



Flora and Fauna

Brookhaven National Laboratory has a wildlife management program to protect and manage flora and fauna and their habitats. The Laboratory's wildlife management strategy is based on an understanding of the resources onsite, ensuring compliance with applicable regulations, protecting and monitoring the ecosystem, research, and communication. Monitoring to determine whether current or historical activities have impacted wildlife is part of this program. In 1999, deer and fish sampling results were consistent with previous years. Deer residing on the BNL site were found to contain concentrations of cesium-137 higher than those observed in offsite deer. Fish from the Peconic River collected at the BNL boundary continue to show a slightly elevated radionuclide content compared to control samples. Radionuclide levels in fish continue to decrease compared to historical values. Although there was no sampling for local farm grown produce in 1999, historical analyses of farm produce reported in BNL Site Environmental Reports over the past ten years has indicated that no Laboratory-generated radionuclides have been detected.

6.1 WILDLIFE MANAGEMENT PROGRAM

The purpose of the wildlife management program at BNL is to promote stewardship of the natural resources found at the Laboratory, as well as to integrate natural resource protection with the Laboratory’s mission. In 1998 BNL developed a Wildlife Management Plan that describes the program strategy, elements, and planned activities. This plan was updated in 1999 to incorporate comments from the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC) (Naidu 1999). The plan and related natural resources information about the Laboratory can be found at the Environmental Services Division website at <<http://www.esh.bnl.gov/wildlife/>>. The program elements and some of the associated activities are summarized below.

6.1.1 IDENTIFICATION AND MAPPING OF NATURAL RESOURCES

An understanding of the environmental baseline is the starting point for wildlife management planning. The Central Pine Barrens Commission conducted a natural resources inventory of the BNL site based on data collected from 1970 to 1990. This mapping process has identified environmentally sensitive areas and significant wildlife communities. BNL is in the process of updating this inventory.

As noted in Chapter 1, a wide variety of vegetation, birds, reptiles, amphibians, and mammals reside onsite at BNL. There is only one New York State endangered species that inhabits BNL property: the tiger salamander (*Ambystoma tigrinum*) (see Figure 6-1). Two New York State threatened species have been identified: the banded sunfish (*Enneacanthus obesus*) (see Figure 6-2) and the stiff goldenrod (*Solidago rigida*) plant. In addition, several species that inhabit the BNL site, or visit during migration, are listed as “rare,” “species of special concern,” or ‘exploitably vulnerable’ (see Table 6-1).

6.1.2 HABITAT PROTECTION AND ENHANCEMENT

Activities to eliminate or minimize negative impacts on sensitive or critical species are either incorporated into BNL procedures or into specific program or project plans. Environmental restoration efforts remove pollutant sources that could contaminate habitats. Access to critical habitats is restricted. A map of tiger salamander breeding locations is maintained

and reviewed when new projects are proposed to ensure that the projects do not negatively affect the breeding areas. (This map is “Confidential” and limited in its distribution in order to protect the tiger salamander from being exploited.) In some cases, habitats are enhanced to improve survival or increase populations. Routine activities (e.g., road maintenance) that are not expected to impact habitats are permitted to proceed.

Table 6-1. New York State Threatened, Endangered, and Species of Special Concern.

Common Name	Scientific Name	State Status
Fish		
Banded sunfish	<i>Enneacanthus obesus</i>	T
Amphibians		
Eastern tiger salamander	<i>Ambystoma tigrinum tigrinum</i>	E
Marbled salamander	<i>Ambystoma opacum</i>	SC
Reptiles		
Spotted turtle	<i>Clemmys guttata</i>	SC
Eastern box turtle	<i>Terrapene carolina</i>	SC
Eastern hognose snake	<i>Heterodon platyrhinos</i>	SC
Birds (nesting or common)		
Horned lark	<i>Eremophila alpestris</i>	SC
Whip-poor-will	<i>Caprimulgus vociferus</i>	SC
Vesper sparrow	<i>Poocetes gramineus</i>	SC
Grasshopper sparrow	<i>Ammodramus savannarum</i>	SC
Plants		
Butterfly weed	<i>Asclepias tuberosa</i>	V
Spotted wintergreen	<i>Chimaphila maculata</i>	V
Flowering dogwood	<i>Cornus florida</i>	V
Pink lady's slipper	<i>Cypripedium acaule</i>	V
Winterberry	<i>Ilex verticillata</i>	V
Sheep laurel	<i>Kalmia angustifolia</i>	V
Narrow-leafed bush clover	<i>Lespedeza angustifolia</i>	R
Ground pine	<i>Lycopodium obscurum</i>	V
Bayberry	<i>Myrica pennsylvanica</i>	V
Cinnamon fern	<i>Osmunda cinnamomera</i>	V
Clayton's fern	<i>Osmunda claytoniana</i>	V
Royal fern	<i>Osmunda regalis</i>	V
Swamp azalea	<i>Rhododendron viscosum</i>	V
Stiff goldenrod	<i>Solidago rigida</i>	T
New York fern	<i>Thelypteris novaboracensis</i>	V
Marsh fern	<i>Thelypteris palustris</i>	V
Virginia chain-fern	<i>Woodwardia virginica</i>	V

Notes:
 Information based on 6 NYCRR 182, 6 NYCRR 193, and BNL survey data.
 No federally listed threatened or endangered species are known to occur at BNL.
 E=endangered
 T=threatened
 SC=species of special concern
 R=rare
 V=exploitably vulnerable

Efforts to protect the tiger salamander include determining when adult salamanders are migrating toward breeding locations, when metamorphosis has been completed, and when juveniles are migrating after metamorphosis. During these times, construction and/or



Figure 6-1. Tiger Salamander (*Ambystoma tigrinum*), a New York State listed endangered species. The salamander was released immediately after the photograph was taken.

maintenance activities near tiger salamander habitats are required to be reviewed by BNL environmental protection staff, and every effort is made to minimize impacts. Water quality testing is conducted as part of the routine monitoring of water basins. These data are used to assess the quality of water prior to the breeding cycle. In cooperation with NYSDEC, limited habitat surveys were conducted in 1999 during the tiger salamander breeding season. In 2000, more comprehensive surveys of known and suspected tiger salamander habitats will be conducted. The results of these surveys will help determine the length of the breeding period and provide the information needed to determine a window for construction activities in and around the breeding areas. The information may also identify changes in site use that are needed and possible activities that could be affecting this species. The map of the breeding areas will be updated periodically to include any new observations.

Banded sunfish protection efforts include ensuring that adequate flow of the river is maintained within areas currently identified as sunfish habitat, ensuring that existing vegeta-

tion in the sunfish habitat is not disturbed, and evaluating all river remediation efforts for potential impacts on these habitats. The banded sunfish is shown in Figure 6-2.

BNL's Wildlife Management Plan also calls for habitat enhancement. In 1999, all readily available data were compiled to establish BNL's bird list. A total of 216 species have been identified at BNL since 1948, of which at least 85 are known to nest onsite. Some of these nesting birds have shown declines in their populations nationwide over the past 30 years. In 2000, the Laboratory plans to establish permanent bird survey routes through various habitats, allowing for consistent monitoring of songbird populations. Bluebirds have been identified as one of the declining species of migratory birds in North



Figure 6-2. Banded Sunfish (*Enneacanthus obesus*), a New York State "special concern" species. This live specimen was returned to the water body immediately after the photograph was taken. (Scale shown in this picture is in centimeters.)

America. This decline is due to loss of habitat and nest site competition by the European starling. In 2000, BNL plans to install 20 to 40 bluebird boxes around open grassland areas of the site to enhance the bluebird population. Once the boxes are installed, they will be monitored two to three times during the breeding season to determine use and nesting success.

6.1.3 POPULATION MANAGEMENT

BNL also manages other species populations as necessary to ensure that they are sustained and to control invasive species. For

example, the Laboratory monitors populations of “species of interest,” such as the wild turkey. The onsite population of wild turkeys is estimated to be between 60 and 80 birds (see Figure 6-3). The wild turkeys onsite are apparently doing well, as approximately one third of the estimated population is composed of juvenile birds. Updated population reports are periodically sent to NYSDEC to assist with their population estimates. The population will continue to be monitored to determine reproductive success.

BNL is currently updating information on the onsite deer population. Since there are no natural predators onsite and hunting is not permitted at BNL, there are no significant pressures on the population to migrate beyond their typical home range of approximately one mile. A 1992 study indicated that the population of deer onsite exceeded 700, or approximately 100 per square mile (Thomlinson 1993). Normally a population density of 10 to 30 per square mile is considered an optimum sustainable level for a given area. Overpopulation can affect both animal and human health (e.g., deer ticks transmit Lyme disease), decrease species diversity such as song birds (due to selective grazing and destruction of habitat), and can also result in increased property damage and traffic accidents as animals forage into developed areas for food. Reduction of property damage due to deer/vehicle collisions is one aspect considered in planning deer population management. In 1999, there were four deer/vehicle collisions reported. This was down from 12 reported collisions in 1997, after property adjacent to the lab was cleared for development,

and 6 reported collisions in 1998. Options for managing the deer population are being evaluated, and BNL will work with state regulators and the community if active management (such as culling the herd) is deemed necessary.

6.1.4 COMPLIANCE ASSURANCE AND POTENTIAL IMPACT ASSESSMENT

The National Environmental Policy Act (NEPA) review process at BNL is one of the keys to ensuring that environmental impacts of a proposed action are adequately evaluated and addressed. BNL will continue to use NEPA, or NEPA-like values under the Comprehensive Environmental Response, Compensation and Liability Act program, as the process for identifying potential environmental impacts associated with site activities (especially physical alterations). As appropriate, stakeholders such as the EPA, NYSDEC, Suffolk County Department of Health Services (SCDHS), the Nature Conservancy, the Town of Brookhaven, the Community Advisory Council, and local environmental advocacy groups are involved in reviewing projects which have potential environmental impacts.

6.2 MONITORING ACTIVITIES

6.2.1 DEER SAMPLING

Deer in New York State typically grow to large sizes, with average weights of males at approximately 150 pounds; females are slightly less at about 100 pounds. However, deer on Long Island tend to be much smaller in size, with an average weight of less than 80 pounds. The available meat on local deer ranges from 20 to 40 pounds per deer.

In 1999, as in recent years, an offsite deer sampling program was again conducted in cooperation with the NYSDEC Wildlife Branch. NYSDEC samples provide data on deer moving beyond BNL boundaries where they can be legally hunted. This program also provides control data on deer living in locations that are distant from BNL. The total number of samples obtained near the BNL site was again very limited in 1999, as in past years, due to a low response rate from hunters approached for samples at state checkpoints. In all, eight deer samples were obtained onsite and eight were gathered from offsite locations.

BNL has been monitoring radionuclide levels in deer onsite since 1992. Onsite samples



Figure 6-3. Wild Turkeys are commonly seen at BNL.

were collected primarily from deer killed in automotive incidents. Samples were analyzed for gamma-emitting radionuclides; the results are shown in Table 6-2. It was previously established that deer taken on the BNL site contain concentrations of cesium-137 (half-life = 30 years) at levels above those taken from offsite. This is most likely the result of deer grazing on vegetation growing in soils where elevated cesium-137 levels are known to exist. Cesium-137 in these soils can be transferred to aboveground plant matter via root uptake, where it then becomes available to browsing animals. Remediation of

contaminated soil areas is being addressed as part of the site environmental restoration program. All data taken since 1992 are presented in Table 6-3 and was used to show the distribution of cesium-137 levels in deer versus distance from the Lab. The cesium-137 concentration in deer meat samples taken within one mile of the Laboratory boundary is approximately the same as in samples taken onsite. Cesium-137 concentrations decrease sharply beyond one mile from the site (see Figure 6-4). This indicates that deer feeding on Laboratory property have the potential to migrate offsite

Table 6-2. Radiological Analysis of Deer Tissue (1999).

Location	Collect Date	Tissue	K-40 (pCi/g,wet)	Cs-137 (pCi/g, wet)
BNL				
Yale Road across from first entrance to garage	01/04/99	Flesh	5.78 ± 1.35	7.47 ± 1.49
Mobile Trailer Park/5-8	01/18/99	Liver	2.80 ± 0.51	2.22 ± 0.40
Mobile Trailer Park/5-8	01/18/99	Flesh	2.87 ± 0.65	8.11 ± 1.44
Mobile Trailer Park/5-8*	01/18/99	Flesh	2.64 ± 0.47	9.69 ± 1.66
Southeast of Child Development Center	02/18/99	Tumor	1.41 ± 0.37	0.35 ± 0.08
Southeast of Child Development Center	02/18/99	Flesh	2.17 ± 0.37	0.72 ± 0.12
Main gate-South Bound Lane	03/19/99	Flesh	5.42 ± 1.19	2.90 ± 0.58
Main gate-South Bound Lane*	03/19/99	Flesh	2.41 ± 0.42	0.26 ± 0.05
Main gate-South Bound Lane*	03/19/99	Flesh	2.05 ± 0.35	0.94 ± 0.16
Main gate-South Bound Lane*	03/19/99	Flesh	2.43 ± 0.95	0.29 ± 0.10
Main gate-South Bound Lane	03/19/99	Liver	2.69 ± 0.46	1.22 ± 0.21
Intersection of Railroad/Cornell Ave., East of 701	03/20/99	Liver	2.33 ± 0.56	0.05 ± 0.02
Intersection of Railroad/Cornell Ave., East of 701	03/20/99	Flesh	3.25 ± 0.55	0.17 ± 0.03
West side of Bldg. 815	04/19/99	Flesh	3.20 ± 0.55	0.08 ± 0.02
Bldg.1005 inside of RHIC Ring	04/27/99	Flesh	2.88 ± 0.48	0.75 ± 0.13
Bldg.1005 inside of RHIC Ring	04/27/99	Liver	1.79 ± 0.33	0.19 ± 0.04
Intersection of Princeton/Southgate Rd.	06/11/99	Flesh	2.52 ± 0.42	0.30 ± 0.05
Intersection of Princeton/Southgate Rd.	06/11/99	Liver	1.19 ± 0.22	0.10 ± 0.02
Offsite				
Mashomack, Shelter Island	01/06/99	Flesh	2.37 ± 0.42	0.85 ± 0.15
1/3 Mile N. of Rt. 25, Ridge Rd.	01/06/99	Flesh	3.8 ± 0.64	0.61 ± 0.15
Breslin Property (Wm. Floyd)	01/08/99	Flesh	2.15 ± 0.37	3.55 ± 0.61
Noyak, Town of Southampton	01/18/99	Flesh	2.19 ± 0.39	ND
Rt. 25, 100 yds. west of main entrance to Brookhaven Shooting Range	02/16/99	Flesh	2.22 ± 0.38	2.34 ± 0.39
Ridge Road, 200 feet North of School	03/19/99	Flesh	2.82 ± 0.47	0.26 ± 0.05
Rt. 25, 100 yds west of main entrance	03/23/99	Flesh	2.97 ± 0.52	2.91 ± 0.50
Wm. Floyd Pkwy, 1/4 mile South of Main gate	10/22/99	Flesh	2.24 ± 0.41	3.52 ± 0.60
Wm. Floyd Pkwy, 1/4 mile South of Main gate*	10/22/99	Flesh	2.07 ± 0.38	3.55 ± 0.59
Wm. Floyd Pkwy, 1/4 mile South of Main gate	10/22/99	Liver	2.22 ± 0.25	0.78 ± 0.13
BNL Flesh Average	12 Samples		3.14 ± 0.65	2.64 ± 0.49
Offsite Flesh Average	9 Samples		2.54 ± 0.44	1.95 ± 0.34
BNL Liver Average	5 Samples		2.16 ± 0.42	0.76 ± 0.14
Offsite Liver Average	1 Sample		2.22 ± 0.25	0.78 ± 0.13

Notes:

All values shown with a 95% confidence interval.

All summary statistics include duplicate analysis results.

ND = Not Detected.

*Duplicate analysis, a second sample from the same animal.

Table 6-3. Radiological Analysis of Deer Tissue (Historical Data 1992 - 1999).

Year	Location	Distance (miles)	Tissue	K-40 (pCi/g, wet)	Cs-137 (pCi/g, wet)
1992	BNL	0	Flesh	7.72	6.15
1992	BNL	0	Liver	1.88	1.12
1996	BNL	0	Flesh	2.86 ± 0.51	1.01 ± 0.18
1996	BNL	0	Liver	2.11 ± 0.41	0.65 ± 0.12
1996	BNL	0	Flesh	2.70 ± 0.44	5.14 ± 0.88
1996	BNL	0	Flesh	3.34 ± 0.56	6.66 ± 1.12
1996	BNL	0	Liver	3.30 ± 0.91	2.53 ± 0.50
1996	BNL	0	Liver	3.06 ± 0.92	2.11 ± 0.40
1996	BNL	0	Liver	3.07 ± 0.65	1.56 ± 0.28
1996	BNL	0	Flesh	3.01 ± 0.51	5.61 ± 0.95
1996	BNL	0	Flesh	3.68 ± 1.15	11.74 ± 2.27
1996	BNL	0	Liver	2.45 ± 0.89	3.36 ± 0.88
1997	BNL	0	Flesh	2.51 ± 0.48	0.23 ± 0.05
1997	BNL	0	Liver	3.51 ± 0.98	0.50 ± 0.12
1997	BNL	0	Flesh	3.27 ± 0.58	1.35 ± 0.24
1997	BNL	0	Liver	2.24 ± 0.41	0.41 ± 0.07
1997	BNL	0	Flesh	2.81 ± 0.68	2.39 ± 0.56
1997	BNL	0	Liver	1.68 ± 0.30	0.21 ± 0.04
1997	BNL	0	Flesh	3.19 ± 0.54	0.19 ± 0.04
1997	BNL	0	Liver	1.84 ± 0.33	0.03 ± 0.01
1997	BNL	0	Flesh	2.81 ± 0.47	6.04 ± 1.03
1997	BNL	0	Liver	2.21 ± 0.40	3.73 ± 0.64
1997	BNL	0	Flesh	3.58 ± 0.60	1.04 ± 0.16
1997	BNL	0	Liver	1.68 ± 0.29	0.16 ± 0.03
1998	BNL	0	Flesh	1.86 ± 0.32	ND
1998	BNL	0	Liver	2.84 ± 0.53	ND
1998	BNL	0	Flesh	5.26 ± 1.58	0.24 ± 0.15
1998	BNL	0	Liver	3.19 ± 2.21	ND
1998	BNL	0	Flesh	4.07 ± 0.97	ND
1998	BNL	0	Liver	1.77 ± 0.43	ND
1998	BNL	0	Flesh	4.15 ± 1.05	8.79 ± 1.54
1998	BNL*	0	Flesh	2.51 ± 0.44	7.01 ± 1.21
1998	BNL	0	Flesh	2.22 ± 0.42	1.92 ± 0.32
1998	BNL	0	Liver	4.72 ± 1.15	14.59 ± 2.88
1998	BNL	0	Flesh	2.55 ± 0.43	6.56 ± 1.10
1998	BNL	0	Liver	2.11 ± 0.48	1.85 ± 0.42
1998	BNL Lilco Substation	0	Flesh	3.80 ± 0.66	0.24 ± 0.05
1999	BNL	0	Flesh	5.78 ± 1.35	7.47 ± 1.49
1999	BNL	0	Tumor	1.41 ± 0.37	0.35 ± 0.08
1999	BNL	0	Flesh	2.17 ± 0.37	0.72 ± 0.12
1999	BNL	0	Flesh	5.42 ± 1.19	2.90 ± 0.58
1999	BNL	0	Flesh	2.41 ± 0.42	0.26 ± 0.05
1999	BNL	0	Flesh	2.05 ± 0.35	0.94 ± 0.16
1999	BNL	0	Flesh	2.43 ± 0.95	0.29 ± 0.10
1999	BNL	0	Liver	2.69 ± 0.46	1.22 ± 0.21
1999	BNL	0	Liver	2.33 ± 0.56	0.05 ± 0.02
1999	BNL	0	Flesh	3.25 ± 0.55	0.17 ± 0.03
1999	BNL	0	Flesh	3.20 ± 0.55	0.08 ± 0.02
1999	BNL	0	Flesh	2.88 ± 0.48	0.75 ± 0.13
1999	BNL	0	Liver	1.79 ± 0.33	0.19 ± 0.04
1999	BNL	0	Flesh	2.52 ± 0.42	0.30 ± 0.05
1999	BNL	0	Liver	1.19 ± 0.22	0.10 ± 0.02
1999	Mobile Trailer Park/5-8	0	Liver	2.80 ± 0.51	2.22 ± 0.40
1999	BNL*	0	Flesh	2.64 ± 0.47	9.69 ± 1.66
1999	BNL	0	Flesh	2.87 ± 0.65	8.11 ± 1.44
1999	Breslin Property (Wm. Floyd)	0.1	Flesh	2.15 ± 0.37	3.55 ± 0.61
1999	Wm. Floyd Pkwy, 1/4 mile South of main gate	0.1	Flesh	2.24 ± 0.41	3.52 ± 0.60
1999	Wm. Floyd Pkwy, 1/4 mile South of main gate*	0.1	Flesh	2.07 ± 0.38	3.55 ± 0.59
1999	Wm. Floyd Pkwy, 1/4 mile South of main gate	0.1	Liver	2.22 ± 0.25	0.78 ± 0.13
1998	Wm. Floyd Pkwy, 1/4 mile N. of BNL	0.25	Liver	1.15 ± 0.21	ND
1998	Wm. Floyd Pkwy, 1/4 mile N. of BNL*	0.25	Liver	1.86 ± 0.54	0.35 ± 0.08
1998	Wm. Floyd Pkwy, 1/4 mile N. of BNL	0.25	Flesh	3.20 ± 0.76	ND
1997	1/2 mile SW of Shultz	0.75	Flesh	1.94 ± 0.33	4.71 ± 0.80
1998	Middle Island Conservation Center	1	Flesh	6.32 ± 1.46	3.20 ± 0.65
1998	Middle Island Conservation Center	1	Liver	0.99 ± 0.16	0.26 ± 0.04

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Table 6-3. Radiological Analysis of Deer Tissue (Historical Data 1992 - 1999) (continued).

Year	Location	Distance (miles)	Tissue	K-40 (pCi/g, wet)	Cs-137 (pCi/g, wet)
1999	Rt. 25, 100 yds. west of main entrance to Brookhaven Shooting Range	1	Flesh	2.22 ± 0.38	2.34 ± 0.39
1999	Rt. 25, 100 yds. west of main entrance	1	Flesh	2.97 ± 0.52	2.91 ± 0.50
1999	1/3 mile N. of Rt. 25, Ridge Rd.	1.33	Flesh	3.80 ± 0.64	0.61 ± 0.15
1998	Brookhaven State Park	1.5	Liver	2.29 ± 0.39	ND
1998	Wm. Floyd Pkwy, 1 mile N. of Rt.25	1.5	Flesh	2.24 ± 0.50	ND
1998	Brookhaven State Park	1.5	Liver	3.34 ± 1.42	0.41 ± 0.18
1998	Brookhaven State Park*	1.5	Liver	2.84 ± 1.00	ND
1998	Brookhaven State Park	1.5	Thyroid	21.23 ± 18.14	4.3 ± 2.87
1998	Brookhaven Sate Park	1.5	Flesh	3.12 ± 0.74	2.14 ± 0.4
1998	Brookhaven Sate Park	1.5	Liver	2.15 ± 0.58	0.27 ± 0.06
1998	Brookhaven State Park	1.5	Flesh	2.63 ± 0.60	0.99 ± 0.18
1998	Brookhaven State Park	1.5	Liver	4.44 ± 1.22	2.16 ± 0.45
1999	Ridge Road, 200 feet N of School	1.5	Flesh	2.82 ± 0.47	0.26 ± 0.05
1996	Yaphank	3.3	Liver	1.33 ± 0.37	0.44 ± 0.09
1998	Camp Wawepea, Ridge	5	Liver	2.23 ± 0.39	ND
1998	Camp Wawepea, Ridge*	5	Liver	2.70 ± 1.26	0.14 ± 0.14
1998	Ridge 5 miles N. of 25	5.5	Flesh	2.40 ± 0.64	ND
1998	Intersection Rt. 111/Rt.51	8.5	Flesh	2.26 ± 0.47	0.53 ± 0.1
1998	Intersection Rt. 111/Rt.51*	8.5	Flesh	2.50 ± 0.42	0.66 ± 0.11
1996	Hubbard Park	20	Liver	2.62 ± 1.63	0.35 ± 0.14
1996	Mattituck	21	Liver	3.77 ± 1.07	ND
1996	Southampton	25	Flesh	2.41 ± 0.47	ND
1999	Noyak, Town of Southampton	25	Flesh	2.19 ± 0.39	ND
1996	North Sea	26	Flesh	2.01 ± 0.38	ND
1996	Watermill	29	Liver	2.14 ± 0.39	0.08 ± 0.02
1998	Bridgehampton	30	Flesh	2.81 ± 0.53	0.05 ± 0.02
1996	Shelter Island	33	Liver	3.06 ± 0.76	0.10 ± 0.04
1996	Shelter Island	33	Flesh	2.25 ± 0.39	0.9 ± 0.16
1999	Mashomack, Shelter Island	33	Flesh	2.37 ± 0.42	0.85 ± 0.15
1996	East Hampton	38	Liver	3.00 ± 0.59	0.15 ± 0.04
BNL Flesh Average		32	Samples	3.30 ± 0.66	3.22 ± 0.57
Offsite Flesh Average		22	Samples	2.68 ± 0.53	1.40 ± 0.25
BNL Liver Average		22	Samples	2.48 ± 0.64	1.66 ± 0.34
Offsite Liver Average		17	Samples	2.48 ± 0.72	0.32 ± 0.08

Notes:

All values except 1992 data shown with a 95% confidence interval.

All summary statistics include duplicate analysis results.

ND = Not Detected

*Duplicate analysis, a second sample from the same animal.

and also supports the estimates of the deer home range being one square mile.

The maximum onsite concentration of cesium-137 detected in all hind meat samples was 9.69 pCi/g (0.36 Bq/g) wet weight (the concentration prior to drying for analysis). The arithmetic average concentration of all samples of hind meat in which cesium-137 was detected was 2.88 pCi/g (0.11 Bq/g). This may be compared with the maximum and average hind meat cesium-137 concentrations recorded in offsite samples of 3.55 and 1.95 pCi/g (0.13 and 0.07 Bq/g), respectively. Maximum and average cesium-137 concentrations in liver samples from deer collected onsite show a similar pattern of elevation. Figure 6-5 shows the ranges of

cesium-137 concentrations in hind samples from onsite deer collected since 1996.

The potential radiological dose resulting from deer meat consumption is discussed in Chapter 8. The New York State Department of Health (NYSDOH) has formally assessed the potential public health risk associated with the elevated cesium-137 levels in onsite deer and determined that neither hunting restrictions nor formal health advisories are warranted (NYSDOH 1999). Their report may be accessed at <http://www.esh.bnl.gov/wildlife/deer_issues.htm/>.

With respect to the health of the onsite deer population, the International Atomic Energy Agency (IAEA) has concluded that

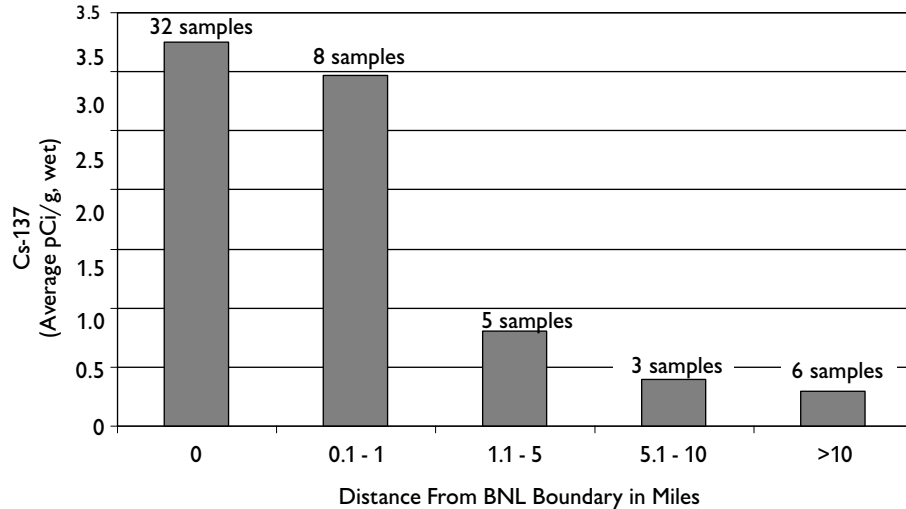


Figure 6-4. Geographical Distribution for Cs-137 in Deer Meat in Relation to BNL Property, 1996-1999.

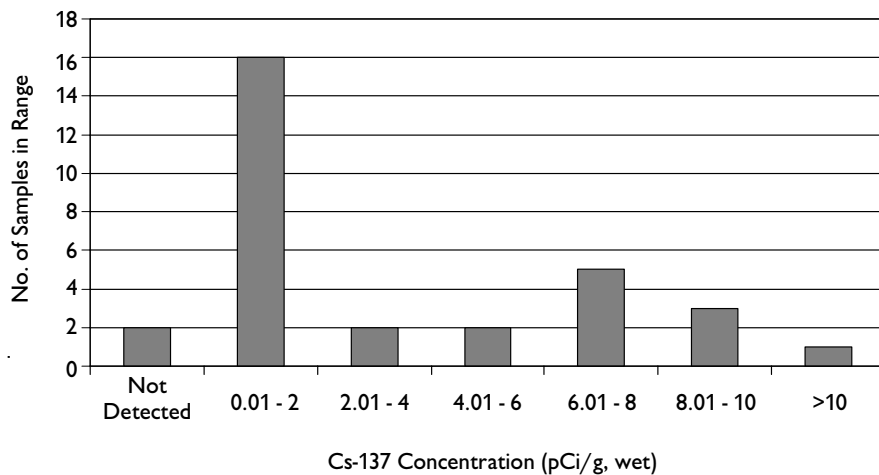


Figure 6-5. Distribution for Cs-137 Concentration Ranges in Deer Meat From BNL Site Since 1996.

chronic dose rates of 100 millirad per day (1 mGy/d), to even the most radiosensitive species in terrestrial ecosystems, are unlikely to cause detrimental effects in animal populations (IAEA 1992). A deer containing a uniform distribution of cesium-137 at the highest levels observed to date would carry a total body burden of about 0.2 μ Ci (0.007 MBq). Under these conditions, an animal would receive an absorbed dose of approximately 3 millirad per day (0.03 mGy/d), which is only 3 percent of the threshold evaluated by the IAEA. Deer observed and sampled onsite appear to be healthy.

6.2.2 FISH SAMPLING

BNL, in collaboration with the NYSDEC Fisheries Division, maintains an ongoing program for the collection of fish from the Peconic River and surrounding fresh water bodies. In 1999 various species of fish were collected from onsite portions of the Peconic River, as well as from offsite locations such as Donahue’s Pond and Forge Pond (see Figure 5-8 in Chapter 5 for geographic locations). Figure 6-6 is a photograph of fish sampling activities. No control locations, such as Carmans River, were sampled in 1999 by BNL. The control



Figure 6-6. Environmental Sampling of Yellow Perch (*Perca flavescens*) Using a Gill Net.

location sampling data used in this report was provided to BNL by SCDHS.

6.2.2.1 RADIOLOGICAL ANALYSIS OF FISH

Brown bullhead (*Ictalurus nebulosus*), chain pickerel (*Esox niger*), largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), pumpkinseed (*Lepomis gibbosus*), and yellow perch (*Perca flavescens*) species were collected in 1999 by BNL and SCDHS for radiological analysis. Gamma spectroscopy analysis was performed on both BNL and SCDHS samples, and alpha spectroscopy analysis was performed on SCDHS samples. Specific information regarding the sampling point, species collected, and analytical results is presented in Table 6-4 (gamma data) and Table 6-5 (alpha data). All sample results are presented as wet weight concentrations.

Additionally, fish collected by the NYSDEC Fisheries Division in the spring of 1998 were analyzed in 1999 as part of the environmental restoration program's plutonium sampling project. The fish samples underwent both alpha and gamma spectroscopy. No americium-241, plutonium-238, plutonium-239/240, or uranium-235 were detected in any of the fish collected from the Peconic River. Cesium-137, uranium-233/234 and uranium-238 were detected at low levels. Cesium-137 was detected in all samples with the highest value detected being 0.70 ± 0.13 pCi/g (0.03 ± 0.005 Bq/g). The highest level of uranium-233/234 detected was in a brown bullhead taken at North Street with a value of 0.006 ± 0.002 pCi/g (0.21 ± 0.07 mBq/g).

Table 6-4. Radiological Analysis (Gamma Data) of Fish from the Peconic River System and Control Locations (BNL and Suffolk County Data 1999).

Fish/Sample Type	K-40 (pCi/g, wet)	Cs-137 (pCi/g, wet)
BNL EA - HMn		
Yellow Perch (whole)	3.58 ± 0.11	0.37 ± 0.20
Chain Pickerel (flesh)	4.09 ± 0.04	0.70 ± 0.13
Chain Pickerel (bone/viscera)	1.81 ± 0.10	0.53 ± 0.13
Chain Pickerel (whole)*	2.40	0.52
Chain Pickerel (whole)*	2.70	0.36
Chain Pickerel (whole)*	2.70	0.38
Brown Bullhead (whole)	2.20 ± 0.04	0.48 ± 0.09
Brown Bullhead (whole)*	2.50	0.35
Brown Bullhead (whole)*	2.40	0.39
Brown Bullhead (whole)*	2.50	0.42
Brown Bullhead (whole)*	2.30	0.32
Brown Bullhead (whole)*	2.20	0.34
Donahue's Pond		
Largemouth Bass (flesh)	1.36 ± 0.05	0.10 ± 0.02
Largemouth Bass (bone/viscera)	4.11 ± 0.07	0.38 ± 0.10
Largemouth Bass (whole)*	2.50	0.21
Largemouth Bass (whole)*	2.50	0.12
Largemouth Bass (whole)*	2.50	0.17
Largemouth Bass (whole)*	2.60	0.15
Largemouth Bass (whole)*	2.40	0.19
Pumpkin Seed (flesh)	2.86 ± 0.06	0.20 ± 0.06
Pumpkin Seed (bone/viscera)	1.85 ± 0.06	0.10 ± 0.02
Bluegill (whole)*	2.20	0.11
Bluegill (whole)*	2.10	0.12
Bluegill (whole)*	2.30	0.15
Bluegill (whole)*	2.20	0.15
Bluegill (whole)*	2.10	0.18
Brown Bullhead (whole)*	2.50	0.14
Brown Bullhead (whole)*	2.70	0.19
Forge Pond		
Bluegill (flesh)	3.12 ± 0.04	0.11 ± 0.03
Bluegill (bone/viscera)	1.89 ± 0.05	0.06 ± 0.02
Bluegill (whole)*	2.30	0.05
Bluegill (whole)*	2.10	0.05
Bluegill (whole)*	2.30	0.05
Bluegill (whole)*	2.60	0.07
Bluegill (whole)*	2.30	0.07
Bluegill (whole)*	2.00	0.07
Largemouth Bass (whole)*	2.70	0.09
Largemouth Bass (whole)*	2.50	0.08
Largemouth Bass (whole)* D	2.40	0.08
Largemouth Bass (whole)*	2.50	0.08
Largemouth Bass (whole)*	2.30	0.15
Largemouth Bass (whole)*	2.50	0.10
Largemouth Bass (whole)*	2.20	0.06
Connetquot River (Control)		
Pumpkin Seed (whole)*	1.60	ND
Pumpkin Seed (whole)*	2.60	0.01
Pumpkin Seed (whole)*	2.50	ND
Bluegill (whole)*	2.00	ND
Bluegill (whole)*	2.40	ND
Brown Bullhead (whole)*	2.50	ND
Largemouth Bass (whole)*	2.50	0.02
Largemouth Bass (whole)*D	2.40	0.01
Largemouth Bass (whole)*	3.10	0.02

Notes:

All BNL values shown with a 95% confidence interval.

* Suffolk County data (provided without confidence interval information).

D=Duplicate

ND=Not Detected

Table 6-5. Radiological Data (Alpha Analysis) of Fish From the Peconic River and Control Locations (Data provided by Suffolk County Department of Health Services 1999).

Species	Am-241 pCi/g, wet	U-238 pCi/g, wet	U-234 pCi/g, wet
Forge Pond			
Bluegill	ND	ND	ND
Bluegill	ND	0.0012 ± 0.0007	0.0011 ± 0.0007
Bluegill	ND	ND	ND
Bluegill	ND	ND	ND
Bluegill	ND	ND	ND
Largemouth Bass	ND	0.0010 ± 0.0005	0.0010 ± 0.0005
Largemouth Bass	ND	0.0014 ± 0.0006	0.1113 ± 0.0006
Largemouth Bass	ND	ND	ND
Largemouth Bass	ND	ND	ND
Largemouth Bass	ND	ND	ND
Brown Bullhead	ND	ND	ND
Donahue's Pond			
Bluegill	ND	0.0012 ± 0.0008	ND
Bluegill	ND	0.005 ± 0.0005	0.008 ± 0.0006
Bluegill	ND	0.0012 ± 0.0007	0.0019 ± 0.0009
Bluegill	ND	0.0004 ± 0.0003	0.006 ± 0.0003
Bluegill	ND	0.0007 ± 0.0004	0.0008 ± 0.0004
Largemouth Bass	ND	ND	ND
Largemouth Bass	ND	ND	ND
Largemouth Bass	ND	ND	ND
Largemouth Bass	ND	ND	ND
Largemouth Bass	ND	ND	ND
Brown Bullhead	ND	0.0006 ± 0.0003	0.0004 ± 0.0003
Brown Bullhead	ND	0.0006 ± 0.0003	0.0007 ± 0.0004
BNL-STP			
Brown Bullhead	0.0021 ± 0.0008	0.0008 ± 0.0004	0.0020 ± 0.0007
Brown Bullhead*	TNR	0.0018 ± 0.0009	0.0020 ± 0.001
Brown Bullhead	0.0008 ± 0.0005	0.0013 ± 0.0005	0.0022 ± 0.0008
Brown Bullhead	0.0018 ± 0.0007	0.008 ± 0.0004	0.0014 ± 0.0005
Brown Bullhead*	0.0017 ± 0.0008	0.0004 ± 0.0004	0.0022 ± 0.0009
Brown Bullhead	0.0022 ± 0.0009	0.0006 ± 0.0003	0.0013 ± 0.0005
Brown Bullhead*	0.0015 ± 0.0008	0.0007 ± 0.0005	0.0018 ± 0.0008
Brown Bullhead	0.0036 ± 0.0013	0.0013 ± 0.0006	0.0018 ± 0.0007
Chain Pickerel	0.0004 ± 0.0003	ND	ND
Chain Pickerel	TNR	0.0012 ± 0.0005	0.0006 ± 0.0003
Chain Pickerel	ND	0.0005 ± 0.0003	0.0008 ± 0.0004
Connetquot River (Control)			
Pumpkin Seed	ND	0.0019 ± 0.0009	0.0029 ± 0.0012
Pumpkin Seed*	ND	ND	ND
Pumpkin Seed	ND	0.0007 ± 0.0003	0.0008 ± 0.0003
Pumpkin Seed	ND	ND	0.0008 ± 0.0004
Pumpkin Seed	ND	ND	ND
Bluegill	ND	0.0013 ± 0.0007	0.0013 ± 0.0007
Bluegill	ND	0.0005 ± 0.0003	0.0005 ± 0.0003
Largemouth Bass	ND	ND	ND
Largemouth Bass	ND	ND	ND
Brown Bullhead	ND	ND	ND

Notes:
 All samples were whole fish
 ND=Not Detected
 TNR=Test Not Run
 *Indicates duplicate sample

A uranium-238 value of 0.008 ± 0.002 pCi/g (0.31 mBq/g ± 0.07) was detected in a sample of bone/viscera from onsite samples. For more detail on the project results, refer to the *Plutonium Contamination Characterization and Radiological Dose and Risk Assessment Report* that was placed in the Administrative Record for public review in February 2000 (BNL 2000) and can be found in the BNL Research Library and several local public libraries.

In general, all 1999 BNL and SCDHS data agree with the exception of americium-241. Data from SCDHS showed no evidence of plutonium-238, plutonium-239/240, or uranium-235, which was consistent with BNL data. Data did show detection of cesium-137, uranium-233/234, and uranium-238, as well as very low levels of americium-241. Levels of cesium-137 reported by the SCDHS were at levels comparable to those detected by BNL's surveillance monitoring program. The highest level of cesium-137 seen in SCDHS onsite data 0.52 pCi/g (19 mBq/g) was in a chain pickerel, and is comparable to BNL data for the same area (see Table 6-4). Uranium-233/234 and uranium-238 values were comparable to, or lower than, levels detected by the plutonium study. SCDHS detected americium-241 at very low levels in the Peconic River fish taken onsite. The levels detected were just above the minimum detection limit of 0.001 pCi/g (0.037 mBq/g), with the highest level of 0.0036 pCi/g (0.13 mBq/g) detected in a brown bullhead. Americium-241 levels found in brown bullheads are shown in Figure 6-7.

Data for fish are generated from small sample numbers and each sample may have been a composite sample (composed of several small fish) due to weight requirements needed to obtain accurate radiological analysis. Analyses performed by the SCDHS utilized the whole fish for testing in order to represent the consumption of the whole fish by some members of the public; analyses performed by BNL were done separately on the flesh and skin, the viscera and bones, and occasionally the whole fish. Segregating the tissues provides information regarding the localization of radionuclides in certain parts of a fish, as different radionuclides tend to concentrate in different tissues due to their specific chemical characteristics. Segregated analysis also allows for more realistic dose calculations since different radionuclides may become localized in different discrete

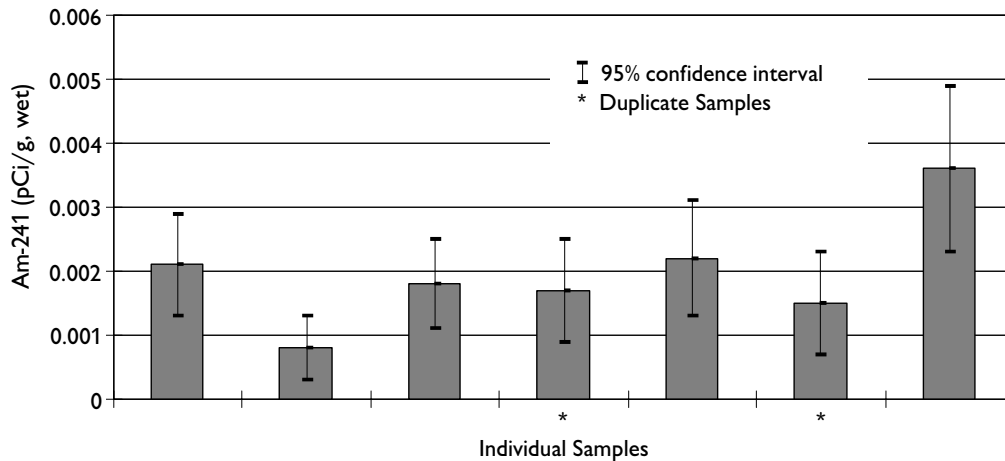


Figure 6-7. Am-241 in Individual Brown Bullhead Catfish Samples Taken From the BNL Site During 1999.

tissues; and, therefore, if the tissue in which a radionuclide concentrates is considered by most consumers to be inedible (e.g., bones and viscera), the source of intake can be eliminated.

Concentrations of naturally occurring potassium-40 (a radionuclide common to soil and vegetation) were observed to be very consistent between Peconic River and control location fish, validating the comparability of the data. The only anthropogenic (man-made) radionuclide found in any fish sample, control or otherwise, was cesium-137.

Some cesium-137 is detectable in the environment worldwide as a result of global fallout from past aboveground nuclear weapons testing. This is evident when examining the analytical results of control location fish. In the past, cesium-137 values up to 0.43 pCi/g (16 mBq/g) were found in yellow perch flesh taken from Swan Pond. In order to account for the different feeding habits and weights of various species, it is important to compare species with similar feeding habits to each other. In general cesium-137 concentrations in bullheads collected near the BNL Sewage Treatment Plant outfall were elevated in comparison to the control locations. The elevations became less pronounced with increasing distance from the Sewage Treatment Plant outfall (see the Donahue's Pond and Forge Pond values in Table 6-4).

Though it is clear from discharge records and sediment sampling that historical BNL operations have contributed to anthropogenic radionuclide levels in the Peconic River system,

most of these radionuclides (with the exception of tritium) were released between the late 1950's and early 1970's. Radionuclides in Peconic River fish have been measured since 1974 by the NYSDOH. Both the NYSDOH and BNL data indicate a continuing decrease in radionuclide concentrations in all fish species over time (NYSDOH 1996). This is due to a lack of significant new radioactive discharges and the radioactive decay of materials discharged in the past.

6.2.2.2 NONRADIOLOGICAL ANALYSIS OF FISH AND SHELLFISH

In 1997, under the Operable Unit (OU) V remediation program, the BNL environmental restoration program conducted sampling and analysis of fish samples from the Peconic River for metals, pesticides, and PCBs (see the BNL *Site Environmental Report for Calendar Year 1997* [BNL 1999] for more information). Results indicated that the levels found were not considered to have any health impacts on fish or human. However, DOE directed that the sampling of fish for pesticides, metals, and PCBs should be incorporated into the annual environmental sampling program. This analysis was conducted in 1999, and the results were compared to the 1997 data as an extension of the 1997 survey. It should be noted that the 1997 sampling was performed during the April-May period, while in 1999 sampling was performed during the September-December period. This makes the comparison more tenuous, as seasonal variations in feeding and energy consumption by fish can be significant.

Table 6-6. Metals Analysis of Fish and Shellfish From the Peconic River and Control Locations (1999).

Location	Matrix	Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc	Sodium	Iron
ppm (µg/g) (wet weight)															
Seafood, NY (Control)	Clams (flesh)	2.12	0.25	<MDL	0.27	4.71	0.53	10.19	0.04	1.31	<MDL	0.23	28.68	13,442	38.8
Seafood, NY (Control)	Clams (flesh)	2.61	0.23	<MDL	0.23	5.59	0.55	11.93	0.05	1.60	<MDL	0.44	36.89	16,489	48.3
Peconic Bay	Clams (flesh)	1.94	<MDL	0.1	<MDL	1.68	<MDL	3.40	<MDL	0.75	<MDL	0.41	6.00	5,869	11.8
Flanders Bay	Clams (flesh)	0.94	0.25	0.12	<MDL	2.09	<MDL	7.85	<MDL	0.45	<MDL	0.61	9.09	5,838	32.3
Forge Pond	Bluegill flesh	<MDL	2.21	<MDL	<MDL	0.59	<MDL	3.29	0.09	0.15	<MDL	<MDL	21.62	770	<MDL
Donahue's Pond	Largemouth Bass (flesh)	0.91	0.24	0.12	<MDL	2.05	<MDL	7.54	<MDL	0.42	<MDL	0.20	8.74	5,709	31.5
Donahue's Pond	Pumpkin Seed (flesh)	<MDL	0.73	<MDL	<MDL	0.62	<MDL	1.02	0.15	0.10	<MDL	<MDL	15.55	768	<MDL
BNL Site: EA to HMn	Chain Pickerel (flesh)	<MDL	1.62	<MDL	<MDL	1.30	<MDL	2.24	0.10	<MDL	<MDL	0.35	21.15	658	8.63
BNL Site: EA to HMn	Bullhead (flesh)	<MDL	2.11	<MDL	<MDL	2.15	<MDL	2.04	0.40	0.18	<MDL	<MDL	14.25	1,376	39.3
MDL (varies by sample aliquot)		0.30	0.18	0.066	0.10	0.20	0.132	0.20	0.02	0.11	0.50	0.10	0.40	100	7.5

Notes:
See Chapter 5, Figure 5-8 for locations.
MDL=Minimum Detection Limit

Table 6-7. Pesticide Analysis of Fish and Shellfish From the Peconic River and Control Locations (1999).

Pesticide	Seaford, NY (Control)	Seaford, NY (Control)	Peconic Bay	Flanders Bay	Forge Pond	Donahue's Pond	Donahue's Pond	BNL EA to HMn	BNL EA to HMn
	<i>clams</i>	<i>clams (duplicate)</i>	<i>clams</i>	<i>clams</i>	<i>Bluegill</i>	<i>Largemouth Bass</i>	<i>Pumpkin Seed</i>	<i>Pickarel</i>	<i>Bullhead</i>
	ppm (µg/g) (wet weight)								
alpha-BHC	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.00097
beta-BHC	0.005	0.0017	0.0017	0.0019	0.0017	0.0017	0.0017	0.0017	0.0017
delta-BHC	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
gamma-BHC(Lindane)	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
Heptachlor	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0019
Aldrin	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
Heptachlor epoxide	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
Endosulfan I	0.0016	0.0014	0.0017	0.00094	0.0017	0.0017	0.0017	0.0017	0.0017
Dieldrin	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.007
4,4'-DDE	0.0033	0.0033	0.0033	0.0033	0.002	0.0024	0.003	0.0071	0.022
Endrin	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033
Endosulfan II	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0048
4,4'-DDD	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0022	0.0033	0.017
Endosulfan sulfate	0.0033	0.0033	0.0033	0.0028	0.0033	0.0033	0.0033	0.0033	0.0033
4,4'-DDT	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033
Methoxychlor	0.017	0.014	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Endrin ketone	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033
Endrin aldehyde	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0054	0.019
alpha-Chlordane	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.011
gamma-Chlordane	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0015	0.015
Toxaphene	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17

Notes:

See Chapter 5, Figure 5-8 for locations.

All values given a qualifier "J," which indicates that the values were estimated above instrument detection limit but below method detection limit.

Table 6-6 shows the concentration levels of metals in fish and shellfish (clams) for 1999. None of the metal concentrations were considered to be capable of impacting the health of the consumers of such fish or clams. In comparing the metals results between 1997 and 1999 for those species that were analyzed during both periods, it was found that mercury levels in the 1997 onsite samples were higher than those found in 1999. This could be the result of seasonal difference in the sampling (spring vs. summer) and/or significant differences in the size of fish caught during the different seasons.

Table 6-7 shows the concentration levels of pesticides in fish for 1999. The levels do not exceed any standards that constitute health impacts on the consumers of such fish and, therefore, are not considered harmful. The data from 1997 were compared to that observed in 1999 for concentration of pesticides in fish. The compounds selected for the comparison, DDD and alpha-chlordane, were the pesticides that were analyzed in both years. The results indicated no significant differences in concentrations between the 1997 and 1999 samples.

Table 6-8 shows the concentration levels of PCBs in fish for 1999. Concentrations found in offsite fish indicated that the levels were at or below the minimum detection limit. However, a significant reduction in the principal PCB component, AROCLOR 1254, was noted in the 1999 samples when compared to the 1997 samples. AROCLOR 1254 was the PCB historically used in transformers and other electrical equipment at BNL. At the observed levels, these concentrations do not pose any health hazards to the consumers of fish containing PCBs.

6.2.3 MARINE/ESTUARINE SAMPLING

Annual sampling for clams, sediment, and seawater in the Peconic Bay, Flanders Bay, Indian Point, and Seaford (control location) was continued in 1999. Stakeholder concern that BNL's discharges have affected the clamming industry prompted the Laboratory to continue this sampling program. The NYSDEC Marine Fisheries Branch has continued to assist BNL in coordinating the sampling with local baymen. Table 6-9 summarizes the radiological data. The naturally-occurring radionuclide potassium-40

Table 6-8. PCB Analysis of Fish and Shellfish From the Peconic River and Control Locations (1999).

	Seaford, NY (Control)	Seaford, NY (Control)	Peconic Bay	Flanders Bay	Forge Pond	Donahue's Pond	Donahue's Pond	BNL EA to HMn	BNL EA to HMn
	<i>clams</i>	<i>clams</i> (duplicate)	<i>clams</i>	<i>clams</i>	<i>Bluegill</i>	<i>Largemouth Bass</i>	<i>Pumpkin Seed</i>	<i>Pickarel</i>	<i>Bullhead</i>
PCB									
	ppm (µg/g) (wet weight)								
Aroclor -1016	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Aroclor -1221	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067
Aroclor -1232	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Aroclor -1242	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Aroclor -1248	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Aroclor -1254	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.224*	0.610*
Aroclor -1260	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.047	0.170

Notes:
See Chapter 5, Figure 5-8 for locations.
All values were accorded a qualifier "J," indicating that they were estimated values, except as indicated next to the number as (*), which indicates that it is a real number.

Table 6-9. Radiological Analysis Results for Shellfish, Aquatic Vegetation, Marine Waters, and Sediment (1999).

Location	K-40 (pCi/g, wet)	Cs-137 (pCi/g, wet)
Peconic Bay		
Clams (flesh)	0.72 ± 0.16	ND
Sea Water	0.22 ± 0.04	ND
Sediment	1.32 ± 0.26	ND
Flanders Bay		
Clams (flesh)	9.21 ± 2.14	ND
Sea Water	0.33 ± 0.05	ND
Sediment	0.94 ± 0.18	0.01 ± 0.01
Seaford, NY (control)		
Clams (flesh)	1.63 ± 0.43	ND
Clams (flesh)*	0.82 ± 0.32	ND
Indian Point		
<i>Salicornia</i>	2.23 ± 1.15	ND
<i>Spartina patens</i>	3.23 ± 1.49	ND
<i>Spartina alterniflora</i>	2.84 ± 0.82	ND
High tide brush	4.42 ± 0.95	ND

Notes:
All values shown with a 95% confidence interval.
ND=Not Detected
*Duplicate sample

continues to be the only radionuclide observed in these samples. Additionally, in 1999, estuarine vegetation located in the Indian Point area was sampled. The results also indicated that potassium-40 was the only radionuclide observed. No BNL-generated radionuclides have been detected since sampling began in 1992.

6.2.4 VEGETATION SAMPLING

No farm vegetable samples were collected from the farms surrounding BNL for radiological analysis in 1999. However, analysis of farm produce data reported in BNL Site Environmental Report over the past ten years indicates only the presence of naturally-occurring potassium-40 at levels that are typical of these types of samples. No radionuclides attributable to BNL operations have ever been observed.

6.2.5 PECONIC RIVER SEDIMENT SAMPLING

Sampling of the Peconic River sediments for radionuclides was conducted during 1999 as part of the sampling project reported in section 2.6.1.1 of Chapter 2. Although the project was focussed on plutonium 238, other radionuclides were analyzed including americium-241, cesium-137, plutonium-239/240, uranium-233/234, uranium-235, and uranium-238. The plutonium findings for the Peconic River are summarized below. For more detailed information on the media and radionuclides evaluated for this project, see the Plutonium Report (BNL 2000), which was placed in the Administrative Record for public review in February 2000.

Plutonium found in the environment has two potential sources: (1) fallout of plutonium released during atmospheric testing of nuclear weapons, and (2) reactor operations. Atmospheric fallout has been distributed globally and has been measured on Long Island in both soils and sediment. The potential source of reactor-related plutonium and related radionuclides would be the Brookhaven Graphite Research

Reactor, which ceased operations in 1969 and is in the process of being decontaminated and decommissioned. Plutonium levels in onsite sections of the Peconic River were found to be elevated above those in another Long Island river, the Connetquot River, which was used as a reference river (i.e., control location not impacted by BNL operations). The plutonium concentration decreased as the distance downstream of the Sewage Treatment Plant increased, with most of the downstream station concentration levels being comparable in range to Connetquot River samples. As determined by the plutonium risk assessment, all Peconic River levels were below those posing a threat to human health and do not, therefore, require cleanup.

Plutonium was, however, found in areas with elevated levels of metals in both the onsite and near offsite sections of the Peconic River, which have been proposed for cleanup. Plans for the removal of the sediment above cleanup goals for the metals will further reduce the already low levels of plutonium in the river. Refer to the detailed report in the Administrative Record for additional plutonium project information (BNL 2000).

6.3 TOXICITY TESTING AT THE SEWAGE TREATMENT PLANT

Under the State Pollutant Discharge Elimination System discharge permit, BNL conducts toxicity testing for the Sewage Treatment Plant effluent. Two species are evaluated - the fathead minnow (*Pimephales promelas*) and the water flea (*Ceriodaphnia dubia*). Results from this testing program are presented in Chapter 3.

6.4 PRECIPITATION MONITORING

As part of the environmental monitoring program, precipitation samples are collected approximately quarterly at Stations P4 and S5 (see Figure 4-4 for station locations) and analyzed for radioactive content. Five samples were taken from each of these two stations in 1999. Gross alpha activity measurements above the minimum detection limit were seen on two samples, one from each location. The sample from the P4 location showed 5.3 pCi/L activity while the sample from the S5 location had an activity level of 9.1 pCi/L. Both of these values are within the range of historic values reported for gross alpha activity. Gross beta activity was measured in four samples at each of the sam-

pling locations. Location P4 had a maximum activity level of 11.9 pCi/L with an average of 5.7 pCi/L. Location S5 had a maximum of 11.1 pCi/L with the average activity being 5.3 pCi/L. Gross beta activity values were within the range of values seen historically at these two locations. Tritium was not detected in any of the samples from either location.

6.5 WILDLIFE MANAGEMENT EDUCATION, OUTREACH, AND RESEARCH

BNL sponsors a variety of educational and outreach activities on natural resources. These programs are designed to provide an understanding of the ecosystem and foster interest in science. They are conducted at the Laboratory in collaboration with DOE, local agencies, and local high schools and colleges. Ecological research is also conducted onsite to update the current natural resources inventory, gain a better understanding of the ecosystem, and guide management planning.

In 1998, a Smithtown High School student completed a follow-up study of the BNL Gamma Forest (Superina 1998). The Gamma Forest research project, which began in 1961, examined the effects of long-term irradiation on a forest ecosystem. No evaluations of the area had been done since the project terminated in 1979. In the 1998 follow-up study, an innovative method of depicting population and habitat relationships, in particular with regard to sediment chemistry and types, was developed. The results of this study were presented at the annual Pine Barrens Research Forum that was held at BNL in 1999.

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