Water Quality

5

Brookhaven National Laboratory operations discharge wastewater to surface waters via the Sewage Treatment Plant (STP) or to groundwater recharge basins. Some of these wastewaters may contain very low levels of radiological, organic, or inorganic contaminants. Monitoring, pollution prevention, and careful operation of treatment facilities helps ensure that these discharges comply with all applicable requirements and that the public, employees, and environment are protected.

Analytical data for 2002 showed that the average gross alpha and beta activity levels in the STP discharge were within the range typical of historical levels and were well below drinking water standards. Tritium releases to the Peconic River continued to decline and were the lowest since monitoring began in 1966. Cesium-137 and strontium-90 were detected infrequently in the effluent and at levels significantly less than the drinking water standard. No other gamma-emitting nuclides attributable to BNL operations were detected in the effluent. Nonradiological monitoring of the effluent showed that, with the exception of isolated incidents of noncompliance, organic and inorganic parameters were within State Pollutant Discharge Elimination System effluent limitations or other applicable standards.

Inorganic data from the upstream, downstream, and control locations demonstrated that elevated amounts of aluminum, iron, and zinc detected within the Peconic River are a result of natural geology. In addition, the low pH of water samples collected at several sections of the river was also due to natural causes. Very low concentrations of tritium were detected at the STP outfall, but there were no detections above the minimum detection limit at all downstream monitoring stations. The maximum tritium concentration at the STP outfall was approximately 3 percent of the drinking water standard. Based on the 2002 nonradiological and radiological data, the Peconic River water quality is comparable to other local freshwater rivers and is of consistent quality both upstream and downstream of BNL.

5.1 SURFACE WATER MONITORING PROGRAM

Treated wastewater from the BNL Sewage Treatment Plant (STP) is discharged into the headwaters of the Peconic River. This discharge is permitted by the New York State Department of Environmental Conservation (NYSDEC) point source discharge program. Effluent limits are based on the water quality standards established by NYSDEC, as well as historical operational data. To assess the impact of this discharge on the quality of the river, surface water monitoring is conducted at several locations upstream and downstream of the point of discharge. Monitoring Station HY, located on site but upstream of all BNL operations, provides information on the background water quality of the Peconic River. The Carmans River is monitored as a geographic control

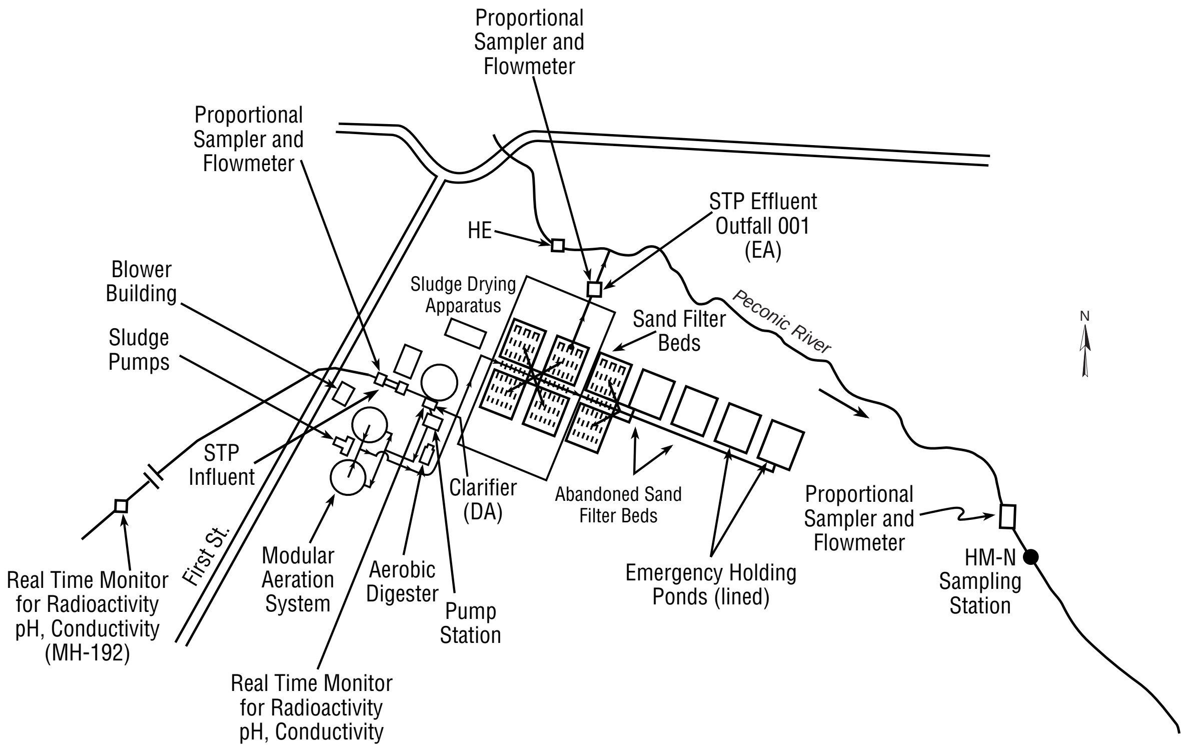

Figure 5-1. Schematic of BNL's Sewage Treatment Plant (STP).

location for comparative purposes, as it is not affected by BNL operations.

On the BNL site, the Peconic River is an intermittent stream. Off-site flow only occurs during periods of sustained precipitation, typically in the spring. Due to severe drought conditions in the spring and summer of 2002, there was no off-site flow recorded.

The following sections describe BNL's surface water monitoring and surveillance program.

5.2 SANITARY SYSTEM EFFLUENTS

The STP effluent (Outfall 001) is a discharge point operated under a State Pollutant Discharge Elimination System (SPDES) permit. Figure 5-1 shows a schematic of the STP and the STP sampling locations. The BNL STP treatment system includes: 1) primary clarification to remove settleable solids and floatable materials, 2) aerobic oxidation for secondary removal of biological matter and nitrification of ammonia, 3) secondary clarification, 4) sand filtration for final solids removal, and 5) ultraviolet disinfection for bacterial control prior to discharge to the Peconic River.

Tertiary treatment for nitrogen removal is also provided by controlling the oxygen levels in the aeration tanks. During the aeration process (i.e., Step 2), the oxygen levels are allowed to drop to the point where microorganisms use nitrate-bound oxygen for respiration; this liberates nitrogen gas and consequently reduces the concentration of nitrogen in the STP discharge. Nitrogen is an essential nutrient in biological systems that, in high concentrations, can cause excessive aquatic vegetation growth. Since vegetation utilizes oxygen during nighttime hours, too much aquatic plant life can deprive a water system of oxygen needed by fish and other aquatic organisms for survival. Reducing the concentration of nitrogen in the STP discharge allows plant growth within the Peconic River to remain in balance with the nutrients provided by natural sources. During 2002, the STP discharge continuously met the nitrogen limit of 10 mg/L specified in the SPDES permit.

Real-time monitoring of the sanitary waste stream for radioactivity, pH, and conductivity takes place at two locations. The first site is approximately 1.1 miles upstream of the STP, providing at least 30 minutes warning to the STP operator that wastewater is en route that may exceed SPDES limits or BNL effluent release criteria (which are much more stringent than DOE-specified levels). The second site is at the point where the influent enters the primary clarifier. In addition to the two full monitoring stations, effluent leaving the primary clarifier is also monitored for radioactivity.

Any influent to the clarifier that does not meet SPDES limits or BNL effluent release criteria is diverted to lined holding ponds. The total combined capacity of the two holding ponds exceeds 7,000,000 gallons, or approximately 14 days of flow. Diversion continues until the effluent's water quality meets the permit limits or release criteria. If wastewater is diverted to the holding ponds, it is tested and evaluated against the requirements for release. If necessary, the wastewater is treated, then reintroduced into the STP at a rate that ensures compliance with SPDES permit limits or BNL effluent release criteria. No diversions were necessary in 2002.

Solids separated in the clarifiers are pumped to a new digester, where they are reduced in volume by aerobic bacteria. Periodically, a fraction of the sludge is emptied into a drying bed. The drying bed uses solar energy to dry the watery sludge to a semisolid cake. Since the dried sludge contains very low levels of radioactivity (e.g., Co-60 < 0.1 to 2 pCi/g), it is put into containers for off-site disposal at an authorized facility.

In 2002, BNL completed the third and final phase of STP upgrades. These upgrades included completion of the new aerobic digester, upgrades to the pipe distribution system within the sand filters, relining of the holding ponds, and replacement, repair, or relining of approximately 16,000 linear feet of sewer collection and conveyance piping.

5.2.1 Sanitary System Effluent – Radiological Analyses

Wastewater at the STP is sampled at the output of the primary clarifier (Station DA) and at the Peconic River Outfall (Station EA). At each location, samples are collected on a flow-proportional basis; that is, for every 1,000 gallons of water treated, approximately 4 fluid ounces of sample are collected and composited into a 5-gallon collection container. These samples are analyzed for gross alpha and gross beta activity and tritium concentrations. During 2002, samples were collected three times weekly. Samples collected from these locations are also composited and analyzed monthly for gamma-emitting radionuclides and strontium-90.

Although the Peconic River is not used as a direct source of potable water, BNL applies the stringent Safe Drinking Water Act (SDWA) standards for comparison purposes when monitoring the effluent, in lieu of DOE wastewater criteria. The SDWA specifies that no individual may receive an annual dose greater than 4 mrem (40 mSv) in a year from radionuclides present in drinking water. The SDWA annual average gross alpha activity limit is 15 pCi/L (0.6 Bq/L) (including radium-226, but excluding radon and uranium). The SDWA also stipulates a 50 pCi/L (1.85 Bq/L) gross beta activity screening level, above which radionuclide-specific analysis is required. BNL goes beyond this basic screening requirement by performing radionuclide-specific gamma analysis, regardless of the gross beta activity. Other SDWA-specified drinking water limits are 20,000 pCi/L (740 Bq/L) for tritium and 8 pCi/L (0.3 Bq/L) for strontium-90. For all other radionuclides, Derived Concentration Guides (DCGs) found in DOE Order 5400.5 (DOE 1993) are used to determine the concentration of the nuclide, which, if continuously ingested over a calendar year, would produce an effective dose equivalent (EDE) of 4 mrem (40 mSv).

Gross activity (alpha and beta) measurements were used as a screening tool for detecting the presence of radioactivity. Table 5-1 shows the monthly gross alpha and beta activity data and tritium concentrations for the STP influent and effluent during 2002. Annual average gross alpha and beta activity of the STP effluent was 2.25 ± 0.25 pCi/L (0.08 ± 0.009 Bq/L) and 8.24 ± 0.5 pCi/L (0.31 ± 0.02 Bq/L), respectively. These concentrations are well below the New York State Drinking Water Standard (DWS) of 15 and 50 pCi/L, respectively. Control location data (Carman's River Station HH) show average gross alpha and beta levels of 0.49 ± 0.73 pCi/L

Table 5-1. Tritium and Gross Activity in Water at the Sewage Treatment Plant.

	Monthly Flow (Liters)	Tritium Maximum	Tritium Average	Gross Alpha Maximum	Gross Alpha Average	Gross Beta Maximum	Gross Beta Average
		(pCi/L)					
STP Influent							
January	3.97E+07	< 355	-19 ± 80	6.25 ± 2.81	1.25 ± 0.99	12.10 ± 5.35	7.78 ± 1.32
February	2.98E+07	< 313	24 ± 41	5.38 ± 2.49	1.53 ± 0.98	13.80 ± 5.82	8.85 ± 1.37
March	3.85E+07	<386	33 ± 91	6.01 ± 3.05	2.27 ± 1.17	13.10 ± 6.05	8.18 ± 1.66
April	4.44E+07	< 268	31 ± 48	4.17 ± 2.20	1.95 ± 0.61	12.20 ± 5.66	9.29 ± 0.91
May	5.19E+07	381 ± 221	57 ± 73	6.16 ± 2.32	3.51 ± 0.88	24.80 ± 5.62	11.85 ± 2.87
June	5.34E+07	< 357	74 ± 84	4.54 ± 1.99	3.23 ± 0.63	15.00 ± 4.83	9.55 ± 1.83
July	7.39E+07	508 ± 197	189 ± 78	5.05 ± 2.48	2.70 ± 0.80	11.80 ± 4.29	7.23 ± 1.40
August	6.16E+07	444 ± 254	137 ± 80	2.96 ± 1.60	1.96 ± 0.53	11.10 ± 4.07	7.35 ± 1.28
September	5.54E+07	< 398	150 ± 53	6.05 ± 2.23	3.01 ± 0.91	11.80 ± 4.30	7.80 ± 1.61
October	4.46E+07	342 ± 203	78 ±103	3.76 ± 1.81	2.39 ± 0.64	12.60 ± 4.56	9.33 ± 1.04
November	3.43E+07	< 331	22 ± 72	3.98 ± 2.24	2.33 ± 0.59	16.80 ± 5.05	10.40 ± 1.54
December	3.50E+07	351 ± 248	52 ± 80	4.62 ± 2.44	2.74 ± 0.68	14.90 ± 4.61	9.02 ± 1.89
Annual Average		70 ± 23			2.41 ± 0.25		8.89 ± 0.51
STP Effluent							
January	3.47E+07	< 355	19 ± 68	< 3.49	1.27 ± 0.68	8.90 ± 5.44	5.77 ± 1.15
February	2.80E+07	< 383	43 ± 38	5.11 ± 3.15	1.47 ± 0.95	13.00 ± 6.03	7.86 ± 1.60
March	3.41E+07	640 ± 216	43 ±125	5.07 ± 2.62	1.75 ± 1.21	10.70 ± 6.19	7.88 ± 0.94
April	3.94E+07	< 299	-2 ± 61	4.71 ± 2.16	2.06 ± 0.90	18.10 ± 6.06	8.92 ± 2.16
May	4.53E+07	< 314	41 ± 79	4.09 ± 2.23	2.28 ± 0.59	15.50 ± 4.72	9.37 ± 1.30
June	4.73E+07	554 ± 279	155 ±109	4.16 ± 2.08	2.44 ± 0.70	27.60 ± 5.90	9.86 ± 3.66
July	6.64E+07	563 ± 199	170 ±101	6.40 ± 2.31	2.67 ± 1.12	11.60 ± 4.51	7.85 ± 1.33
August	6.17E+07	< 413	127 ± 73	4.37 ± 2.17	2.27 ± 0.67	13.10 ± 4.87	8.15 ± 1.44
September	4.33E+07	525 ± 242	166 ± 83	3.90 ± 1.90	2.27 ± 0.49	12.70 ± 4.55	8.01 ± 1.22
October	3.86E+07	398 ± 217	117 ± 71	6.15 ± 2.70	2.87 ± 0.83	12.50 ± 4.61	9.04 ± 1.44
November	3.75E+07	< 334	16 ± 61	4.81 ± 2.32	3.26 ± 0.61	13.30 ± 4.78	9.48 ± 1.47
December	3.60E+07	< 317	3 ± 73	5.35 ± 2.31	2.46 ± 0.93	11.20 ± 4.28	6.82 ± 1.24
Annual Average			75 ± 25		2.25 ± 0.25		8.24 ± 0.50
Total Release	5.12E+08		56.8 mCi		1.2 mCi		4.2 mCi
SDWA Limit			20,000 (pCi/L)		15.0 (pCi/L)		50.0 (pCi/L)
Average MDL			343 (pCi/L)		2.28 (pCi/L)		6.93 (pCi/L)

Notes:
All values shown with a 95% confidence interval.
Negative numbers occur when the measured value is lower than background.
To convert values from pCi to Bq, divide by 27.03.
MDL = Minimum Detection Limit
SDWA = Safe Drinking Water Act

(0.02 ± 0.03 Bq/L) and 0.85 ± 2.37 pCi/L (0.03 ± 0.09 Bq/L), respectively (see Table 5-7).

Tritium detected at the STP originates from either HFBR sanitary system releases or small, infrequent batch releases that meet BNL discharge criteria from other facilities. Although the HFBR is no longer operating, tritium continues to be released from the facility at very low concentrations, due to evaporative losses of residual tritium remaining in the reactor coolant and from off-gassing of the facility. Once tritium is in the air stream, it condenses as a component of water vapor in the air conditioning or air compressor units and is discharged in these wastewater streams. To minimize the quantity of tritium released to the STP, efforts have been made to capture most of the air conditioning condensate collected on the equipment level of the HFBR. A plot of the 2002 tritium concentrations recorded in the STP effluent is presented in Figure 5-2. A 15-year trend plot of annual average tritium concentrations measured in the STP discharge is shown in Figure 5-3. Annual average concentrations have been declining since 1995.

In 2002, the annual average tritium concentration as measured in the STP effluent (EA, Outfall 001) was 75 ± 25 pCi/L (2.8 ± 0.9 Bq/L), down from 136 pCi/L (5.0 Bq/L) in 2001. This value is less than one-quarter the average minimum detection limit (MDL) for the BNL Analytical Services Laboratory of 343 pCi/L (13.0 Bq/L), and well below the DWS of 20,000 pCi/L. A total of 0.057 Ci (2.1 billion Bq) of tritium was released during the year. This level is 22 percent less than the discharge recorded for 2001, is the lowest annual release of tritium to the Peconic River

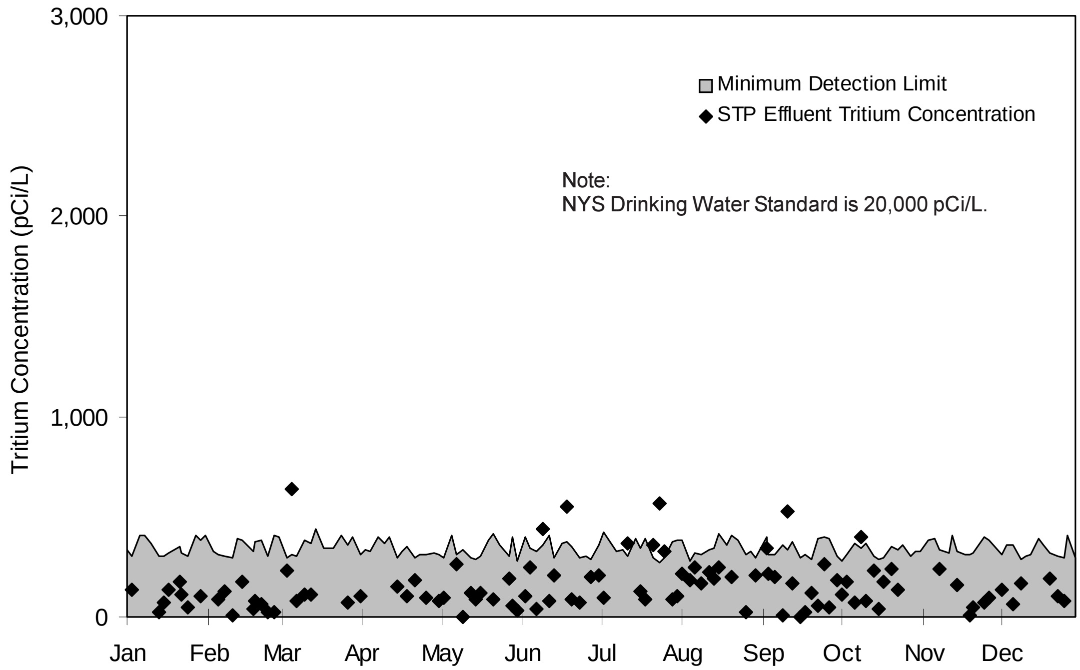

Figure 5-2. Tritium Concentration in Effluent from the Sewage Treatment Plant.

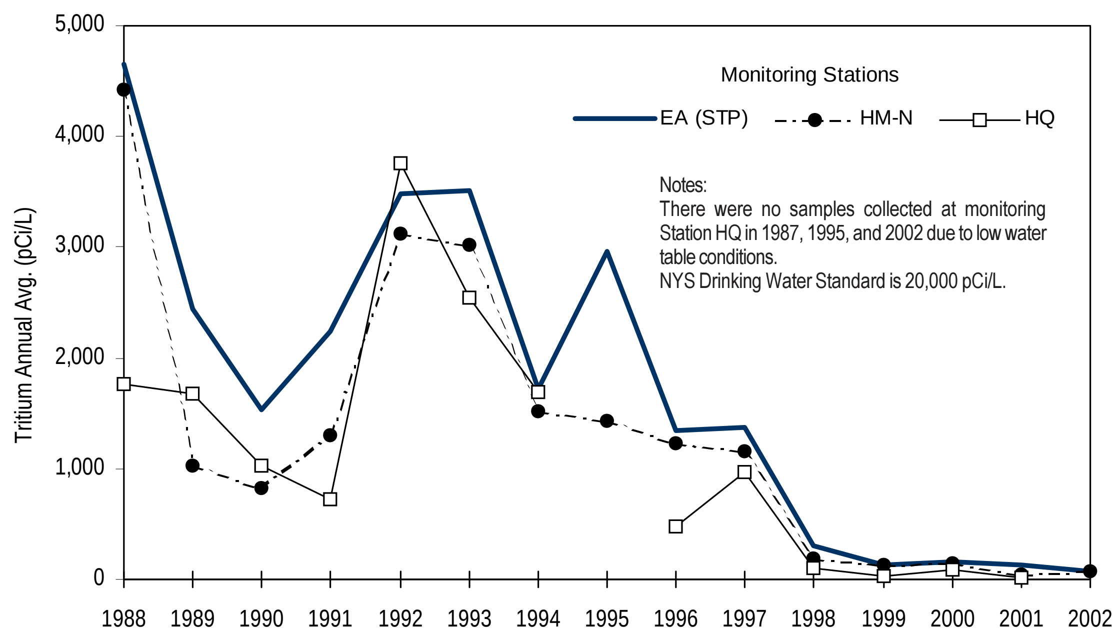

Figure 5-3. Sewage Treatment Plant/Peconic River Annual Tritium Concentrations (1988 — 2002).

observed since routine measurements began in 1966, and is less than 2 percent of the peak values released in the late 1980s (see Figure 5-4). Tritium was detected above the MDL in less than 10 percent of the samples collected at the STP discharge to the Peconic River. The maximum concentration of tritium was 640 pCi/L (23.7 Bq/L), detected in March. Reduced concentrations of tritium are primarily the result of operations readying the HFBR for permanent closure. In 2000, most of the primary coolant, which had very high concentrations of tritium, was drained from the reactor and shipped off site. The reactor was subsequently partially filled with tap water. The level of tritium released from the HFBR has decreased more than 20 percent from 2001 levels and will continue to drop as the HFBR moves into permanent decommissioning.

Table 5-2 presents the gamma spectroscopy analytical data for the monthly STP composite samples. During 2002, the samples showed the presence of cesium-137 once in the STP effluent and not in the influent. The concentration of cesium-137 detected in the effluent was less than 1 percent of the SDWA drinking water standard. The presence of cesium-137 in the STP effluent is due to the continued leaching of very small amounts of cesium-137 from the STP sand filter beds and from sludge residuals in the piping systems. This radionuclide was deposited during pre-1990 releases to the site sanitary system. The cesium-137 concentrations in the STP influent and effluent have been steadily decreasing since 1990, as shown in Figure 5-5. Although the total release of cesium-137 in 2002 (0.06 mCi) was approximately twice that for 2001 (0.03 mCi), the concentration in the discharge was essentially the same in both years (1.4 versus 1.2 pCi/L). In 2002, the Environmental Restoration Program began a cleanup of the residual radionuclides in the sand filter beds and associated berms. Approximately 1,320 cubic yards of sand and debris containing low levels of radioactivity and heavy metals were removed and staged for off-site disposal. Soil disposal will continue into 2003.

Stronitum-90 was detected at very low levels in the STP effluent monthly composite samples on two occasions in 2002. Strontium-90 was detected in January at 3.92 ± 0.52 pCi/L (0.15 ± 0.02 Bq/L), and in March at 0.25 ± 0.13 pCi/L (0.01 ± 0.005 Bq/L). All subsequent monthly data showed levels to be nondetectable. Strontium-90 was discharged from BNL facilities in the 1950s and 1960s and has remained in the sludge within the sanitary piping system. All levels are less than the DWS of 8.0 pCi/L (0.3 Bq/L).

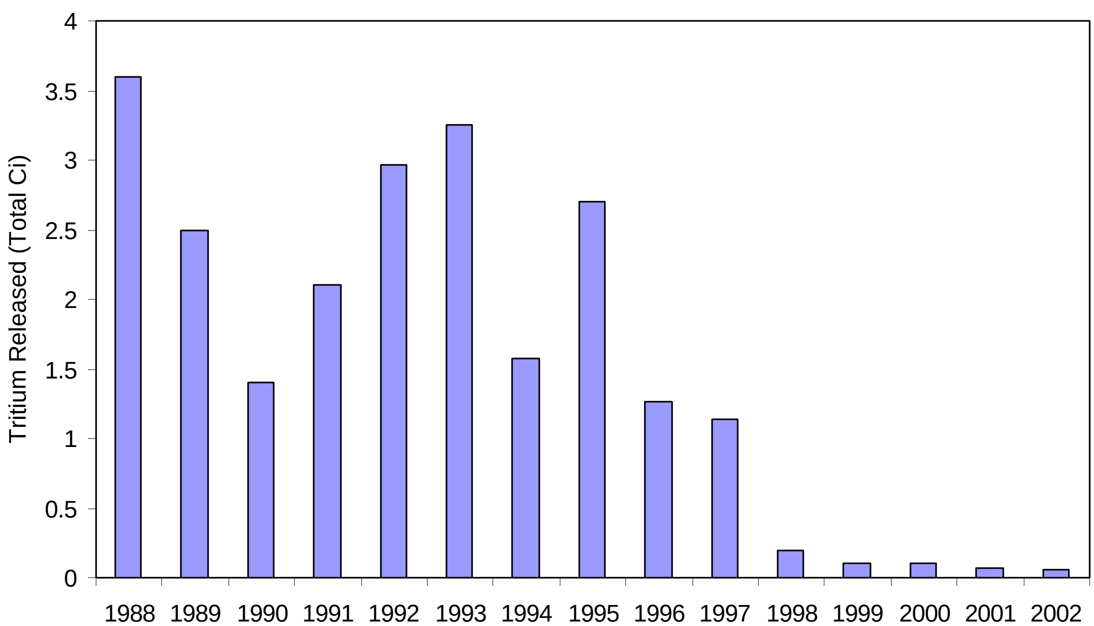

Figure 5-4. Tritium Released to the Peonic River, 15-Year Trend (1988 — 2002).

Table 5-2. Gamma-Emitting Radionuclides and Strontium-90 in Water at the Sewage Treatment Plant.

	Flow	Co-60	Cs-137	Be-7	Na-22	Sr-90
	— L —	pCi/L				
STP Influent						
January	3.97E + 07	ND	ND	ND	ND	< 0.34
February	2.98E + 07	ND	ND	ND	ND	< 0.14
March	3.85E + 07	ND	ND	ND	ND	< 0.28
April	4.44E + 07	ND	ND	ND	ND	< 0.17
May	5.19E + 07	ND	ND	ND	ND	< 0.39
June	5.34E + 07	ND	ND	ND	ND	< 0.46
July	7.39E + 07	ND	ND	ND	ND	< 0.64
August	6.16E + 07	ND	ND	ND	ND	< 1.01
September	5.54E + 07	ND	ND	ND	ND	< 0.51
October	4.46E + 07	ND	ND	ND	ND	< 0.42
November	3.43E + 07	ND	ND	ND	ND	< 0.51
December	3.50E + 07	ND	ND	ND	ND	< 0.20
STP Effluent						
January	3.47E + 07	ND	ND	ND	ND	3.92 ± 0.52[(1)]
February	2.80E + 07	ND	ND	ND	ND	< 0.24
March	3.41E + 07	ND	ND	ND	ND	0.25 ± 0.13[(1)]
April	3.94E + 07	ND	1.40 ± 0.85	ND	ND	< 0.30
May	4.53E + 07	ND	ND	ND	ND	< 0.14
June	4.73E + 07	ND	ND	ND	ND	< 0.34
July	6.64E + 07	ND	ND	ND	ND	< 0.45
August	6.17E + 07	ND	ND	ND	ND	< 0.60
September	4.33E + 07	ND	ND	ND	ND	< 0.31
October	3.86E + 07	ND	ND	ND	ND	< 0.58
November	3.75E + 07	ND	ND	ND	ND	< 0.37
December	3.60E + 07	ND	ND	ND	ND	< 0.16
Total Release		**0**	**0.06 mCi**	**0**	**0**	**0.15 mCi**
DOE Order 5400.5 DCG		5,000	3,000	50,000	10,000	1,000
Dose Limit of 4 mrem EDE		100	200	6,000	400	8

Notes:
All values shown with a 95% confidence interval.
DCG = Derived Concentration Guide
EDE = Effective Dose Equivalent
ND = Not Detected
(1) This is an estimated value.

5.2.2 Sanitary System Effluent – Nonradiological Analyses

In addition to the compliance monitoring discussed in Chapter 3, effluent from the STP is also monitored for nonradiological contaminants under the BNL Environmental Surveillance Program. Data are collected for field-measured parameters, such as temperature, specific conductivity, pH, and dissolved oxygen, as well as inorganic parameters such as chlorides, nitrates, sulfates, and metals measured in the BNL Analytical Services Laboratory. Composite samples of the STP effluent are collected using a flow-proportional refrigerated sampling device (ISCO Model 3700RF). The BNL Analytical Services Laboratory analyzes these composite samples for 21 inorganic compounds. In addition, grab samples are collected monthly from the STP effluent and analyzed for 38 different volatile organic compounds (VOCs). Daily influent and effluent logs are maintained by the STP operators for flow, pH, temperature, and settleable solids as part of routine monitoring of STP operations.

Table 5-3 summarizes the inorganic analytical results for the STP samples. Comparing the

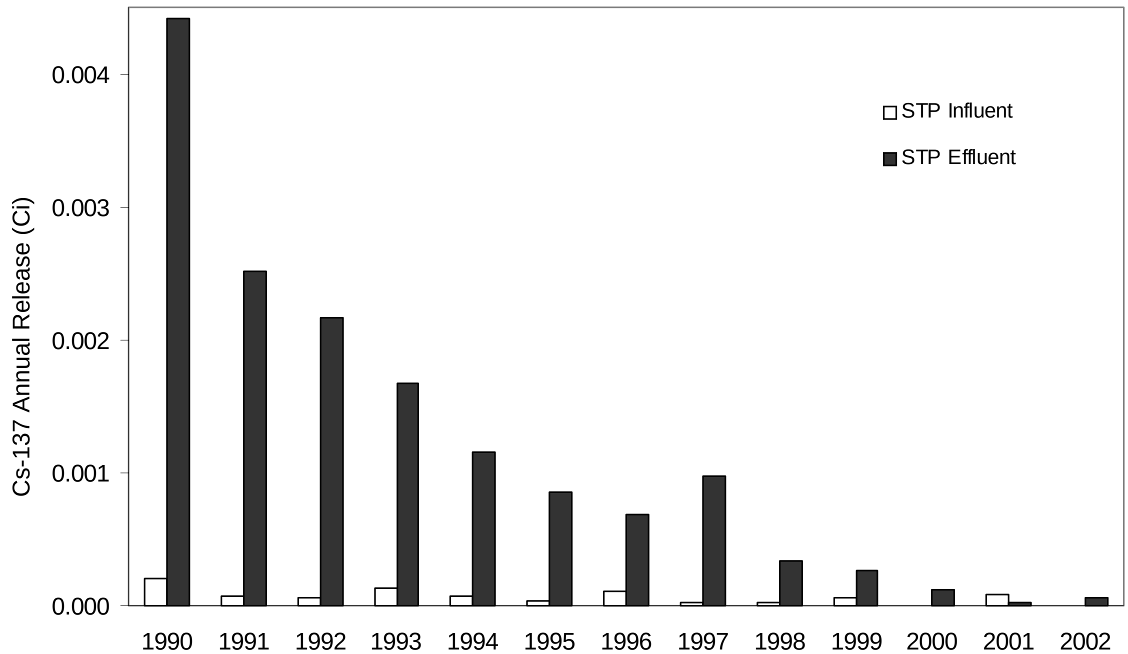

Figure 5-5. Cesium-137 in the Sewage Treatment Plant Influent and Effluent (1990 – 2002).

effluent data to the SPDES effluent limits (or other applicable standard) shows that the majority of the analytical parameters were within SPDES effluent permit limits (see also the compliance data in Chapter 3). Copper and iron were detected once and twice respectively at concentrations exceeding SPDES limits. There were no detections of these elements above SPDES limits during routine compliance monitoring (see Chapter 3). There are no defined sources that would explain these three elevated readings. Aluminum was also detected periodically at levels exceeding the ambient water quality standard of 100 µg/L. Aluminum is a component of native soils and is most likely attributable to fine particles of sand media carried over in the effluent. There are no other defined sources that would explain the elevated readings for aluminum.

Except for a single detection of diethyl ether (4.5 µg/L), no organic compounds were detected above the MDL throughout 2002. Although there are no SPDES limits or ambient water quality standards specified for diethyl ether, NYSDEC imposes a generic limit of 50 µg/L for unlisted organic compounds. The diethyl ether reading was less than 10 percent of NYSDEC's generic limit.

5.3 PROCESS-SPECIFIC WASTEWATER

Wastewater that may contain constituents above SPDES permit limits or groundwater discharge standards is held by the generating facility and characterized to determine the appropriate means of disposal. The analytical results are compared with the appropriate discharge limit, and the wastewater is released to the sanitary system only if the volume and concentration of contaminants in the discharge would not jeopardize the quality of the STP effluent and subsequently the Peconic River.

The BNL SPDES permit includes requirements for quarterly sampling and analysis of process-specific wastewater discharged from the photographic developing operations in Building 197B, the printed-circuit-board fabrication operations conducted in Building 535B, the metal cleaning operations in Building 498, cooling tower discharges from Building 902, and boiler blowdown from satellite boilers at Buildings 244 and 423. These operations were monitored for contaminants such as metals, cyanide, VOCs (EPA Method 624), and semiVOCs (EPA Method 625). Analyses of these waste streams showed that, although several operations contributed contaminants to the STP in concentrations exceeding SPDES-

Table 5-3. Sewage Treatment Plant (STP) Average Water Quality and Metals Analytical Results.

	STP Influent				STP Effluent				SPDES Limit or Ambient Water Quality Standard[(1)]
	No. of Samples	Min.	Max.	Avg.	No. of Samples	Min.	Max.	Avg.	
pH (SU)[(2)]	139	6.1	7.2	NA	152	6	8	NA	5.8–9.0
Conductivity (µS/cm)[(2)]	NA	NA	NA	NA	152	220	396	300.60	SNS
Temperature (°C)[(2,3)]	NA	NA	NA	NA	152	5.2	26.1	15.70	SNS
Dissolved Oxygen (mg/L)	NA	NA	NA	NA	152	6.6	15.1	9.60	SNS
Chlorides (mg/L)	11	24.1	73.4	47.3	12	23	66.8	42.90	SNS
Nitrate* (as N) (mg/L)	11	< 1	4.6	2.9	12	< 1	7.3	4.40	10 (Total N)
Sulfates (mg/L)	11	13.9	23.3	17.2	12	14.5	21.7	17.00	250 (GA)
Aluminum (µg/L)	12	39.2	1600	743.79	12	14.7	796	126.80	100 (Ionic)
Antimony (µg/L)	12	< 0.88	4.1	< 0.88	12	< 0.9	< 3.5	< 3.5	3 (GA)
Arsenic (µg/L)	12	< 3.0	< 12	< 12	12	< 3	< 12	< 12	150 (Dissolved)
Barium (µg/L)	12	28.3	63.1	39.34	12	14.8	31.3	21.02	1,000 (GA)
Beryllium (µg/L)	12	< 0.66	4.46	< 1.3	12	< 0.66	< 2.64	< 2.64	11 (Acid Soluble)
Cadmium (µg/L)	12	< 1.1	< 4.4	< 4.4	12	< 1.1	< 4.4	< 4.4	1.1 (Dissolved)
Chromium (µg/L)	12	< 1.0	10.9	3.4	12	1.28	6.6	2.40	34.4 (Dissolved)
Cobalt (µg/L)	12	0.31	4.87	1.35	12	0.26	2.4	0.86	5 (Acid Soluble)
Copper (µg/L)	12	35.2	285	125.17	12	33.7	206.6	58.56	150 (SPDES)
Iron (mg/L)	12	0.426	1.3	0.85	12	0.117	0.422	0.25	0.37 (SPDES)
Mercury (µg/L)	12	< 0.1	0.99	0.11	12	< 0.1	0.23	< 0.1	0.8 (SPDES)
Manganese (µg/L)	12	11.5	70.6	36.2	12	3.4	28.5	10.86	300 (GA)
Molybdenum (µg/L)	12	< 5.0	116	23.8	12	< 5	143	30.24	SNS
Nickel (µg/L)	12	2.71	15	7.69	12	2.57	8.7	4.61	110 (SPDES)
Lead (µg/L)	12	4.18	58	18.6	12	< 1.32	16.7	3.36	19 (SPDES)
Selenium (µg/L)	12	< 5.0	< 20	< 20	12	< 5	<20	< 20	4.6 (Dissolved)
Silver (µg/L)	12	< 1.0	6.4	< 4.0	12	< 1	7.7	2.30	15 (SPDES)
Sodium (mg/L)	12	26.2	48.8	40.75	12	25.8	56.4	39.06	SNS
Thallium (µg/L)	12	< 0.7	4.3	< 1.3	12	< 0.66	2.6	< 0.66	8 (Acid Soluble)
Vanadium (µg/L)	12	< 5.5	< 22	< 22	12	< 5.5	< 22	< 22	14 (Acid Soluble
Zinc (µg/L)	12	31.4	132	65.88	12	18.9	94.7	46.03	100 (SPDES)

Notes:
See Figure 5-1 for locations of the STP influent and effluent monitoring locations.
All analytical results were generated using total recoverable analytical techniques.
For Class C standards, the solubility state for the metal is provided.
GA = Class GA (groundwater) Ambient Water Quality Standard
NA = Not Applicable
SNS = Standard Not Specified
SPDES = State Pollutant Discharge Elimination System
SU = Standard Units
* Holding times for nitrate analyses are routinely exceeded.
(1) Unless otherwise provided, the reference standard is 6 NYCRR Part 703.5 Class C Surface Water.
(2) The pH and temperature values reported are based on analysis of daily grab samples.
(3) Continuously monitored by STP operators.

permitted levels, the concentration did not affect the quality of the STP effluent.

Process wastewaters that were not expected to be of consistent quality because they were not routinely generated were held for characterization before release to the site sewer system. The process wastewaters typically included ion-exchange column regeneration wastes, primary closed-loop cooling water, and other industrial wastewaters. To determine the appropriate disposal method, samples were analyzed for contaminants specific to the process. The analyses were then reviewed and the concentrations were compared to the SPDES effluent limits and BNL effluent criteria. If the concentrations were within limits, authorization for sewer disposal was granted; if not, alternate means of disposal were pursued. Any waste that contained

Figure 5-6. BNL Outfall Locations.

elevated levels of hazardous or radiological contaminants in concentrations that exceed BNL effluent criteria was sent to the BNL Waste Management Facility for proper disposal.

5.4 RECHARGE BASINS

Recharge basins are used for the discharge of "clean" wastewater streams, including once-through cooling water, storm water runoff, and cooling tower blowdown. With the exception of elevated temperature and increased natural sediment content, these wastewaters are suitable for direct replenishment of the groundwater aquifer. Figure 5-6 shows the locations of BNL's discharges to recharge basins. An overall schematic of water use at BNL is presented in Figure 5-7. Nine recharge basins are used for managing once-through cooling water, cooling tower blowdown, and stormwater runoff, as described below.

- Basins HN, HT-W, and HT-E receive once-through cooling water discharges generated at the Alternating Gradient Synchrotron (AGS) and Relativistic Heavy Ion Collider (RHIC), as well as cooling tower blowdown and stormwater runoff.
- Basin HS receives predominantly stormwater runoff, once-through cooling water from Building 555 (Chemistry Department), and minimal cooling tower

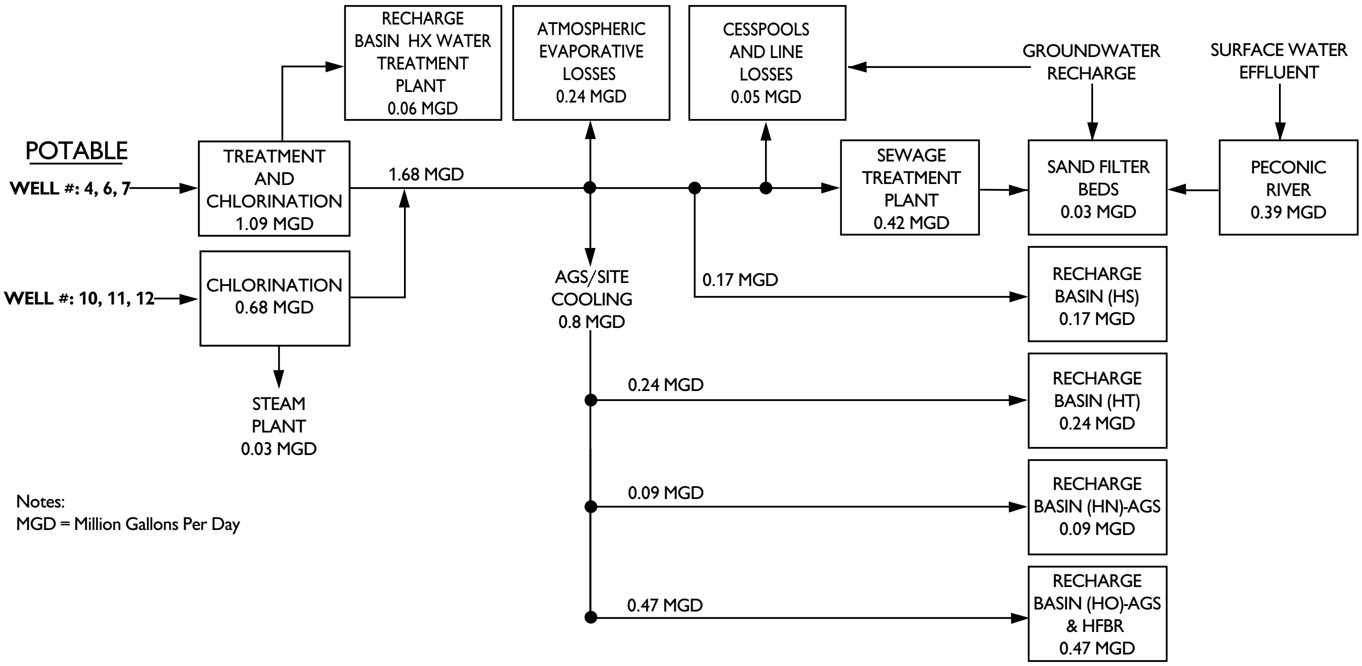

Figure 5-7. Schematic of Waste Use and Flow at BNL.

blowdown from the National Synchrotron Light Source.

- Basin HX receives Water Treatment Plant filter backwash water.
- Basin HO receives cooling water discharges from the AGS and stormwater runoff from the area surrounding the High Flux Beam Reactor.
- Several other recharge areas are used exclusively for discharging stormwater runoff, including Basin HW in the warehouse area, Basin CSF at the Central Steam Facility, Basin H-WM at the Former Waste Management Facility, and a newly constructed Basin HZ, which receives stormwater from the area around Building 902.

Each of the recharge basins is a permitted point source discharge under BNL's SPDES permit. Where required by the permit, the discharge to the basin is equipped with a flow monitoring station, and weekly recordings of flow are collected, with measurements of pH. The specifics of the SPDES compliance monitoring program are provided in Chapter 3. To supplement that monitoring program, samples also are routinely collected and analyzed under BNL's Environmental Monitoring Program for radioactivity, VOCs, metals, and anions. During 2002, water samples were collected from Basins HN, HO, HS, HT-E, HT-W, HW, and the CSF.

5.4.1 Recharge Basins - Radiological Analyses

Discharges to the recharge basins were sampled throughout the year to measure concentrations of gross alpha and beta activity, gamma-emitting radionuclides, and tritium. Radiological results for water samples that were collected at the recharge basins are presented in Table 5-4. The data show there were extremely low levels of beta activity detected in most of the basins, with Basin HW exhibiting higher concentrations than the others. The maximum concentration of beta activity detected in Basin HW was 21.6 ± 1.7 pCi/L (0.8 ± 0.06 Bq/L), which is less than 45 percent of the drinking water standard. With the exception of low level detections of cesium-137 in Basin HW, the accompanying gamma analysis of water samples collected from all basins showed that only potassium-40, lead-212, thallium-208, and beryllium-7 were detectable in these water samples. These gamma-emitting nuclides are attributed to natural terrestrial/geological or cosmic sources. With regard to Basin HW, cesium-137 was detected in two of four sampling events at concentrations of 2.12 ± 1.27 pCi/L (0.08 ± 0.05 Bq/L) and 1.31 ± 1.00

Table 5-4. Radiological Analysis of Samples from On-Site Recharge Basins.

Basin		Gross Alpha	Gross Beta	Tritium	Sr-90
		(pCi/L)			
HN	N	4	4	4	NS
	Max.	2.40 ± 0.65	3.45 ± 0.94	<386	
	Avg.	1.18 ± 0.93	2.17 ± 1.31	131 ± 89	
HO	N	4	4	4	NS
	Max.	5.06 ± 0.75	2.99 ± 1.07	<347	
	Avg.	1.25 ± 2.53	1.40 ± 1.62	79 ± 41	
HS	N	4	4	4	NS
	Max.	0.84 ± 0.51	3.21 ± 1.39	<386	
	Avg.	0.68 ± 0.11	2.34 ± 0.95	191 ± 74	
HT-E	N	4	4	4	NS
	Max.	4.21 ± 0.73	5.03 ± 1.02	<386	
	Avg.	1.76 ± 2.13	1.54 ± 2.33	175 ±123	
HT-W	N	4	4	4	NS
	Max.	1.96 ± 0.63	3.60 ± 1.41	<386	
	Avg.	0.70 ± 1.08	1.79 ± 1.75	182 ±197	
HW	N	3	3	4	NS
	Max.	4.75 ± 0.85	21.60 ± 1.66	<336	
	Avg.	2.15 ± 2.57	6.21 ±15.40	26 ± 64	
SDWA Limit		15	50	20,000	8

Notes:
Figure 5-6 provides the locations of outfall/recharge basins.
All values reported with a 95% confidence interval.
N = Number of samples collected for analysis
NA = Not Applicable
NS = Samples not collected for this analysis
SWDA = Safe Drinking Water Act

pCi/L (0.05 ± 0.04 Bq/L). Due to the high error (i.e., > 50 percent) associated with these detections, the concentrations are at best estimates. Cesium-137 is present in natural sediments at very low levels (i.e., < 1 pCi/g). Carryover of sediment in the storm water could explain these low levels of detection. Tritium was not detected in any basin above minimum detection limits during 2002.

5.4.2 Recharge Basins - Nonradiological Analyses

To determine the overall impact of the recharge basin discharges on the environment, the nonradiological analytical results were compared to groundwater discharge standards promulgated under Title 6 of the New York Codes, Rules, and Regulations, Part 703.6. Samples were collected quarterly for water quality parameters, metals, and VOCs, and analyzed by the BNL Analytical Services Laboratory. Field-measured parameters (pH, conductivity, and temperature) were routinely monitored and recorded. The water quality and metals analytical results are summarized in Tables 5-5 and 5-6, respectively.

Low concentrations of disinfection byproducts were routinely detected in several discharges. These VOCs included bromoform, chloroform, dibromochloromethane, and dichlorobromomethane. Concentrations ranged from nondetectable to a maximum of 4.7 µg/L. Sodium hypochlorite and bromine, used to control algae in cooling towers, are responsible for the formation of these compounds. Acetone was detected in several samples collected from Recharge Basin HW at concentrations up to 13 µg/L. Acetone is commonly found as a contaminant in analytical laboratories and may be present due to its ability to evaporate in one area and then redissolve in water in another area of the Laboratory.

The analytical data in Tables 5-5 and 5-6 show that most parameters, except for aluminum and iron, complied with the respective groundwater discharge or water quality standards. Chlorides were found to be very high in a sample collected in January from Basin HW. Since this basin receives runoff from paved roads, the most likely contributor to this observation is salt from deicing of roadways. Aluminum and iron are natural components of soil and readily dissolve when water samples are acidified for preservation. Iron is present naturally in Long Island groundwater at concentrations that exceed the New York State groundwater effluent limit. Selenium was also detected in several samples approaching or slightly exceeding the groundwater discharge standard. However, these values were estimated and are suspect, due to the presence of selenium in the laboratory blank.

Investigation of lead concentrations in soil samples collected at the Central Steam Facility (CSF) outfall continued in 2002. A significant area of soil containing lead in concentrations greater than 10,000 mg/Kg is still under investigation. Historical operations of the CSF, specifically the combustion of waste oils and the washing of boiler ash to this outfall, are the most likely cause. Investigation activities in 2002 included the collection of more than 100 soil

Table 5-5. Water Quality Data for On-site Recharge Basin Samples.

Recharge Basin		pH (SU)	Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/L)	Chlorides (mg/L)	Sulfates (mg/L)	Nitrate as N* (mg/L)
HN	N = 4							
(RHIC)	Min.	7.7	99	5.6	9.1	17.6	11.9	< 1
	Max.	7.9	280	15.3	12.1	27.6	20.1	< 1
	Avg.	NA	148	8.8	10.9	21.8	14.4	< 1
HO	N = 4							
(AGS/HFBR)	Min.	7.5	165	13.6	8.7	15.2	11.5	< 1
	Max.	7.8	221	22.2	10.3	25.4	13.3	< 1
	Avg.	NA	182	17.8	9.5	20.7	12.2	< 1
HS	N = 4							
stormwater)	Min.	6.6	25	5.1	9.8	< 4	< 4	< 1
	Max.	7.8	267	16.6	12.3	42.5	18.9	1.8
	Avg.	NA	155	10.1	10.9	30.3	13.9	1.2
HT-E	N = 4							
(AGS)	Min.	6.6	93	6.6	9.0	15.1	11.2	< 1
	Max.	8.0	181	14.1	11.7	23.7	13.0	< 1
	Avg.	NA	137	9.4	10.8	18.5	11.7	< 1
HT-W	N = 4							
(Linac)	Min.	7.6	120	7.2	8.5	15.9	10.7	< 1
	Max.	8.1	177	18.7	13.0	28.0	13.3	< 1
	Avg.	NA	142	12.3	10.8	22.4	12.0	< 1
HW	N = 3							
(Weaver Rd)	Min.	6.5	31	5.8	8.3	< 4	< 4	< 1
	Max.	7.3	325	24.2	12.9	2,230	35.8	3.9
	Avg.	NA	129	14.1	10.5	743	11.8	1.3
CSF	N = 3							
(stormwater)	Min.	6.5	47	13.7	7.7	< 4	11.5	< 1
	Max.	7.2	89	23.2	8.9	5.4	13.3	1.4
	Avg.	NA	67.7	18.8	8.3	< 4.0	12.2	< 1
NYSDEC Effluent Standard		**6.5–8.5**	**SNS**	**SNS**	**SNS**	**500**	**500**	**10**
Typical MDL		**NA**	**10**	**NA**	**NA**	**4**	**4**	**1**

Notes:
* Holding times for nitrate analyses are routinely exceeded.
See Figure 5-6 for the locations of recharge basins.
There was no discharge to basin HP in 2002. This basin no longer receives cooling water from the BMRR.
AGS/HFBR = Alternating Gradient Synchrotron/High Flux Beam Reactor
BMRR = Brookhaven Medical Research Reactor
CSF = Central Steam Facility
Linac = Linear Accelerator
MDL = Minimum Detection Limit
N = Number of Samples
SU = Standard Units
NA = Not Applicable
NS = Not Sampled
NYSDEC = New York State Department of Environmental Conservation
RHIC = Relativistic Heavy Ion Collider
SNS = Effluent Standard Not Specified

samples that were used to delineate the area of contamination. A draft remedial work plan has been prepared and is currently under regulatory review. As discussed in Chapter 3, the SPDES permit now requires quarterly sampling for lead. On two occasions the lead concentration in the sample exceeded the SPDES permit limit of 50 µg/L when analyzed by the total recoverable method (i.e., acid preservation immediately after sample collection). However, samples that were filtered prior to acid preservation were well within the standard. To mitigate future permit excursions, a geotextile fabric was installed at the outfall to prevent the resuspension of sediments. Since installation of the geotextile, there have been no further SPDES violations.

5.4.3 Stormwater Assessment

All recharge basins receive storm water runoff. At BNL, storm water is managed by collecting runoff from paved surfaces, roofs, and other impermeable surfaces and directing it to recharge basins via underground piping and abovegrade vegetated swales. Recharge Basin

Table 5-6. Metals Analytical Results for On-Site Recharge Basin Samples.

Recharge Basin	No. of Samples	Ag µg/L	Al µg/L	As µg/L	Ba µg/L	Be µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe mg/L	Hg µg/L	Mn µg/L	Mo µg/L	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se µg/L	Tl µg/L	V µg/L	Zn µg/L
HN (RHIC,	N = 4																					
total)	Max.	<2.0	42.8	< 6.0	30.2	<1.3	<2.2	1.2	<2.0	37.9	0.1	<0.1	22.9	<10.0	43.6	< 2.2	<2.6	<1.8	<10.0	<1.3	<11.0	62.6
	Avg	<2.0	22.6	<6.0	20.9	<1.3	<1.1	0.4	<2.0	31.1	<0.075	<0.1	12.1	<10.0	33.1	< 2.2	<2.6	<1.8	<10.0	<1.3	<11.0	39.1
HN (RHIC,	N = 2																					
filtered)	Min.	<1.0	5.5	<3.0	19.7	<0.7	<1.1	<0.12	<1.0	27.4	<0.075	<0.1	3.3	<5.0	30.2	<1.1	<1.3	<0.9	<5	<0.7	<5.5	19.3
	Max	<1.0	14.4	< 3.0	26.4	<0.7	<1.1	0.3	< 1.0	27.6	<0.075	<0.1	6.5	<5.0	41.3	<1.1	<1.3	<0.9	<5	<0.7	< 5.5	19.3
HO (AGS,	N = 4																					
total)	Min.	<1.0	< 2.2	< 3.0	15.5	<0.7	<1.1	<0.12	< 1.0	4.4	<0.075	<0.1	<2.0	<5.0	18.1	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
	Max.	<2.0	11.7	< 6.0	19.4	<1.3	<2.2	0.4	< 2.0	9.1	0.1	<0.1	13.9	<10.0	25.9	2.7	<2.6	<1.8	<10.0	<1.3	<11.0	8.7
	Avg.	<2.0	6.1	< 3.0	17.0	<1.3	<2.2	< 0.2	< 2.0	6.6	<0.075	<0.1	6.1	<5.0	22.2	<2.2	<2.6	<1.8	<10.0	<1.3	< 5.5	<8.0
HO (AGS,	N = 2																					
filtered)	Min.	<1.0	2.9	< 3.0	15.0	<0.7	<1.1	0.2	< 1.0	5.0	<0.075	<0.1	<2.0	<5.0	25.8	<1.1	<1.3	<0.9	<5.0	<0.7	< 5.5	<4.0
	Max.	<1.0	21.3	< 3.0	18.9	<0.7	<1.1	0.4	< 1.0	6.0	1.3	<0.1	<2.0	<5.0	35.6	<1.1	<1.3	<0.9	10.0	<0.7	<5.5	<4.0
HS (total	N = 4																					
stormwater)	Min.	<1.0	5.4	< 3.0	31.0	<0.7	<1.1	<0.12	< 1.0	4.4	<0.075	<0.1	5.3	<5.0	25.7	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	5.3
	Max.	<2.0	609.4	< 6.0	41.4	<1.3	<2.2	0.2	2.2	62.6	0.1	<0.1	9.3	<10.0	30.1	<2.2	3.0	<1.8	22.4	<1.3	<11.0	23.8
	Avg.	<2.0	171.5	< 6.0	34.3	<1.3	<2.2	< 0.2	< 2.0	20.0	<0.075	<0.1	7.1	<10.0	28.2	<2.2	<2.6	<1.8	<10.0	<1.3	<11.0	13.1
HS (filtered	N = 2																					
stormwater)	Min.	<1.0	18.6	< 3.0	3.8	<0.7	<1.1	<0.12	< 1.0	6.3	<0.075	<0.1	2.8	<5.0	1.1	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
	Max.	<1.0	120.0	<3.0	28.9	<0.7	<1.1	0.2	1.1	6.6	0.3	<0.1	5.4	15.3	27.0	1.3	4.1	<0.9	10.6	<0.7	<5.5	34.1
HT-E (AGS,	N = 4																					
total)	Min.	<1.0	2.7	<3.0	15.5	<0.7	<1.1	<0.12	<1.0	6.1	<0.075	<0.1	2.9	< 5.0	17.9	< 1.1	<1.3	<0.9	< 5.0	<0.7	< 5.5	4.0
	Max.	<2.0	30.2	< 6.0	25.6	<1.3	<2.2	0.3	< 2.0	34.5	0.1	<0.1	34.4	<10.0	27.1	< 2.2	4.1	<1.8	<10.0	<1.3	<11.0	9.1
	Avg.	<2.0	12.3	< 6.0	18.8	<1.3	<2.2	0.2	< 2.0	16.6	<0.075	<0.1	14.3	<10.0	23.8	< 2.2	<2.6	<1.8	<10.0	<1.3	<11.0	7.5
HT-E (AGS,	N = 2																					
filtered)	Min.	<1.0	16.9	< 3.0	16.9	<0.7	<1.1	0.2	< 1.0	6.7	<0.075	<0.1	< 2.0	< 5.0	22.9	< 1.1	<1.3	<0.9	< 5.0	<0.7	< 5.5	<4.0
	Max.	<1.0	18.6	< 3.0	23.1	<0.7	<1.1	0.4	< 1.0	14.5	<0.075	<0.1	4.9	<5.0	26.1	1.1	<1.3	<0.9	10.2	<0.7	<5.5	6.9
HT-W (Linac,	N = 2																					
filtered)	Min.	<1.0	22.1	<3.0	14.7	<0.7	<1.1	0.3	<1.0	10.8	<0.075	<0.1	< 2.0	< 5.0	23.4	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
	Max.	<1.0	36.6	< 3.0	19.4	<0.7	<1.1	0.6	<1.0	15.7	<0.075	<0.1	6.1	< 5.0	26.6	< 1.1	<1.3	2.4	9.7	<0.7	< 5.5	11.4
HT-W (Linac,	N = 4																					
total)	Min.	<1.0	15.8	< 3.0	18.0	<0.7	<1.1	<0.12	<1.0	8.1	<0.075	<0.1	9.2	< 5.0	16.1	< 1.1	<1.3	<0.9	< 5.0	<0.7	< 5.5	12.5
	Max.	<2.0	1900.0	< 6.0	31.2	<1.3	<2.2	1.1	5.5	139.0	0.7	<0.1	78.8	<10.0	32.1	3.1	4.1	<1.8	22.1	<1.3	<11.0	16.2
	Avg.	<2.0	504.3	<6.0	22.3	<1.3	<2.2	0.3	< 2.0	48.9	0.2	<0.1	27.9	<10.0	26.4	<2.2	<2.6	<1.8	< 10	<1.3	<11.0	15.1
HW (total	N = 3																					
stormwater)	Min.	<2.0	1600.0	< 6.0	20.1	<1.3	<2.2	< 0.5	5.7	70.7	0.5	<0.1	27.5	<10.0	3.6	5.9	16.6	<1.8	< 5.0	<1.3	<11.0	31.7
	Max.	<4.0	2390.0	<12.0	69.9	<2.6	<4.4	1.4	10.4	186.1	1.9	<0.1	70.5	24.9	583.0	15.0	24.8	<3.5	21.4	<2.6	<22.0	95.9
	Avg.	<4.0	1915.2	<12.0	38.2	<2.6	<4.4	0.8	8.6	132.2	1.2	<0.1	49.1	<20.0	198.1	9.5	20.9	<3.5	<20.0	<2.6	<22.0	74.1
HW (filtered,	N = 3																					
stormwater)	Min.	<1.0	53.1	< 3.0	5.2	<0.7	<1.1	0.2	< 1.0	17.0	<0.075	<0.1	5.4	< 5.0	2.1	1.3	<1.3	<0.9	<5.0	<0.7	< 5.5	34.1
	Max.	15.3	119.6	3.8	56.0	<0.7	1.3	0.8	1.2	82.4	0.2	<0.1	43.3	21.5	587.0	4.5	4.1	<0.9	10.5	<0.7	< 5.5	73.4
	Avg.	5.1	78.3	< 3.0	21.7	<0.7	<1.1	0.6	< 1.0	35.1	<0.075	<0.1	22.5	12.3	196.7	2.9	2.0	<0.9	< 5.0	<0.7	< 5.5	56.0

(continued on next page)

Table 5-6. Metals Analytical Results for On-Site Recharge Basin Samples *(concluded).*

Recharge Basin	No. of Samples	Ag µg/L	Al µg/L	As µg/L	Ba µg/L	Be µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe mg/L	Hg µg/L	Mn µg/L	Mo µg/L	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se µg/L	Tl µg/L	V µg/L	Zn µg/L
CSF (total stormwater)	N = 4																					
	Min.	<2.0	2736.4	< 6.0	17.5	<1.3	<2.2	0.4	2.9	37.8	1.4	<0.1	14.4	<10.0	3.1	6.2	11.9	<1.8	<10.0	<1.3	<11.0	24.0
	Max.	<4.0	3842.0	<12.0	57.3	<2.6	<4.4	2.4	10.1	201.4	2.6	<0.1	56.6	<20.0	36.4	26.6	44.3	<3.5	<20.0	<2.6	36.6	62.2
Avg.		<4.0	3303.6	<12.0	35.0	<2.6	<4.4	1.6	6.4	92.5	2.0	<0.1	39.7	<20.0	13.3	20.2	29.1	<3.5	<20.0	<2.6	<22.0	45.8
CSF (filtered stormwater)	N = 3																					
	Min.	<1.0	88.4	< 3.0	14.8	<0.7	<1.1	0.4	< 1.0	4.5	< 0.06	<0.1	4.8	< 5.0	3.9	5.4	2.5	<0.9	< 5.0	<0.7	< 5.5	14.6
	Max.	2.1	137.0	< 3.0	34.4	<0.7	<1.1	0.8	< 1.0	16.0	0.1	<0.1	14.8	< 5.0	36.4	18.1	5.5	<0.9	9.4	<0.7	29.0	28.9
	Avg.	<1.0	105.3	< 3.0	17.6	<0.7	<1.1	0.6	< 1.0	9.7	0.1	<0.1	10.8	< 5.0	14.3	13.3	3.6	<0.9	< 5.0	<0.7	13.0	23.5
NYSDEC Effluent Limitation or AWQS		50.0	2000.0	50.0	2000.0	SNS	10.0	5.0	100.0	1000.0	0.6	1.4	600.0	SNS	SNS	200.0	50.0	6.0	20.0	SNS	SNS	5,000
Typical MDL		1.0	2.2	3.0	1.8	0.7	1.1	0.1	1.0	2.0	0.015	0.2	2.0	5.0	1.0	1.1	1.3	0.9	5.0	0.7	5.5	4.0

Notes:
See Figure 5-6 for locations of recharge basins.
Recharge basin HX was not sampled for metals during 2002.
AGS/HFBR = Alternating Gradient Synchrotron/High Flux Beam Reactor
AWQS = NYSDEC 6 NYCRR Part 703.5 Ambient Water Quality Standard
CSF = Central Steam Facility
MDL = Minimum Detection Limit.
NYSDEC = New State Department of Environmental Conservation
RHIC = Relativistic Heavy Ion Collider
SNS = Effluent Standard Not Specified

HS receives most of the stormwater runoff from the central, developed portion of the BNL site (all properties south of Cornell Avenue and west of Railroad Avenue). Basins HN, HZ, HT-W, and HT-E receive runoff from the AGS and portions of the RHIC complex; Basin HO receives runoff from the BGRR and HFBR areas; Basin CSF receives runoff from the area around the Central Steam Facility, and areas along Cornell Avenue east of Railroad Avenue; Basin HW receives runoff from the warehouse area; and HW-M receives runoff from the fenced area at the waste management facility.

Stormwater runoff from the BNL site typically has elevated levels of inorganics and low pH. The inorganics are attributable to high sediment content and the natural occurrence of these elements in native soils. In an effort to further protect the quality of storm water runoff, BNL has finalized formal requirements for managing and maintaining outdoor work and storage areas. These requirements include covering areas to prevent contact with stormwater, an aggressive maintenance and inspection program, and formal restoration of these areas when operations cease. These requirements have become part of the revised *Storage and Transfer of Hazardous and Nonhazardous Materials* Subject Area.

5.5 PECONIC RIVER SURVEILLANCE

Several locations were monitored along the Peconic River to assess the overall water quality of the river and to assess any impact from BNL discharges. Sampling points along the Peconic River are identified in Figure 5-8. In total, 10 stations are monitored: three upstream and seven downstream of the STP outfall. In addition, a sampling station along the Carmans River (HH) is also monitored as a geographic control location that is not affected by BNL operations. All locations are monitored for radiological and nonradiological parameters on a routine basis. In addition to the data reported here, water samples are also collected at locations where fish and aquatic vegetation samples are collected. The results for these data are reported in Chapter 6.

The sampling stations are located as follows.

Downstream sampling stations

- HM-N, on site, 0.5 mile downstream of the STP outfall
- HM-S, on site on a typically dry tributary of the Peconic River
- HQ, on site, 1.2 miles downstream of the STP outfall
- HA and HB, off site, 3.1 and 3.3 miles downstream of the STP outfall
- HC, off site, 4.3 miles downstream of the STP outfall
- HR, off site, 13 miles downstream of the STP outfall (in Riverhead)

Upstream locations

- HE, on site, approximately 20 feet upstream of the STP Outfall
- HV, on site, just east of the 10 o'clock Experimental Hall in the RHIC ring
- HY, on site, just east of the William Floyd Parkway

Control location

- HH, Carmans River

5.5.1 Peconic River - Radiological Analyses

Radionuclide measurements were performed on surface water samples collected from the Peconic River at nine of ten locations. As previously stated, low flow conditions within the Peconic due to drought prevented sample collection from HQ in 2002. Routine samples at Station HM-N were collected once per month. Station HE was collected quarterly in 2002. Since February 1995, Stations HE, HM-N, and HQ have been equipped with Parshall flumes that allow automated flow-proportional sampling and volume measurements. All other sites were sampled quarterly by collecting instantaneous grab samples, as flow allowed.

The radiological data from Peconic River surface water sampling in 2002 are summarized in Table 5-7. Radiological analysis of upstream water samples showed that gross alpha and beta activities were occasionally detected at low levels at all three upstream locations. Samples collected downstream of the BNL STP discharge showed higher concentrations than upstream values. All detected levels were below the drinking water standard, with the exception of single gross alpha values at stations HB and HC. Resuspension of sediment that contains natural alpha emitters and possibly low levels of radionuclides discharged by BNL past operations is the most likely contributor to these detections. No gamma-emitting radionuclides attributable to BNL operations were detected either upstream or downstream of the STP.

Tritium analytical results of water samples collected upstream and downstream from the STP discharge were below detectable levels at all stations.

Monitoring for strontium-90 was performed at eight of the nine stations sampled in 2002. Trace levels were found at all locations, with the highest at Station HE. Strontium-90 was detected at Station HE at a maximum concentration of 1.09 ± 0.26 pCi/L (0.04 ± 0.01 Bq/L), which is approximately 14 percent of the drinking water standard and comparable to the levels detected at this location historically.

5.5.2 Peconic River - Nonradiological Analyses

Samples collected in 2002 were analyzed for water quality parameters (pH, temperature, conductivity, and dissolved oxygen), anions (chlorides, sulfates, and nitrates), metals, and VOCs. The inorganic analytical data for the Peconic River and Carmans River samples are summarized in Tables 5-8 (water quality) and 5-9 (metals).

No VOCs were routinely detected in river water samples above the minimum detection limits. Methyl tertiary butyl ether (MTBE) was detected at Stations HR and HH on several occasions. This compound was used as a gasoline oxygenating agent until 2002. The product was removed from formulated gasoline due to its recent nationwide detection in groundwater and very high aqueous mobility. The highest concentration, 17.6 mg/L, was detected at Station HR. Concentrations of MTBE at Station HH ranged from 3.8 to 10 mg/L. Trace levels of 1,1,1-

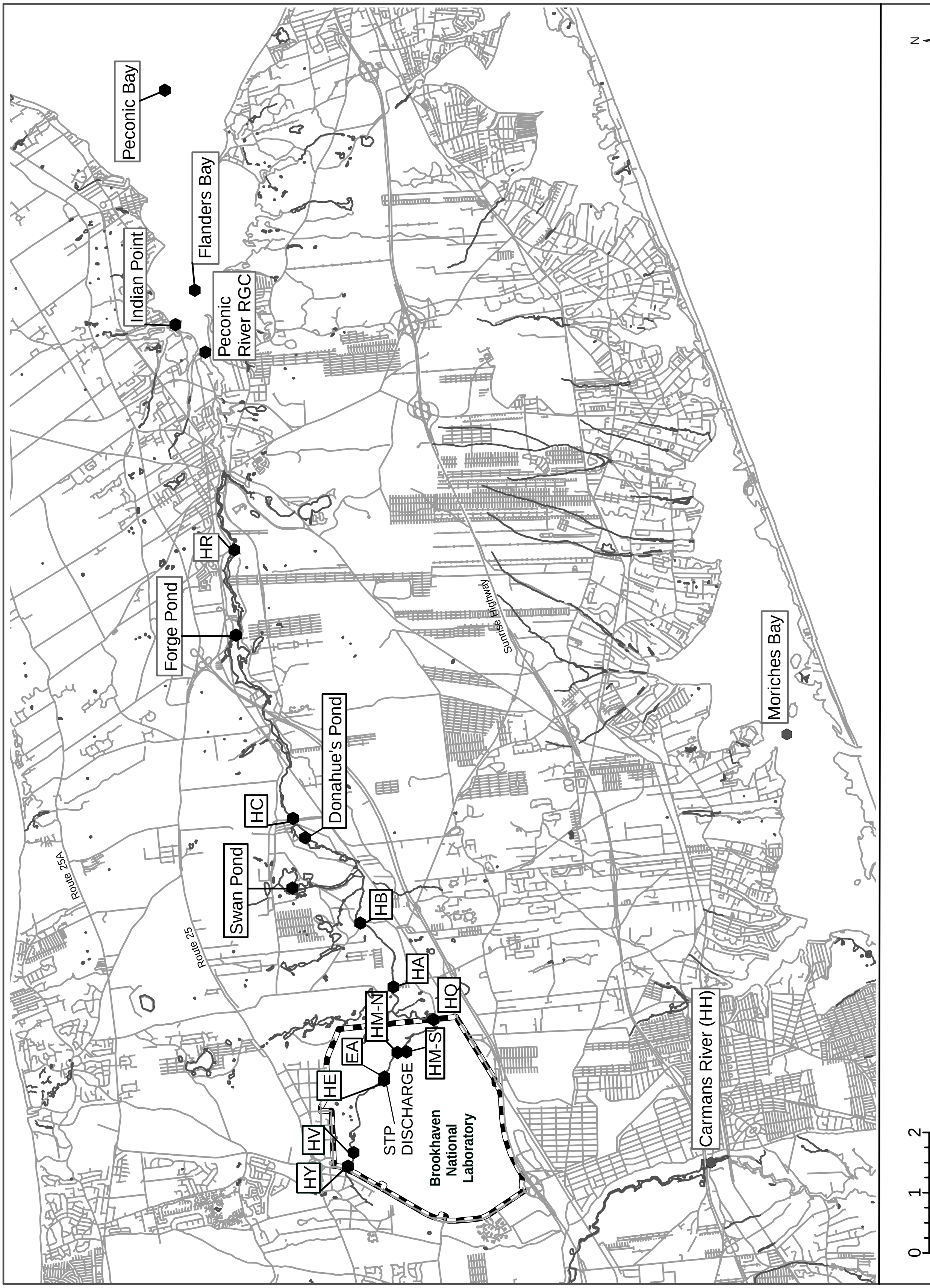

Figure 5-8. Sampling Stations for Surface Water, Fish, and Shellfish.

Table 5-7. Radiological Results for Surface Water Samples Collected along the Peconic and Carmans Rivers.

Sample Station	Geographic Location		Gross Alpha	Gross Beta	Tritium	Sr-90
			(pCi/L)			
HY	Peconic River (headwaters) on site, west of the RHIC ring	N	2	2	3	2
		Max.	1.52 ± 0.58	2.05 ± 1.10	<316	<0.59
		Avg.	0.83 ± 1.36	1.55 ± 0.98	-263 ± 216	0.23 ± 0.21
HV	Peconic River (headwaters) on site, inside the RHIC ring	N	2	2	2	NS
		Max.	1.24 ± 0.53	2.87 ± 1.14	<375	
		Avg.	0.90 ± 0.68	1.69 ± 2.31	-321 ± 266	
HE	Peconic River, upstream of STP outfall	N	4	4	4	4
		Max.	1.09 ± 0.46	2.72 ± 1.11	<294	1.09 ± 0.26
		Avg.	0.51 ± 0.38	1.07 ± 1.10	-111 ± 137	0.73 ± 0.34
HM-N	Peconic River, 0.4 mi from STP, on site	N	11	11	11	6
		Max.	3.17 ± 1.69	15.90 ± 6.19	<34	30.52 ± 0.16
		Avg.	1.60 ± 0.51	8.16 ± 2.26	78 ± 96	0.20 ± 0.15
HM-S	Peconic River tributary, on site	N	1	1	1	1
		Max.	<0.73	<1.96	<375	<0.23
HQ[(1)]	Peconic River, BNL boundary	N	NS	NS	NS	NS
HA	Peconic River, off site	N	4	4	4	2
		Max.	7.28 ± 0.99	6.72 ± 1.10	< 347	< 0.56
		Avg.	2.44 ± 3.20	2.12 ± 3.73	-27 ± 136	0.20 ± 0.25
HB	Peconic River, off site	N	4	4	4	2
		Max.	24.40 ± 1.83	7.21 ± 1.21	<347	<0.60
		Avg.	7.19 ±11.38	4.42 ± 3.36	67 ± 121	0.06 ± 0.30
HC	Peconic River, off site	N	4	4	4	2
		Max.	20.30 ± 1.69	6.30 ± 1.17	<347	0.29 ± 0.15
		Avg.	5.60 ± 9.62	2.36 ± 3.21	-26 ± 144	0.28 ± 0.01
HR	Peconic River, Riverhead	N	4	4	4	2
		Max.	1.06 ± 0.42	2.66 ± 0.90	<347	<0.21
		Avg.	0.30 ± 0.53	1.69 ± 1.13	14 ± 129	0.04 ± 0.19
HH	Carmans River (control location)	N	4	4	4	2
		Max.	1.50 ± 0.49	3.71 ± 0.95	<347	<0.46
		Avg.	0.49 ± 0.73	0.85 ± 2.37	22 ± 115	0.01 ± 0.58
SDWA Limit			15	50	20,000	8

Notes:
See Figure 5-8 for sample station locations.
All values shown with 95% confidence interval.
Negative numbers occur when the measured value is lower than analytical laboratory background levels.
Avg. = Average value
Max. = Maximum value
N = Number of samples analyzed
NS = Not Sampled for this analyte
SDWA = Safe Drinking Water Act
(1)There was no flow recorded at Station HQ throughout 2002.

trichloroethane were detected on one occasion at Station HR. Neither MTBE or 1,1,1 trichloroethane are the result of BNL operations, but may be the result of roadway runoff or other off-site sources.

Comparison of Peconic River water quality data collected upstream and downstream showed that water quality parameters were consistent throughout the river system. These data were also consistent with data from the Carmans River control location (HH). Chlorides, sulfates, and nitrates tend to be slightly higher in samples collected immediately downstream of the STP discharge (Stations HM-N and HQ) and were consistent with the concentrations in the STP discharge. Chlorides were, however, highest at

Table 5-8. Water Quality Data for Surface Water Samples Collected along the Peconic and Carmans Rivers.

Sample Station	Geographic Location		pH (SU)	Conductivity (μS/cm)	Temp. (°C)	Dissolved Oxygen (mg/L)	Chlorides (mg/L)	Sulfates (mg/L)	Nitrates as N* (mg/L)
HY	Peconic River (headwaters) on site, east of Wm. Floyd Pkwy.	N	3	3	3	3	3	3	3
		Min.	4.1	69	3.4	8.5	6.6	< 4	< 1
		Max.	7.2	260	9.9	13.2	748.0	28.4	1.8
		Avg.	NA	155	6.2	11.5	313.0	9.5	< 1
HE	Peconic River, upstream of STP outfall	N	3	3	3	3	3	3	3
		Min.	6.3	43	7.6	9.1	5.8	8.5	< 1
		Max.	7.3	123	10.6	11.5	7.3	32.1	< 1
		Avg.	NA	88	8.6	10.2	6.6	21.5	< 1
HM-N	Peconic River, 0.4 mi from STP, on site	N	11	11	11	11	11	11	11
		Min.	6.4	216	3.6	6.2	23.0	13.7	1.2
		Max.	7.3	350	23.5	14.5	61.1	23.3	6.8
		Avg.	NA	274	13.3	10.3	40.1	17.0	4.4
HM-S	Peconic River tributary, on site	N	1	1	1	1	1	1	1
		Value	4.0	79	11.1	8.5	5.3	4.1	< 1
HQ	Peconic River, BNL boundary	N	0[(a)]						
HA	Peconic River, off site	N	4	4	4	4	4	4	4
		Min.	6.2	53	1.0	3.3	6.4	4.6	< 1
		Max.	6.5	101	20.8	9.6	6.7	25.2	< 1
		Avg.	NA	76	10.5	7.8	6.6	10.3	< 1
HB	Peconic River, off site	N	4	4	4	4	4	4	4
		Min.	5.3	58	0.7	5.5	7.5	< 4	< 1
		Max.	6.3	152	22.8	8.8	9.3	49.0	< 1
		Avg.	NA	86	10.6	7.1	8.3	15.2	< 1
HC	Peconic River, off site	N	4	4	4	4	4	4	4
		Min.	6.3	69	2.8	4.5	10.0	< 4	< 1
		Max.	6.6	80	26.5	12.6	11.2	13.1	< 1
		Avg.	NA	74	14.1	9.0	10.6	7.9	< 1
HR	Peconic River off site, at Riverhead	N	4	4	4	4	4	4	4
		Min.	6.5	119	4.1	7.3	16.1	9.4	< 1
		Max.	7.0	150	26.1	11.2	25.5	13.1	1.4
		Avg.	NA	129	13.9	9.2	18.7	11.2	< 1
HH	Carmans River (control location)	N	4	4	4	4	4	4	4
		Min.	6.5	130	4.6	10.0	18.3	11.0	< 1.0
		Max.	7.0	170	23.4	11.5	26.0	12.3	2.0
		Avg.	NA	153	13.1	10.8	23.4	11.8	1.1
NYS AWQS			6.5 – 8.5	SNS	SNS	> 4.0	250[(b)]	250[(b)]	10[(b)]
Typical MDL			NA	10	NA	NA	4.0	4.0	1.0

Notes:
See Figure 5-8 for sample station locations.
N = No. of samples
NA = Not Applicable
NS = Not Sampled
MDL = Minimum Detection Limit
SNS = Standard Not Specified
SU = Standard Units
* Holding times for nitrate analyses are routinely exceeded.
(a) There was no flow recorded at Station HQ throughout 2002.
(b) Because there are no Class C Surface Water Ambient Water Quality Standards (AWQS) for these compounds, the AWQS for groundwater is provided, if specified.

upstream Station HY. The sample collected from Station HY in January measured 748 mg/L, most probably due to road salting and surface runoff, due to that station's proximity to William Floyd Parkway. There are no limits imposed for chloride discharges to surface water; however, a discharge limit of 500 mg/L is imposed for discharges to groundwater.

The pH measured at several locations was very low due to the low pH of precipitation, groundwater, and the formation of humic acids from decaying organic matter. As the spring rains

Table 5-9. Analysis of Metals in Surface Water Samples Collected along the Peconic and Carmans Rivers.

Station	N		Ag µg/L	Al µg/L	As µg/L	Ba µg/L	Be µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe mg/L	Hg µg/L	Mn µg/L	Mo µg/L	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se* µg/L	Tl µg/L	V µg/L	Zn µg/L
Peconic River																							
HY (total)	3	Min.	<2.0	595.0	<6.0	14.6	<1.3	<2.2	0.8	3.1	17.3	0.4	<0.1	20.2	< 10.0	6.5	<2.2	7.1	<1.8	<10.0	<1.3	<11.0	23.4
		Max.	<4.0	2106.0	<12.0	44.8	<2.6	<4.4	1.2	10.8	129.3	1.6	<0.1	70.4	<20.0	485.0	18.2	13.9	<3.5	<20.0	<2.6	<22.0	39.3
		Avg.	<4.0	1500.3	<12.0	29.7	<2.6	<4.4	1.0	6.2	82.2	0.8	<0.1	44.4	<20.0	199.8	7.5	9.7	<3.5	<20.0	<2.6	<22.0	32.7
HY (D)	1	Val.	<1.0	79.6	3.4	24.6	<0.7	<1.1	0.4	2.8	76.7	0.1	<0.1	25.1	<5.0	446.3	2.4	1.4	<0.9	10.1	<0.7	<5.5	20.3
HE (total)	4	Min.	<1.0	116.0	<3.0	18.0	<0.7	<1.1	0.3	<1.0	<2.0	0.5	<0.1	62.7	<5.0	5.3	<2.2	<1.3	<0.9	<5.0	<0.7	<5.5	10.9
		Max.	<2.0	204.0	<6.0	32.2	<1.3	<2.2	1.0	<2.0	<4.0	1.0	<0.1	164.0	<10.0	6.9	<2.2	<2.6	<1.8	<10.0	<1.3	<11.0	44.7
		Avg.	<2.0	164.7	<6.0	23.8	<1.3	<2.2	0.6	<2.0	<4.0	0.8	<0.1	115.6	<10.0	6.1	<2.2	<2.6	<1.8	<10.0	<1.3	<11.0	25.0
HE (D)	2	Min.	<1.0	79.0	<3.0	11.4	<0.7	<1.1	0.6	<1.0	<2.0	0.4	<0.1	114.1	<5.0	5.9	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	4.2
		Max.	<1.0	152.9	<3.0	20.2	<0.7	<1.1	0.7	<1.0	2.5	0.6	<0.1	115.4	<5.0	6.4	1.8	<1.3	<0.9	8.7	<0.7	<5.5	17.0
HM-N (total)	11	Min.	<1.0	45.9	<3.0	9.1	<0.7	<1.1	0.4	<2.0	29.6	0.2	<0.1	<8.0	<5.0	30.6	<4.4	<1.3	<0.9	<5.0	<0.7	<5.5	11.2
		Max.	22.7	2828.0	<12.0	54.8	<2.6	<4.4	2.8	15.2	240.0	2.1	1.5	113.0	127.0	40.9	10.8	14.6	<3.5	23.9	<2.6	<22.0	91.5
		Avg.	3.8	501.2	< 12.0	22.7	<2.6	<4.4	0.7	3.3	77.1	0.5	0.17	23.8	28.5	31.8	5.3	5.4	<3.5	<20.0	<2.6	<22.0	41.6
HM-N (D)	6	Min.	<1.0	8.2	<3.0	10.0	<0.7	<1.1	0.3	<1.0	29.6	0.1	<0.1	6.1	<5.0	28.5	3.1	<1.3	<0.9	<5.0	<0.7	<5.5	9.3
		Max.	1.6	69.2	3.6	25.6	<0.7	<1.1	0.6	1.6	53.9	0.2	0.1	19.9	88.9	53.4	6.1	1.8	<0.9	12.1	<0.7	8.8	81.8
		Avg.	<1.0	42.4	<3.0	15.9	<0.7	<1.1	0.5	1.3	39.2	0.1	<0.1	10.2	14.8	36.6	4.0	<1.3	<0.9	<5.0	<0.7	<5.5	36.9
HM-S (total)	1	Val.	<4.0	2327.2	<12.0	27.6	2.6	<4.4	<0.5	<4.0	158.2	0.5	<0.1	34.6	<20.0	5.9	8.8	6.2	<3.5	58.2	<2.6	<22.0	30.6
HQ (total)	0[(a)]																						
HA (total)	4	Min.	<1.0	44.9	<3.0	10.4	<0.7	<1.1	0.3	<1.0	<2.0	1.1	<0.1	45.5	<5.0	4.7	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
		Max.	<4.0	786.0	<12.0	18.3	<2.6	<4.4	0.5	6.7	139.1	3.6	<0.1	135.0	<20.0	7.3	< 4.4	< 5.3	< 3.5	<20.0	<2.6	<22.0	19.7
		Avg.	<4.0	332.5	< 12.0	14.5	<2.6	<4.4	0.4	1.7	103.8	1.7	< 0.1	82.6	< 20.0	5.8	<4.4	<5.3	<3.5	<20.0	<2.6	<22.0	<16
HA (D)	2	Min	<1.0	29.8	<3.0	6.4	<0.7	<1.1	0.3	<1.0	<2.0	0.5	<0.1	74.5	<5.0	5.0	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
		Max.	<1.0	56.0	<3.0	8.5	<0.7	<1.1	0.4	<1.0	<2.0	1.9	<0.1	75.9	<5.0	5.0	<1.1	<1.3	<0.9	8.9	<0.7	<5.5	12.0
HB (total)	4	Min.	<1.0	41.9	< 3.0	8.4	<0.7	<1.1	0.2	<1.0	<2.0	0.7	<0.1	40.5	<5.0	5.9	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
		Max.	<4.0	613.6	<12.0	40.2	2.7	<4.4	2.8	10.1	89.0	4.0	<0.1	281.0	<20.0	10.1	9.9	16.8	3.5	<20.0	<2.6	<22.0	44.4
		Avg.	<4.0	189.8	<12.0	19.2	0.7	<4.4	1.1	2.5	22.3	1.9	<0.1	120.5	<20.0	7.3	2.9	4.2	0.9	<20.0	<2.6	<22.0	11.1
HB (D)	2	Min.	<1.0	25.5	<3.0	7.3	<0.7	<1.1	0.3	<1.0	<2.0	0.4	<0.1	41.3	<5.0	<0.1	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
		Max	<1.0	39.7	< 3.0	9.1	<0.7	<1.1	0.4	<1.0	<2.0	2.0	<0.1	83.1	<5.0	6.1	<1.1	<1.3	< 0.9	8.5	<0.7	< 5.5	< 4.0
HC (total)	4	Min.	<1.0	9.6	<3.0	10.9	<0.7	<1.1	<0.1	<1.0	<2.0	0.4	<0.1	23.2	<5.0	6.7	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
		Max.	<4.0	1543.2	<12.0	28.8	3.0	<4.4	2.9	<4.0	113.8	3.0	<0.1	160.0	<20.0	11.7	6.7	7.5	<3.5	<20	<2.6	<22	<16
		Avg.	<4.0	339.5	<12.0	15.7	<1.3	<4.4	0.8	<4.0	28.8	1.3	<0.1	89.8	<20.0	10.1	<2.2	1.8	<3.5	<20	<2.6	<22	<16
HC (D)	2	Min	<1.0	31.6	<3	9.6	<0.7	<1.1	0.2	<1.0	<2.0	0.3	<0.1	21.6	<5.0	3.2	<1.1	<1.3	< 0.9	<5.0	<0.7	<5.5	< 4.0
		Max.	<1.0	54.6	<3.0	12.8	<0.7	<1.1	0.4	<1.0	<.0	2.9	<0.1	154.5	<5.0	7.8	<1.1	1.8	<0.9	8.9	<0.7	<5.5	<4.0
HR (total)	4	Min.	<1.0	26.3	<3.0	20.5	<0.7	<1.1	0.1	<1.0	<2.0	0.5	<0.1	99.2	<5.0	1.7	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
		Max.	<2.0	1095.2	<12.0	33.8	<2.6	<4.4	1.1	8.2	196.8	1.3	<0.1	234.2	<5.0	17.8	13.4	32.4	<3.5	<20.0	<2.6	<22.0	<16
		Avg.	<2.0	302.6	<12.0	28.2	<2.6	<4.4	0.4	2.1	49.2	0.8	<0.1	149.4	<5.0	15.3	3.4	8.1	<3.5	<20.0	<2.6	<22.0	<16
HR (D)	2	Min.	<1.0	10.5	<3.0	18.1	<0.7	<1.1	<0.12	<1.0	<2.0	0.3	<0.1	102.0	<5.0	4.5	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
		Max.	<1.0	81.2	<3.0	24.2	<0.7	<1.1	0.4	<1.0	<2.0	0.4	<0.1	103.0	<5.0	12.2	<1.1	<1.3	<0.9	9.1	<0.7	<5.5	<4.0
Carmans River																							
HH (total)	4	Min.	<1.0	21.1	<3.0	19.5	<0.7	<1.1	<0.1	<1.0	<2.0	0.2	<0.1	27.0	<5.0	12.2	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
		Max.	<2.0	743.0	<6.0	49.2	<1.3	<2.2	0.4	3.1	74.5	0.8	<0.1	129.0	<10.0	18.9	<5.9	4.4	<1.8	<20.0	<1.3	<11.0	38.8
		Avg.	<2.0	222.2	<6.0	38.3	<1.3	<2.2	0.2	<2	23.8	0.5	<0.1	78.1	<10.0	15.2	<5.9	<2.6	<1.8	<20.0	<1.3	<11.0	11.2

(continued on next page)

Table 5-9. Analysis of Metals in Surface Water Samples Collected along the Peconic and Carmans Rivers *(concluded)*.

Station	N		Ag µg/L	Al µg/L	As µg/L	Ba µg/L	Be µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe mg/L	Hg µg/L	Mn µg/L	Mo µg/L	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se* µg/L	Tl µg/L	V µg/L	Zn µg/L
HH (D)	2	Min.	<1.0	10.2	<3.0	27.4	<0.7	<1.1	0.2	<1.0	2.1	0.2	<0.1	35.1	<5.0	<1.0	<1.1	<1.3	<0.9	<5.0	<0.7	<5.5	<4.0
		Max.	<1.0	93.6	<3.0	35.9	<0.7	<1.1	0.3	<1.0	2.4	0.2	<0.1	96.0	<5.0	19.6	2.8	<1.3	<0.9	8.8	<0.7	<5.5	< 4.0
NYSDEC AWQS			0.1	100	150	SNS	11	1.1	5	34	4	0.3	0.2	SNS	SNS	SNS	23	0.1	SNS	4.6	8	14	0.1
Solubility State			I*	I*	D		AS	D	AS	D	D	AS	D				D	D		D	AS	AS	I*
Typical MDL			1	2.2	3	1.8	0.66	1.1	0.12	1	2	0.075	0.2	2	5	1	1.1	1.3	0.88	5	0.66	5.5	4

Notes:
See Figure 5-8 for sample station locations.
*The concentration of selenium detected in several samples is estimated, due to contamination of the blank. Analysis of the method blank showed detectable levels of selenium very similar to those found in the samples.
AS = Acid Soluble
D = Dissolved
I* = Ionic
MDL = Minimum Detection Limit
N = No. of Samples
NYSDEC AWQS = New York State Department of Environmental Conservation Ambient Water Quality Standard for Class C Surface Water
SNS = Standard Not Specified for these elements for Class C waters
Surface water location HV was not sampled for metals in 2002.
[a]There was no flow recorded at Station HQ in 2002.
* Holding times for nitrate analyses are routinely exceeded.

mix with the decaying matter, these acids decrease the already low pH of precipitation, resulting in a pH as low as 4.1 Standard Units. A discussion of precipitation monitoring is provided in Chapter 6 of this report.

Ambient water quality standards for metallic elements are based on their solubility state. Certain metals are only biologically available to aquatic organisms if they are in a dissolved or ionic state, whereas other metals are toxic in any form (i.e., dissolved and particulate combined). In 2002, the BNL monitoring program continued to assess water samples for both the dissolved and particulate form. Dissolved concentrations were determined by first filtering the samples prior to acid preservation and analysis. Examination of the metals data showed that aluminum, copper, iron, lead, selenium, and zinc were present in concentrations that exceeded ambient water quality standards at locations both upstream and downstream of the STP discharge, and at the control location HH. Additionally, silver and mercury were detected above water quality standards at Station HM-N, immediately downstream of the STP discharge. The concentration of selenium was highest in a water sample collected at Station HM-S, a tributary not impacted by STP operations. Copper was detected at high levels in samples collected at the upstream station (HY), immediately downstream of the STP discharge (HM-N), and at the Riverhead Station HR. Due to its wide range of detection, this element is most likely attributable to native sediment carried over into the water column. Similarly, concentrations of iron, aluminum, lead, and zinc are high throughout the Peconic River and may be indicative of sediment carryover.

The concentration of copper, mercury, and silver are highest at Station HM-N. These elements are the metals of interest under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Operable Unit (OU) V investigation. During 2002, disturbances to the riverbed from pilot studies may explain their high levels. A full description of the OU V activities conducted in 2002 is contained in Chapter 2. While these elements are detected in the STP discharge, the concentrations detected in the river are much higher than those in the STP effluent. Filtration of samples had a drastic impact on the concentration of metals. In most instances, the concentration was significantly lower in the filtered sample than in the unfiltered (i.e., acid-digested) sample, indicating that sediments contained in the water were the likely contributor to the observed concentrations. The BNL STP effluent is routinely monitored for suspended solids. The concentration of solids in the STP discharge is typically nondetectable (see Table 3-3); consequently, the current BNL STP discharge is not the source of these contaminants. The most likely source is sediment scoured from the riverbed and entrained in the flowing stream. BNL will continue to collect both filtered and unfiltered samples to assess water quality impacts.

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