8 FLORA, FAUNA, PRECIPITATION, SOILS, AND PECONIC RIVER

CHAPTER CONTENTS

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FISH, AQUATIC VEGETATION, AND SEDIMENT

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 6, November 29, 2011

IMPLEMENTATION DATE January 1, 2012

POINT OF CONTACT Tim Green (631) 344-3091

SUMMARY OF PROPOSED CHANGES

This data quality objective (DQO) was updated to reflect changes in DOE Orders pertaining to environmental monitoring. Analysis for pesticides and polychlorinated biphenyls (PCBs) have been removed. PCBs are covered in the on-site sampling of fish for the Peconic River Post-Cleanup Monitoring DQO.

DESCRIPTION AND TECHNICAL BASIS

BNL has historically carried out surveillance monitoring of fish, aquatic vegetation, sediment, 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 (STP) operations, environmental management programs (Comprehensive Environmental Response, Compensation and Liability Act [CERCLA]), and the Peconic Estuary Program. Historic data typically indicates the presence of cesium-137 (Cs-137), various heavy metals, PCBs, and certain pesticides within the various aquatic media at locations on site, with declining concentrations downstream of the Laboratory. PCBs and pesticides have also been detected in control locations. Historic data consistently indicates 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 establishes 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 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, Forge Pond, and at Lower Lake on the Carmans River (a control location). Annual sampling on site between 1990 and 1999 had resulted in a depletion of the number and size of fish available for sampling. As a result, sampling was suspended to allow the fish population to recover. Drought and clean-up operations had prevented the re-establishment of sufficient fish populations for sampling, and the suspension of on-site sampling continued until the populations recovered. In 2007, sufficient numbers and sizes of fish were present on site to allow sampling. Continued presence of water throughout the year within the Peconic River suggests that fish sampling can now be supported. Results of sampling at other areas along the Peconic River have shown a decline in the levels of Cs-137 found in fish, both over time and distance from the Laboratory. However, fish sampling along the Peconic River has also consistently shown the presence of PCBs, pesticides, and some heavy metals in fish tissues that are attributable to historical BNL practices

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

____ Compliance
_x_ Support compliance
_x_ Surveillance
_x_ Restoration

- DOE Order 436.1 (2011), *Departmental Sustainability*, requires sites to maintain an Environmental Management System (EMS). BNL's EMS specifies requirements for conducting general surveillance monitoring to evaluate the effects, if any, of site operations. DOE Order 458.1, *Radiation Protection of the Public and Environment* (2011), 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 STP 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.
- Surveillance monitoring to document continued effectiveness of environmental cleanup operations and trends of changing levels of contaminants in fish is also considered a "best management practice."

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. 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). Problems in the monitoring program include: documentation of the continued decline in existing contaminants, documentation of the success of cleanup operations along the river, and having a mechanism to complete additional sampling of sediment, 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, vegetation, and sediment surveillance monitoring programs can be represented through the following questions:

- Are contaminants attributable to Laboratory operations present in fish, vegetation, and sediment within the Peconic River System?
- Are fish populations and fish sizes on site large enough to support 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 sediment 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
- New York State Department of Environmental Conservation (NYSDEC) consumption guidelines: 15 lb/year/person of fish for dose assessment
- U.S. Environmental Protection Agency (EPA) water quality criteria for methyl mercury (0.3 mg/kg)
- Field Sampling Team field logs and records maintained by field sampling personnel
- Environmental Monitoring Standard Operating Procedures (SOPs)
- Documented remediation of contaminated river sediment
- Records of Decision (RODs) for the STP remediation in Operable Unit (OU) V
- Closeout reports for the STP and Peconic River Cleanup Projects
- Peconic River Annual Monitoring Report and 5-Year Reviews
- 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. Sampling is carried out during the spring and summer months when oxygen levels support the presence of fish in the shallow waters of the Peconic River.

Step 5: Develop the Decision Rule

Decision 1

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

If surveillance monitoring of fish, vegetation, and sediment detect BNL-attributed contaminants such as heavy metals, Cs-137, PCBs, or pesticides, **then** surveillance monitoring will continue.

If historic data for fish, 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 will 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 to determine the need for additional monitoring or resuming suspended monitoring in an area.

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 surveillance monitoring?

If annual fish population and size surveys indicate that sufficient numbers of fish exist at sizes large enough for sampling, **then** surveillance monitoring of fish will occur on site.

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 be 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 that surveillance samples can be obtained 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 sediment, **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 Environmental Protection Division (EPD) 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 sediment within the Peconic River?

Since cleanup of the upper reaches of the Peconic River is complete, surveillance monitoring should document the effectiveness of the cleanup.

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

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

If the assessment indicates that further monitoring is necessary, **then** an evaluation will be completed to identify all aspects of the continued presence of contaminants in the Peconic River System.

Step 6: Specify Acceptable Error Tolerances

Because the upper reaches of the Peconic River are typically fed by discharges from the BNL STP, the effects of these discharges must be monitored. Historic discharges have resulted in various contaminants accumulating in river sediment. Monitoring data will be of sufficient quality to measure constituents to the same level of detection used for drinking water standards. False positives and negatives will be minimized and data will 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 and other appropriate sampling techniques to collect the highest number of 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 feet east of the east firebreak up to the outfall of the STP.

Fish sampling will include at least five samples of each species of fish, as is practical or available, including brown bullhead, chain pickerel or largemouth bass, or yellow perch. Fish from different feeding guilds (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: BNL site, when population sizes permit; Swan Pond; Donahue's Pond; Forge Pond on the Peconic River; and Lower Lake on the Carmans River (control location). Additional locations along the Peconic River may be sampled as part of monitoring for the post-cleanup of the Peconic River (i.e., Manor Road area and Shultz Road area). Fillets of larger species of fish will be utilized as being representative of edible portions. Radionuclide (gamma) analysis may require composite sampling of two or more fish to ensure sufficient sample volume for analysis. In order to maximize the analytical process, sample analysis will be conducted in priority order of: mercury, metals, PCBs (on site samples only), and gamma emitting radionuclides. It may be necessary to take separate samples or composite samples to gather radionuclide data. Smaller species will be composited and analyzed as whole body and will be indicative of prey- or bait-type fish.

Fish sampled under the Peconic River Post-Cleanup DQO on site and at Donahue's Pond will also be tested for metals other than mercury.

In addition to fish sampling from these ponds, a sediment sample and a single vegetation sample of any abundant emergent aquatic plant will be taken (no on site samples). Sufficient material will be taken in order to complete the analysis for gamma-emitting radionuclides, PCBs (BNL only), and metals.

Table 8.1.1 2009 Aquatic Surveillance Monitoring Program

Matrix	Location	Number of Samples	Analysis	Frequency	Sample Type
Fish	BNL	10 + 1QA*	PCBs, Metals, Gamma	Annual	Grab
	Swan Pond	10 + 1QA	Gamma, Metals	Annual	Grab
	Donahue's Pond	10 + 1QA*	Gamma, Metals	Annual	Grab
	Forge Pond	10 + 1QA	Gamma, Metals	Annual	Grab
	Lower Lake, Carmans River	10 + 1QA	Gamma, Metals	Annual	Grab
Vegetation	Swan, Donahue's, and Forge Ponds, Carmans River	4 + 1QA	Gamma, Metals	Annual	Grab
Sediment	Swan, Donahue's, and Forge Ponds, Carmans River	4	Gamma, Metals	Annual	Grab
Water	Swan, Donahue's, and Forge Ponds, Carmans River	4	Gamma, Metals	Annual	Grab
Water	Meadow Marsh	1	Metals, Nutrients, Water Quality Parameters	Annual	Grab
Fish	BNL (as needed)	Population Survey	Length and Weight (if possible)	Annual	Grab

TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

The proposed sampling program will result in an increase in sampling and analysis costs.

FY2011 Costs $36,500
FY2012 Costs $40,052
Difference + $3,552

See Appendix B for the monitoring program for this DQO.

PECONIC RIVER POST-CLEANUP MONITORING

DQO START DATE January 1, 2007

REVISION NUMBER/DATE Rev. 4, November 30, 2011

IMPLEMENTATION DATE January 1, 2012

POINT OF CONTACT Tim Green (631) 344-3091

SUMMARY OF PROPOSED CHANGES

On an annual basis and after 5 years of annual monitoring (through 2010), BNL/DOE will evaluate all environmental data collected since completion of the cleanup for each of the Record of Decision (ROD)-required monitoring activities (sediment, surface water, fish). BNL/DOE will then recommend future monitoring activities and/or response actions, as appropriate, and submit them to the Environmental Protection Agency (EPA), New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health (NYSDOH), and Suffolk County Department of Health Services (SCDHS) as part of the Annual Peconic River Monitoring Report and the BNL Five-Year Review.

In 2011, the as part of the BNL Five-Year Review, BNL made recommendations to the appropriate agencies for reduced water, sediment, and fish monitoring for the Peconic River based on demonstration of successfully meeting clean-up criteria. The reduced level of sampling is reflected in modifications to this data quality objective (DQO).

DESCRIPTION AND TECHNICAL BASIS

BNL completed the cleanup and restoration of the Peconic River in May 2005 and additional supplemental clean-up of three small areas in 2011. The cleanup operation removed sediment containing mercury and other co-located contaminants including polychlorinated biphenyls (PCBs), pesticides, heavy metals, and cesium-137 (Cs-137) from approximately 19 acres of the river starting at the Sewage Treatment Plant (STP) outfall and extending to the area of Manor Road, approximately 4.5 miles downstream of the STP. Cleanup resulted in an average level of mercury in the remaining sediments of approximately 0.2 ppm and removal of approximately 90 percent of the co-located contaminants.

This DQO describes the reduced post-remediation environmental monitoring based on the 2011 Five-Year Review that will be performed to demonstrate compliance with the Operable Unit (OU) V Peconic River ROD. To promote sampling efficiency, some environmental samples will also be analyzed to meet the requirements of the surveillance monitoring program. The mission of the surveillance monitoring program is to provide early detection of potential releases of contaminants through environmental monitoring not otherwise required by remediation-required or permit-required compliance monitoring.

Based on sampling between 2006 and 2010, sediment sampling will be reduced from 30 locations to 3 locations that underwent supplemental clean-up in 2011. The 5-year review of monitoring indicated the successful clean-up of all but three sites that required supplemental clean-up. Therefore, following a similar line of reasoning establishing the original monitoring, only those

areas associated with supplemental cleanup will be monitored for mercury, PCBs, and Cs-137. Analysis for silver and copper will no longer be included in the monitoring. Monitoring of fish associated with post-cleanup monitoring will be reduced to collection of samples every other year after the 2011 sampling. Locations for fish sampling will be reduced to two areas on site, Shultz Road and Donahue's Pond. Fish tissues (edible portions) will be analyzed for mercury and radionuclides. As required by the ROD, fish collected on site will also be monitored for PCBs. Fish will be sampled when collections can be obtained without impacting the wellbeing of the fish population. Surface water samples will continue to be collected twice annually (June and July), but the number of locations will be reduced to 16 from 22 locations and samples will continue to be analyzed for mercury, methyl mercury, and Total Suspended Solids (TSS).

The continued effectiveness of the cleanup during the second 5 years will be evaluated through an annual review of the sampling data with EPA, NYSDEC, NYDSOH, and SCDHS in 2012 for 2011 sampling year, then subsequently reported in BNL's Site Environmental Report. On an annual basis, sampling modifications will be made for subsequent sampling, if necessary, as well as the need for potential additional response actions.

For each of the ROD-required monitoring activities (sediment, surface water, fish), after 5 years of annual monitoring, BNL/DOE will evaluate all environmental data collected since completion of the cleanup. BNL/DOE will then recommend future monitoring activities and/or response actions, as appropriate, and submit them in 2016 to EPA, NYSDEC, NYDDOH, and SCDHS as part of the BNL Five-Year Review.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

____	Compliance
x	Support compliance
x	Surveillance
x	Restoration

- OU V ROD for Area of Concern 30 (Peconic River).
- Final Closeout Report, Peconic River Remediation Phases 1 and 2.
- OU I Soils and OU V Long-Term Monitoring and Maintenance Plan.
- Peconic River post-cleanup monitoring data can be used to determine impacts from discharges from the STP. Collection of this monitoring data 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.
- Surveillance monitoring to document continued effectiveness of environmental cleanup operations and trends of changing levels of contaminants in sediments and water column is also considered a "best management practice."
- 2011 Five-Year Review Recommendations

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 improvements to the STP and pollution prevention practices include upgrades of the treatment system to the tertiary level, improved waste minimization and waste handling practices, and minimized use of specific hazardous materials (e.g. mercury

and silver). Sewer cleaning and remediation of the sand filter beds at the STP and minimization of mercury sources throughout the Laboratory lessen the likelihood of mercury being released to the Peconic River System. These improvements have greatly reduced the potential for future releases of contaminants (conventional and radiological). However, there is always a slight potential that contaminants could be released in an "upset" situation, and very small amounts of mercury are permitted to be released under BNL's State Pollutant Discharge Elimination System (SPDES) permit.

This monitoring program addresses the problems in documenting the achievement and maintenance of the cleanup goals required by the Peconic River ROD with data of appropriate quality to meet Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and ROD mandates.

The Peconic River cleanup was completed in 2005 and annual post-cleanup monitoring was initiated in 2006. Monitoring will continue until the remedial action has been demonstrated to be protective of human health and the environment. The Peconic River monitoring program is designed such that if the value of a sediment sample is greater than or equal to 2.0 mg/kg, then the nature and extent of mercury contamination will be characterized in a 100 square foot area surrounding the original sample point. Sampling modifications will be made for subsequent sampling, if necessary. After 5 years of annual monitoring, BNL/DOE will evaluate all environmental data that have been collected since the completion of the cleanup. BNL/DOE will then recommend future monitoring activities and/or response actions, as appropriate, to EPA, NYS-DEC, NYSDOH, and SCDHS as part of the BNL Five-Year Review in 2016. Changes to this DQO are reflective of recommendations from the 2011 BNL Five-Year Review.

Annual monitoring will be guided by the DQO analysis and monitoring summaries that follow and are detailed in the OU I Soils and OU V Long-Term Monitoring and Maintenance Plan. The monitoring data will be summarized in an Annual Peconic River Monitoring Report for 2011, which BNL/DOE will submit to EPA, NYDEC, NYSDOH, and SCDHS for review, and then subsequently reported in BNL's Site Environmental Reports. The DQO process that follows will be used to guide data interpretation and recommendations to the regulators. The DQO decisions may be modified in response to potential changes in data needs.

Step 2: Identify the Decision

The desired decisions for demonstration of the success of the Peconic River cleanup can be represented through the following question:

Have cleanup actions reduced the amount of mercury, PCBs, and radionuclides in the sediment and fish and have they reduced the amount of mercury and methyl mercury in the water column to levels protective of human health and the environment in sections of the Peconic River impacted by BNL operations?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 include:

- Baseline monitoring before cleanup of the Peconic River
- Post-cleanup sediment confirmation data
- Reference location monitoring data for the Connetquot River station
- STP discharge monitoring data

- Environmental Protection Division (EPD) Field Sampling Team field logs and records
- Environmental Monitoring standard operating procedure
- RODs for the STP and Peconic River remediation in OU V
- Closeout reports for the STP and Peconic River Cleanup Projects
- Data summary reports for mercury and methyl mercury for Peconic River surface water
- Annual Peconic River Monitoring Reports
- BNL Five-Year Review Recommendations

Step 4: Define the Study Boundaries

The boundaries of this study include the Peconic River cleanup area from the BNL STP outfall, downstream to approximately one quarter mile east of Manor Road. The downstream extent of monitoring is at Donahue's Pond. A reference location for comparison of the surface water data is located at the Connetquot River, approximately 20 miles to the southwest of BNL. Data collection and temporal boundaries include sediment sampling in June, regardless of water level; surface water sampling in June and July; and fish sampling between April and August. If necessary, to avoid potential drought or high water periods, fish and surface water collections may occur somewhat earlier or later.

Step 5: Develop the Decision Rule

Decision 1

Are the levels of BNL-attributable contaminants present in annual Peconic River sediment samples remaining stable relative to mercury cleanup goals?

If the average annual mercury concentration in sediment remains below the cleanup limits of 1.0 ppm and 0.75 ppm for samples collected on and off Laboratory property, respectively, and no individual sample equals or exceeds the goal that all mercury concentrations in the remediated areas are less than 2.0 ppm following the cleanup, **then** the current sampling plan will continue to be implemented without modification from 2012 through 2015.

If any individual sediment sample equals or exceeds the goal that all mercury concentrations in the remediated areas are less than 2.0 ppm following the cleanup, **then** BNL/DOE will characterize the nature and extent of contamination in the area surrounding the sample point(s) with the elevated value(s). The detailed characterization will be implemented by re-sampling the original data point location, plus four additional sample points located 5 feet upstream, 5 feet downstream, 5 feet to the left, and 5 feet to the right of the original sample, thus characterizing a 100 square foot area.

If the average mercury concentration of the five re-sample points is greater than or equal to 2.0 ppm, **then** additional nature and extent sampling of the sediment in the area of the elevated sediment mercury concentrations will be required. These data will be evaluated to assess the potential for the elevated sediment mercury concentrations to require near-term cleanup to prevent impact to human health and the environment.

If after 5 years of sediment sampling (through 2015) the average annual mercury concentration in sediment remains below the cleanup goals of 1.0 ppm and 0.75 ppm for samples collected on and off site, respectively, and no sample equals or exceeds the goal that all mercury concentrations in the remediated areas are less than 2.0 ppm following the cleanup, **then** BNL/DOE will evaluate and recommend to EPA, NYSDEC, NYSDOH, and SCDHS that the ROD-required Peconic River sediment sampling be replaced with routine long-term surveillance sampling beyond 2015.

If after 5 years of sediment sampling (through 2010) the average annual mercury concentration in sediment equals or exceeds the cleanup goals of 1.0 ppm and 0.75 ppm for samples collected on and off site, respectively, and/or sediment sample(s) equal or exceed the goal that all mercury concentrations in the remediated areas are less than 2.0 ppm following the cleanup, **then** BNL/DOE will evaluate all environmental data collected since completion of the cleanup and recommend future monitoring activities and/or response actions, as appropriate, to EPA, NYSDEC, NYSDOH, and SCDHS as part of the BNL Five-Year Review in 2016.

Decision 2

Are the average levels of BNL-attributable mercury, PCBs, and radionuclides in Peconic River fish trending toward levels that are protective of human health?

After the concentrations of environmental contaminants in sediment are removed or reduced, the body burden of contaminants in fish tissue typically require several years for substantial reduction depending on the contaminant, the environment, and the feeding guild. For this reason, the concentrations of contaminants in fish tissue resulting from each year of monitoring between 2006 and 2010 should be trended relative to the pre-cleanup levels.

If the annual levels of BNL-attributable mercury, PCBs, and radionuclides in Peconic River fish are trending toward levels that are more protective of human health, **then** BNL/DOE will continue to monitor Peconic River fish, as required by the Peconic River ROD.

If the annual levels of BNL-attributable mercury, PCBs, and radionuclides in Peconic River fish are trending toward levels that are less protective of human health, **then** BNL/DOE will evaluate and recommend to EPA, NYSDEC, NYSDOH, and SCDHS that sampling protocols be modified to better characterize potential source terms.

If after 5 years of fish sampling the average levels of BNL-attributable mercury, PCBs, and radionuclides in Peconic River fish are at levels protective of humans, **then** BNL/DOE will propose to EPA, NYSDEC, NYSDOH, and SCDHS that fish monitoring required by the Peconic River ROD be replaced by long-term surveillance monitoring beyond 2016.

If after 5 years of fish sampling the average levels of BNL-attributable mercury, PCBs, and radionuclides in Peconic River fish are not trending toward levels that are protective of human health, **then** BNL/DOE will evaluate all environmental data collected since completion of the cleanup and recommend future monitoring activities and/or response actions, as appropriate, to EPA, NYSDEC, NYSDOH, and SCDHS as part of the BNL Five-Year Review in 2016.

Decision 3

Have cleanup actions reduced the amount of mercury and methyl mercury in the water column in the Peconic River?

Confirmatory sampling of Peconic River sediments at the time of cleanup of the Peconic River indicate that, on average, the level of mercury in sediments is approximately 0.2 ppm and co-located PCBs and Cs-137 were reduced by approximately 90 percent. Mercury and methyl mercury analysis of the water column samples is geared toward indicating the section(s) of the river with the most optimal conditions for contributing total mercury and methyl mercury from the sediment to the water column and converting inorganic mercury to methyl mercury.

If sampling and trending shows declining levels over 5 years of mercury and methyl mercury in the water column, **then** BNL will re-evaluate the methyl mercury monitoring program when values have been maintained or have declined over a period of 5 years, or if the methyl mercury monitoring program data has not been useful in evaluating the long-term effectiveness of the remedy. Re-evaluation will consider whether the methyl mercury sampling program should be maintained at the current level or modified. After 5 years of annual monitoring, BNL/DOE will evaluate all environmental data collected since completion of the cleanup. BNL/DOE will then recommend future monitoring activities, as appropriate, to EPA, NYSDEC, NYSDOH, and SCDHS for review in 2016.

If sampling and trending shows that mercury and methyl mercury in the water column have been increasing in concentration and have been increasing over the past 5 years, **then** BNL/DOE will evaluate all environmental data collected since completion of the cleanup and then recommend future monitoring activities and/or response actions, as appropriate, to EPA, NYSDEC, NYSDOH, and SCDHS as part of the BNL Five-Year Review in 2016.

Step 6: Specify Acceptable Error Tolerances

The monitoring data discussed in this section and detailed in the OU I Soils and OU V Long-Term Monitoring and Maintenance Plan are collected to satisfy the sampling requirements specified in the Peconic River ROD. Following 4 years of post cleanup data collection reported in full EPA CLP style, the data packages will now be reported in standard format. Analytical methods and Quality Assurance/Quality Control (QA/QC) requirements are specified in the OU I Soils and OU V Long Term Monitoring and Maintenance Plan, Appendix C.

Step 7: Optimize the Design

Analytical results from Peconic River sediment, fish, and surface water sampling will be used to document the condition of the Peconic River resulting from cleanup operations and will be evaluated on an annual basis to determine whether modification or additional optimization are needed.

Sediment samples are collected annually between June and August from three locations along the Peconic River from the areas of supplemental clean-up (PR-WC-06, sediment trap, PR-SS-15). Samples will be analyzed for mercury, PCBs, and radionuclides. Samples will be collected at each of the sample locations regardless of whether it is covered by water. Within each sample area, fine-grained depositional sediment will be selected for sampling.

Sediment samples will also be collected from within and beneath the sediment trap prior to and after it is removed. In addition, sediment samples will also be obtained immediately upstream of the trap. The sediment trap will be removed, as required, by the Peconic River ROD when water levels are sufficiently low. Low water conditions usually occur between late summer and late fall to early winter. A total of 14 sediment samples will be collected. Mercury will be analyzed for all 14 samples. PCBs and Cs-137 will be analyzed for 10 samples, and silver and copper will be analyzed for 6 of the samples (refer to the Peconic River Sediment Trap Removal Work/Sampling and Analysis Plan for details.

Fish samples will be collected from four sections of the Peconic River. To the extent that water level, fish abundance, and size allow, fish will be collected from the sections of the river detailed in Table 8.2.1.

Table 8.2.1 Peconic River Fish Collection Locations

Remediation Area	Location Description
Area A	Between stream gauging stations HE and HMn.
Area D	Along North Street in the ponded sections of the river upstream and downstream of stream gauging station HQ. If water level or fish population size is not sufficient for fish collection, the ponded section of the river in remediation Area C may be substituted or added to supplement on site Area D collections.
Area P (Shultz Rd.)	Upstream of Schultz Road. If water level or fish population size is not sufficient for fish collection, the Ice Pond in remediation Area P may be substituted.
Donahue's Pond	Donahue's Pond is an impounded section of the Peconic River at the Peconic River Sportsman's Club.

To the extent possible, a minimum of five fish of sufficient size to obtain an edible fillet will be collected for analysis from each of two feeding guilds. However, a sufficient mass of fish will be collected from each age group present in the collection to analyze for each of the required analytes and to trend potential changes in contaminant concentration for each age group for each year. The age of all fish collected through 2015 will be determined by interpreting the growth rings on the fish scales. Brown bullheads do not have scales, so growth rings on the otoliths (inner ear bones) will be used.

Brown bullheads will represent the bottom feeding guild. Chain pickerel and/or large mouth bass will represent the carnivore feeding guild. Sunfish may be used if chain pickerel or bass are not available. If fish sizes are insufficient to obtain fillets, smaller fillets from several fish or whole bodies may be composited for analysis. All analytical results will be reported as wet weight mass of contaminant per unit mass of fish tissue.

Surface water samples (see Table 8.2.2) will be collected at 16 locations in June and July (provided sufficient water is present) along the Peconic River beginning just west of the BNL STP outfall and ending just downstream of Manor Road. The sampling locations also include an additional sample at a reference location at the Connetquot River in western Suffolk County and a sample of the STP effluent. A total of 18 samples will be collected twice annually.

Table 8.2.2 Peconic River Routine Water Column Sampling Stations

Station	Description	Distance Downstream of STP (miles)
Routine Water Column Monitoring Stations		
Connetquot River	Reference Site in Connetquot River	
PR-WC-15	Upstream of STP and Forest Path	-0.17
PR-WC-14	Upstream of STP	-0.13
PR-WC-13	Upstream of STP	-0.07
PR-WC-12D7	Upstream of STP	-0.04
STP-EFF-UVG	STP Outfall	0.00
PR-WC-11DS	50' downstream of STP outfall	0.01
PR-WC-10	West of HMnl	0.3
PR-WC-09	Downstream of HMn	0.56
PR-WC-08	South of Area B	0.78
PR-WC-07	South of Area C	0.96
PR-WC-06	North of Area D	1.1
PR-WC-05	Downstream of HQ	1.46
PR-WC-04	2nd Downstream of HQ	1.7
PR-WC-03	3rd West of Schultz Road	2.1
PR-WC-02	2nd West of Schultz Road	2.52
PR-WC-01	Schultz Road (West side)	2.98
PR-WCS-03	Manor Road	4.44

Table 8.2.3 summarizes the Peconic River ROD-required and surveillance monitoring program for all samples collected between the BNL STP outfall and Connecticut Avenue. The data quality for all samples will support comparison with the Peconic River Remedial Investigation and confirmation sampling data. Specific supplemental sampling efforts may be required, based on the results of routine sampling, and will be identified, as needed, separate from the Environmental Monitoring Plan.

Table 8.2.3 Peconic River Post-Cleanup Monitoring Summary based on 2011 Five-Year Review Recommendations

AOC	Name	Medium	No. of Samples	Parameters	Method	Frequency
30	Peconic River	Surface water[1]	16	Methyl mercury Mercury TSS	EPA Method 1630 EPA Method 1631 EPA Method 160.2	Twice annually (June and July)
30	Peconic River	Sediment[2]	3	Mercury PCBs Cesium-137	EPA Method 7471a EPA Method 8082 EPA Method 901.1	Annually (June - July)
30	Peconic River	Fish on BNL property	30	Mercury PCBs Gamma-emitting radio-nuclides	EPA Method 7471a EPA Method 8082 EPA Method 901.1	Every other year (between March and July)
30	Peconic River	Fish outside BNL property	60	Mercury Gamma-emitting radio-nuclides	EPA Method 7471a EPA Method 901.1	Every other year (between March and July)

Notes:
[1] Sample type is Grab
[2] Sample type is Core
[3] 22 stations are sampled in June and July; 8 are also sampled 2 weeks prior to and 2 weeks after the June and July sample events See Table 8.2.4 for station identification.

TOTAL SAMPLING AND ANALYSIS COSTS

The proposed sampling program will result in an annual cost of $86,400. Peconic River post-cleanup monitoring is in its fifth year of inclusion in the Environmental Monitoring Plan. The distribution of the costs is summarized in Table 8.2.4.

Table 8.2.4 Sampling and Analysis Costs

AOC	Name	Medium	Emphasis	Cost[1]
30	Peconic River	Surface water	Methyl mercury, Mercury, and TSS	$13,000
30	Peconic River	Peconic River sediment on and off BNL property and HQ sediment trap sediment	Mercury, , PCBs, pesticides, Cs-137, and other Gamma-emitting radio-nuclides	$1,200
30	Peconic River	Peconic River fish on and off BNL property[2]	Mercury, PCBs, and Gamma-emitting radio-nuclides	$15,800 Not collected 2012
				Total Cost $14,200

Notes:
[1] Costs include contract analytical laboratory costs and sampling labor.

FY2011 Costs $86,400
FY2012 Costs $14,200
Difference ($72,200)

See Appendix B for the monitoring program for this DQO.

FARM AND GARDEN VEGETABLES AND SOILS

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 3, November 30, 2011

IMPLEMENTATION DATE January 1, 2012

POINT OF CONTACT Tim Green (631) 344-3091

SUMMARY OF PROPOSED CHANGES

Reference to DOE Order 450.1A was removed from this data quality objective (DQO) and monitoring linked to DOE Order 436.1 (2011), *Departmental Sustainability,* and DOE Order 458.1 (2011), *Radiation Protection of the Public and Environment*. A new decision statement for the elimination of garden vegetables and soils was added. Farm vegetables were sampled in 2009. The next sampling is scheduled for 2013.

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 of the public. Sampling locations for farm vegetables and soil are downwind of BNL (primarily northeast and southeast). Results from this sampling program have consistently indicated that no man-made radionuclides attributable to Laboratory operations have 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 very low detectable levels of cesium-137 (Cs-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. The Brookhaven Graphite Reactor (BGRR) and the High Flux Beam Reactor (HFBR) shared a 300-foot stack for air emissions, and the BMRR had its own 100-foott stack for air emissions. Due to the nature of the emissions from these reactors, both stacks required continuous emissions monitoring.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

____ Compliance
_x_ Support compliance
_x_ Surveillance
____ Restoration

- DOE Order 436.1 requires sites to maintain an Environmental Management System (EMS). BNL's EMS specifies requirements for conducting general surveillance monitoring to evaluate the effects, if any, of site operations.
- DOE Order 458.1 requires DOE sites to maintain surveillance monitoring for determining radiological impacts to the public and environment.

- Surveillance monitoring to determine impacts from historic 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 5 years, or as necessary as determined by other sampling procedures, 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 historic 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 necessary to support the decisions in Step 2 include:

- Date of reactor closures
- Historic farm and garden vegetation results, as reported in annual 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 (i.e., air)
- Field Sampling Team field logs and records
- Environmental Monitoring Standard Operating Procedures (SOPs)
- 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 BNL. Based on prevailing winds, this 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 will be conducted once every 5 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 vegetables, 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** data will be reviewed 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 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 data review process will determine the need to close or move the garden to a more appropriate location and inform gardeners of the identified contamination.

Decision 4

Does historic data from soil used to grow garden vegetables on site, and do the vegetables themselves, indicate that radionuclides attributable to BNL operations are not of concern and monitoring can be reduced or discontinued?

If review of historic data concerning garden vegetables and soils taken on site indicate levels of radionuclides attributable to BNL operations at or below background, **then** BNL may determine that further sampling may be reduced or eliminated.

Step 6: Specify Acceptable Error Tolerances

Surveillance monitoring is used to identify areas that may be potentially affected by operations of BNL facilities. The Laboratory has historically sampled local farm vegetation for the presence of anthropogenic radionuclides potentially released from BNL operations. Historic data indicates that no Laboratory-related anthropogenic radionuclides have 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 Laboratory 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 5 years is designed to verify the continued absence of anthropogenic radionuclides originating from BNL. Periodic review of acquired data provides a mechanism for the reestablishment of annual surveillance sampling of farm vegetables and associated soils, if necessary, after documentation of BNL-attributable radionuclides being 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 Table 8.3.1. These sampling and analysis requirements will be implemented every 5 years to confirm the continued absence of anthropogenic radionuclides attributable to BNL. The next scheduled sampling of farm vegetables will occur in 2013. Garden vegetables and associated soil will be sampled annually.

Table 8.3.1 Farm Vegetables and Associated Soil Monitoring Program

Analysis	Sampling Location	Frequency (times per summer)
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
	Route 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
Radiological (gamma)	BNL Garden	5 to 7 vegetables 1 soil sample

TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

Sampling costs for farm and garden vegetable sampling will not change in calendar year 2012.

FY2011 Costs	$4,500
FY2012 Costs	$4,500
Difference	0

See Appendix B for the monitoring program for this DQO.

PRECIPITATION MONITORING

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 2, November 30, 2011

IMPLEMENTATION DATE January 1, 2012

POINT OF CONTACT Tim Green (631) 344-3091

SUMMARY OF PROPOSED CHANGES

Reference to DOE Order 450.1A was removed from this data quality objective (DQO) and monitoring linked to DOE Order 436.1 (2011), *Departmental Sustainability,* and DOE Order 458.1 (2011), *Radiation Protection of the Public and Environment* .

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 Sewage Treatment Plant [STP]) in support of reactor operations. BNL's three reactors have all been permanently shut down. The Brookhaven Graphite Reactor (BGRR) ceased operation in 1968 and is currently undergoing decontamination and decommissioning. The High Flux Beam Reactor (HFBR) was permanently shut down in 1999 and has been placed in a safe and secure configuration. The Brookhaven Medical Research Reactor (BMRR) was permanently shut down in December 2000 and is also in a 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 (Sr-90) that had been considered erroneous, but 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.

Additionally, the cleanup of the Peconic River, which was primarily driven by mercury in sediments, has raised questions about the importance of atmospheric deposition of mercury. To answer this question, low level mercury analysis is being added to the precipitation monitoring program.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

____ Compliance
_x_ Support compliance
_x_ Surveillance
_x_ Restoration

- DOE Order 436.1 requires sites to maintain an Environmental Management System (EMS). BNL's EMS specifies requirements for conducting general surveillance monitoring to evaluate the effects, if any, of site operations. DOE Order 458.1 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.
- Peconic River cleanup and subsequent monitoring for mercury and methyl mercury in order to document that the river remains in a clean state warrants investigating, whether atmospheric deposition of mercury is significant or not.

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Historical precipitation data suggests the occasional detection of radionuclides related to Laboratory operations. Therefore, the problem is documenting whether or not BNL-related radionuclides are deposited in the environment through precipitation. Additionally, precipitation monitoring may be able to determine whether or not mercury is being deposited from the atmosphere in precipitation.

Step 2: Identify the Decision

The desired decision for precipitation monitoring is:

Does precipitation contain radionuclides attributable to BNL operations and is mercury being deposited from the atmosphere?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 include:

- Historical precipitation data
- Closure of all nuclear reactors at BNL (source term)
- Field Sampling Team field logs and records

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 STP. No off-site precipitation is collected for analysis at these locations.

Step 5: Develop the Decision Rule

Decision 1

Does precipitation contain radionuclides attributable to BNL operations and is mercury being deposited from the atmosphere?

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

If quarterly precipitation data show evidence of mercury from atmospheric deposition, **then** report data in the BNL Site Environmental Report and continue monitoring quarterly.

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 BNL Site Environmental Report.

If data covering a period of 5 years post-reactor operations indicate that no BNL-attributable radionuclides are present and data covering a period of 5 years since initiation of mercury testing indicate no measurable levels of mercury from atmospheric deposition, **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. Mercury analysis should be conducted under Environmental Protection Agency (EPA) method 1631 and meet the quality assurance guidelines of this method.

Step 7: Optimize the Design

Quarterly precipitation data should be acquired from 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.

Table 8.4.1 Precipitation Surveillance Monitoring

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
	8	Low Level Hg	Annual	Grab

TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

There is no change in cost to the program in calendar year 2012.

FY2011 Costs	$3,922
FY2012 Costs	$3,922
Difference	0

See Appendix B for the monitoring program for this DQO.

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TERRESTRIAL VEGETATION AND SOIL MONITORING

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 3, November 30, 2007

IMPLEMENTATION DATE January 1, 2011

POINT OF CONTACT Tim Green (631) 344-3091

SUMMARY OF PROPOSED CHANGES

This data quality objective (DQO) was revised to reflect changes in DOE Orders. Reference to DOE Order 450.1A was removed from this data quality objective (DQO) and monitoring linked to DOE Order 436.1 (2011), *Departmental Sustainability,* and DOE Order 458.1 (2011), *Radiation Protection of the Public and Environment*.

DESCRIPTION AND TECHNICAL BASIS

Historical operations of BNL 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 Cs-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, 6 to 12 inches in depth. Other areas containing higher levels of Cs-137 contamination (650 Sump Outfall and the former Hazardous Waste Management Facility [HWMF]) have recently been cleaned up. Cs-137 at detectable levels are still present at the former HWMF, but have been covered with clean fill material to allow natural attenuation. The continued presence of soil contamination and the potential for uptake by plants, which can then be passed along to animals, must be monitored. This can be done through surveillance monitoring of deer. Soil and vegetation monitoring within the former HWMF is necessary to document whether or not uptake is occurring. The periodic assessment of soil and vegetation within remediated landscaped soils should be conducted in order to determine uptake and/or redistribution of contaminants. Additionally, to support the calculation of dose to biota from Lab operations, annual sampling should be conducted as a best management practice. The remainder of the soil and vegetation monitoring at BNL will follow a graded approach, as outlined below.

The terrestrial vegetation and soil-monitoring program at BNL is 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 greatly reduced. Areas of beam stops associated with the various accelerators may result in soil activation which in turn may result in uptake of activation products by biota.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

___ Compliance
_x_ Support compliance
_x_ Surveillance
_x_ Restoration

- DOE Order 436.1 requires sites to maintain an Environmental Management System (EMS). BNL's EMS specifies requirements for conducting general surveillance monitoring to evaluate the effects, if any, of site operations. DOE Order 458.1 requires DOE sites to maintain surveillance monitoring for determining radiological impacts to the public and environment.
- DOE-STD-1153-2002, A Graded Approach for Evaluation of Radiation Doses to Aquatic and Terrestrial Biota, recommends sampling design to assess radiological impacts to the biotic community.
- 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.
- Periodic monitoring to determine effectiveness of cleanup operations is necessary to document compliance with requirements of the Record of Decision (ROD) for Operable Unit (OU) I former HWMF.
- Periodic monitoring is necessary to determine effectiveness of cleanup operations of landscape soils in order to calculate a dose to biota.

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 reactors 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 air monitoring locations when radionuclides attributable to BNL or particulate contamination are detected that may affect biota. The cleanup of the former HWMF has been completed. Under the requirements of the Long Term Maintenance and Monitoring Plan for OU I and V, vegetation and soil sampling should occur in the first year and every 5 years after completion of cleanup to document the success of the cleanup operation.

Step 2: Identify the Decision

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

- Will a graded approach to soil and vegetation monitoring using the results of air sampling be protective of the environment?
- Are radionuclides being taken up by vegetation at the former HWMF and are they also found in surface soils within this facility?
- Are radionuclides being taken up by vegetation in the cleaned up landscape soils and 650 sump areas?

Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 include:

- DOE-established dose to biota guidelines of 1 mrad/day for flora and fauna
- Field Sampling Team field logs and records
- Environmental Monitoring Standard Operating Procedures (SOPs)
- 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
- Close-out report for the former HWMF

Step 4: Define the Study Boundaries

The boundaries of this study include the 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 site, but detection is most likely in the downwind sectors. For this reason, soil and vegetation samples will be taken primarily in the vicinity of air monitoring stations when air monitoring indicates that sampling is needed, or every 3-5 years. 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. The close-out report for the former HWMF specifically identified the former HWMF and its associated wetlands as a defined study area.

Step 5: Develop the Decision Rule

Decision 1

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

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 established cleanup criteria, **then** an evaluation will be completed to determine a path forward.

Decision 2

Are radionuclides being taken up by vegetation at the former HWMF and are they also found in surface soils within this facility.

If soil and vegetation sampling results in the first year after cleanup do not indicate radionuclides being taken up by plant and in the surface soils at the former HWMF, **then** sampling will take place in year five after cleanup to reconfirm presence/absence of radionuclides in vegetation and surface soils.

If soil and vegetation sampling results indicate radionuclides being taken up by plants and in surface soils, **then** an evaluation will be completed to determine a path forward.

Decision 3

Are radionuclides being taken up by vegetation in the cleaned up landscape soils and 650 sump areas?

If soil and vegetation sampling results from within historically cleaned up landscape soils do not indicate radionuclides being taken up by plants or in the surface soils, **then** sampling will take place every 5 years to reconfirm the presence/absence of radionuclides in vegetation and surface soils.

If soil and vegetation sampling results indicate radionuclides being taken up by plants and in surface soils, **then** an evaluation will be completed 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.

For vegetation and soil sampling within the former HWMF, 650 Sump area, and from landscaped soils cleanup areas, analytical data showing radionuclides above background should be reported with errors less than 20 percent. Values with errors greater than 20 percent will be reviewed and may warrant additional sampling for verification.

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 soil and vegetation sampling occurs, at least one off-site soil and vegetation sample must be obtained from established background locations.

Soil and vegetation sampling will necessitate obtaining at least five samples of each media in the upland area and two samples of sediment and emergent vegetation from the eastern portions of the former HWMF wetlands. Additionally, 10 samples of each media should be obtained from the cleaned up landscape soils area and two samples of each media from the 650 Sump area. The first year of sampling at the former HWMF was in 2006; the second round of sampling should occur in 2012.

Table 8.5.1 Terrestrial Soil and Vegetation Surveillance Monitoring

Matrix	Number of Samples	Analysis	Frequency	Type
Vegetation	29 + 2QA	Gamma	Annual	Grab
Soil	29 + 2QA	Gamma	Annual	Grab

TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

The sampling program will result in an increase in cost for calendar year 2012.

FY2011 Costs	$14,637
FY2012 Costs	$19,000
Difference	+$4,363

See Appendix B for the monitoring program for this DQO.

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DEER AND SMALL MAMMAL SAMPLING

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 2, November 30, 2007

IMPLEMENTATION DATE January 1, 2012

POINT OF CONTACT Tim Green (631) 344-3091

SUMMARY OF PROPOSED CHANGES

Reference to DOE Order 450.1A was removed from this data quality objective (DQO) and monitoring linked to DOE Order 436.1 (2011), *Departmental Sustainability,* and DOE Order 458.1 (2011), *Radiation Protection of the Public and Environment* .

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 the Laboratory, 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. Srontium-90 (Sr-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 cleanup standards. Other areas known to contain Cs-137, including the 650 Sump Outfall, Sewage Treatment Plant (STP) sand filter beds, and the former Hazardous Waste Management Facility (HWMF) were all completed in September 2005.

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 their smaller home range. The smaller home range enables Laboratory 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 on site exists, because samples can be gathered across the site instead of relying on road kill, as in the current deer-sampling program.

BNL eliminated small mammal sampling in 2008 but retains the ability to utilize small mammal sampling in localized areas if determined necessary. Deer sampling will continue as described below.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

____ Compliance
____ Support compliance
_x_ Surveillance
____ Restoration

- DOE Order 436.1 requires sites to maintain an Environmental Management System (EMS). BNL's EMS specifies requirements for conducting general surveillance monitoring to evaluate the effects, if any, of site operations. DOE Order 458.1 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 cesium-137 (Cs-137). Although most areas of radiological soil contamination have been remediated, two areas with higher contamination (Sewage Treatment Plant [STP] and the former Hazardous Waste Management Facility [HWMF]) are either in the process of cleanup or 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 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, the Laboratory should monitor the deer population to track and trend Cs-137 levels in 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 Cs-137 levels in deer meat above levels considered protective of human health?
- Are the Cs-137 levels in deer continuing to decline after remediation of contaminated soils?
- Are levels of Cs-137 in deer from areas within one mile of BNL identical to on-site levels?
- Do small mammals (squirrels) accurately depict Cs-137 contamination across the Laboratory site? (Removed in 2008)
- Can small mammals be a surrogate sampling medium for deer? (Removed in 2008)

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

- New York State Department of Health (NYSDOH) guideline consumption rate, 64 lb/year/person of deer meat > 6.9 pCi/g of Cs-137 (wet weight)
- Field Sampling Team field logs and records
- Environmental Monitoring Standard Operating Procedures (SOPs)
- Documented remediation of radiologically-contaminated soils
- Records of Decision (RODs) for OU 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 1 mile of BNL's boundary, as well as deer taken more than 1 mile from BNL (generally considered background or control deer). Sampling is conducted annually (with trends developed for a rolling 5-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 1 mile from the Laboratory. Sampling is on an annual basis, with sample events spread across the four calendar quarters. Routine small mammal sampling was discontinued in 2008, but is retained for potential future use.

Step 5: Develop the Decision Rules

Decision 1

Are Cs-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 Cs-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 to determine the path forward.

Decision 2

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

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

If Cs-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 Cs-137 values in on-site deer meat samples begin to increase after remediation of contaminated soils, **then** an evaluation will be conducted to determine the path forward.

Decision 3

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

If Cs-137 concentrations in deer meat samples taken within 1 mile of BNL are statistically the same as values on site, **then** monitoring will be maintained.

If Cs-137 concentrations in deer meat samples taken within 1 mile of BNL indicate an increasing trend or steady trend compared to on-site values, **then** an investigation will be conducted to determine the path forward.

Decision 4

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

If squirrel sampling clearly shows Cs-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. Difficulty in obtaining significant sample numbers prevents implementing this decision rule.

If squirrel sampling does not appear to provide a clear indication of Cs-137 contamination in wildlife across the Laboratory, **then** small mammal sampling will be reviewed for reduction or elimination. Due to the difficulty in obtaining significant numbers of squirrels, this decision should be eliminated, as should sampling squirrels.

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 Cs-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.

While it appears that small mammals contain similar amounts of Cs-137, difficulty in obtaining sufficient numbers prevents them from being a good alternative to continued deer sampling.

Step 6: Specify Acceptable Error Tolerances

The presence of Cs-137 in some deer samples indicates that Cs-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 1 mile of BNL. In the past, high values of Cs-137 in deer have been examined, considered to be accurate, and reported to the general public, and then subsequently discovered to be in error. The values were, in fact, much lower than initially reported. This “false positive” caused substantial concern to the community at large. False positives should be minimized. All values greater than historic high values will be investigated and verified through multiple retesting. Cs-137 is the single highest contributing factor for potential exposures to the general public from Laboratory operations. BNL must have an accurate understanding of Cs-137 distribution in deer.

Small mammal sampling was initiated in 2000 to determine its appropriateness as a surrogate for deer sampling. Out of 20 on-site samples over 2 years, three samples could be considered high for Cs-137 in comparison to all others. The three samples originated near known sources of Cs-137

contamination. Because squirrels are available to other wildlife as a food source, having an understanding of where squirrels are acquiring Cs-137 is important in order to protect other wildlife. Accuracy of data is important to verify the presence or absence of Cs-137 concentrations in the squirrels sampled. Due to difficulties in obtaining samples over the past 3 years, this sampling program should be eliminated.

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 Cs-137 in deer tissues. The lower number of on-site samples is due to the higher concentration of Cs-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 non-detections 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 (Sr-90) in bone (when available).

BNL has historically relied on opportunistic sampling through hunter donations and notification of road-killed deer on site. In 2002, the Laboratory 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 site. Off-site sampling of up to 40 deer will continue through collection of road-killed deer and acceptance of hunter donations and deer obtained through donation by other agencies, such as the New York State Department of Environmental Conservation (NYSDEC) and U.S. Fish and Wildlife Services (FWS).

Table 8.6.1 Deer and Small Mammal Sampling Program

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

TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

No net change in cost for calendar year 2012.

CY2011 Cost	$42,606
CY2012 Cost	$42,606
Difference	$0

See Appendix B for the monitoring program for this DQO.

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