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

## CHAPTER CONTENTS


| Section | | Page |
|---|---|---|
| 8.1 | Fish, Shellfish, Aquatic Vegetation, and Sediment | 8.1-1 |
| 8.2 | Peconic River Post-Cleanup Monitoring | 8.2-1 |
| 8.3 | Farm and Garden Vegetables and Soils | 8.3-1 |
| 8.4 | Precipitation Monitoring | 8.4-1 |
| 8.5 | Terrestrial Vegetation and Soil Monitoring | 8.5-1 |
| 8.6 | Deer and Small Mammal Sampling | 8.6-1 |

*Intentionally Left Blank*

# FISH, AQUATIC VEGETATION, AND SEDIMENT

**DQO START DATE** January 1, 2003

**REVISION NUMBER/DATE** Rev. 8, November 30, 2013

**IMPLEMENTATION DATE** January 1, 2014

**POINT OF CONTACT** Tim Green (631) 344-3091

## SUMMARY OF PROPOSED CHANGES

Changes for calendar year (CY) 2014 reflect alternating year of fish sample collection and the associated costs.

## 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 data quality objective (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 cleanup 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.

Due to long-term data sets showing little or no influence from the Laboratory, sampling at Swan Pond and Forge Pond will be discontinued beginning in 2013. Based on the 5-year review of the Peconic River cleanup program, fish sampling between post-cleanup monitoring and surveillance monitoring will be alternated. Post-cleanup monitoring will occur in odd numbered years and surveillance monitoring will occur in even numbered years, until such time as BNL no longer discharges effluents to the Peconic River.

## 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 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)
- Need for suitable data to determine Dose to Biota
- 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** discharges to the Peconic River exist from BNL operations, **then** surveillance monitoring will continue.

**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 rules 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** trending shows declining levels of contaminants in fish, vegetation, and sediment and/or BNL discontinues discharges to the Peconic River, **then** evaluation for continued monitoring will take place.

**If** trends in contaminant concentrations in fish, vegetation, and sediment are found to be increasing, **then** an evaluation will be conducted 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 may 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 for surveillance monitoring 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 (Area D) when population sizes permit; Donahue's 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., Area A and/or C on site, Manor Road area and/or Shultz Road area). Fillets of larger species of fish will be utilized as being representative of edible portions. Radionuclide (gamma) and metals 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, water sample, and a single vegetation sample of any abundant emergent aquatic plant will also be taken (no on-site samples). Sufficient material will be taken in order to complete the analysis for gamma-emitting radionuclides, and metals including mercury.

Table 8.1.1 2013 Aquatic Surveillance Monitoring Program

| Matrix | Location | Number of Samples | Analysis | Frequency | Sample Type |
|---|---|---|---|---|---|
| Fish | BNL | 10 + 1QA | PCBs, Metals, Gamma | biennial (even yrs) | Grab |
| | Donahue's Pond | 10 + 1QA | Gamma, Metals | biennial (even yrs) | Grab |
| | Lower Lake, Carmans River | 10 + 1QA | Gamma, Metals | Annual | Grab |
| Vegetation | BNL | 4 | Gamma | 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 a decrease in analysis costs.

| | |
|---|---|
| CY 2013 Analytical Costs | $ 5,862 |
| CY 2014 Analytical Costs | $17,240 |
| Difference | + $11,378 |

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. 6, November 30, 2013

**IMPLEMENTATION DATE** January 1, 2014

**POINT OF CONTACT** Tim Green (631) 344-3091

## SUMMARY OF PROPOSED CHANGES

Changes for calendar year (CY) 2014 reflect alternating years for fish collection and the associated costs.

## DESCRIPTION AND TECHNICAL BASIS

BNL completed the cleanup and restoration of the Peconic River in May 2005, and additional supplemental cleanup 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 data quality objective (DQO) describes the reduced post-remediation environmental monitoring based on the 2011 5-year review that will be performed to demonstrate compliance with the Operable Unit (OU) V Peconic River Record of Decision (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 cleanup in 2011. The 5-year review of monitoring indicated the successful cleanup of all but three sites that required supplemental cleanup. 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 and will occur in odd numbered years. Locations for fish sampling will be reduced to two areas on site (Areas A and D), 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 the U.S. 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) in 2012 for the 2011 sampling year, and 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, NYSDOH, and SCDHS as part of the Peconic River 5-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 Peconic River 5-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 at the Laboratory 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, NYSDEC, NYSDOH, and SCDHS as part of the Peconic River 5-Year Review in 2016. Changes to this DQO are reflective of recommendations from the 2011 Peconic River 5-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 Report. 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 (SOP)
- 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
- Peconic River 5-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 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** 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 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 2015) 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 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 Peconic River 5-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 2011 and 2015 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 Peconic River 5-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 recommend future

monitoring activities and/or response actions, as appropriate, to EPA, NYSDEC, NYSDOH, and SCDHS as part of the Peconic River 5-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 cleanup (PR-WC-06, sediment trap area, 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.

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 5-Year Review Recommendations

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

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 2014 |
| | | | | Total Cost $30,000 |

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

CY 2013 Costs $30,000
CY 2014 Costs $14,200
Difference - $15,800

See Appendix B for the monitoring program for this DQO.

# FARM AND GARDEN VEGETABLES AND SOILS – SUSPENDED

**DQO START DATE** January 1, 2003

**REVISION NUMBER/DATE** Rev. 5, December 3, 2013

**IMPLEMENTATION DATE** January 1, 2014

**POINT OF CONTACT** Tim Green (631) 344-3091

## SUMMARY OF PROPOSED CHANGES

Since the environmental cleanup of the Brookhaven Graphite Research Reactor (BGRR) was completed in 2012, farm vegetable surveillance will be reduced in calendar year (CY) 2013 and will be the final year of surveillance. In addition, garden vegetables from the BNL garden have consistently shown no uptake of radionuclides; therefore, garden vegetable surveillance will also be discontinued in CY 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 on site to the sampling program. Only one vegetable showed 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 BGRR and the High Flux Beam Reactor (HFBR) shared a 300-foot stack for air emissions, and the BMRR had its own 100-foot stack for air emissions. Due to the nature of the emissions from these reactors, both stacks required continuous emissions monitoring.

Based on historic sampling, the absence of radionuclides in garden vegetables over the past decade supports the elimination of monitoring at the BNL garden in 2013. In 2012, the environmental cleanup of the BGRR was completed and the stack was isolated, eliminating emissions from this source. Based on the BGRR cleanup and the lack of radionuclides found in farm vegetables, a reduction in the number and location of samples in CY 2013 is justified.

## DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

____ Compliance
_x_ Support compliance
_x_ Surveillance
____ Restoration

- DOE Order 436.1 (2011), *Department 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 (2011), *Radiation Protection of the Public and the Environment,* 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 data quality objective (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.

### 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?

### Step 3: Identify Inputs to the Decision

Inputs necessary to support the decisions in Step 2 include:

- Date of reactor closures
- Final cleanup of the BGRR and isolation of the BGRR/HFBR stack
- 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 control location 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.

#### 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 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.

##### 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 to resume annual farm vegetable surveillance monitoring.

#### 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 CY 2013.

Table 8.3.1 Farm Vegetables and Associated Soil Monitoring Program

| Analysis | Sampling Location | Frequency (times per summer) |
|---|---|---|
| Radiological (gamma) | Lewin's Farm | 5 vegetables<br>1 soil sample |
| | Bruno Farm | 4 vegetables<br>1 soil sample |
| | Mays Farm | 5 vegetables<br>1 soil sample |
| | Cornell Farm (control) | 3 vegetables<br>1 soil sample |

### TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

Analytical costs for farm and garden vegetable sampling will increase in CY 2013 due to the 5 year schedule of farm vegetable collection.

| | |
|---|---|
| CY 2013 Costs | $1,714 |
| CY 2014 Costs | $0 |
| Difference | - $1,714 |

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, 2014

**POINT OF CONTACT** Tim Green (631) 344-3091

## SUMMARY OF PROPOSED CHANGES

There are no proposed changes for calendar year (CY) 2014.

## DESCRIPTION AND TECHNICAL BASIS

BNL currently samples precipitation on a quarterly basis at two locations on site (Station P4 at the apartment area on site 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 with decontamination and decommissioning completed in 2012. 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(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 (2011), *Radiation Protection of the Public and the Environment*, 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 data quality objective (DQO) affects only 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 on site 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 the U.S. 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 CY 2014.

| | |
|---|---|
| CY 2013Costs | $3,922 |
| CY 2014 Costs | $3,922 |
| Difference | 0 |

See Appendix B for the monitoring program for this DQO.

*Intentionally Left Blank*

# TERRESTRIAL VEGETATION AND SOIL MONITORING

**DQO START DATE** January 1, 2003

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

**IMPLEMENTATION DATE** January 1, 2014

**POINT OF CONTACT** Tim Green (631) 344-3091

## SUMMARY OF PROPOSED CHANGES

There are no proposed changes for calendar year (CY) 2014.

## 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 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 (2011), *Department 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 (2011), *Radiation Protection of the Public and the Environment*, 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 for the 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 four 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 5 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, with 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 feet 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 last round of sampling at the former HWMF was in 2012; the next round of sampling should occur in 2017.

Table 8.5.1 Terrestrial Soil and Vegetation Surveillance Monitoring

| Matrix | Number of Samples | Analysis | Frequency | Type |
|---|---|---|---|---|
| Vegetation | 10-15 + 2QA | Gamma | Annual | Grab |
| Soil | 10-15 + 2QA | Gamma | Annual | Grab |

## TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

There is no change in cost to the program in CY 2014.

| | |
|---|---|
| CY 2013 Costs | $1,632 |
| CY 2014Costs | $1,632 |
| Difference | -$0 |

See Appendix B for the monitoring program for this DQO.

*Intentionally Left Blank*

# DEER SAMPLING

**DQO START DATE** January 1, 2003

**REVISION NUMBER/DATE** Rev. 3, December 3, 2012

**IMPLEMENTATION DATE** January 1, 2014

**POINT OF CONTACT** Tim Green (631) 344-3091

## SUMMARY OF PROPOSED CHANGES

There are no proposed changes for calendar year (CY) 2014.

## 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. 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.

## DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

____ Compliance
____ Support compliance
_x_ Surveillance
____ 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 (2011), *Radiation Protection of the Public and the Environment*, 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. Regardless of when clean-up was 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 consumed by humans.

### 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?

### 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 radiological-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 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.

#### 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.

#### 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 poten-

tial exposures to the general public from Laboratory operations. BNL must have an accurate understanding of Cs-137 distribution in deer.

**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).

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<br>40 off site<br>+ 6 QA | Gamma | Annually | Grab |
| Liver (as available) | 25 on site<br>40 off site<br>+6 QA | Gamma | Annually | Grab |

## TOTAL SAMPLING AND ANALYSIS COST FOR MONITORING PROGRAM

There is no change in cost to the program in CY 2014.

| | |
|---|---|
| CY2013 Cost | $11,587 |
| CY2014Cost | $11,587 |
| Difference | -$0 |

See Appendix B for the monitoring program for this DQO.