Action Levels (MCLs, as described in the Groundwater Protection Contingency Plan)
- Analytical methods and detection limits:
  - Tritium – EPA Method 906
  - Gross alpha/beta – EPA Method 908
  - Gamma spectroscopy – EPA Method 901
  - Strontium-90 – EPA Method 905

Step 4: Define the Study Boundaries

The decision for this project applies to the area in the immediate vicinity of the BMRR facility and the nearest practical monitoring points for the source. The period for which the individual decisions will be made is 180 days for tritium and 365 days for the other radiological parameters, based on the following factors:

- Minimum combined travel time from a release of tritium through the vadose zone and aquifer to the nearest monitoring point is 60 days.
- Minimum travel time for other potential radiological parameters is approximately 120 days, based on retardation factors.

Although tritium concentrations have not decreased as quickly as expected after controls have been implemented (that is, to non-detectable concentrations), concentrations have shown a marked reduction and remain below the drinking water standard. Nevertheless, it warrants careful monitoring.

Step 5: Develop the Decision Rules

Are the controls effective at eliminating further discharges to soils and groundwater below the BMRR?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response:

If for any monitoring well:

- Radionuclide concentrations in a sample exceed the applicable water quality standards (and this result is confirmed by re-sampling), OR
- Radionuclide concentrations indicate a new release from a previously unknown source (and this result is confirmed by re-sampling),

Then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response:

If for any monitoring well:

- Radionuclide concentrations are greater than 50% but less than 100% of the applicable water quality standards (and this result is confirmed by re-sampling).

Then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances:

Table 12.29.1 Decisions, Potential Errors, and Potential Consequences			
Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching lead to the groundwater.	See Step 3 for inputs	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 135 feet long and 30 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Protection Contingency Plan). Potential erosion of stakeholder confidence.

*Assumes results from one sample period were inaccurate and all operational and engineered controls (i.e., leak detection or secondary containment) were to fail.

There are no potential receptors immediately downgradient of the BMRR, and groundwater travel time to the nearest current potential downgradient receptor is greater than ten years, and most homes located south of BNL have been connected to public water. Contaminant concentrations have historically not exceeded drinking water standards and are not expected to exceed them in the future because the BMRR operations ended in 2000, and the remaining nuclear fuel and activated primary cooling water are scheduled to be removed by the end of 2003. Therefore, it is very unlikely that decision error will result in adverse consequences to human health. The consequences of decision error relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions.

Step 7: Optimize the Design**Number and Location of Wells**

The three wells located downgradient of the BMRR are biased toward detecting the highest contamination, and the monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders (Figure 12.29.1). Because the groundwater flow direction has been relatively constant in this area in recent years and the relatively small size of the potential source, no refinements are recommended.

Parameters and Frequency

As described above, four wells around the BMRR are monitored semiannually. Since 1997, samples collected from the BMRR monitoring network have been analyzed for tritium, gross alpha, gross beta, and gamma spectroscopy, and occasionally for strontium-90.

- A significant amount of groundwater data has been collected since 1997. These data indicate that tritium concentrations remain below the drinking water standard of 20,000 pCi/L. Although tritium concentrations have not declined to non-detectable levels following the implementation of new operational and engineered controls in 1997, tritium concentrations have declined from a maximum of 17,100 pCi/L in 1999 to <5,000 pCi/L in 2002. Because tritium concentrations for the past several years have been less than one quarter of the drinking water standard, and the primary cooling water system has been drained, the collection of semiannual samples for tritium analysis should provide adequate groundwater surveillance data for the BMRR.
- Since the beginning of the monitoring program in 1997, no other reactor-related radionuclides have been observed in the groundwater downgradient of the BMRR. Therefore, annual monitoring for the other radiological parameters should provide adequate groundwater surveillance data for the BMRR.
- Future evaluation of the sampling program for optimization purposes will need to consider that the facility is scheduled for full decommissioning and demolition.

Table 12.29.2 Comparison of CY 2002 and CY 2003 Monitoring Programs

WELL	CY2002 SAMPLING FREQUENC Y	CY2003 SAMPLING FREQUENC Y	AFFECTED PARAMETERS
084-12	Semiannual	No Change	None
084-13	Semiannual	No Change	None
084-27	Semiannual	No Change	None
084-28	Semiannual	No Change	None

- Because tritium concentrations have not been observed at concentrations above the drinking water standard and because of the declining concentration trend, the frequency of monitoring for tritium should be reduced to semiannually (see below).

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Although there are no changes to the monitoring program, sampling and analysis rate changes will result in an overall cost increase of \$200.

TOTAL COST FOR MONITORING PROGRAM

\$4,700

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Douglas Paquette (631) 344-7046

Figure 1

Environmental Surveillance
Monitoring Well Locations
Medical Research Reactor Area

LEGEND

Monitoring well

Buildings, Facilities

June 2000 Groundwater
Elevation (ft AMSL)

Direction of
Groundwater Flow

SCALE

GROUNDWATER MONITORING AT THE SEWAGE TREATMENT PLANT

DATE November 22, 2002

PROPOSED CHANGES

Reduce the sampling frequency from semiannual to annual for the three wells that monitor groundwater quality downgradient of the emergency holding ponds. As part of Phase III Sewage Treatment Plant Upgrades project in 2001, the original single liners of the holdings ponds were replaced with double lines and an integrated leak detection system. These upgrades significantly reduce the risk of leaks of contaminated water that may be held in the emergency holding ponds.

DESCRIPTION AND TECHNICAL BASIS

BNL has established an environmental monitoring program at STP to evaluate potential impacts to environmental quality and to demonstrate compliance with DOE requirements and applicable federal, state and local laws, regulations and permits. The primary monitoring program is conducted in accordance with BNL's SPDES permit. Because approximately 15 percent of the water sent to the STP's filter beds is recharged directly to groundwater, BNL uses groundwater monitoring to provide a secondary means of evaluating potential impacts of STP operations. Monitoring well sampling frequency and methods of analysis for 2003 are summarized in Tables 12.24.1 and 12.24.2.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☒ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS**Step 1: State the Problem**

The STP processes sanitary sewage for BNL facilities. The STP processes an average of 0.72 million gallons per day (MGD) during non-summer months and approximately 1.25 MGD during the summer months. Treatment of the sanitary waste stream includes: primary treatment to remove settleable solids and floatable materials; aerobic oxidation for secondary removal of the biological matter and nitrification of ammonia; secondary clarification; sand filtration for final effluent polishing; and, ultraviolet disinfection for bacterial control prior to discharge into the Peconic River. By regulating the oxygen levels during the treatment process, nitrogen can be biologically removed by using nitrate

bound oxygen for respiration. This discharge is regulated under a NYSDEC SPDES permit (NY-0005835).

Wastewater from the STP's clarifier is released to the sand filter beds, where the water percolates through three feet of sand before being recovered by an underlying clay tile drain system, which transports the water to the discharge point at the Peconic River (SPDES Outfall 001). Approximately 15% of the water released to the filter beds is either lost to evaporation or to direct groundwater recharge. At the present time, six sand filter beds are used in rotation.

Two emergency hold-up ponds are located to the east of the sand filter bed area. The hold-up ponds are used for the emergency storage of sanitary waste in the event of an upset condition or if the influent contains contaminants in concentrations exceeding BNL administrative limits and/or SPDES permit effluent release criteria. The hold-up ponds are equipped with fabric reinforced (hypalon) plastic liners that are heat-welded along all seams. The first lined hold-up pond was constructed in 1978, and has a capacity of approximately four million gallons. A second four million gallon capacity lined pond was constructed in 1989, for a combined capacity of nearly eight million gallons. The combined capacity of the hold-up ponds provides the Laboratory with the ability to divert all sanitary system effluent for approximately twelve days. As part of Phase III Sewage Treatment Plant Upgrades project in 2001, the original single liners were replaced with double lines and an integrated leak detection system.

The collection of groundwater samples from wells located near the filter beds and downgradient of the emergency holding ponds is required to demonstrate that current operational and engineered controls are effective in protecting groundwater quality. These controls include:

- BNL has developed a comprehensive pollution prevention program, which includes worker education on proper use and disposal of hazardous materials. These programs are integrated into the BNL Standards Based Management System.
- In accordance with the SPDES permit, BNL carefully monitors both the influent and effluent from the STP. SPDES monitoring is the primary means of ensuring that the engineered and operational controls are working.

Step 2: Identify the Decision

The decision for this monitoring program is:

- Are the operations of the STP impacting groundwater quality? If so, do concentrations exceed drinking water standards at the point of assessment (i.e., the closest downgradient well(s)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the STP
- Direction and velocity of groundwater flow
- Volatile organic compound, radionuclide, metals and anion concentrations in groundwater
- Locations of background and downgradient wells relative to known or potential source areas
- Regulatory requirements (DOE Order 5400.1)
- Action levels (as described in the Groundwater Contingency Plan)
- Analytical methods and detection limits
  - Volatile Organic Compounds (EPA Method 524.2)
  - Radionuclides analyses: Tritium, Gross Alpha/Beta, Gamma, Strontium-90 (optional)
  - Metals (EPA Method 200 Series)
- Nature of use of emergency holdup ponds

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the STP facility. A decision period of 180 days for the filter bed area is sufficient to provide a secondary means of verifying that the operational and engineered controls in place are effective. A decision period of one year for the emergency holding ponds area is sufficient to provide a secondary means of verifying that the operational and engineered controls in place are effective. This time frame is based upon the following:

- Influent and effluent of the STP is carefully monitored as required by the SPDES permit. A more frequent monitoring program can be implemented if a significant contaminant release to the sanitary system is discovered or suspected.
- Groundwater monitoring conducted for the past five years has demonstrated that STP operations are not significantly impacting groundwater quality in the area. All VOC, radionuclide and anion concentrations have been below applicable water quality standards. Some metals, such as sodium, are occasionally detected at concentrations slightly above standards.

- Once contaminants have migrated to groundwater, the travel time from the STP filter bed area or emergency holding ponds to the site boundary is estimated to be greater than ten years. Although there is a potential for contaminated groundwater originating from the northern filter bed areas to enter the Peconic River via groundwater discharge, the time of travel is likely to be more than 180 days.
- There are no drinking water supply wells located near the STP.
- The new double lines and integrated leak detection system installed in the emergency holding ponds significantly reduce the risk of leaks of contaminated water that may be diverted to the ponds.

Step 5: Develop the Decision Rules

Are the operational and engineered controls effective at preventing the introduction of contaminants to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response:

If for any monitoring well:

- The contaminant concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling), OR
- Contaminant concentrations indicate a new release, an unexpected release rate, or previously unknown source (and this result is confirmed by re-sampling)

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response:

If for any monitoring well:

- Contaminant concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling)

then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.30.1 Decisions, Potential Errors, and Potential Consequences			
Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the discharge of contaminants to the groundwater.	See Step 3 for inputs	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 300 feet long could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and one or more operational and engineered controls (i.e., SPDES monitoring, leak detection, secondary containment) were to fail.

There are no potential receptors (i.e., potable water supply wells) located immediately downgradient of STP area. Travel time from the STP area to the BNL southern boundary is greater than 10 years, and most homes located east of BNL have been connected to public water. Therefore, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions under applicable NYS regulations.

Step 7: Optimize the Design**Number and Location of Wells**

The wells are located as close as possible to the potential source areas to allow for early detection of contaminant releases (Figure 12.30.1). Six wells are located near the STP filter beds and three wells are located near the emergency holding ponds. The current monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years, no refinements are recommended.

Parameters and Frequency

Multiple sets of analytical data are available to assess potential impacts from recent operations. As noted above, groundwater monitoring conducted for the past five years

has demonstrated that STP operations are not significantly impacting groundwater quality in the area. All VOC, radionuclide and anion concentrations have been below applicable drinking water or ambient water quality standards. Some metals, such as sodium, are occasionally detected at concentrations slightly above standards.

Table 12.30.2 Comparison of CY 2002 and CY 2003 Sampling Programs			
WELL	CY2002 SAMPLING FREQUENCY	CY2003 SAMPLING FREQUENCY	AFFECTED PARAMETERS
038-02	Semiannual	No Change	None
038-03	Semiannual	No Change	None
039-07	Semiannual	No Change	None
039-08	Semiannual	No Change	None
039-86	Semiannual	No Change	None
039-87	Semiannual	No Change	None
039-88	Annual	No Change	None
039-89	Annual	No Change	None
039-90	Annual	No Change	None

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Based upon current sampling and analysis rates, there will be a cost reduction of \$1,700.

TOTAL COST FOR MONITORING PROGRAM

\$17,600

IMPLEMENTATION DATE   January 1, 2003

POINTS OF CONTACT   Douglas Paquette (631) 344-7046

Figure 12.30.1

Environmental Surveillance Monitoring Well Locations Sewage Treatment Plant and Live Fire Range Area

LEGEND

- Monitoring well
- Buildings, Facilities
- Active Filter Beds
- Emergency Holding Ponds

June 2001 Groundwater
Elevation (ft AMSL)

General Direction of
Groundwater Flow

SCALE

GROUNDWATER MONITORING AT THE BNL SHOTGUN AND LIVE-FIRE RANGES

DATE November 22, 2002

PROPOSED CHANGES

Sampling frequency metals will be reduced from yearly to once every two years. Monitoring conducted to date indicates that operations at these facilities have not impacted groundwater quality. The next monitoring period for these facilities will be in 2004.

DESCRIPTION AND TECHNICAL BASIS

During 1999, BNL installed monitoring wells at the shotgun range (Wells 064-02 and 064-03) and the Live-Fire Range (Wells 039-91 and 039-92) to evaluate the potential impact to groundwater by the long-term use of lead shot and bullets. Based upon data collected to date, groundwater quality in these two areas has not been impacted by lead, and anion concentrations are consistent with ambient conditions.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☒ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

There is a potential that the use of lead bullets at the BNL Live Fire Range and lead shot at the Shotgun Range could cause soil contamination and potentially impact groundwater quality. At the BNL Shotgun Range, it is estimated that as many as 30,000 shotgun rounds per year are used. Until 2000, when BNL placed an administrative ban on the use of lead shot, as much as 2,100 pounds of lead could have been deposited on the surface of the range annually. Although the down range berm at the Live-Fire Range is screened for spent bullets on an annual basis, some amount of the bullets may be missed. Lead can also be imparted directly onto soils as the bullets impact with sand grains. Although it is thought to be of minor concern, lead could leach into the soils as it is exposed to rain water that is typically slightly acidic.

The collection of groundwater samples from wells located downgradient of Shotgun and Live-Fire Ranges was used to demonstrate that the operational and engineered controls are effective in protecting groundwater quality. These controls include

- At the Live-Fire Range: Reducing the potential for lead contamination of soils and exposure of spent lead bullets by periodically screening the soils to remove the bullets and by using copper and teflon coated bullets.
- At the Shotgun Range: Requiring the use of steel shot (requirement implemented in 2000).

Step 2 Identify the Decision

The decision for this monitoring program is:

- Are the operations of the Live-Fire and Shot Gun Ranges impacting groundwater quality? If so, do concentrations exceed water quality standards at the point of assessment (i.e., the closest downgradient well)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the ranges
- Direction and velocity of groundwater flow
- Metals concentrations in groundwater (including data on naturally occurring metals concentrations)
- Locations of background and downgradient wells relative to each range
- Regulatory requirements (DOE Order 5400.1)
- Action levels (as described in the Groundwater Contingency Plan)
- Analytical methods and detection limits (as described in the Environmental Monitoring Plan)
  - Metals (EPA Method 200 Series)

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the Live-Fire and Shotgun Range areas. The period for which decisions are made is 730 days. This time frame is based upon the following:

- The time required for lead to migrate through the vadose zone and reach the groundwater table (potentially in dissolved form by means of rainwater leachate) is likely expected to be greater than 365 days.
- Once the lead has migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, which is typically located 50 feet from the source) is on the order of 75 or more days.
- Current data indicate that groundwater quality has not been impacted by lead contamination at either range.

Step 5: Develop the Decision Rules

Are the operational controls effective at preventing or reducing the leaching of lead from spent bullets, shot or contaminated soils to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response:

If for any monitoring well:

- The lead concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling)

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response:

If for any monitoring well:

- The lead concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling)

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.31.1 Decisions, Potential Errors, and Potential Consequences			
Decision	Inputs	Potential Error Based on Data	Potential Consequences

Are controls effective at eliminating or controlling the leaching lead to the groundwater.	See Step 3 for inputs	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 200 feet long and 20 to 100 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and that lead will be in a state that will allow it to readily migrate in the aquifer system (i.e., lead migration is not retarded).

There are no potential receptors (i.e., potable water supply wells) located immediately downgradient of LFR. However, there is a potential that contaminants entering the groundwater near the Live-Fire Range could enter the Peconic River during certain hydrologic (high water table) conditions. At the Shotgun Range, groundwater travel time to the nearest potential downgradient receptor (Potable Wells 11 and 12) is greater than five years. Due to these factors, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require additional remedial actions.

There are no potential receptors (i.e., potable water supply wells) located immediately downgradient of LFR. However, there is a potential that contaminants entering the groundwater near the Live-Fire Range could enter the Peconic River during certain hydrologic (high water table) conditions. At the Shotgun Range, groundwater travel time to the nearest potential downgradient receptor (Potable Wells 11 and 12) is greater than five years. Due to these factors, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require additional remedial actions.

Step 7: Optimize the Design

Number and Location of Wells

The wells located downgradient of the Live-Fire and Shotgun Ranges are biased toward detecting contamination originating from areas of the ranges where lead accumulates (Figure 12.31.1). The wells are located as close as possible to these potential source areas to allow for early detection of contaminant releases. The current monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. No additional monitoring wells are recommended.

Parameters and Frequency

Groundwater quality at the Live-Fire and Shotgun Range areas has been evaluated using monitoring wells that were installed in early 2000. Multiple sets of analytical data are available to assess potential impacts from lead shot and bullets at the ranges.

- Detectable levels of lead were not found in any of the groundwater samples collected since the wells were installed in 2000. Because these ranges have been in operation for many years, the results indicate that lead from bullets and shotgun pellets is not being leached at appreciable levels, and is not impacting groundwater quality. Groundwater samples will be collected on a once every two years basis to verify that the continued operation of these ranges is not impacting groundwater quality.

Table 12.31.2 Comparison of CY 2002 and CY 2003 Sampling Programs – Shotgun Range

WELL	CY2002 SAMPLING FREQUENCY	CY2003 SAMPLING FREQUENCY	AFFECTED PARAMETERS
046-01	Annual	None	Sample in 2004
046-02	Annual	None	Sample in 2004
046-03	Annual	None	Sample in 2004

Table 12.31.3 Comparison of CY 2002 and CY 2003 Sampling Programs – Live-Fire Range

WELL	CY2002 SAMPLING FREQUENCY	CY2003 SAMPLING FREQUENCY	AFFECTED PARAMETERS
039-91	Annual	None	Sample in 2004
039-92	Annual	None	Sample in 2004

TOTAL COST FOR MONITORING PROGRAM

Compared to CY2000, the changes described above will result in an overall cost reduction of \$1,500 for the Shotgun Range monitoring program and \$1,100 for the Live-Fire Range monitoring program

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Douglas Paquette (631) 344-7046

Figure 12.31.1

Environmental Surveillance
Monitoring Well Locations
BNL Shotgun Range Area

LEGEND

Monitoring well

Potable Supply Well

Buildings, Facilities

June 2001 Groundwater
Elevation (ft. AMSL)

General Direction of
Groundwater Flow

SCALE

Figure 12.31.2

Environmental Surveillance
Monitoring Well Locations
Sewage Treatment Plant
and
Live Fire Range Area

LEGEND

- Monitoring well
- Buildings, Facilities
- Active Filter Beds
- Emergency Holding Ponds
- June 2001 Groundwater Elevation (ft AMSL)
- General Direction of Groundwater Flow

SCALE

GROUNDWATER MONITORING AT THE BNL MOTOR POOL FACILITY**DATE** November 20, 2002**PROPOSED CHANGES** None**DESCRIPTION AND TECHNICAL BASIS**

In 1996, BNL installed two monitoring wells downgradient of the gasoline underground storage tanks (USTs). Data from these wells indicate that current fuel storage and dispensing operations are not impacting groundwater quality. In 1999, BNL installed six additional monitoring wells to evaluate the potential impact to groundwater quality from two oil spills. Monitoring results from six rounds of sampling indicated that the two oil spills had not impacted groundwater quality. Based upon these data, the NYSDEC removed the spill sites from their Active Spills List. However, the continued operations of the facility and historical small-scale spillage of the degreasing agent 1,1,1-trichloroethane and gasoline requires a continuation of the groundwater monitoring program. Monitoring well sampling frequency and methods of analysis for 2003 are summarized in Tables 12.24.1 and 12.24.2.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

☐	Compliance
☐	Support Compliance
☒	Surveillance
☐	Restoration

DATA QUALITY OBJECTIVE ANALYSIS**Step 1: State the Problem**

Potential environmental concerns at the Motor Pool include the historical and current use of USTs for the storage of gasoline and waste oil, hydraulic fluids used for lift stations, and the use of solvents for parts cleaning. In August 1989, the USTs, pump islands, and associated piping were upgraded to comply with Suffolk County Article 12 requirements for secondary containment, leak detection devices and overfill alarms. Following the removal of the old USTs, there were no obvious signs of soil contamination. The present tank inventory includes two 8,000 gallon-capacity USTs used for the storage of unleaded gasoline, one 260 gallon-capacity UST used for waste oil, and one 3,000 gallon-capacity UST for No. 2 fuel oil. The facility also has five vehicle lift stations. In 2002, the petroleum-based hydraulic fluid for the lifts was replaced with a vegetable-based product.

In December 1996, BNL removed an underground propane tank located near the adjacent Site Maintenance Facility (Building 326). During this removal, the surrounding soils had a distinct petroleum staining and smell. These soils were contaminated from a previously unknown historical oil spill. The site was excavated to the extent that the footings of the building were almost undermined. Although approximately 60 cubic yards of contaminated soil were removed, there was clear evidence that contaminated soils remained. In February 1998, it was discovered that hydraulic fluid was leaking from one of the lift stations in Building 423. The lift was excavated and approximately 50 cubic yards of contaminated soils were removed.

In response to a NYSDEC request, BNL installed six new monitoring wells in the Motor Pool (Building 423/326) area to evaluate the potential impacts of the two oil spills. As part of the Stipulation Agreement with the NYSDEC, BNL measured for floating product on a monthly basis, and collected quarterly samples for VOCs and Semi-VOCs. One well (102-08) was installed upgradient of the Motor Pool area to provide background water quality data, and one well (102-09) was installed directly downgradient of the Building 423 vehicle lift station. Four wells were installed downgradient of the Building 326 fuel oil spill site.

The collection of groundwater samples from wells located downgradient of the Motor Pool area is required to demonstrate that the remedial actions (i.e., removal of contaminated soils) and current operational and engineered controls are effective in protecting groundwater quality. These controls include

All USTs, pump islands, and associated piping comply with Suffolk County Article 12 requirements for secondary containment, leak detection devices, and overfill alarms.

- BNL maintains an inventory/accounting of gasoline stored in USTs at the Motor Pool.
- BNL maintains an inventory of all chemical degreasers in use at the Motor Pool.
- All spent degreasing agents are properly stored and disposed of.

Step 2: Identify the Decision

The decision for this monitoring program is:

- Are the operations of the Motor Pool impacting groundwater quality? If so, do concentrations exceed water quality standards at the point of assessment (i.e., the closest downgradient well(s))?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the Motor Pool

- Direction and velocity of groundwater flow
- Volatile and semi-volatile organic compound concentrations in groundwater
- Floating product determination measurements
- Locations of background and downgradient wells relative to known or potential source areas
- Regulatory requirements (DOE Order 5400.1)
- Action levels (as described in the Groundwater Contingency Plan)

- Analytical methods and detection limits
  - Volatile Organic Compounds (EPA Method 524.2)
  - Semi-volatile Organic Compounds (EPA Method 625)

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the Motor Pool/Site Maintenance Buildings. The period for which decisions are made is 180 days. This time frame is based upon the following:

- The USTs, pump islands, and associated piping were upgraded to comply with Suffolk County Article 12 requirements for secondary containment, leak detection devices and overfill alarms. A more frequent monitoring program can be implemented if a leak is found or suspected. Vegetable-based products replaced petroleum-based hydraulic fluids in the vehicle lift stations.
- The time required for small-scale petroleum hydrocarbons and solvent spills to migrate through the vadose zone and reach the groundwater table is likely to be 30 or more days. It is important to note that some petroleum hydrocarbons are not readily mobile in soils.
- Once contaminants have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, which are located approximately 20 feet from the USTs or historical spill areas) is on the order of 30 days.
- A decision period of 180 days is sufficient to provide a secondary means of verifying that the operational and engineered controls in place at the Motor Pool are effective, and evaluate the potential continued impact from historical solvent, oil and gasoline spills.

Step 5: Develop the Decision Rules

Are the operational and engineered controls effective at preventing the introduction of petroleum hydrocarbons and solvents to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response:

If for any monitoring well:

- The VOC or Semi-VOC concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling), OR
- VOC or Semi-VOC concentrations indicate a new release, an unexpected release rate, or previously unknown source (and this result is confirmed by re-sampling), OR
- Floating product is detected.

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response:

If for any monitoring well:

- The VOC or Semi-VOC concentrations are greater than 50 percent but less than 100 percent of the applicable drinking water standards (and this result is confirmed by re-sampling).

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.32.1 Decisions, Potential Errors, and Potential Consequences			
Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching lead to the groundwater.	See Step 3 for inputs	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 480 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and all operational and engineered controls (i.e., inventory resolution, leak detection, secondary containment) were to fail.

There are no potential receptors (i.e., potable water supply wells) located immediately downgradient of Motor Pool area. Travel time from the Motor Pool area to the BNL southern boundary is greater than 15 years, and most homes located south of BNL have been connected to public water. Therefore, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions under NYS regulations.

Step 7: Optimize the Design**Number and Location of Wells**

The wells located at the Motor Pool are biased toward detecting contamination originating from the UST area and petroleum contaminated soils associated with the spills discussed above (Figure 12.32.1). The wells are located as close as possible to these potential source areas to allow for early detection of contaminant releases. The current approved monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years and the relatively small size of the potential source, no refinements are recommended.

Parameters and Frequency

Groundwater quality at the Motor Pool/Site Maintenance Facility area has been evaluated using monitoring wells that were installed in 1999. Multiple sets of analytical data are available to assess potential impacts from current operations and historical spills.

- The solvent 1,1,1-trichloroethane is routinely detected at concentrations up to 50 µg/L. (The NYS Ambient Water Quality Standard for TCA is 5 µg/L.) It is important to note that TCA has not been used as a parts degreaser at the Motor Pool for many years, and its presence in groundwater is likely to be related to historical spillage.
- Contaminants associated with the historical oil spill and recent hydraulic oil spill have not been detected in groundwater samples. Based upon these results, the NYSDEC removed the two oil spill areas from its active spill list, and ended the sampling requirements outlined in the Stipulation Agreement.
- The gasoline additive MTBE is occasionally detected in samples collected from wells located downgradient of Building 423/326 at concentrations up to 70 µg/L. (The NYS Ambient Water Quality Standard for MTBE is 10 µg/L). The occurrence of MTBE in groundwater is likely due to possible historical (pre-1989) gasoline leakage from the older USTs or possibly historical or ongoing small-scale surface spills during vehicle re-fueling operations.

Groundwater samples will be collected on a semiannual basis from wells located downgradient of the gasoline USTs and annually from wells located downgradient of Buildings 423/326 to verify that continued operations at the Motor Pool are not impacting groundwater quality. Samples from three wells located downgradient of the USTs will be analyzed semiannually for VOCs and annually for Semi-VOCs. Samples from the four wells located downgradient of the historical oil spills will be analyzed on an annual basis for VOCs and Semi-VOCs. Floating product determination measurements in wells located downgradient of the USTs will also be conducted semiannually.

Table 12.32.2 Comparison of CY 2002 and CY 2003 Sampling Programs			
WELL	CY2002 SAMPLING FREQUENCY	CY2003 SAMPLING FREQUENCY	AFFECTED PARAMETERS
102-05	Semiannual	No Change	None
102-06	Semiannual	No Change	None

102-10	Semiannual	No Change	None
102-08	Annual	No Change	None
102-11	Annual	No Change	None
102-12	Annual	No Change	None
102-13	Annual	No Change	None

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Compared to CY2002, the changes described above will result in an overall cost increase of \$825.

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Douglas Paquette (631) 344-7046

Figure 12.32.1

Environmental Surveillance
Monitoring Well Locations
Motor Pool Area

LEGEND

Monitoring well

Buildings, Facilities

June 2001 Groundwater
Elevation (ft AMSL)

General Direction of
Groundwater Flow

SCALE

MLO - 04/09/02
Thermal and Facilities Inspection, mfp and
Graphical Facilities Inspection, mfp, (2.1)

GROUNDWATER MONITORING AT THE UPTON SERVICE STATION**DATE** November 22, 2002**PROPOSED CHANGE** None**DESCRIPTION AND TECHNICAL BASIS**

In 1996, BNL installed two monitoring wells downgradient of the Service Station. In 1999, BNL installed three additional monitoring wells to improve the monitoring of the UST area. Data from these wells indicate that while the USTs are not impacting groundwater quality, small-scale historical spillage of petroleum hydrocarbons and degreasing solvents have impacted groundwater quality in the Service Station area. Semi-volatile organic compounds have not been detected in groundwater. Monitoring well sampling frequency and analytical methods for 2003 are summarized in Tables 12.24.1 and 12.24.2.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☒ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS**Step 1: State the Problem**

Potential environmental concerns at the Upton Service Station include the historical and current use of USTs for the storage of gasoline and waste oil, hydraulic fluids used for lift stations, and the use of solvents for parts cleaning. In 1989, the USTs, pump islands, and associated piping were upgraded to conform with Suffolk County Article 12 requirements for secondary containment, leak detection devices and overfill alarms. Following the removal of the old USTs, there were no obvious signs of soil contamination. The present tank inventory includes three 8,000-gallon capacity USTs used for the storage of unleaded gasoline, and one 500-gallon capacity UST used for waste oil. The facility also has five vehicle lift stations. In 2002, the petroleum-based hydraulic fluids in the vehicle lift stations were replaced with a vegetable oil product.

The collection of groundwater samples from wells located downgradient of the Service Station is used to demonstrate that current operational and engineered controls are effective in protecting groundwater quality. These controls include:

- All USTs, pump islands, and associated piping conform with Suffolk County Article 12 requirements for secondary containment, leak detection devices, and overfill alarms.
- BNL maintains an inventory/accounting of gasoline stored in USTs at the service station.
- BNL maintains an inventory of all chemical degreasers in use at the service station.
- All spent degreasing agents are properly stored and disposed of.

Step 2: Identify the Decision

The decision for this monitoring program is:

Are the operations of the Upton Service Station impacting groundwater quality? If so, do concentrations exceed drinking water standards at the point of assessment (i.e., the closest downgradient wells)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the Service Station
- Direction and velocity of groundwater flow
- Volatile organic compound concentrations in groundwater
- Floating product determination measurements
- Locations of background and downgradient wells relative to known or potential source areas
- Regulatory requirements (DOE Order 5400.1)
- Action levels (as described in the Groundwater Contingency Plan)
- Analytical methods and detection limits (as described in the Environmental Monitoring Plan)
  - Volatile Organic Compounds (EPA Method 524.2)
  - Semi-volatile Organic Compounds (EPA Method 625) – (*One round, every two years)

- Fuel inventory and waste management records

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the service station facility. The period for which decisions are made is 180 days. This time frame is based upon the following:

- The USTs, pump islands, and associated piping were upgraded to comply with Suffolk County Article 12 requirements for secondary containment, leak detection devices and overfill alarms. A more frequent monitoring program can be implemented if a leak is found or suspected.
- The time required for small-scale petroleum hydrocarbons and solvent spills to migrate through the vadose zone and reach the groundwater table is likely to be 30 or more days. It is important to note that some petroleum hydrocarbons are not readily mobile in soils.
- Once contaminants have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, which are located approximately 20 feet from the USTs) is on the order of 30 days.
- A decision period of 180 days is sufficient to provide a secondary means of verifying that the operational and engineered controls in place at the Service Station are effective, and evaluate the potential continued impact from historical solvent and oil spills.

Step 5: Develop the Decision Rule

Are the operational and engineered controls effective at preventing the introduction of petroleum hydrocarbons and solvents to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response:

If for any monitoring well:

- The VOC concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling), OR
- VOC concentrations indicate a new release, an unexpected release rate, or previously unknown source (and this result is confirmed by re-sampling), OR

- Floating petroleum is found at the water table

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response:

If for any monitoring well:

- The VOC concentrations are greater than 50% but less than 100% of the applicable water quality standards (and this result is confirmed by re-sampling), OR
- VOC concentrations indicate a new release, an unexpected release rate, or previously unknown source (and this result is confirmed by re-sampling),

then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.33.1 Decisions, Potential Errors, and Potential Consequences			
Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling release of contaminants to the groundwater.	See Step 3 for inputs	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 480 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and all operational and engineered controls (i.e., inventory resolution, leak detection, secondary containment) were to fail.

There are no potential receptors (i.e., potable water supply wells) located immediately downgradient of Service Station area. Travel time from the Service Station area to the BNL southern boundary is greater than 15 years, and most homes located south of BNL have been connected to public water. Therefore, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility.

Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions under applicable NYS regulations.

Step 7: Optimize the Design

Number and Location of Wells

The wells are located as close as possible to these potential source areas to allow for early detection of contaminant releases (Figure 12.33.1). The current monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years and the relatively small size of the potential source, no refinements are recommended.

Parameters and Frequency

Groundwater quality at the Service Station area has been evaluated using seven monitoring wells; two were installed in 1997, and five in 1999. Multiple sets of analytical data are available to assess potential impacts from current operations and historical spills.

- In 2000, petroleum hydrocarbon compounds such as xylenes (up to 420 µg/L) and ethylbenzene (up to 77 µg/L) and the solvent tetrachloroethylene (up to 36 µg/L) were detected in several monitoring wells located directly downgradient of the service station. (The NYS Ambient Water Quality Standard for these compounds is 5 µg/L.) An evaluation of Service Station operations indicated that the underground storage tanks and associated distribution lines were not leaking and that all waste oils and used solvents were being properly stored and recycled. Therefore, the petroleum hydrocarbon related compounds and tetrachloroethylene detected in groundwater were likely to have originated from small-scale releases from historical vehicle maintenance and fuel dispensing operations. Since 2000, xylene and tetrachloroethylene concentrations have decreased to < 10µg/L.
- High levels of carbon tetrachloride (up to 2,300 µg/L) can be detected in a number of groundwater monitoring wells located upgradient and downgradient of the Service Station. The high level of contamination is related to an inadvertent release of carbon tetrachloride during an April 1998 removal of an underground storage tank that was located approximately 200 feet northwest of the station. This release was not associated with Service Station activities, and the carbon tetrachloride contamination is being remediated as part of BNL's Environmental Restoration program.
- The gasoline additive MTBE is occasionally detected (up to 64 µg/L) in wells located downgradient of the gasoline USTs since 1997. (The NYS Ambient Water Quality Standard for MTBE is 10 µg/L.) The occurrence of MTBE in groundwater is likely due to historical or ongoing small-scale surface spills during vehicle re-fueling operations.

Groundwater samples will be collected on a semiannual basis to verify that continued operations at the Service Station are not impacting groundwater quality. Samples from seven Service Station monitoring wells will be analyzed semiannually for VOCs. Floating product determination measurements in wells located downgradient of the USTs will also be conducted semiannually. Samples will be also be analyzed on an annual basis for semi-volatile organic compounds to verify that these compounds are not impacting groundwater quality.

Table 12.33.2 Comparison of CY 2002 and CY 2003 Sampling Programs			
WELL	CY2002 SAMPLING FREQUENC Y	CY2003 SAMPLING FREQUENC Y	AFFECTED PARAMETERS
085-16	Semiannual	No Change	None
085-17	Semiannual	No Change	None
085-235	Semiannual	No Change	None
085-236	Semiannual	No Change	None
085-237	Semiannual	No Change	None

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Compared to CY2001, the changes described above will result in an overall cost **increase** of \$120.

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Douglas Paquette (631) 344-7046

Figure 12.33.1

Environmental Surveillance
Monitoring Well Locations
Service Station Area

LEGEND

Monitoring well

Buildings, Facilities

June 2001 Groundwater
Elevation (ft AMSL)

General Direction of
Groundwater Flow

SCALE

Former Carbon Tetrachloride UST

TR0529

Pump Island

Service Station Building

Former Waste Oil UST

TR0833 Current Waste Oil UST

Fuel Oil UST

Current Gasoline USTs

TR0612

0455

0630

0659

GROUNDWATER MONITORING AT THE MAJOR PETROLEUM FACILITY

DATE November 20, 2002

PROPOSED CHANGE

No new changes. In early 2002, the NYSDEC expanded the required analysis list for the MPF wells to include volatile organic compounds, including testing for MTBE. (Although MTBE is a common gasoline additive, it can be introduced to fuel oil as a contaminant during the refining process.) This change was implemented in April 2002. Monitoring well sampling frequency and analytical methods for 2003 are summarized in Tables 12.24.1 and 12.24.2.

DESCRIPTION AND TECHNICAL BASIS

In accordance with the New York State operating license for the Major Petroleum Facility, BNL routinely monitors groundwater quality downgradient of the MPF's bulk oil storage tanks. The monitoring program was initiated in the 1980s with five wells. Three additional wells were installed in 1999. In accordance with the updated license, the wells are monitored semiannually for semi-volatile organic and volatile organic compounds and monthly for floating petroleum products. To date, no fuel-related compounds or floating product have been detected.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☒ Compliance
- ☐ Support Compliance
- ☐ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS**Step 1: State the Problem**

The Major Petroleum Facility (MPF) is the holding area for fuels used at the Central Steam Facility (CSF). Fuel oil for the CSF is held in a network of seven above ground storage tanks, two of which are currently inactive. All fuel storage tanks are located in bermed containment areas that have a capacity to hold >110% of the volume of the largest tank located within each bermed area. The bermed areas have bentonite clay liners consisting of either Environmat (consisting of bentonite clay sandwiched between geotextile material) or bentonite clay mixed into the native soils to form an impervious soil/clay layer. Nevertheless, there is a potential that small-scale leakage from the base of the tanks may go undetected.

The collection of groundwater samples from wells located downgradient of the bulk storage area is required to demonstrate that current operational and engineered controls are effective in protecting groundwater quality. These controls include:

- The fuel storage tanks are connected to the CSF by above ground pipelines that have secondary containment and leak detection devices.
- All fuel storage tanks are located in bermed containment areas that have a capacity to hold >110% of the volume of the largest tank located within each bermed area.
- The bermed areas have bentonite clay liners consisting of either Environmat (consisting of bentonite clay sandwiched between geotextile material) or bentonite clay mixed into the native soils to form an impervious soil/clay layer.
- All fuel unloading operations were consolidated in one centralized building that has secondary containment features.
- BNL maintains an accurate inventory/accounting of fuel oil stored at the MPF.

Step 2: Identify the Decision

The decision for this monitoring program is:

- Are the operations of the MPF impacting groundwater quality? If so, do concentrations exceed water quality standards at the point of assessment (i.e., the closest downgradient well(s))?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the MPF
- Direction and velocity of groundwater flow
- Semi-volatile organic compound concentrations in groundwater
- Floating product determination measurements
- Locations of background and downgradient wells relative to known or potential source areas
- Regulatory requirements (NYSDEC Permit)
- Action levels – detection of floating petroleum on the water table, or detection of semi-volatile organic compounds at concentrations exceeding levels outlined in the Groundwater Contingency Plan
- Analytical methods and detection limits (as described in the Environmental Monitoring Plan)
- Volatile Organic Compounds (EPA 624 including MTBE)
- Semi-volatile Organic Compounds (EPA Method 625)
- Fuel inventory records

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediately downgradient of the MPF. A decision period of 180 days is sufficient to provide a secondary means of verifying that the operational and engineered controls in place at the MPF are effective. This time frame is based upon the following:

- As described above, the MPF has a number of engineered and operational controls that are designed to prevent leakage of fuel oil to the environment. A more frequent monitoring program can be implemented if a leak is found or suspected.
- The time required for small-scale petroleum hydrocarbons to migrate through the vadose zone and reach the groundwater table is likely to be 90 or more days. It is important to note that some petroleum hydrocarbons are not readily mobile in soils.
- Once contaminants have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, which are located approximately 100 feet from the tanks) is on the order of 130 days.
- The MPF is outside the 5-year capture zone for the BNL supply wells.

Step 5: Develop the Decision Rules

Are the operational and engineered controls effective at preventing the introduction of petroleum hydrocarbons to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response:

If for any monitoring well:

- The Semi-VOC concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling), and the contaminants are related to MPF operations, OR
- VOC or Semi-VOC concentrations exceed applicable water quality standards and indicate a release from a source not associated with known historical releases or current MPF operations (and this result is confirmed by re-sampling), OR
- Floating petroleum is found at the water table

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response:

If for any monitoring well:

- VOC or Semi-VOC concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling), OR
- VOC or Semi-VOC concentrations exceed applicable water quality standards (and this result is confirmed by re-sampling) and the suspected source is associated with a known historical spill, results may call for new/modified corrective actions,

then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.34.1 Decisions, Potential Errors, and Potential Consequences			
Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the release of contaminants to the groundwater.	See Step 3 for inputs	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 200 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and all operational and engineered controls (i.e., inventory resolution, leak detection, secondary containment) were to fail.

There are no potential receptors (i.e., potable water supply wells) located immediately downgradient of the MPF area. Travel time from the MPF area to the BNL southern boundary is greater than 15 years, and most homes located south of BNL have been connected to public water. Therefore, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental

degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions under applicable NYS regulations.

Step 7: Optimize the Design

Number and Location of Wells

The wells are located as close as possible to potential MPF source areas to allow for early detection of contaminant releases (Figure 12.34.1). The current approved monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years, and the relatively small size of the potential source, no refinements are recommended.

Parameters and Frequency

Groundwater quality at the MPF area is evaluated using eight monitoring wells; five were installed in the 1980s, and three were installed in 2000. Multiple rounds of analytical data are available to assess potential impacts from past and current operations. No impacts from MPF operations have been observed to date. During 2002, 1,2-dichloroethene and tetrachloroethylene were detected in one MPF well at concentrations exceeding the NYSAWQS of 5 ug/L. This contamination is thought to have originated from historical spills near the Central Steam Facility.

- In accordance with the NYSDEC operating permit, groundwater samples will continue to be collected on a semiannual basis for volatile organic (including MTBE) and semi-volatile organic compounds, and the wells will be checked monthly for the presence of floating petroleum.

Table 12.34.2 Comparison of FY 2002 and CY 2003 Sampling Programs			
WELL	CY2002 SAMPLING FREQUENC Y	CY2003 SAMPLING FREQUENC Y	AFFECTED PARAMETERS
076-16	Semiannual	No Change	None
076-17	Semiannual	No Change	None
076-18	Semiannual	No Change	None
076-19	Semiannual	No Change	None
076-25	Semiannual	No Change	None
076-378	Semiannual	No Change	None
076-379	Semiannual	No Change	None
076-380	Semiannual	No Change	None

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Compared to CY 2002, the program costs will increase by approximately \$2,000. This increase is due to the NYSDEC requirement to sample for VOCs.

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Douglas Paquette (631) 344-7046

Figure 12.34.1

Environmental Surveillance
Monitoring Well Locations
Major Petroleum Facility Area

LEGEND

- **Monitoring well**

- ## Buildings, Facilities

June 2001 Groundwater
Elevation (ft AMSL)

General Direction of
Groundwater Flow
June 2001

SCALE

JLH - 04/08/02

GROUNDWATER MONITORING AT THE BIOLOGY DEPARTMENT GREENHOUSE AREA

DATE November 20, 2002

PROPOSED CHANGE

Sampling frequency will be reduced from yearly to once every two years.

DESCRIPTION AND TECHNICAL BASIS

During 1999, BNL installed two monitoring wells downgradient of the Biology Department's greenhouse area (Wells 084-36 and 084-37) to evaluate the potential impact to groundwater by the use of pesticides, fertilizers and herbicides. Based upon data collected to date, groundwater quality in the greenhouse area has not been impacted by greenhouse operations.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

- ☐ Compliance
- ☐ Support Compliance
- ☒ Surveillance
- ☐ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

The Biology Department facility (Building 463) includes 11 greenhouses where various types of plants are grown for biological research. Eight of the greenhouses have dirt floors and three presently have concrete floors. Pesticides, such as Endosulphan II, and fertilizers have been routinely used in the greenhouses. Records also indicate that copper sulfate was also applied to the dirt floors on an annual basis up to 15 years ago. The pesticide Endosulphan II has been detected in soil samples collected from a dry well located within Greenhouse 10. It is likely that other pesticides have been used over the operational history of the facility.

The collection of groundwater samples from wells located downgradient of the greenhouse area is required to demonstrate that the operational and engineered controls are effective in protecting groundwater quality. These controls include:

- BNL maintains an inventory of all chemicals in storage and maintains records all chemical applications. All applicator personnel are trained and certified by the New

York Department of Environmental Conservation for the safe handling and application of these chemicals.

- The greenhouses are fully enclosed, and there are no direct pathways for rainwater to interact with potentially contaminated greenhouse soils. However, use of internal irrigation systems may cause some of the contaminants of concern to migrate into the soils below the greenhouses. The dry well located in Greenhouse 10 was sealed.

Step 2: Identify the Decision

The decision for this monitoring program is:

- Are the operations of the Biology Department's greenhouses impacting groundwater quality? If so, do concentrations exceed water quality standards at the point of assessment (i.e., the closest downgradient well)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the greenhouses
- Direction and velocity of groundwater flow
- Pesticide and metals concentrations in groundwater (including data on naturally occurring metals concentrations)
- Locations of background and downgradient wells relative to each range
- Regulatory requirements (DOE Order 5400.1)
- Action levels (as described in the Groundwater Contingency Plan)
- Analytical methods and detection limits:
- Pesticides/PCBs (EPA Method 608)
  - Metals (EPA Method 200 Series)
  - Anions (EPA Method 300)

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the Biology Department's greenhouses. The period for which decisions are made is 730 days. This time frame is based upon the following:

- The time required for most pesticides and heavy metals to migrate through the vadose zone and reach the groundwater table is expected to be greater than 365 days. It is important to note that many pesticides and metals are not readily mobile in soils under normal conditions.

- Once pesticides or heavy metals had migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, which is located approximately 100 feet from the greenhouses) is on the order of 130 or more days.
- Current data do not indicate that operations of the greenhouses are impacting groundwater quality.

Step 5: Develop the Decision Rules

Are the operational and engineered controls effective at preventing the introduction of pesticides or heavy metals to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response:

If for any monitoring well:

- The pesticide or metals concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling), OR
- Pesticide or metals concentrations indicate a new release from a previously unknown source (and this result is confirmed by re-sampling),

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response:

If for any monitoring well:

- The pesticide or metals concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling)

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.35.1 Decisions, Potential Errors, and Potential Consequences			
Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching lead to the groundwater.	See Step 3 for inputs	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 200 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and that the contaminants of concern are readily mobile in the aquifer system.

There are no potential receptors (i.e., potable water supply wells) located immediately downgradient of Biology Department greenhouse area. Travel time from the greenhouse area to the BNL southern boundary is greater than 20 years. Therefore, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions under NYS regulations.

Step 7: Optimize the Design**Number and Location of Wells**

The wells located downgradient of the Biology Department greenhouse area are biased toward detecting contamination originating from greenhouse operations (Figure 12.35.1). The wells are located as close as possible to these potential source areas to allow for early detection of contaminant releases. The current monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years and the relatively small size of the potential source, no refinements are recommended.

Parameters and Frequency

Groundwater quality at the Biology Department's greenhouse area has been evaluated using monitoring wells that were installed in early 2000. Multiple sets of analytical data are available to assess potential impacts from greenhouse operations.

- Detectable levels of pesticides were not found in any of the groundwater samples collected since the wells were installed in 2000. Nitrate levels are less than one-third the NYS Ambient Water Quality Standard of 10 mg/L, and no metals (including copper) associated with greenhouse operations have been detected. Because the greenhouses have been in operation for many years, the results indicate that use of pesticides, herbicides and fertilizers at this facility has not impacted groundwater quality. Groundwater samples will be collected every two years to verify that the continued greenhouse operations will not impact groundwater quality. The next sample period will be during 2004, and samples will be analyzed for pesticides, anions and metals.

Table 12.35.2 Comparison of CY 2002 and CY 2003 Sampling Programs

WELL	CY2002 SAMPLING FREQUENCY	CY2003 SAMPLING FREQUENCY	AFFECTED PARAMETERS
084-36	Annual	None	Sample in 2004
084-37	Annual	None	Sample in 2004

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Compared to CY2002, the changes described above will result in an overall cost reduction of \$1,700.

IMPLEMENTATION DATE   January 1, 2003

POINT OF CONTACT   Douglas Paquette (631) 344-7046

Figure 12.35.1

Environmental Surveillance
Monitoring Well Locations
Biology Department Greenhouse Area

LEGEND

Monitoring well

Supply Well

Dry Well

Buildings, Facilities

June 2001 Groundwater
Elevation (ft AMSL)

General Direction of
Groundwater Flow

SCALE

Acronyms and Technical Terms

AGS	Alternating Gradient Synchrotron
ALARA	As Low As Reasonably Achievable
amu	Atomic Mass Unit
ANSI	American National Standards Institute
AOC	Area of Concern
ASL	Analytical Services Laboratory
AS/SVE	Air Sparging/Soil Vapor Extraction
BGRR	Brookhaven Graphite Research Reactor
BLIP	Brookhaven Linac Isotope Producer
BMRR	Brookhaven Medical Research Reactor
BNL	Brookhaven National Laboratory
BOD ₅	Biological Oxygen Demand
BSA	Brookhaven Science Associates
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CA	Collider Accelerator
CAA	Clean Air Act
CASIM	Cascade Simulation
CCWP	Central Chilled Water Plant
CEM	Continuous Emissions Monitoring
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
CFR	U.S. Code of Federal Regulations
Ci	Curie
CO ₂	Carbon Dioxide
COC	Contaminant (or Chemical) of Concern
CSF	Central Steam Facility
CWA	Clean Water Act
CY	Calendar Year
D ₂ O	Deuterium; Heavy Water
DCA	1,1-Dichloroethane
DCE	1,1-Dichloroethylene
DCG	Derived Concentration Guide
DMR	Discharge Monitoring Report
DOE	U.S. Department of Energy
DOELAP	Department of Energy Laboratory Accreditation Program
DQO	Data Quality Objective
DWS	Drinking Water Standards
EDB	Ethylene dibromide
EDE	Effective Dose Equivalent
EIMS	Environmental Information Management System
ELAP	Environmental Laboratory Approval System
EM	Environmental Monitoring

EML	Environment Measurements Laboratory
EMP	Environmental Monitoring Plan
EMS	Environmental Management System
ER	Environmental Restoration
ERD	Environmental Restoration Division
EPA	Environmental Protection Agency
ES	Environmental Surveillance
ESD	Environmental Services Division
FFA	Federal Facilities Agreement
FFCA	Federal Facilities Compliance Act
FY	Fiscal Year
FWS	U.S. Fish and Wildlife Service
GAB	Gross Alpha Beta
GAC	Granulated Activated Carbon
GC/ECD	Gas Chromatography/Electron Capture Detector
GC/MS	Gas Chromatography/Mass Spectrometry
GEL	General Engineering Laboratory
GIS	Geographic Information System
GMR	Groundwater Monitoring Report
HAP	Hazardous Air Pollutant
HEDP	Hydroxyethylidene diphosphoric Acid
HEPA	High Efficiency Particulate Air
HFBR	High Flux Beam Reactor
HITL	Heavy Ion Transfer Line
HTO	Tritiated Water (liquid or vapor)
HWMF	Hazardous Waste Management Facility (former)
IAG	Interagency Agreement
IC	Ion-Chromatography
ICP/MS	Inductively Coupled Plasma/Mass Spectrometry
ISO	International Organization for Standardization
LED	Light Emitting Diode
LIE	Long Island Expressway
LINAC	Linear Accelerator
MCL	Maximum Concentration Level
MDL	Minimum Detection Limit
MEI	Maximally Exposed Individual
MGD	Million Gallons per Day
MH	Manhole
MOA	Memorandum of Agreement
MPF	Major Petroleum Facility
MRC	Medical Research Center
MTBE	Methyl Tertiary Butyl Ether
MW	Megawatt
NAAQS	National Ambient Air Quality Standards

ND	Not Detected or No Dose
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute for Standards and Technology
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSLS	National Synchrotron Light Source
NYCRR	New York Codes, Rules, and Regulations
NYS	New York State
NYSAWQS	New York State Ambient Water Quality Standard
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDWS	New York State Drinking Water Standard
O&M	Operation & Maintenance
ORPS	Occurrence Reporting and Processing System
OU	Operable Unit
PE	Plant Engineering
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethylene
PNNL	Pacific Northwest National Laboratory
ppb	Parts Per Billion
ppm	Parts Per Million
PPGMBE	Polypropylene Glycol Monobutyl Ether
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAP	Quality Assurance Program
QAPP	Quality Assurance Program Plan
QC	Quality Control
QES	Quarterly Emission Statement
QM	Quality Management
RA	Removal Action
RACT	Reasonably Achievable Control Technology
RCRA	Resource Conservation and Recovery Act
RESRAD	Residual Radioactive Material
RHIC	Relativistic Heavy Ion Collider
RI/FS	Remedial Investigations/Feasibility Study
ROD	Record of Decision
RTF	Radiation Therapy Facility
SARA	Superfund Amendments and Reauthorization Act
SCDHS	Suffolk County Department of Health Services
SDWA	Safe Drinking Water Act
SER	Site Environmental Report
SOC	Synthetic Organic Compound
SOP	Standard Operating Procedure
SO ₂	Sulfur Dioxide

SPCC	Spill Prevention Control and Countermeasures
SPDES	State Pollutant Discharge Elimination System
SPING	Sampler, Particulate, Iodine, and Noble Gas
STEM	Scanning Transmission Electron Microscope
STP	Sewage Treatment Plant
SVOC	Semivolatile Organic Compound
t _{1/2}	Half-Life
TAL	Target Analyte List
TCA	1,1,1-Trichloroethane
TCE	Trichloroethylene
TEDA	Triethylene Diamamine
TLD	Thermoluminescent Dosimeter
TOC	Total Organic Carbon
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
TSS	Total Suspended Solids
TTA	Tolytriazole
TVOC	Total Volatile Organic Compounds
UIC	Underground Injection Control
USC	United States Code
UST	Underground Storage Tank
VOC	Volatile Organic Compound
VUV	Vacuum Ultraviolet
WAC	Waste Acceptance Criteria
WCF	Waste Concentration Facility
WMF	Waste Management Facility
WQ	Water Quality
WSRRSA	Wild, Scenic, and Recreational River Systems Act
WTP	Water Treatment Plant

The definitions below reflect the typical manner in which the terms are used for this specific document and may not apply to all situations.

A

accuracy - The degree of agreement of a measurement with an accepted reference or true value. It is expressed as the difference between two values, as a percentage of the reference or true value, or as a ratio of the measured value and the reference or true value.

activation - The process of making a material radioactive by bombardment with neutrons, protons, or other high energy particles.

activation products - A material that has become radioactive through the process of activation.

activity - Synonym for radioactivity.

Administrative Record - A collection of documents established in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program. Consists of information upon which the CERCLA lead agency bases its decision on the selection of response actions. The Administrative Record file should be established at or near the facility and made available to the public. An Administrative Record can also be the record for any enforcement case.

aerosol - A gaseous suspension of very small particles of liquid or solid.

air sparging - A method of extracting volatile organic compounds from the groundwater *in situ* (i.e., in place) using compressed air. The vapors are typically collected using a soil vapor extraction system.

air stripping - A process whereby volatile organic chemicals are removed from contaminated water by forcing a stream of air through the water in a vessel. The contaminants are evaporated into the air stream. The air may be further treated before it is released into the atmosphere.

ALARA - As Low As Reasonably Achievable, a phrase that describes an approach to minimize exposures to individuals and minimize releases of radioactive or other harmful material to the environment to levels as low as social, technical, economic, practical, and public policy considerations will permit. ALARA is not a dose limit, but a process with a goal to keep dose levels as far below applicable limits as is practicable.

alpha radiation - The emission of alpha particles during radioactive decay. Alpha particles are identical in makeup to the nucleus of a helium atom and have a positive charge. Alpha radiation is easily stopped by materials as thin as a sheet of paper and has a range in air of only an inch or so. Despite its low penetration ability, alpha radiation is densely ionizing and therefore very damaging when ingested or inhaled. Naturally occurring radioactive elements such as radon emit alpha radiation.

ambient air - The surrounding atmosphere, usually the outside air, as it exists around people, animals, plants, and structures. It does not include the air immediately adjacent to emission sources.

analyte - A constituent that is being analyzed.

anion - A negatively charged ion, often written as a negative sign after an element symbol, such as Cl⁻.

anthropogenic radionuclides - Radionuclides produced as a result of human activity (i.e., human-made).

aquifer - A water saturated layer of rock or soil below the ground surface that can supply usable quantities of groundwater to wells and springs. Aquifers can be a source of water for domestic, agricultural, and industrial uses.

area of concern (AOC) - Under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), this term refers to an area where releases of hazardous substances may have occurred or a location where there has been a release or threat of a release into the environment of a hazardous substance, pollutant, or contaminant (including radionuclides). AOCs may include, but need not be limited to, former spill areas, landfills, surface impoundments, waste piles, land treatment units, transfer stations, wastewater treatment units, incinerators, container storage areas, scrap yards, cesspools, tanks, and associated piping that are known to have caused a release into the environment or whose integrity has not been verified.

atomic absorption (AA) - A method used to determine the elemental spectroscopy composition of a sample. In this method, the sample is vaporized and the amount of light it absorbs is measured.

B

background – a sample or location used as reference or control to compare BNL analytical results to those in areas that could not have been impacted by BNL operations.

background radiation - Radiation present in the environment as a result of naturally occurring radioactive materials, cosmic radiation, or human-made radiation sources, including fallout.

becquerel (Bq) - A quantitative measure of radioactivity. This is an alternate measure of activity used internationally and with increasing frequency in the United States. One Bq of activity is equal to one nuclear decay per second. All references to quantities of radioactive material in this report are made in curies, followed in parentheses by the equivalent in Bq.

beta radiation - Beta radiation is composed of charged particles emitted from a nucleus during radioactive decay, with a mass equal to 1/1837 that of a proton. A negatively charged beta particle is identical to an electron. A positively charged beta particle is called a positron. Beta radiation is slightly more penetrating than alpha, but may be stopped by materials such as aluminum or Lucite panels. Naturally occurring radioactive elements such as potassium-40 emit beta radiation.

biochemical oxygen demand (BOD) - A measure of the amount of oxygen in biological processes that breaks down organic matter in water; a measure of the organic pollutant load. It is used as an indicator of water quality.

blank – A sample (usually reagent grade water) in the same type of container used for quality control of field sampling methods, to demonstrate that cross contamination has not occurred.

blowdown - Water discharged from either a boiler or cooling tower in order to prevent the build-up of inorganic matter within the boiler or tower and to prevent scale formation (i.e., corrosion).

C

cap - A layer of material, such as clay or a synthetic material (like Gunitite™), used to prevent rainwater from penetrating and spreading contaminated materials. The surface of the cap is generally mounded or sloped so water will drain off.

carbon adsorption/carbon treatment - A treatment system in which contaminants are removed from groundwater, surface water, and air by forcing water or air through tanks containing activated carbon (a specially treated material that attracts and holds or retains contaminants).

carbon tetrachloride – A poisonous, nonflammable, colorless liquid, CCl₄.

chain-of-custody - A method for documenting the history and possession of a sample from the time of collection, through analysis and data reporting, to its final disposition.

characterization - Facility or site sampling, monitoring and analysis activities to determine the extent and nature of contamination. Characterization provides the basis of necessary technical information to select an appropriate cleanup alternative.

Class GA groundwater - New York State Department of Environmental Conservation classification for high quality groundwater, where the best intended use is as a source of potable water.

closure - Under the Resource Conservation and Recovery Act (RCRA) regulations, this term refers to a hazardous or solid waste management unit that is no longer operating and where potential hazards that it posed have been addressed (through clean up, immobilization, capping, etc.) to the satisfaction of the regulatory agency.

Code of Federal Regulations (CFR) - A codification of all regulations developed and finalized by federal agencies in the Federal Register.

collective effective dose equivalent - A measure of health risk to a population exposed to radiation. It is the sum of the effective dose equivalents of all individuals within an exposed population, frequently considered to be within 50 miles (80 kilometers) of an environmental release point. It is expressed in person-rem or person-sievert.

committed effective dose equivalent - The total Effective Dose Equivalent received over a 50-year period following the internal deposition of a radionuclide. It is expressed in rem or sieverts.

composite sample - A sample of an environmental media that contains a certain number of sample portions collected over a period of time. The samples may be collected from the same location or different locations. They may or may not be collected at equal time intervals over a predefined period of time (e.g., 24 hours).

confidence interval - A numerical range within which the true value of a measurement or calculated value lies. In this report, radiological values are shown with a 95% confidence interval, i.e., there is a 95 percent probability that the true value of a measurement or calculated value lies within the specified range.

contamination - Unwanted radioactive and/or hazardous material that is dispersed on or in equipment, structures, objects, air, soil, or water.

control – See background.

cooling water - Water that is used to cool machinery and equipment. Contact cooling water is any wastewater that contacts machinery or equipment to remove heat from the metal. Non-contact cooling water is water used for cooling purposes but has no direct contact with any process material or final product. Process wastewater cooling water is water used for cooling purposes that may have become contaminated through contact with process raw materials or final products.

curie (Ci) - A quantitative measure of radioactivity. One Ci of activity is equal to 3.7×10^{10} decays per second.

D

decay product - A nuclide resulting from the radioactive disintegration of a radionuclide, being formed either directly or as a result of successive transformations in a radioactive series. A decay product may be either radioactive or stable.

decontamination - The removal or reduction of radioactive or hazardous contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques to achieve a stated objective or end condition.

Department of Energy (DOE) - The federal agency that sponsors energy research and regulates nuclear materials used for weapons production. DOE has responsibility for the national laboratories and the science and research conducted at these laboratories, including BNL.

derived concentration guide (DCG) - The concentration of a radionuclide in air or water that, under conditions of continuous exposure for one year by a single pathway (e.g., air inhalation/immersion, water ingestion), would result in an effective dose equivalent of 100 mrem (1 mSv). The values have been established by DOE in Order 5400.5, *Radiation Protection of the Public and the Environment*. 1990, change 2, 1/7/93.

disposal - Final placement or destruction of waste.

dosimeter - A portable detection device for measuring the total accumulated exposure to ionizing radiation.

downgradient - In the direction of groundwater flow from a designated area; analogous to “downstream.”

E

effective dose equivalent (EDE) - A value used to express the health risk from radiation exposure to a tissue or tissues in terms of an equivalent whole body exposure. It is a normalized value that allows the risk from radiation exposure received by a specific organ or part of the body to be compared with the risk due to whole body exposure. It is equal to the sum of the doses to different organs of the body multiplied by their respective weighting factors. It includes the sum of the effective dose equivalent due to radiation from sources external to the body and the committed effective dose equivalent due to the internal deposition of radionuclides. EDE is expressed in units of rem or sieverts.

effluent - Any liquid discharged to the environment, including stormwater runoff at a site or facility.

emission - Any gaseous or particulate matter discharged to the atmosphere.

environment - Surroundings in which an organization operates (including air, water, land, natural resources, flora, fauna, and humans) and their interrelation.

environmental aspect - Elements of an organization’s activities, products, or services that can interact with the environment.

Environmental Assessment (EA) - A report that identifies potentially significant environmental impacts from any federally approved or funded project that may change the physical environment. If an EA identifies a “significant” impact (as defined by the National Environmental Policy Act [NEPA]), an Environmental Impact Statement is required.

environmental impact - Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization’s activities, products, or services.

environmental media - Includes air, groundwater, surface water, soil, flora and fauna.

environmental monitoring or surveillance - Sampling for contaminants in air, water, sediments, soils, food stuffs, plants, and animals, either by directly measuring or by collecting and analyzing samples.

Environmental Protection Agency (EPA) - The federal agency responsible for developing and enforcing environmental laws. Although state regulatory agencies may be authorized to administer environmental regulatory programs, EPA generally retains oversight authority.

ethylene dibromide (EDB) - A colorless, nonflammable, heavy liquid with a sweet odor; slightly soluble in water, soluble in ethanol, ether, and most organic solvents. It was used as an additive in leaded gasoline, as a soil and grain fumigant, and in waterproofing preparations. It is still used to treat felled logs for bark beetles; to control wax moths in beehives; as a chemical intermediary for dyes, resins, waxes, and gums; to spot-treat milling machinery; and to control Japanese beetles in ornamental plants. The U.S. Department of Health and Human Services has determined that ethylene dibromide may reasonably be anticipated to be a carcinogen.

Environmental Protection Agency (EPA) – The federal agency responsible for developing and enforcing environmental laws. Although state regulatory agencies may be authorized to administer environmental regulatory programs, the EPA retains oversight authority.

evapotranspiration - A process by which water is transferred from the soil to the air by plants that take the water up through their roots and release it through their leaves and other aboveground tissue.

exposure - A measure of the amount of ionization produced by x-rays or gamma rays as they travel through air. The unit of radiation exposure is the roentgen (R).

F

fallout - Radioactive material made airborne as a result of aboveground nuclear weapons testing that has been deposited on the Earth’s surface.

feasibility study (FS) - A process for developing and evaluating remedial actions using data gathered during the remedial investigation. The FS defines the objectives of the remedial program for the site and broadly develops remedial action alternatives, performs an initial screening of these alternatives, and performs a detailed analysis of a limited number of alternatives that remain after the initial screening stage.

G

gamma radiation - Gamma radiation is a form of electromagnetic radiation, like radio waves or visible light, but with a much shorter wavelength. It is more penetrating than alpha or beta radiation, capable of passing through dense materials such as concrete.

gamma spectroscopy - This analysis technique identifies specific radionuclides. It measures the particular energy of a radionuclide's gamma radiation emissions. The energy of these emissions is unique for each nuclide, acting as a "fingerprint" to identify a specific nuclide.

grab sample - A single sample collected at one time and place.

groundwater - Water found beneath the surface of the ground (subsurface water). Groundwater usually refers to a zone of complete water saturation containing no air.

Gunitite™ - A mixture of cement, sand, and water sprayed on a metal mold.

H

half-life ($t_{1/2}$) - The time required for one half of the atoms of any given amount of a radioactive substance to disintegrate; the time required for the activity of a radioactive sample to be reduced by one half.

hazardous waste - Toxic, corrosive, reactive, or ignitable materials that can negatively affect human health or damage the environment. It can be liquid, solid, or sludge, and include heavy metals, organic solvents, reactive compounds, and corrosive materials. It is defined and regulated by the Resource Conservation and Recovery Act (RCRA), Subtitle C.

heat input - The heat derived from combustion of fuel in a steam generating unit. It does not include the heat from preheated combustion air, recirculated flue gases, or the exhaust from other sources.

heavy water (D_2O) - A form of water containing deuterium, a nonradioactive isotope of hydrogen.

hot cell - Shielded and air controlled facility for the remote handling of radioactive material.

hydrology - The science dealing with the properties, distribution, and circulation of natural water systems.

I

inert - Lacking chemical or biological action.

influent - Liquid (e.g., wastewater) flowing into a reservoir, basin, or treatment plant.

intermittent river - A stream that dries up on occasion, usually as a result of seasonal factors or decreased contribution from other sources (e.g., a sewage treatment plant).

ionizing radiation - Any radiation capable of displacing electrons from atoms or molecules, thereby producing ions. Some examples are alpha, beta, gamma, x-rays, neutrons, and light. High doses of ionizing radiation may produce severe skin or tissue damage.

isotope - Two or more forms of a chemical element having the same number of protons in the nucleus (or the same atomic number), but having different numbers of neutrons in the nucleus (or different atomic weights). Isotopes of a single element possess almost identical chemical properties.

L

leaching - The process by which soluble chemical components are dissolved and carried through soil by water or some other percolating liquid.

light water – Tap water.

liquid scintillation counter - An analytical instrument used to quantify tritium, carbon-14, and other beta-emitting radionuclides.

M

maximally exposed individual (MEI) - The hypothetical individual whose location and habits tend to maximize his/her radiation dose, resulting in a dose higher than that received by other individuals in the general population.

mean sea level (MSL) - The average height of the sea for all stages of the tide. Used as a benchmark for establishing groundwater and other elevations.

minimum detection limit (MDL) - The lowest level to which an analytical parameter can be measured with certainty by the analytical laboratory performing the measurement. While results below the MDL are sometimes measurable, they represent values that have a reduced statistical confidence associated with them (less than 95% confidence).

mixed waste - Waste that contains both a hazardous waste component regulated under Subtitle C of the Resource Conservation and Recovery Act (RCRA) and a radioactive component.

monitoring - The collection and analysis of samples or measurements of effluents and emissions for the purpose of characterizing and quantifying contaminants, and demonstrating compliance with applicable standards.

monitoring well - A well that collects groundwater for the purposes of evaluating water quality, establishing groundwater flow and elevation, determining the effectiveness of treatment systems, and determining whether administrative or engineered controls designed to protect groundwater are working as intended.

N

nuclide - A species of atom characterized by the number of protons and neutrons in the nucleus.

O

on site - The area within the boundaries of a site that is controlled with respect to access by the general public.

opacity - Under the Clean Air Act (CAA), a measurement of the degree to which emissions (e.g., smoke) other than water reduce the transmission of light and obscure the view of an object in the background.

operable unit (OU) - Division of a contaminated site into separate areas based on the complexity of the problems associated with it. Operable units may address geographical portions of a site, specific site problems, or initial phases of an action. They may also consist of any set of actions performed over time, or actions that are concurrent, but located in different parts of a site. An operable unit can receive specific investigation and a particular remedy may be proposed. A record of decision (ROD) is prepared for each operable unit (*see* Record of Decision).

outfall - The place where wastewater is discharged.

oxides of nitrogen (NO_x) - All oxides of nitrogen, except nitrous oxide, which is expressed as nitrogen dioxide (NO₂).

ozone (O₃) - A very reactive form of oxygen formed naturally in the upper atmosphere and providing a shield for the earth from the sun's ultraviolet rays. At ground level or in the lower atmosphere, it is pollution that forms when oxides of nitrogen and hydrocarbons react with oxygen in the presence of strong sunlight. Ozone at ground level can lead to health effects and cause damage to trees and crops.

P

percent recovery – For analytical results, the ratio of the measured amount, divided by the known (spiked) amount, multiplied by 100.

permit - An authorization issued by a federal, state or local regulatory agency. Permits are issued under a number of environmental regulatory programs, including the Resource Conservation and Recovery Act (RCRA), Clean Air Act (CAA), Clean Water Act (CWA), and Toxic Substances Control Act (TSCA). They grant permission to operate, to discharge, to construct, etc. Permit provisions may include emission/effluent limits and other requirements such as the use of pollution control devices, monitoring, record keeping and reporting. Also called a “license” or “certificate” under some regulatory programs.

pH - A measure of hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH less than 7, neutral solutions have a pH of 7, and basic solutions have a pH greater than 7 and up to 14.

plume - A body of contaminated groundwater or polluted air flowing from a specific source. The movement of a groundwater plume is influenced by such factors as local groundwater flow patterns, the character of the aquifer in which groundwater is contained, and the density of contaminants. The movement of an air contaminant plume is influenced by the ambient air motion, the temperatures of the ambient air and of the plume, and the density of the contaminants.

plume – A body of contaminated groundwater flowing from a specific source. The movement of the groundwater is influenced by such factors as local groundwater flow patterns, the character of the aquifer in which groundwater is contaminated, and the density of contaminants.

point source - Any confined and discrete conveyance (e.g., pipe, ditch, well, or stack) of a discharge.

pollutant - Any hazardous or radioactive material naturally occurring or added to an environmental media, such as air, soil, water, or vegetation.

pollution prevention (P2) - Preventing or reducing the generation of pollutants, contaminants, hazardous substances, or wastes at the source, or reducing the amount for treatment, storage, and disposal through recycling. Pollution prevention can be achieved through reduction of waste at the source, segregation, recycle/reuse, and the efficient use of resources and material substitution. The potential benefits of pollution prevention include the reduction of adverse environmental impacts, improved efficiency, and reduced costs.

polychlorinated biphenyls (PCBs) - A family of organic compounds used from 1926 to 1979 (when they were banned by EPA) in electrical transformers, lubricants, carbonless copy paper, adhesives, and caulking compounds. PCBs are extremely persistent in the environment because they do not break down into different and less harmful chemicals. PCBs are stored in the fatty tissues of humans and animals through the bioaccumulation process.

potable water - Water of sufficient quality for use as drinking water without endangering the health of people, plants, or animals.

precision - The dispersion around a central value, usually represented as a variance, standard deviation, standard error, or confidence interval.

putrescible waste - Garbage that contains food and other organic biodegradable materials. There are special management requirements for this waste in 6 NYCRR Part 360.

Q

qualifier – A letter or series of letter codes indicating that the associated value is estimated. A qualified value is an estimated value.

quality assurance (QA) - In environmental monitoring, any action to ensure the reliability of monitoring and measurement data. Aspects of QA include procedures, inter-laboratory comparison studies, evaluations, and documentation.

quality control (QC) - In environmental monitoring, the routine application of procedures to obtain the required standards of performance in monitoring and measurement processes. QC procedures include calibration of instruments, control charts, and analysis of replicate and duplicate samples.

R

radioactive series - A succession of nuclides, each of which transforms by radioactive disintegration into the next until a stable nuclide results. The first member of the series is called the parent and the intermediate members are called daughters or progeny.

radioactivity - The spontaneous transition of an atomic nucleus from a higher energy to a lower energy state. This transition is accompanied by the release of a charged particle or electromagnetic waves from the atom. Also known as “activity.”

radionuclide - A radioactive element characterized by the number of protons and neutrons in the nucleus. There are several hundred known radionuclides, both artificially produced and naturally occurring.

recharge - The process by which water is added to a zone of saturation (aquifer) from surface infiltration typically when rainwater soaks through the earth to reach an aquifer.

recharge basin - A basin (natural or artificial) that collects water. The water will infiltrate to the aquifer.

Record of Decision (ROD) - A document that records a regulator agency’s decision for the selected remedial action. The ROD also includes a responsiveness summary and a bibliography of documents that were used to reach the remedial decision. When the ROD is finalized, remedial design and implementation can begin.

relative percent difference – A measure of precision, expressed by the formula: $RPD = [(A-B)/(A+B)] \times 200$, where A equals the concentration of the first replicate: and B equals the concentration of the second replicate.

release - Spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of a hazardous substance, pollutant, or contaminant into the environment. The National Contingency Plan also defines the term to include a threat of release.

rem - Stands for “roentgen equivalent man,” a unit by which human radiation dose is assessed. This is a risk-based value used to estimate the potential health effects to an exposed individual or population.

remedial (or remediation) alternatives - Options considered under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) for cleaning up contamination at a site, such as an operable unit (OU) or area of concern (AOC). Remedial actions are long-term activities that stop or substantially reduce releases, or prevent possible releases, of hazardous substances that are serious but not immediately life-threatening. See also feasibility study (FS) and record of decision (ROD).

remedial investigation (RI) - An investigation that includes extensive sampling and laboratory analyses to characterize the nature and extent of contamination, define the pathways of migration, and measure the degree of contamination in surface water, groundwater, soils, air, plants, and animals. Information gathered during the RI attempts to fully describe the contamination problem at the site so that the appropriate remedial action can be developed.

removal actions (RA) or removals - Interim actions that are undertaken to prevent, minimize, or mitigate damage to the public health or environment that may otherwise result from a release or threatened release of hazardous substances, pollutants, or contaminants pursuant to Comprehensive Environmental Response, Compensation, and Recovery Act (CERCLA), and that are not inconsistent with the final remedial action. Under CERCLA or Superfund, the U.S. Environmental Protection Agency may respond to releases or threats of releases of hazardous substances by starting a removal action. The purpose of the removal action is to stabilize or clean up an incident or site that poses an immediate threat to public health or welfare. Removal actions differ from remedial actions. However, removal actions must contribute to the efficiency of future remedial actions.

residual fuel – Crude oil, Nos. 1 and 2 fuel oil that have a nitrogen content greater than 0.05 weight percent, and all fuel oil Nos. 4, 5, and 6, as defined by the American Society of Testing and Materials in ASTM D396-78, *Standard Specifications for Fuel Oils*, (c. 2001).

runoff - The movement of water over land. Runoff can carry pollutants from the land into surface waters or uncontaminated land.

S

sampling - The extraction of a prescribed portion of an effluent stream or environmental media for purposes of inspection or analysis.

sediment - The layer of soil and minerals at the bottom of surface waters, such as streams, lakes, and rivers.

sensitivity - The minimum amount of an analyte that can be repeatedly detected by an instrument.

sievert (Sv) - A unit for assessing the risk of human radiation dose, used internationally and with increasing frequency in the United States. One sievert is equal to 100 rem.

skyshine - Radiation emitted over an open-topped shielded enclosure and reflected by air so as to radiate people on the outside.

sludge - Semisolid residue from industrial or water treatment processes.

soil vapor extraction - An *in situ* (in place) method of extracting volatile organic chemicals from soil. The chemicals are extracted by applying a vacuum to the soil and collecting the air, which can be further treated to remove the chemicals or discharged to the atmosphere.

sole source aquifer - An area defined by the U.S. Environmental Protection Agency as being the primary source of drinking water for a particular region. Includes the surface area above the sole source aquifer and its recharge area.

spallation - The process by which a high energy particle striking a nucleus causes fragments to be ejected from the nucleus. The resulting atom is usually radioactive.

stable - Nonradioactive.

stakeholder - People or organizations with vested interests in BNL and its environment and operations. Stakeholders include federal, state, and local regulators; the public; the U.S. Department of Energy; and BNL staff.

State Pollution Discharge Elimination System (SPDES) - A program under which permits are issued by the state to regulate wastewater discharges. The permit specifies the maximum discharge limits for the parameters present in the particular discharge.

stripping - A process used to remove volatile contaminants from a substance (*see also* Air Stripping).

sump - A pit or tank that catches liquid runoff for drainage or disposal.

T

thermoluminescent dosimeter (TLD) - A device used to measure radiation dose to occupational workers or radiation levels in the environment.

total volatile organic compounds (TVOC) - A sum of all individual VOC concentrations detected in a given sample.

trichloroethylene (TCE) (also, trichloroethene) - A stable, colorless liquid with a low boiling point. TCE has many industrial applications, including use as a solvent and as a metal degreasing agent. TCE may be toxic to people when inhaled or ingested, or through skin contact, and can damage vital organs, especially the liver (*see also* volatile organic compounds).

tritium - The heaviest and only radioactive nuclide of hydrogen, with a half-life of 12.3 years and a very low energy radioactive decay (beta emitter).

U

underground injection control (UIC) - Any hole whose vertical dimensions are larger than its largest horizontal dimensions and used for disposal of waste water.

underground storage tank (UST) - A stationary device, constructed primarily of nonearthen material, designed to contain petroleum products or hazardous materials. In a UST, 10% or more of the volume of the tank system is below the surface of the ground.

upgradient/upslope - A location of higher groundwater elevation; analogous to “upstream.”

V

vernal pool - A small, isolated, and contained basin that holds water on a temporary basis, most commonly during winter and spring. It has no aboveground outlet for water and is extremely important to the life cycle of many amphibians (such as the spotted salamander), as it is too shallow to support fish, a major predator of amphibian larvae.

volatile organic compounds (VOCs) - Secondary petrochemicals, including light alcohols, acetone, trichlorethylene, perchloroethylene, dichloroethylene, benzene, vinyl chloride, toluene, and methylene chloride. These potentially toxic chemicals are used as solvents, degreasers, paints, thinners, and fuels. Because of their volatile nature, they readily evaporate into the air, increasing the potential for human exposure. Due to their widespread industrial use, they are commonly found in soil and groundwater.

W

waste minimization - An action that avoids or reduces the generation of waste by source reduction, reduces the toxicity of hazardous waste, improves energy usage, or recycling. This action is consistent with the general goal of minimizing present and future threats to human health, safety, and the environment. Associated with pollution prevention, but more likely to occur after the waste has already been generated.

water table - The water-level surface below the ground at which the unsaturated zone ends and the saturated zone begins. It is the level to which a well that is screened in the unconfined aquifer would fill with water.

watershed - The region draining into a river, a river system, or a body of water.

weighting factor - A factor which, when multiplied by the dose equivalent delivered to a body organ or tissue, yields the equivalent risk due to a uniform radiation exposure of the whole body.

wind rose - A diagram that shows the frequency of wind from different directions at a specific location.

Environmental Monitoring Matrix CY 2003

The Environmental Monitoring Matrix CY 2003 Table on the following pages provides a combined list of measured parameters by media. Entries marked with a √ indicate a change from the previous calendar year (the corresponding data quality objective statement can be found in Chapters 5 through 12).

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
Water-SPDES: Compliance (See Chapter 9)						
	STP Effluent (8 months/year)	Monthly	Yes (cc)	ESD	24 Hr. Composite	TAL metals, nitrogen series, BOD ₅ , TSS, total phosphorus; sampled and analyzed 2x/month.
	STP Effluent (4 months/year)	Monthly	Yes (cc)	ESD	24 Hr. Composite	TAL metals, nitrogen series, BOD ₅ , TSS, total phosphorus, whole effluent toxicity testing; sampled and analyzed 3x/month.
	STP Effluent (1 month/year)	Annually	Yes (cc)	ESD	24 Hr. Composite (Grab)	Semi-VOCs (EPA 8270 and 15 compound library search), herbicides (EPA 8150), pesticides (EPA 608, grab sample). Sampled and analyzed 3x/month.
	STP Influent (8 months/year)	Monthly	Yes (cc)	ESD	24 Hr. Composite	TAL metals, BOD ₅ , TSS; sampled and analyzed 2x/month.
	STP Influent (4 months/year)	Monthly	Yes (cc)	ESD	24 Hr. Composite	TAL metals, BOD ₅ , TSS; sampled and analyzed 3x/month.
	STP Effluent (8 months/year)	Monthly	Yes (cc)	ESD	Grab Sample	VOCs (EPA 624) and ketones, cyanide, fecal coliform; sampled and analyzed 2x/month.
	STP Effluent (4 months/year)	Monthly	Yes (cc)	ESD	Grab Sample	VOCs (EPA 624) and ketones, cyanide, fecal coliform, PCBs (EPA 608); sampled and analyzed 3x/month.
	STP Effluent (Daily)	Monthly	Yes (cc)	EP	Grab Sample	Temperature, pH, suspended solids, flow; sampled and analyzed daily.
	HN, HT-W, HS, CSF, HT-E, HW, Bldg 1004/1002-Outfall 002B (Monthly)	Monthly	Yes (cc)	ESD	Grab Sample	Oil and grease and pH, (VOCs EPA 624, HW only); sampled and analyzed monthly.
	HX (Monthly)	Monthly	Yes (cc)	ESD/EP	Grab Sample	Flow (EP totalizer) and pH; sampled and analyzed monthly.
✓	HN, HT-W, HT-E, HW, CSF, HS, Bldg 1004/1002-Outfall 002B (Quarterly)	Quarterly	Yes (cc)	ESD	Grab Sample	HEDP, TTA, Copper at HS, VOCs (EPA 624) at HN, TAL Metals at HN, CSF, and HW (filtered and unfiltered); sampled and analyzed quarterly.
	Bldg. 535 Printed Circuit Board Lab	Quarterly	Yes (cc)	ESD/IO	Grab Sample	pH, Semi-VOCs (EPA 625), flow (IO), TAL metals (surveillance); sampled and analyzed quarterly.
	Bldg. 498 Central Cleaning Facility	Quarterly	Yes (cc)	ESD/EP	Grab Sample	pH, VOCs (EPA 624), Semi-VOCs (EPA 625), TAL metals, flow; sampled and analyzed quarterly.

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
Water-SPDES: Compliance (See Chapter 9)						
	Bldg. 197 Graphics Arts; 2 Locations (Quarterly)	Quarterly	Yes (cc)	ESD/ID	Grab Sample	pH, phenol, cyanide, silver, total nitrogen; sampled and analyzed quarterly.
	Bldg. 902 Cooling Tower (Quarterly)	Quarterly	Yes (cc)	ESD/CA	Grab Sample	pH, flow (CA), PPGMBE; sampled and analyzed quarterly.
	Satellite Boilers	Quarterly	No	EP/ESD	Grab Sample	pH, flow; sampling and analysis varies.
	HS, HO, HN, HT-W, HT-E, HM-N, HM-S, HQ, HE, HZ, and Outfall 002B (Flow circular chart/strip chart exchange)	Monthly	Yes (cc)	ESD	Grab Sample	Flow readings collected weekly. HO, HZ, HE, HM-S, HM-N, and HQ surveillance only not reported to regulators.
Potable Water: Compliance (See Chapter 11)						
	Potable Wells 4, 6, 7, 10, 11, and 12	Quarterly	Yes (cc)	ESD	Grab Sample	Gross alpha/beta, gamma, tritium, Sr-90, inorganic chemicals (IOC Groups 1, 2, 3, 4); sampled and analyzed quarterly.
	Potable Wells 4, 6, 7, 10, 11, 12, 10-GAC, 11-GAC, and 12-GAC	Quarterly	Yes (cc)	EP	Grab Sample	Principle Organic Contaminants (EPA 502.2); sampled and analyzed quarterly.
	Potable Wells 4, 6, 7, 10, 10-GAC, 11, 11-GAC, 12, 12-GAC, and Water Treatment Facility	Quarterly	Yes (cc)	EP	Grab Sample	Bacteriology; sampled and analyzed quarterly.
✓	Potable Water Distribution System	Monthly	Yes (cc)	EP	Grab Sample	Bacteriology; sampled and analyzed at 7 locations monthly.
		Quarterly	Yes (cc)	EP	Grab Sample	Water Quality; sampled and analyzed quarterly at 3 locations.
		Semiannual	Yes (cc)	EP	Grab Sample	Inorganic Chemicals (IOC 1, 2, 3, 4), Nitrate/Nitrite; sampled and analyzed semiannually.
		Annual	Yes (cc)	EP	Grab Sample	Asbestos; sampled and analyzed once per year.
		Triennially	Yes (cc)	EP	Grab Sample	Lead and Copper; sampled and analyzed once every three years at 20 locations.
	Western Well Field (Wells 4, 6, and 7)	Annually	Yes (cc)	EP	Composite	SOCs sampled and analyzed once per year. Sample composited by analytical laboratory.

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
Potable Water: Compliance (See Chapter 11)						
	Eastern Well Field (Wells 10, 11, and 12)	Annually	Yes (cc)	EP	Composite	SOCs sampled and analyzed once per year. Sample composited by analytical laboratory.
	Points of Entry	Biweekly	Yes (cc)	EP	Grab	Temperature, conductivity, and pH sampled and analyzed biweekly by operating personnel.
Groundwater: Compliance (See Chapter 12)						
✓	Major Petroleum Facility (8 monitoring wells)	Semiannual	Yes (cc)	ESD	Grab Sample	VOCs and MTBE (EPA 624), Semi-VOCs (EPA 625); sampled and analyzed semiannually.
		Semiannual	Yes (cc)	ESD	Grab Sample	Floating product check; sampled and checked monthly.
	Motor Pool Facility (6 monitoring wells)	Quarterly	Yes (cc)	ESD	Grab Sample	Floating product check; sampled and checked monthly.
		Quarterly	Yes (cc)	ESD	Grab Sample	VOCs and MTBE (EPA 624), Semi-VOCs (EPA 625); sampled and analyzed quarterly.
Sewage Treatment Plant: Surveillance (See Chapter 9)						
	EA	SER	SER	ESD	Composite	Metals, anions; sampled and analyzed monthly.
		SER	SER	ESD	Grab Sample	VOCs (EPA 524.2); sampled and analyzed monthly.
		SER	SER	ESD	Composite	Sr-90 and gamma; sampled three times per week and composited by the ASL for monthly analysis.
		SER	SER	ESD	Composite	Gross alpha/beta, tritium; sampled and analyzed 3x/week.
	DA	SER	SER	ESD	Composite	Metals, anions; sampled and analyzed monthly.
		SER	SER	ESD	Composite	Sr-90 and gamma; sampled three times per week and composited by ASL for monthly analysis.
		SER	SER	ESD	Composite	Gross alpha/beta, tritium; sampled and analyzed 3x/week.
	HFBR – MH #232	SER	SER	ESD	Weekly Composite	Tritium; sampled and analyzed once per week

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
<i>Sewage Treatment Plant: Surveillance (See Chapter 9)</i>						
	HFBR – MH #232	SER	SER	ESD	Weekly Composite	Gross alpha/beta, gamma; sampled once per month
<i>Surface Water - Peconic River: Surveillance (See Chapter 10)</i>						
	HY – Outside RHIC Ring	SER	SER	ESD	Grab Sample	Gross alpha/beta, gamma, tritium, Sr-90, metals (unfiltered), anions, VOCs (EPA 524.2); sampled and analyzed quarterly. Filtered metals samples collected semiannually
	HV – Inside RHIC Ring	SER	SER	ESD	Grab Sample	Gross alpha/beta, gamma, tritium; sampled and analyzed quarterly
	HE	SER	SER	ESD	24 Hr. Composite	Metals (unfiltered), anions, Sr-90, gamma, gross alpha/beta, tritium; sampled and analyzed quarterly. Filtered metals samples collected semiannually
		SER	SER	ESD	Grab Sample	VOCs (EPA 524.2); sampled and analyzed quarterly
	HM-N	SER	SER	ESD	24 Hr. Composite	Metals (unfiltered), anions; sampled and analyzed monthly. Filtered metals collected every other month.
		SER	SER	ESD	24 Hr. Composite	Sr-90, gamma; sampled monthly and composited by ASL for quarterly analysis
		SER	SER	ESD	24 Hr. Composite	Gross alpha/beta, tritium; sampled and analyzed once per month
		SER	SER	ESD	Grab Sample	VOCs (EPA 524.2); sampled and analyzed once per month
	HM-S	SER	SER	ESD	Grab Sample	Metals (unfiltered), anions, VOCs (EPA 524.2), Sr-90, gross alpha/beta, gamma, and tritium; sampled and analyzed quarterly. Filtered metals samples collected semiannually
	HQ	SER	SER	ESD	24 Hr. Composite	Metals (unfiltered), anions; sampled and analyzed monthly. Filtered metals samples collected every other month.

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
<i>Surface Water: Surveillance - Peconic River (See Chapter 10)</i>						
✓	HQ	SER	SER	ESD	24 Hr. Composite	Sr-90, gamma; sampled monthly and composited by ASL for quarterly analysis
		SER	SER	ESD	24 Hr. Composite	Gross alpha/beta, tritium; sampled and analyzed once per month
		SER	SER	ESD	Grab Sample	VOCs (EPA 524.2); sampled and analyzed once per month
	HA, HH	SER	SER	ESD	Grab Sample	Metals (unfiltered), anions, VOCs (EPA 524.2), gross alpha/beta, gamma, and tritium; sampled and analyzed quarterly. Filtered metals samples collected semiannually.
✓	HB, HC, HR			ESD	None	Sampling discontinued in 2002.
✓	Swan Pond, Donahue's Pond, Forge Pond	SER	SER	ESD	Grab Sample	Metals (unfiltered), anions, VOCs (EPA 524.2), gross alpha/beta, gamma, and tritium; sampled and analyzed quarterly. Filtered metals samples collected semiannually.
<i>Recharge Basins: Surveillance (See Chapter 9)</i>						
	HT-E, HT-W, HS, HN	SER	SER	ESD	24 Hr. Composite	Metals (unfiltered), anions, gross alpha/beta, tritium, and gamma; sampled and analyzed quarterly. Filtered metals samples collected semiannually.
	HT-E, HT-W, HS, HN	SER	SER	ESD	Grab Sample	VOCs (EPA 524.2); sampled and analyzed quarterly
✓	HW, HO, HZ	SER	SER	ESD	Grab Sample	Metals (unfiltered), anions, VOCs (EPA 524.2), gross alpha/beta, tritium, and gamma; sampled and analyzed quarterly. Filtered metals samples collected semiannually.
	CSF	SER	SER	ESD	Grab Sample	Metals (unfiltered), anions, VOCs (EPA 524.2); sampled and analyzed quarterly. Filtered metals samples collected semiannually.

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
Potable Water: Surveillance (See Chapter 11)						
✓	Wells #4, #6, #7, #10, #11, #12	SER	SER	ESD	Grab Sample	VOCs (EPA 524.2); sampled and analyzed quarterly.
	Wells #4, #6, #7, #10, #11, #12	SER	SER	ESD	Grab Sample	Anions, metals; sampled and analyzed annually.
Precipitation: Surveillance (See Chapter 8)						
	P4, S5	SER	SER	ESD	Monthly Composite	Gross alpha/beta, gamma, tritium; sampled and analyzed once per quarter.
Air Monitoring: Surveillance - Particulate Filter (See Chapters 5 and 6)						
	S6, P7, P7-2, S5, P4, P2, P9, NYSDOH	SER	SER	ESD	Weekly Composite	Gross alpha/beta; sampled and analyzed weekly. ASL composites filters for monthly gamma analysis.
	BLIP and Bldg. 801 Non-acid fan	SER	SER	ESD	Weekly Composite	Gross alpha/beta, gamma; sampled and analyzed weekly.
Air Monitoring: Surveillance – Charcoal (See Chapter 5)						
	Bldg. 801 Non-acid fan	SER	SER	ESD	Weekly Composite	Gamma; sampled and analyzed weekly
	BLIP	SER	SER	ESD	Weekly Composite	Gamma; sampled and analyzed weekly when BLIP is running.
Groundwater: Surveillance (See Chapter 12)						
✓	BMRR (4 wells)	SER/GMR	Semiannual	ESD	Grab Sample	Tritium sampled and analyzed semiannually. Gamma, gross alpha/beta sampled and analyzed annually.
✓	BLIP (7 wells)	SER/GMR	Semiannual	ESD	Grab Sample	Tritium sampled and analyzed quarterly. Gamma sampled and analyzed annually.
	STP (9 wells)	SER/GMR	Semiannual	ESD	Grab Sample	Metals, tritium, gross alpha/beta, gamma, anions; sampled and analyzed semiannually
✓	Live Fire Range (2 wells)	SER/GMR	Biennial	ESD	Grab Sample	Metals sampled and analyzed biennially. Next in 2004.
✓	RHIC (14 wells)	SER/GMR	Semiannual	ESD	Grab Sample	Tritium sampled and analyzed semiannually.

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
<i>Groundwater: Surveillance (See Chapter 12)</i>						
✓	AGS (55 Wells)	SER/GMR	Semiannual	ESD	Grab Sample	Tritium sampled and analyzed semiannually.
		SER/GMR	Annual	ESD/ERD	Grab Sample	VOCs (EPA 524.2), Gamma (select wells); sampled and analyzed annually.
	WMF (8 wells)	SER/GMR	Semiannual	ESD	Grab Sample	VOCs (EPA 524.2), tritium, gamma; sampled and analyzed quarterly
		SER/GMR	Semiannual	ESD	Grab Sample	Metals, gross alpha/beta, anions; sampled and analyzed semiannually
✓	Shotgun Range (3 wells)	SER/GMR	Biennial	ESD	Grab Sample	Metals sampled and analyzed biennially. Next in 2004.
✓	Biology Greenhouse (2 wells)	SER/GMR	Biennial	ESD	Grab Sample	Metals, anions, pesticides; sampled and analyzed biennially. Next in 2004.
✓	Water Treatment Plant (5 wells)	--	--	ESD	None	Monitoring discontinued in 2002.
<i>Groundwater: Environmental Restoration (See Chapter 12)</i>						
✓	Site Background (10 wells)	SER/GMR	--	ERD	Grab Sample	VOCs; sampled and analyzed annually
✓	Current Landfill (11 wells)	SER/GMR	--	ERD	Grab Sample	VOCs sampled and analyzed semiannually; anions, metals, cyanide, gross alpha/beta, gamma, tritium, Sr-90, Ra-226; sampled and analyzed quarterly
✓	Former Landfill (8 wells)	SER/GMR	--	ERD	Grab Sample	VOCs sampled and analyzed quarterly to annually; Pesticides/PCBs, gross alpha/beta, gamma, tritium, Sr-90, sampled and analyzed annually; anions, cyanide, sampled and analyzed quarterly; metals sampled and analyzed semiannually.
	OU III - Middle Road (26 wells)	SER/GMR	--	ERD	Grab Sample	VOCs; sampled and analyzed quarterly
✓	Chemical/Animal Holes (36 wells)	SER/GMR	--	ERD	Grab Sample	VOCs sampled and analyzed annually; Sr-90 sampled and analyzed semiannually to quarterly.

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
<i>Groundwater: Environmental Restoration (See Chapter 12)</i>						
✓	OU VI (27 wells)	SER/GMR	--	ERD	Grab Sample	VOCs, gross alpha/beta, tritium; sampled and analyzed annually; EDB sampled and analyzed quarterly
✓	OU I South Boundary (46 wells)	SER/GMR	--	ERD	Grab Sample	VOCs, tritium, Sr-90 sampled and analyzed annually to quarterly; gross alpha/beta, gamma, sampled and analyzed annually
	OU III North Street (23 wells)	SER/GMR	--	ERD	Grab Sample	VOCs, sampled and analyzed quarterly; gross alpha/beta, gamma, tritium, Sr-90; sampled and analyzed annually.
✓	OU III – Central (19 wells)	SER/GMR	--	ERD	Grab Sample	VOCs; sampled and analyzed quarterly
✓	OU III – Building 96 (20 wells)	SER/GMR	--	ERD	Grab Sample	VOCs; sampled and analyzed quarterly
	OU III – Carbon Tetrachloride (31 wells)	SER/GMR	--	ERD	Grab Sample	VOCs; sampled and analyzed quarterly
✓	OU III – South Boundary (39 wells)	SER/GMR	--	ERD	Grab Sample	VOCs; sampled and analyzed annually to quarterly.
✓	OU III – South Boundary Radionuclide (56 wells)	SER/GMR	--	ERD	Grab Sample	Gross alpha/beta, gamma, tritium; sampled and analyzed annually.
✓	OU III Western South Boundary (17 wells)	SER/GMR	--	ERD	Grab Sample	VOCs; sampled and analyzed quarterly
✓	OU III Magothy	SER/GMR	--	ERD	Grab Sample	VOCs; sampled and analyzed quarterly
✓	OU III (BGRR/WCF Sr-90) (61 wells)	SER/GMR	--	ERD	Grab Sample	Sr-90; sampled and analyzed semiannually
	OU III – Offsite (20 wells)	SER/GMR	--	ERD	Grab Sample	VOCs; sampled and analyzed quarterly.
✓	OU III – HFBR (132 wells)	SER/GMR	--	ERD	Grab Sample	Tritium; sampled and analyzed annually to quarterly. VOCs in selected wells; sampled and analyzed annually to quarterly.
✓	OU III – HFBR Low-Flow Remediation (25 wells)	SER/GMR	--	ERD	Grab Sample	Tritium; sampled and analyzed monthly
✓	OU III –Industrial Park (41 wells)	SER/GMR	--	ERD	Grab Sample	VOCs; sampled and analyzed annually to quarterly

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
Groundwater: Environmental Restoration (See Chapter 12)						
	OU IV – AOC 5 (21 wells)	SER/GMR	--	ERD	Grab Sample	VOCs, Semi-VOCs; sampled and analyzed quarterly
	OU IV – AOC 6 (31 wells)	SER/GMR	--	ERD	Grab Sample	Gross alpha/beta, gamma, tritium, Sr-90; sampled and analyzed semiannually
	OU V (34 wells)	SER/GMR	--	ERD	Grab Sample	VOCs, anions, metals, cyanide, gross alpha/beta, gamma, tritium; sampled analyzed semiannually. Pesticides/PCBs, hexavalent chromium in selected wells; sampled analyzed semiannually
Flora and Fauna: Surveillance - Terrestrial Sampling (On site) (See Chapter 8)						
✓	Soil	--	--	ESD	None	Monitoring discontinued in 2003.
✓	Vegetation	--	--	ESD	None	Monitoring discontinued in 2003.
	Deer	SER	SER	ESD	Grab Sample	Gamma and Sr-90 analysis on 25 samples as available.
	Small mammal – Squirrels	SER	SER	ESD	Grab Sample	Gamma and Sr-90 analysis on 10 samples annually.
	Garden Vegetables	SER	SER	ESD	Grab Sample	Gamma analysis on 5 samples annually.
	Soil from Vegetable Garden	SER	SER	ESD	Grab Sample	Gamma analysis on 1 sample annually.
✓	Soil/Sediment – Recharge Basins	SER	SER	ESD	Grab Sample	Metals, gamma, Semi-VOCs, VOCs, PCBs, and TCA analysis at 8 locations in 2003.
Flora and Fauna: Surveillance - Terrestrial Sampling (Off site) (See Chapter 8)						
	Deer	SER	SER	ESD	Grab Sample	Gamma and Sr-90 analysis on 40 samples as available.
	Small mammal – Squirrels	SER	SER	ESD	Grab Sample	Gamma and Sr-90 analysis on 5 samples as available.
✓	Soil	--	--	ESD	None	Monitoring discontinued in 2003.
✓	Vegetation	--	--	ESD	None	Monitoring discontinued in 2003.

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
Flora and Fauna: Surveillance - Aquatic Sampling (See Chapter 8)						
	Fish	SER	SER	ESD	Grab Sample	Gamma, Sr-90, metals, and pesticides/PCBs analysis on 40 samples annually.
✓	Freshwater mussels	--	--	ESD	None	Monitoring discontinued in 2003.
	Vegetation	SER	SER	ESD	Grab Sample	Gamma, metals, and pesticides/PCBs analysis on 8 samples annually.
	Sediment	SER	SER	ESD	Grab Sample	Gamma, Sr-90, metals, and pesticides/PCBs analysis on samples annually.
✓	Estuarine Clams/Mussels	--	--	ESD	None	Monitoring discontinued in 2003.
✓	Surface Water	--	--	ESD	None	Monitoring discontinued in 2003.
✓	Surface Water	--	--	ESD	None	Monitoring discontinued in 2003.
Air Emissions: Surveillance – Radiological - Silica Gel (See Chapters 5 and 6)						
✓	049-DC, 030-DC, 011-DC, 053-DC, 122-DC, 108-DC, 084-DC1, 084-DC2, S6, P7, P7-2, P2, P4, and P9	SER	SER	ESD	Bi-weekly Composite	Tritium; sampled continuously for two weeks and analyzed. (26 samples/year/location)
	BLIP	SER	SER	ESD	Weekly Composite	Tritium; sampled and analyzed weekly
	HFBR T-Tube	SER	Quarterly	HFBR	Monthly Composite	Tritium; sampled and analyzed once per month
Ambient Air: Surveillance - Radiological - TLD Exchange (Off site) - BNL Personnel (See Chapter 7)						
✓	000-TLD1, 000-TLD6, 200-TLD2, 300-TLD2, 300-TLD3, 500-TLD1, 500-TLD2, 500-TLD4, 700-TLD1, 700-TLD2, 700-TLD3, 700-TLD4, 800-TLD1, 800-TLD2, and 999-TLD1	SER	SER	ESD	Quarterly Composite	Beta/gamma; exchanged and analyzed quarterly.

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
Ambient Air: Surveillance – Radiological - TLD Exchange (On site) (See Chapter 7)						
✓	P4, S6, P7, P2, S5, 011-TLD1, 013-TLD1, 025-TLD1, 025-TLD4, 030-TLD1, 034-TLD1, 034-TLD2, 037-TLD1, 043-TLD1, 043-TLD2, 044-TLD1, 045-TLD1, 049-TLD1, 053-TLD1, 054-TLD1, 063-TLD1, 066-TLD1, 073-TLD1, 074-TLD1, 074-TLD2, 075-TLD3, 080-TLD1, 082-TLD1, 084-TLD1, 085-TLD1, 085-TLD2, 086-TLD1, 088-TLD1, 088-TLD2, 088-TLD3, 088-TLD4, 105-TLD1, 108-TLD1, 111-TLD1, 122-TLD1, 126-TLD1 and 15 new locations (Bldgs. 356, 914, 1002, 1004, 1005, and 1006) although sample location identifications have not been assigned	SER	SER	ESD	Quarterly	Beta/gamma; exchanged and analyzed quarterly.
Ambient Air: Surveillance – Radiological- TLD Exchange (Off site Facilities) (See Chapter 7)						
	000-TLD5, 000-TLD7, 400-TLD1, 600-TLD3, and 800-TLD3	SER	SER	ESD	Quarterly Composite	Beta/gamma; exchanged and analyzed quarterly.
Air Emissions: Compliance – Non-radiological (See Chapter 5)						
	CSF – Boiler #6	SER/QES	Yes (cc)	EP	Continuous	NO _x , CO ₂ , CO; Continuous Emissions Monitoring
	CSF – Boiler #7 Stack	SER/QES	Yes (cc)	EP	Continuous	NO _x , CO ₂ , CO; Continuous Emissions Monitoring
	CSF – Boiler #7 Stack	SER/QES	Yes (cc)	EP	Continuous	Opacity; Continuous Emissions Monitoring
	CSF – Tank Nos. 4, 9, and 10	SER/QES	Yes (cc)	EP	Quarterly	Sulfur and Nitrogen fuel content; Quarterly Analysis
	Used AC Shop Compressor Oil and Collider Accelerator Waste Separator Oil	SER/QES	Yes (cc)	EP	3-4 times per year	Cadmium, arsenic, lead, chromium, sulfur, PCBs, total halogens, flashpoint, and gross heat content; sampled and analyzed as needed.

Sampling Location		Reporting to Regulators	Reporting to Departments	Lead Organization	Sample Type	Analysis/Frequency
<i>Miscellaneous Monitoring (See Chapter9)</i>						
	MH #192, STP Influent and Effluent to the primary clarifier	--	--	ESD	Daily Performance Check	Sewer line radiological monitors daily performance checked with Cs-137 button source

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Instrumentation and Analytical Methods

The Analytical Services Laboratory (ASL) is divided into radiological and nonradiological sections to facilitate analysis of specific parameters in each category. The methods and instrumentation for each category are briefly described below. Only validated and regulatory referenced methods were used during the analysis. All samples are collected and preserved by trained technicians according to appropriate referenced methods. Qualified and trained analysts perform each of the different analyses.

RADIOLOGICAL ANALYTICAL METHODS

The ASL is certified by New York State Department of Health (NYSDOH) for gross alpha, gross beta, gamma, tritium and strontium-90 (non-potable water). The following is a description of the radiological analytical methods.

Gross Alpha and Gross Beta Analysis – Water Matrix – EPA 900.0

Water samples are collected in four-liter polyethylene containers by BNL sampling teams and preserved at the time of collection by acidification to pH 2 using nitric acid. Effluent or surface stream samples of 100 ml are extracted for analysis. Groundwater samples are typically analyzed using a 200-mL aliquot. The aliquot is evaporated to near-dryness in a glass beaker. Two drops of concentrated nitric acid are added, after which the solids are policed down the side of the beaker. The sample is transferred to a stainless steel planchet. Four drops of 10 percent Triton-X are added to the sample before it completely evaporates on a hot plate. The planchets are placed in a drying oven at 105°C for a minimum of 2 hours; removed to a desiccator and allowed to cool; and weighed and counted in a gas-flow proportional counter for 50 minutes. Groundwater samples are counted for 200 minutes. Samples are normally processed in batch mode. The first sample of each batch is a background, for which the count rate is subtracted from the raw data before computing net activity concentration. System performance is checked daily with National Institute for Standards and Technology (NIST) traceable standards: americium-241 for alpha and strontium-90 for beta. Spiked duplicates are performed within each batch of samples to determine precision and accuracy.

Gross Alpha and Gross Beta Analysis – Air Particulate Matrix

Air particulate samples are collected on 50-mm glass fiber filters at a nominal flow rate of 15 liters per minute. At the end of the collection, the filters are returned to the analytical laboratory for assay. After a one-week holding time, filters are counted once in a gas flow proportional counter for 50 minutes. This delay permits the short-lived radon/thoron daughters to decay. The first sample of each batch is a blank filter whose count rate is subtracted from the raw data before calculating net activity concentration. The system's performance is checked daily with NIST traceable standards: americium-241 for alpha and strontium-90 for beta.

Tritium Analysis – Water Matrix – EPA 906.0

Water samples are collected in glass containers. No preservatives are added before collecting the sample. Effluent and surface stream samples, as well as groundwater samples, are analyzed using a 7-mL aliquot. Potable-water samples (as well as other samples requiring a low minimum detection limit) are distilled following the method outlined in EPA Method 906.0 (EPA 1980) and a 7-mL aliquot is analyzed. Liquid scintillation cocktail is added to the aliquot so that the final volume in the liquid-scintillation-counting vial is 7 mL of sample plus 10 mL of cocktail. Samples then are counted in a low-background liquid-scintillation counter for 50 minutes. Samples are normally processed in batch mode. The first sample of each batch is a steam-distilled water background that is subtracted from the raw data before calculating the net activity concentration. The second sample in each batch is a NIST traceable tritium standard, which is used to verify the system's performance and efficiency. Each sample is also monitored for quenching. Corrections for background, quenching, and efficiency of the sample matrix are factored into the final net concentrations for each sample. Spiked duplicates are performed within each batch of samples to determine precision and accuracy.

Tritium Analysis – Air Matrix

Concentration of tritium in ambient and facility air is measured by drawing the air through a desiccant at a rate of approximately 200 cc/min. At the end of each collection period, typically one week, the desiccant is brought to the analytical laboratory for processing. It is heated in a glass manifold system. Dedicated glassware are used for environmental samples. The desiccant, containing moisture from the sampled air, is heated using an electric mantle, and the evaporated moisture is condensed by a water-cooled glass condenser. The total volume of water collected is determined gravimetrically. A 7-mL aliquot of this water is then assayed for tritium content. If the desiccant contains less than 7-mL of condensed liquid, a 1-mL aliquot is used. Liquid scintillation cocktail is then added to the aliquot so that the final volume in the counting vial is 17-mL. Samples are then counted in a low-background liquid-scintillation counter for 50 minutes. If a 1-mL aliquot was used, liquid scintillation cocktail is added to the vial so that the final volume is 11-mL. These samples are counted for 100 minutes. Samples are normally processed in batch mode. The first sample of each batch is a steam-distilled water background whose count rate is subtracted from the raw data before computing net activity concentration. The second sample in each batch is a NIST traceable tritium standard, which is used to verify the system's performance and efficiency. Each sample is also monitored for quenching. Corrections for background, water recovery, air sample volume, quenching and efficiency for the sample matrix are factored into the final net concentrations for each sample. Spiked duplicates are performed within each batch of samples to determine precision and accuracy, respectively.

Strontium-90 Analysis

Strontium-90 analyses are currently performed on water. Groundwater samples are processed inhouse using either DOE Method RP500, which utilizes a crown ether to selectively separate strontium from the acidified sample matrix, or an ion exchange resin method. The strontium is eluted from the resin or filtration disk using dilute nitric acid. The resulting eluent is evaporated on a 5 cm stainless steel planchet, and the sample is counted in a gas-flow proportional counter. Samples are prepared in batches, including a standard and a method blank in each batch. Chemical recovery is determined for each sample by the recovery of strontium carbonate. NIST traceable strontium-90 standards are used to calibrate and verify the performance of the counting instrument. Samples are counted once after a 2-week radiological in-growth time.

Potable water samples, as well as samples of solids, are shipped to a contractor laboratory, which is certified to perform the EPA (1980), 905.0 method for strontium-90 in drinking water. This method employs time-consuming and costly wet-chemistry techniques to isolate strontium from the sample. Samples are counted twice to verify strontium-90 and yttrium-90 in-growth. Samples are typically processed in a batch. Backgrounds and system performance are verified with each batch. Chemical recoveries are determined by either gravimetric or gamma emitting strontium-85 standard addition techniques.

Gamma Spectroscopy Analysis – EPA 901.1

Surface, potable, and groundwater surveillance samples are typically of 4 liters and are placed in polyethylene bottles acidified to pH 2 with nitric acid. Samples are then measured into a 4-L Marinelli™ beaker and counted on a calibrated gamma spectroscopy detector for 50,000 seconds. Air-particulate filters and air-charcoal canisters are counted directly on the calibrated gamma spectroscopy detector for 10,000 seconds. Soil, vegetation, and aquatic biota are all processed following collection. Typically, a 100-, 200- or 300-gram aliquot is taken, placed in a Teflon-lined aluminum can, and directly counted. For gamma spectroscopy analyses, overnight backgrounds are counted once per week, with calibration and background checked daily. Analytical results reflect net activity that has been corrected for background and efficiency for each counting geometry used.

NONRADIOLOGICAL ANALYTICAL METHODS

The ASL is certified by the NYSDOH Environmental Laboratory Approval Program (ELAP) for purgeable aromatics, purgeable halocarbons, PCBs, anions, and metal compounds, in both potable and wastewater matrices, using EPA 524, EPA 624, EPA 200.8, EPA 245.2, EPA 236.1, EPA 273.1 and EPA 300.0 methods. Tables D-1 and D-2 list the non-radiological organic and inorganic NYSDOH ELAP certified analytes, respectively.

Purgeable Aromatics and Purgeable Halocarbons

Water samples are collected in 40 mL glass vials with removable teflon-lined caps without any headspace and acidified 1:1 HCl to pH <2.0. Samples are stored at 4°C and analyzed within 14 days. Thirty eight purgeable compounds (including: benzene, toluene, ethyl benzene, total xylenes, chloroform, 1,1-dichloroethane, 1,1-dichloroethylene, tetrachloroethylene, 1,1,1-trichloroethane, trichloroethylene, chlorobenzene, carbon tetrachloride, methyl chloride and acetone) are analyzed under this category following EPA Method 624 protocols using Gas Chromatography/Mass Spectrometry (GC/MS). There are currently two Hewlett-Packard™ GC/MS instruments used to analyze purgeable organic compounds. Since groundwater under BNL is classified as a sole source aquifer under the Safe Drinking Water Act and Class GA groundwater by the New York State Department of Environmental Conservation (NYSDEC), the detection limits reported for the compounds are close to NYS drinking water standards and the ambient water quality standard. EPA drinking water Methods 524.2 and 624 are used to analyze water, based on the project manager's data quality requirements.

The method involves purging a 25-mL aliquot of the sample with ultra pure helium in a specially designed sparger using the Purge and Trap technique. Each sample is spiked with a known concentration of internal standards and surrogates before purging to facilitate identifying, quantifying, and determining the extraction efficiency of analytes from the matrix. The purged analytes are trapped onto a specially designed trap and thermally desorbed on to the capillary chromatographic column by back flushing the trap with helium. Individual compounds are separated with a temperature program of the GC and enter the mass spectrometer where they

undergo fragmentation to give characteristic mass spectra. The unknown compounds are identified by comparing their mass spectra and retention times with reference compounds and quantified by internal standard method. The quantitation data is supported by extensive Quality Assurance/Quality Control, such as tuning the mass spectrometer to meet bromofluorobenzene criteria, initial and continuing calibrations verifying daily response factors, method blanks, surrogate recoveries, duplicate analysis, matrix spike and matrix spike duplicate analysis, and reference standard analysis to verify the daily working standard.

PCB Analysis

The ASL is NYSDOH Certified for PCB Aroclors 1016, 1221, 1232, 1242, 1248, 1254 and 1260. Samples are collected in 50-100 mL glass containers with a Teflon^{TM}-lined lid and stored at 4°C and analyzed within 30 days. Transformer oil, mineral oil, hydraulic fluid, waste oil and spill wipe-samples are analyzed for PCBs using gas chromatography-dual electron capture detector (GC-ECD) method. This method is similar to EPA SW-846 Method 8082 and is targeted to identify and quantify seven different mixtures of PCB congeners in samples.

The method consists of diluting a known weight of the sample with isooctane and removing the interfering compounds with one or more aliquots of concentrated sulfuric acid until the acid layer is almost colorless. The entire oil matrix, along with other interfering polar compounds, is selectively removed from the sample, leaving the PCBs in isooctane solvent.

There is currently a single GC-ECD instrument for analyzing PCB. The PCBs found in the samples are identified and quantified by comparing the retention times and chromatographic patterns with the standards. Methods blanks, duplicates, spikes, calibration and reference check standards are run as part of QA/QC.

Anions

Chloride, nitrate-N, and sulfate are analyzed using Dionex Ion-chromatography (IC) with ion suppression and conductivity detection technique.

Samples from monitoring wells are collected in 100-mL polyethylene bottles, cooled to 4°C, and analyzed within 28 days. For nitrate in drinking water analysis, samples are analyzed within 48 hours. Holding times were exceeded for nitrate analysis of some nonpotable monitoring well samples, but the depletion of nitrate is expected to be negligible. The anions are passed through an anion-exchange polymer column and eluted with carbonate/bicarbonate solution. The eluent then passes through a membrane suppressor, where the background contribution from the eluent is suppressed, improving signal to noise ratio (and detection limits). The target anions are then detected by conductivity meter.

Initially, the system is calibrated with standards to define its working range. The target anions in the samples are identified and quantified by comparing the retention times and areas with the standards. Method blanks, duplicates, replicates, spikes, and reference standards are routinely analyzed as part of QA/QC.

Metals

Samples are collected in 500-mL glass bottles and stabilized with ultra-pure nitric acid to a pH of <2. The samples are analyzed within 6 months, except for mercury, which is analyzed within 26

days. Iron and sodium are analyzed with a Perkin-Elmer atomic absorption spectrometer. Using the flame technique, the sample containing the target element is nebulized and atomized in an oxy-acetylene flame. At the same time, a beam of light from an element-specific hollow cathode lamp corresponding to the absorption frequency of target element is passed through the flame. The atomized element absorbs the energy specific to that element from the cathode lamp and the intensity of absorption is proportional to the concentration of the element in the sample. Calibration curves establish the linearity of the system and samples are quantified by comparing with standards.

Fourteen of the 17 elements offered for certification in potable water by NYSDOH ELAP are analyzed by Inductively Coupled Plasma/Mass Spectrometry (ICP/MS). Iron and sodium are detailed in the preceding paragraph, and mercury in the following. Including aluminum, cobalt, molybdenum and vanadium, for which only wastewater certification is available, there are 18 elements analyzed by the ICP/MS technique. Aqueous samples are nebulized and introduced into a radio frequency argon plasma, at temperatures reaching 8000°K. The de-solvated, atomized analytes are ionized to predominantly singly-charged cations, which are identified and quantified by the use of a quadrupole mass spectrometer. Isobaric and polyatomic ion interferences are corrected using elemental interference equations based on natural isotopic abundances. Internal standardization eliminates or minimizes instrument drift and matrix induced signal suppressions and enhancements. Using this technique, sub-part per billion sample detection limits are achievable.

Using a cold-vapor technique for mercury, a 100-mL aliquot of the sample is digested with potassium permanganate/persulfate oxidizing solution at 95°C for two hours to oxidize any organically bound and/or monovalent mercury-to-mercury (II) oxidation state. Excess oxidizing agent is destroyed with hydroxylamine hydrochloride. The mercuric ion later is reduced to elemental mercury with excess stannous chloride, which is purged with argon into the absorption cell. The absorption is directly proportional to the concentration of mercury in the sample. All the atomic absorption techniques involve initial calibrations to define the calibration range, continuing calibrations, method blanks, duplicates, replicates, matrix spikes, and reference standard analysis as a part of QA/QC.

In the fall of 2000, a Leeman PS 200 II automated mercury analyzer was added. This unit enables improved detection limits (<0.1 µg/L) and a more stable baseline than previous instrumentation. This has resulted in improved data quality.

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Environmental Monitoring Sample Location Identification System

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The Environmental Information Management System (EIMS) became the sole repository for all environmental data in 2002. Previously, the EIMS held only environmental data from Environmental Restoration Division activities.

All data from compliance and environmental surveillance performed by the Environmental Services Division was housed in the environmental database shared with the BNL Analytical Services Laboratory. Data from 1995 to June 2002 held in this database was transferred to EIMS to facilitate its use as the sole repository. This involved changing the sampling location identifications used in previous environmental monitoring plans.

Appendix D on the following pages contains the new framework for developing sampling location identifications for sampling locations, which are not already established and provides the new sample IDs for pre-established sampling locations. It also provides a cross walk between the sampling location identifications used between 1995 and June 2002, and those which will be used from this point on.

The format for developing sample location identifications for non-routine or non-established locations is detailed below:

NON-ROUTINE LOCATION IDS

Location: nnnn
Field Code: -nn
Sequential Number: -nnn

Examples would be 650-GP-1, HO-S-1, and ECO-V-1

The **Location field** should be no longer than four digits and it should be the sampling location, such as a building, recharge basin, or area (i.e., glass holes). If the building number is five digits, such as 1005A, this is acceptable. If a location is not available, then a project code should be used (i.e., ECO for ecological samples collected for environmental surveillance).

The **Field Code** is a one- or two-digit code used to describe the sample collection method or matrix and should be chosen from the following list. If a new code is desired, please contact the author of EI-SOP-001.

A-Air	MU-Mussels	SW-Surface Water
B-Bird	MS-Miscellaneous	T-Turkey
BS-Bathroom Sink	O-Oil	V-Vegetation
CG-Goose	OS-Other sink	VP-Vertical Profile
CL-Clams	P-Paint	W-All other types of Water
CT-Cooling Tower	PW-Potable Water	WF-Water Fountain

CW-Cooling Water	RW-Rainwater	WI-Wipe
D-Deer	S-Soil	WW-Wastewater
DR-Drum	SD-Sediment	
F-Fish	SL-Sludge	
GP-Geoprobe	SQ-Squirrel	
KS-Kitchen Sink	ST-Sink Trap	

The *Sequential Number* should be three digits in length with no leading zeros.

The following table was established by the Environmental Services Division to define those stations, which were in conflict with EIMS:

New ESD Location ID	Previous Grid-ID #	Description
<u>SPDES</u>		
HN	036-600	Outfall 002, AGS cooling water and stormwater discharge
Bldg 1004/1002	036-601	Outfall 002B from Bldgs. 1004 and 1002
STP Influent	038-501	Influent to STP
STP Effluent	039-501, 039-502	Outfall 001, STP Effluent to the Peconic River at Bldg. 580
HT-W	054-600	Outfall 006A, Cooling Tower and Stormwater discharge
HT-E	054-601	Outfall 006B, Cooling Tower and Stormwater discharge
HX	063-600	Outfall 007, WTP Backwash discharge
HO	066-600	Outfall 003, AGS and HFBR Cooling water and stormwater discharge, west pond
197, Rm 1-87	074-727	Outfall 001D, Bldg 197 - Rm 1-87 - C-41 Printing Processor discharge
197, Rm 1-93B	074-731	Outfall 001D, Bldg. 197 - Rm 1-93B - Photo Processor discharge
Bldg 902 CT	074-730	Outfall 001F, Bldg 902 - Cooling Tower
Bldg 535 PCB	075-725	Outfall 001A, Bldg 535B basement - Printed Circuit Board discharge
CSF-OUTFALL	076-600	Outfall 010, Central Steam Facility stormwater discharge at outfall pipe
CSF-PIT	076-600	Outfall 010, CSF stormwater discharge sampled at concrete vault adjacent to Bldg. 528
HWM-Pond	087-650	Outfall 011, Old HWM marsh area outside fence
HP	094-600	Outfall 004, BMRR cooling tower discharge, wet pond
HW	095-600	Outfall 008, Warehouse stormwater discharge
Bldg 498 CF	095-725	Outfall 001B, Bldg. 498 - Central Cleaning Facility discharge
HS	105-600	Outfall 005, NSLS cooling water and stormwater discharge
HZ		Outfall 012, New Recharge Basin in 2002, cooling water and stormwater discharge
CLF-Pond	087-600	Pond, north side of current landfill
<u>Surface Water</u>		
HA	000-658	Peconic River, Schultz-Wading River Rd
HB	000-659	Peconic River, River Rd
HC	000-660	Peconic River, Connecticut Ave.

NewESD Location ID	Previous Grid-ID #	Description
HR	000-662	Peconic River, USGS Guaging Station
HH	000-663	Carmens River, Shirley
Donahue's Pond	000-664	Donahue's Pond, Calverton at Peconic River Sportman's Club
Forge Pond	000-665	Forge Pond, Riverhead Near Forge Road
Swan Pond	000-666	Swan Pond, Calverton off Old River Rd
L L Yaphank	000-667	Lower Lake Yaphank
HY	025-650	Peconic River, outside RHIC ring near North gate
HV	026-650	Peconic River, inside RHIC ring
HE	039-600	Peconic River, just upstream of STP (incorrectly identified as 000-661)
STP Pond1	039-650	STP Holding Pond #1, west pond
STP Pond2	039-651	STP Holding Pond #2, east pond
HM-S	049-600	Tributary to Peconic River, Old HWM Facility stormwater
Peconic River - RGC		Peconic River, near Riverhead Golf Course
Flanders Bay - RC		Flanders Bay, Riverhead town near Reeves Creek
Indian Island		Indian Island County Park, Riverhead near Indian Island in Flanders Bay
Peconic Bay		Peconic Bay- anything past Simmons Point in Flander's Bay
Moriches Bay - GGB		Great Gun Beach on Moriches Bay

Ecological Sampling

NYSDEC-GF		NYSDEC Game Farm, Ridge
May's Farm		May's Farm, Wading River
Lewin's Farm		Lewin's Farm, Wading River
Edward's Ave		Edwards Avenue Farm, Riverhead
Bruno's Farm		Bruno's Farm, Wading River Road South Manor, Exit 69 LIE
Cornell Co-op		Cornell Cooperative Farm, Yaphank Ave., Yaphank

Daily Sampling

EA	039-500	STP Effluent to the Peconic River
DA	038-500	STP Influent
HM-N	040-500	Peconic River on East Firebreak
HQ	061-500	Peconic River at the Site Boundary
	061-500	Peconic River at the Site Boundary
MH 232	075-800	HFBR Sanitary discharge including AC condensate
ZB	075-500	ASL Sampling of Distilled Water - Project: ES-DAILY
FN	075-401	ASL Sampling of Tap Water - Project: ES-DAILY

NewESD Location ID	Previous Grid-ID #	Description
<u>Rainwater</u>		
S5	038-550	Rain Sampler at the Sewage Treatment Plant
P4	109-550	Rain Sampler at the Apartment Laundry
<u>Well Sampling</u>		
Grid-ID	There is one change to how wells are identified The well ID is the 3-digit Grid followed by a 2 or 3-digit ID	
<u>Potable Water</u>		
F1	073-400	WTP INFLUENT
F2	073-401	WTP EFFLUENT
Well 1	075-400	Potable Well #1 - Railroad & Brookhaven
Well 4	083-400	Potable Well #4 - Brookhaven & Wood Shop
Well 6	093-400	Potable Well #6 - Near Compton House
Well 7	092-400	Potable Well #7 - Firebreak West of #6
Well 9	084-302	Process Well #9 - Biology
Well 10	055-400	Potable Well #10 - E. 5th & Thompson
Well 11	056-400	Potable Well #11 - E. 5th
Well 12	056-401	Potable Well #12 - E. 5th
Well 102	063-301	Process - Cooling Well #102 - Upton
Well 10-GAC		Well 10 Granulated Activated Carbon Treated Water
Well 11-GAC		Well 11 Granulated Activated Carbon Treated Water
Well 12-GAC		Well 12 Granulated Activated Carbon Treated Water
<u>Tritium Sampling</u>		
P9	006-300	Block house P9 on North Firebreak
011DC	011-300	Portable Sampler on North Firebreak, 1T
012DC	012-300	Portable Sampler on North Firebreak
P2	017-300	Block house P2 on North Firebreak behind RHIC ring
030DC	030-300	Portable Sampler on East Firebreak, 3T
034DC	034-300	Portable sampler on North Access road, 15T
049DC	049-300	Portable Sampler on East Firebreak near station HM-S, 4T
053DC	053-300	Portable Sampler on West Firebreak, 14T
063DC	063-300	Portable Sampler on West Firebreak, 13T
BLIP	064-350	BLIP - BLDG 931
075DC	075-300	Portable Sampler North of Bldg. 129
HFBR T-Tube	075-354	HFBR - BLDG 750 Blower Room, Collected by Facility Support
076DC1	076-300	Portable sampler in NE corner of the RA V Recharge Basin

NewESD Location ID	Previous Grid-ID #	Description
076DC2	076-301	Portable Sampler in SE corner of the RA V Recharge Basin
076DC3	076-302	Portable Sampler in grass area in front of Bldg. 650
077DC	077-300	Portable Sampler South of NOAA Weather Service Bldg.
080DC	080-300	Portable Sampler on East Firebreak, 5T
082DC	082-300	Portable Sampler on West Firebreak, 12T
084DC1	084-350	Portable Sampler in Bldg 490, ASL Lab Rm 9-527
084DC2	084-351	Portable Sampler in Bldg 490, ASL Lab Rm 9-523
S6	088-300	Block house S6, near the former hazardous waste facility
P7	090-300	Block house P7 on South Firebreak, near East Gate
P7-2	090-301	Block house P7 on S. Firebreak, near East Gate, duplicate sample; mark as blind duplicate
105DC	105-300	Portable Sampler on South Firebreak, near Railroad Street
108DC	108-300	Portable Sampler on South Boundary Road
P4	109-300	Block house P4 near Apartment Laundry
111DC	111-300	Portable Sampler at Apartment Area, 10T
	111-300	Portable Sampler at Apartment Area, 10T
122DC	122-300	Portable Sampler on South Boundary Road
126DC	126-300	Portable Sampler on South Boundary Road near the South Gate, 9T

Particulate Sampling

P9	006-200	
P2	017-200	Block house P2 on North Firebreak behind RHIC Ring
S5	038-250	Block house S5 at the Sewage Treatment Plant
BLIP	064-250	BLIP - BLDG 931
801 Non-Acid	065-251	801 Non-Acid Fan emissions
S6	088-200	Block house S6, near the former hazardous waste facility
P7	090-200	Block house P7 on South Firebreak, near East Gate
P7-2	090-201	Block house P7 on S. Firebreak, near East Gate, duplicate sample; mark as blind duplicate
NYSDOH	090-202	Block house P7 particulate filter collected for NYSDOH
P4	109-200	Block house P4 near Apartment Laundry

Charcoal Sampling

P9	006-100	Block house P9 on North Firebreak
P2	017-100	Block house P2 on North Firebreak behind RHIC ring
S5	038-150	Block house S5 at the Sewage Treatment Plant
BLIP	064-150	BLIP - BLDG 931
801 Non-Acid	065-151	801 Non-Acid Fan emissions
S6	088-100	Block house S6, near the former hazardous waste facility

NewESD Location ID	Previous Grid-ID #	Description
P7	090-100	Block house P7 on South Firebreak, near East Gate
P7-2	090-101	Block house P7 on S. Firebreak, near East Gate, duplicate sample; mark as blind duplicate
P4	109-100	Block house P4 near Apartment Laundry

TLDs

011-TLD1	011-400	North Firebreak, N Sector
013-TLD1	013-400	TLD at Block house P9, NE Sector
P2	017-400	Block house P2 on North Firebreak behind RHIC ring
025-TLD1	025-400	Bldg. 1010 beam stop 1
025-TLD4	025-403	Bldg. 1010 beam stop 4
030-TLD1	030-400	East Firebreak,ENE Sector
043-TLD1	034-400	North Access road, NNW Sector
043-TLD2	034-401	North Meteorolgy,NNW Sector
034-TLD1	034-403	Bldg 1008 collimator 2
034-TLD2	034-405	Bldg 1008 collimator 4
037-TLD1	037-400	Station S-13, near tree dump,NE Sector
S5	038-450	Block house S5 at the Sewage Treatment Plant
044-TLD1	044-400	Bldg. 1006
045-TLD1	045-400	Bldg. 1005S
049-TLD1	049-400	East Firebreak near station HM-S, E Sector
053-TLD1	053-400	West Firebreak, NW Sector
054-TLD1	054-400	Bldg. 914
063-TLD1	063-400	West Firebreak, WNW Sector
066-TLD1	066-400	New HWM Facility
073-TLD1	073-400	West Meteorology - Bldg. 51, W Sector
074-TLD1	074-450	Bldg. 197, W Sector
074-TLD2	074-451	Bldg. 907, W Sector
075-TLD4	075-000	Personnel Monitoring control sample, Bldg. 535A
075-TLD3	075-402	Bldg. 356
080-TLD1	080-400	East Firebreak, ESE Sector
082-TLD1	082-400	West Firebreak, W Sector
084-TLD1	084-400	Tennis Courts
085-TLD1	085-400	TFCU
085-TLD2	085-401	Upton gas station
086-TLD1	086-400	BERA ball fields
S6	088-400	Block house S6, near the former hazardous waste facility
088-TLD1	088-401	On fence at former Hazardous Waste Facility, 50' east of station S6
088-TLD2	088-402	On fence at former Hazardous Waste Facility, 50' west of station S6

NewESD Location ID	Previous Grid-ID #	Description
088-TLD3	088-403	On fence at former Hazardous Waste Facility, 100' west of station S6
088-TLD4	088-404	On fence at former Hazardous Waste Facility, 150' west of station S6
P7	090-400	Block house P7 on South Firebreak, near East Gate
105-TLD1	105-400	South Firebreak near Railroad Street, S Sector
108-TLD1	108-450	Water Tower, SE Sector
P4	109-400	Block house P4 near Apartment Laundry
111-TLD1	111-400	Apartment Area, SW Sector
122-TLD1	122-400	South Boundary Road, SSE Sector
126-TLD1	126-400	South Boundary Road near the South Gate, SSW Sector

ASL Composites**Water**

EA	039-500	Description should contain dates of composites
DA	038-500	Project Code - ES-DAILYC
HM-N	040-500	
HQ	061-500	

Air

P7	090-300/200/100	Description should contain dates of composites
S6	088-300/200/100	Project Code - ES-AIRC
S5	038-250/150	
P4	109-300/200/100	
P2	017-300/200/100	
P9	006-300/200/100	
P7-2	090-301/201/101	

Refer to Non-Routine Format for all Other Samples.**Drinking Water/Faucet Sampling**

373-WF-1	Child Care Center, main fountain upon entering the building
370-KS-1	Little Red Schoolhouse, kitchen sink

Manholes

Standardized Format as follows	This sample ID System follows Plant Engineering's System of numbering manholes.
MH-nnn	i.e., MH-232, MH-118, MH-141A * should be provided by sampler requester

Underground Injection Control

Standardized Format as Follows

These are permanently assigned identification numbers as in the BNL UIC Permit.

Bldg. #-UIC Type-Sequential Number

i.e., 1005-DW-1, 369-CP-3, 535-ST-4, and 911-LF-2

DW = Dry Well

CP = Cesspool

ST = Septic Tank

LF = Leaching Field

* should be provided by sampler requester

Appendix D

Environmental Monitoring Sample Identifications Used 1995 - June 2002

Type 1 - Water Sample Identifications

001 thru 299	Monitoring Well
300 thru 399	Process Well
400 thru 499	Potable Well - (Including Off-site SCDHS-Sequentially)
500 thru 549	Daily (EA, DA, HM-N, HQ)
550 thru 599	Rainwater
600 thru 649	Recharge Basin, Cooling Tower
650 thru 699	Pond, River
700 thru 724	Storm Drain - Sequentially Numbered
725 thru 749	SPDES Discharge
750 thru 799	Water Fountain/Sink - Sequentially Numbered
800 thru 899	Manhole - Sequentially Numbered

Type 2 - Air Sample Identifications

100 thru 149	Charcoal
150 thru 199	Facility Charcoal
200 thru 249	Particulate
250 thru 299	Facility Particulate
300 thru 349	Silica Gel
350 thru 399	Facility Silica Gel
400 thru 449	TLD
450 thru 499	Facility TLD

Type 3,4,5,6,7 Sequential Identifications

001 thru 999	Soil
001 thru 999	Fish
001 thru 999	Oil
001 thru 999	Vegetative
001 thru 999	Fauna

Type 8 - Miscellaneous Identifications

100 thru 199	Cesspool Debris
200 thru 299	Fluid
300 thru 399	Sludge
400 thru 499	Hazardous Waste