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

## CHAPTER CONTENTS

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# 8.1 PECONIC RIVER FISH SURVEILLANCE MONITORING

**DQO START DATE** January 1, 2003

**IMPLEMENTATION DATE** January 1, 2024

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

### SUMMARY OF PROPOSED CHANGES

No changes are proposed for calendar year 2024.

### DESCRIPTION AND TECHNICAL BASIS

Brookhaven National Laboratory (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 used to evaluate impacts from 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, polychlorinated biphenyl (PCB), 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 not impacted by BNL operations. Historic data from the Peconic River consistently indicates that there is no effect from BNL operations far downstream of the site boundary and the current level of surveillance monitoring is sufficient to document known contaminants onsite at BNL.

Changes to the BNL State Pollutant Discharge Elimination System (SPDES) permit for the STP resulted in moving the discharge from the Peconic River to groundwater recharge basins to the southeast of the STP in September 2014. This resulted in a significant change in the extent of wet streambed and open water in the on-site portions of the Peconic River, which, in turn, affects the potential availability of fish sampling on site. This data quality objective (DQO) establishes the decision criteria to decrease or increase fish 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 and off-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.

Until 2015, continued presence of water throughout the year within the Peconic River allowed for fish sampling. With discharges from the STP no longer going to the river, conditions now depend on the river receiving water from groundwater sources when the water table is high and/or from significant precipitation events. Drought conditions may result in the complete drying of on-site portions of the river, resulting in the near complete absence of fish. 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. Fish sampling along the Peconic River has also consistently shown the presence of PCBs, pesticides, and some heavy metals, including mercury in fish tissues that are attributable to historical BNL practices and atmospheric deposition.

Due to long-term data sets showing little or no influence from the Laboratory, sampling at Swan Pond and Forge Pond was discontinued in 2013. Based on the five-year review of the Peconic River cleanup program, fish sampling between post-cleanup monitoring and surveillance monitoring alternated yearly. With the completion of a supplemental cleanup action of a small area on site in 2017, the need for continued fish monitoring associated with cleanup actions is no longer needed. This leaves the surveillance monitoring program as the primary program for the Peconic River. Because of the removal of discharges to the river, aquatic vegetation and sediment monitoring have been eliminated and the decision for continued and modified monitoring of fish is addressed in this DQO.

## DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

____ Compliance
____ Support compliance
__X__ Surveillance
____ Restoration

- DOE Order 436.1A (2023), *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, Admin Chg. 4, (2020) *Radiation Protection of the Public and Environment*, requires DOE sites to maintain surveillance monitoring for determining radiological impacts to the public and environment.
- Surveillance monitoring to determine impacts from past discharges from the STP can also be considered a best management practice to track the continued decay of anthropogenic radionuclides present in the onsite portions of the river.
- Request by the New York State Department of Environmental Conservation under the CERCLA Five-Year Review to monitor small whole fish from onsite portions of the Peconic River for mercury and PCBs.

## 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 permitted discharge point, with eventual migration downstream. Upgrades to the STP include treatment to a tertiary level and the redirection of effluent to groundwater recharge basins and have eliminated the potential of future releases of contaminants (conventional and radiological). Challenges for the monitoring program include documentation of the continued decline in existing contaminants.

## Step 2: Identify the Decision

The desired decisions for the fish surveillance monitoring programs can be represented through the following questions:

- Are contaminants attributable to Laboratory operations present in fish within the Peconic River System?
- Are water levels within the Peconic River System sufficient to support fish populations?
- 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 within the Peconic River System?
- Are levels of known BNL-contributed contaminants available for movement up the food chain?
- Has historic monitoring provided sufficient information to make a decision for continuation, modification, or termination of monitoring?

## 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
- Historic STP discharge monitoring data
- New York State Department of Environmental Conservation (NYSDEC) consumption guidelines: 15 lb/year/person of fish for radiological 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)
- Review of analytical results by project managers in accordance with Environmental Protection Division (EPD) data review procedures to ensure data are of acceptable quality
- Documented remediation of contaminated river sediment
- Records of Decision (RODs) for the STP and Peconic River remediation in Operable Unit (OU) V
- Closeout reports for the STP and Peconic River Cleanup Projects
- Peconic River Annual Monitoring Report and Five-Year Reviews
- Historic aquatic vegetation sampling results
- Historic sediment sampling results
- Historic Peconic River surface water sampling results
- Historic fish results
- Elimination of discharges to the Peconic River
- Presence of water sufficient to support fish
- Presence of fish populations of sufficient number and size for sampling

## Step 4: Define the Study Boundaries

The boundaries of this study include the Peconic River system from the former STP outfall on site, extending downstream to the BNL boundary (HQ). The control location for comparison data is Lower Lake on the Carmans River for fish. 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. Onsite sampling can only occur when sufficient water and abundant fish are present. Off-site

sampling at the Carman's River control location (Lower Lake) will only occur if on-site sampling for larger fish is accomplished to collect edible filets.

Step 5: Develop the Decision Rule

Decision 1

*Are there potential impacts from historic discharges to the Peconic River from contaminants attributable to BNL operations present in fish within the Peconic River System?*

**If** discharges to the Peconic River are terminated, **then** periodic surveillance monitoring will be conducted to document changes in contaminant levels compared to historic data and control locations.

**Note:** With discharges having been eliminated, BNL will periodically monitor fish to track changes in Cs-137, mercury, and PCBs in on-site fish and compare those values to fish from the Lower Lake Carmans River control location for fish of sufficient size to obtain edible portions (filets). For potential food chain impacts from mercury and PCBs, smaller fish may be obtained, however, data from Lower Lake may not be available. *The decision rules below will be followed to determine if sampling can take place.*

Decision 2

*Are water levels within the onsite portion of the Peconic River System sufficient to support fish populations?*

**As noted in Decision 1, since** surveillance monitoring will be continued, **then** the following decision must be made for on-site monitoring. **If** water levels within the on-site portions of the Peconic River are sufficient to support fish populations, **then** monitoring may continue. **If** water levels within the on-site portions are not sufficient to support fish populations, **then** monitoring will not occur.

Decision 3

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

**If** water levels are sufficient to support fish, then the following decisions must be made prior to sampling fish. **If** fish population and size surveys indicate that sufficient numbers of fish exist at sizes large enough for sampling, **then** surveillance monitoring of fish may occur on site. **If** 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 population and size surveys will continue to facilitate documentation of population recovery.

**Note: For human health considerations** in the above decision rules, "sufficient" body and population size mean that enough fish exist to (1) support the preparation of a 1-kg-sample (e.g., edible fillets) of each species desired (composite samples are permitted) 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. **For ecological food chain considerations** in the above decision rules, any fish greater than 50 mm (2 in.) in total length may be composited to obtain 50-gram whole body samples for mercury and PCB analysis. Whenever possible, composite samples should be composed from a single species (e.g., all pumpkinseed, bluegill, etc.). The species, number of individuals, and size range included in a sample will be recorded.

Decision 4

*Are the levels of known BNL-contributed contaminants declining in fish 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 radionuclide contaminants in fish, **then** re-evaluation of the monitoring program will occur when values reach background or are below health criteria. **If** mercury contaminant concentrations in fish are found to be above the 0.3 mg/kg water quality criterion, **then** the data will be reviewed to determine any changes in the environmental monitoring requirements. The data will be shared with EPA, NYSDEC/New York State Department of Health (NYSDOH), and Suffolk County Department of Health Services to document current conditions.

Step 5: Specify Acceptable Error Tolerances

The upper reaches of the Peconic River have historically been fed by discharges from the BNL STP. Historic discharges have resulted in various contaminants accumulating in river sediment. Since the discharges from the STP to the river have been eliminated, the amount of area within the river sustaining fish populations has declined. Sampling for fish may not take place due to low or non-existent water for long periods of time. Radiological monitoring data will be of sufficient quality to measure constituents to the same level of detection used for drinking water. 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 ten percent of the sample collection to check and verify labquality. Data will be reviewed upon being received.

Step 6: Optimize the Design

To document recovery of fish populations and size classes in the on-site portion of the Peconic River, an evaluation of the size and number of fish will occur prior to taking samples. The survey may utilize electro-shocking and other appropriate sampling techniques to collect the highest number of fish possible, with reasonable effort. (Note: Fish are released once population and size measures are completed.) This monitoring can be conducted concurrently with efforts to obtain samples in years where fish samples are taken if the number of samples ensures sufficient numbers of fish of reproductive age remain in the river, allowing sample collection the following year. All fish collected will be identified as to species and, at a minimum, will have total body length measured. Total numbers sampled will be recorded.

Fish sampling for surveillance monitoring will include at least five samples of each species of fish, as is practical or available, and no more than ten samples of each species. Species to be sampled include brown bullhead, chain pickerel or largemouth bass, or yellow perch, or bluegill. Fish from different feeding guilds (e.g., 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 (e.g., game fish). Samples will be taken from locations including but not limited to BNL on-site (Area A or C, and/or D) when population sizes permit and Lower Lake on the Carmans River (control location). Filets of larger species of fish will be utilized as being representative of edible portions suitable for human consumption.

Radionuclide (gamma) and metals analysis may require composite sampling of two or more fish to ensure sufficient sample volume for analysis. To maximize the analytical process, sample analysis will be conducted in priority order of mercury, PCBs (on-site samples only), and gamma-emitting radionuclides. It may be necessary to take separate samples or composite samples to gather radionuclide data supporting dose to biota calculations. See Table 8.1.1, Aquatic Surveillance

Monitoring Program.

**Table 8.1.1. Aquatic Surveillance Monitoring Program**

| Matrix | Location | Number of Samples | Analysis | Frequency | Sample Type |
|---|---|---|---|---|---|
| Fish | BNL | 10 + 1QA | PCBs, Mercury, Gamma | Annually (as possible) | Grab |
| | Lower Lake, Carmans River | 10 + 1QA | Gamma, Mercury | Annual | Grab |
| Fish | BNL (as needed) | Population Survey | Length and Weight (if possible) | As river water levels permit | Grab |
| Water | Meadow Marsh | 1 | Metals, Nutrients, Water Quality Parameters | Annual | Grab |

See Appendix B for the monitoring program for this DQO.

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# 8.2 PRECIPITATION MONITORING

**DQO START DATE** January 1, 2003

**IMPLEMENTATION DATE** January 1, 2024

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

### SUMMARY OF PROPOSED CHANGES

The technical basis was updated to document the removal of reactor stacks which permanently removes potential for discharge.

### DESCRIPTION AND TECHNICAL BASIS

Brookhaven National Lab (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).

Historically, precipitation monitoring was used to determine impacts from 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 and the HFBR stack was demolished in 2021. The Brookhaven Medical Research Reactor (BMRR) was permanently shut down in December 2000 and is in a secure configuration; the BMRR stack was demolished in 2022.

Historical precipitation data has been reported as providing little, if any, indication of BNL-related radionuclides in precipitation. Modifications to precipitation monitoring are based on the need to track atmospheric inputs of mercury to natural systems.

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 has been added to the precipitation monitoringprogram.

### DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

_ Compliance
_ Support compliance
X Surveillance
_ Restoration

- Historic data from Peconic River cleanup and subsequent monitoring for mercury and methyl mercury to document that the river remains in a clean state warrant investigating, whether atmospheric deposition of mercury is significant or not.
- Mercury from atmospheric deposition has been found to potentially affect wildlife; monitoring mercury in precipitation may provide data for future research and track changes over time.

## DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Precipitation monitoring may be able to determine the extent of mercury being deposited from the atmosphere in precipitation, which may then impact the Peconic River and wildlife.

Step 2: Identify the Decision

The desired decision for precipitation monitoring is:

Does precipitation contain mercury that is 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
- Review of analytical results by project managers in accordance with Environmental Protection Division (EPD) data review procedures to ensure data are of acceptable quality
- 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.

Step 5: Develop the Decision Rule

Decision 1

*Does precipitation contain mercury being deposited from the atmosphere?*

**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** data covering a period of five 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

Mercury analysis should be conducted under the U.S. Environmental Protection Agency (EPA) method 1631 and meet the quality assurance guidelines of this method. Data are reviewed when received.

Step 7: Optimize the Design

Quarterly precipitation data should be acquired from on-site precipitation-monitoring locations and analyzed for low-level mercury. Results should be reported to the subject matter expert and reviewed quarterly, and any abnormalities in the data investigated accordingly. See Table 8.2.1.

**Table 8.2.1. Precipitation Surveillance Monitoring**

| Matrix | No. of Samples | Analysis | Frequency | Type |
|---|---|---|---|---|
| Precipitation | 8 | Low Level Hg | Annual (2/quarter) | Grab |

See Appendix B for the monitoring program for this DQO.

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# 8.3 TERRESTRIAL VEGETATION AND SOIL MONITORING

**DQO START DATE** January 1, 2003

**IMPLEMENTATION DATE** January 1, 2024

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

### SUMMARY OF PROPOSED CHANGES

No changes are proposed for calendar year 2024.

### DESCRIPTION AND TECHNICAL BASIS

Historical operations at Brookhaven National Laboratory (BNL) have resulted in the distribution of cesium-137 (Cs-137) in landscape soils. Most 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, from six to 12 inches in depth. Other areas containing higher levels of Cs-137 contamination (e.g., 650 Sump Outfall and the Hazardous Waste Management Facility [HWMF]) have been cleaned.

Detectable levels of Cs-137 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, should be monitored. This pathway can be done through surveillance monitoring of deer. Soil and vegetation monitoring within the former HWMF is necessary to periodically document whether uptake is occurring. The periodic assessment of soil and vegetation within remediated landscaped soils should be conducted 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. Because current BNL operations only produce short-lived radionuclides that are not transported 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 436.1A (2023), *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, Admin Chg 4, (2020), *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 to calculate a dose to biota.

## DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

BNL has been in operation since 1947. Its long history of operations 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 no longer necessary to determine impacts from reactors. Current operations produce no long-lived radionuclides that can be deposited in soils or vegetation. 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 five years after completion of cleanup to document the success of the cleanup operation. Current accelerator operations may result in soil activation products that may be taken up by plants.

Step 2: Identify the Decision

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

- 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?
- Are accelerator operations resulting in soil activation and uptake by plants?
- Are radionuclides found in soils and vegetation resulting in potential dose to biota?

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)

- Review of analytical results by project managers in accordance with Environmental Protection Division (EPD) data review procedures to ensure data are of acceptable quality
- 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 areas around accelerator beam stops and historically contaminated areas that have been cleaned up. 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

*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 after cleanup do not indicate radionuclides being taken up by plant at the former HWMF, **then** sampling will take place every five years 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 at concentrations above cleanup goals, **then** an evaluation will be completed to determine a path forward.

**Decision 2**

*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 five 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.

**Decision 3**

*Are radionuclides being produced due to soil activation and are they taken up by vegetation in beam stop areas?*

**If** soil and vegetation sampling from the area around accelerator beam stops show presence of soil activation products and plant uptake, **then** monitoring will transition to annual routine monitoring of the beam stop to verify occurrence.

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 deer. Therefore, it is acceptable to act on reasonable data.

Analytical data for vegetation and soil sampling within the former HWMF, 650 Sump area, and from landscaped soils cleanup areas 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. Data will be reviewed when received.

Step 7: Optimize the Design

When soil and vegetation sampling occur, 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, ten to 12 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 2022; the next round of sampling should occur in 2027. Random sampling from a variety of locations around the BNL site should be taken to document potential sources of Cs-137 for dose to biota. See Table 8.3.1.

**Table 8.3.1. 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 |

See Appendix B for the monitoring program for this Data Quality Objective.

# 8.4 DEER SAMPLING

**DQO START DATE** January 1, 2003

**IMPLEMENTATION DATE** January 1, 2024

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

### SUMMARY OF PROPOSED CHANGES

No changes proposed for calendar year 2024.

### DESCRIPTION AND TECHNICAL BASIS

Brookhaven National Laboratory (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 to investigate levels present in this matrix and discontinued in 2013. 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 since 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 (e.g., 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 completed in September 2005.

### DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS PROGRAM

_ Compliance
_ Support compliance
X Surveillance
_ Restoration

- DOE Order 436.1A (2023), *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, Admin Chg 4, (2020), *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 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 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)
- Review of analytical results by project managers in accordance with Environmental Protection Division (EPD) data review procedures to ensure data are of acceptable quality
- 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 one mile of BNL's boundary, as well as deer taken more than one mile from BNL (generally considered background or control deer). Deer taken during routine population reduction activities may also be included provided sampling is from individual deer. Sampling is conducted annually (with trends developed for a rolling ten-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 to document trends. **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 decline to 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 and are less than or equivalent to background, **then** monitoring may be discontinued. **If** Cs-137 concentrations in deer meat samples taken within one mile of BNL indicate an increasing trend or steady trend compared to on-site values, **then** monitoring will continue.

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 3,000 deer each year in Suffolk County, some of which are obtained within one 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 determined to be in error (false positive). 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. Therefore, BNL must have, and transmit, an accurate understanding of Cs-137 distribution in deer. Data is reviewed when received to identify errors and determine usability. Potassium-40 is a naturally occurring radionuclide that builds in biological tissues and typically is found in the range of approximately 2-5 pCi/g wet weight in deer. Values significantly outside of this range should trigger a re-analysis of a sample.

Step 7: Optimize the Design

To get sufficient data for comparison and to be statistically sound, samples must be taken both on and off site (see Table 8.4.1). Past efforts indicate that 25 on-site and 40 off-site samples should be obtained annually 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. BNL has established deer management on site that results in the periodic reduction of significant numbers of deer through culling. When this occurs, it provides an opportunity to acquire large numbers of samples meeting the goal of 25 onsite samples/year. Off-site sampling of up to 40 deer will continue through collection of road-killed deer, acceptance of hunter donations, and deer obtained through donation by other agencies, such as the New York State Department of Environmental Conservation.

**Table 8.4.1. Deer Sampling Program**

| Deer | No. of Samples | Analysis | Frequency | Sample Type |
|---|---|---|---|---|
| Flesh (meat) | 25 onsite<br>40 offsite<br>+ 6 QA | Gamma | Annually | Grab |
| Liver (as available) | 25 onsite<br>40 offsite<br>+6 QA | Gamma | Annually | Grab |

See Appendix B for the monitoring program for this Data Quality Objective.