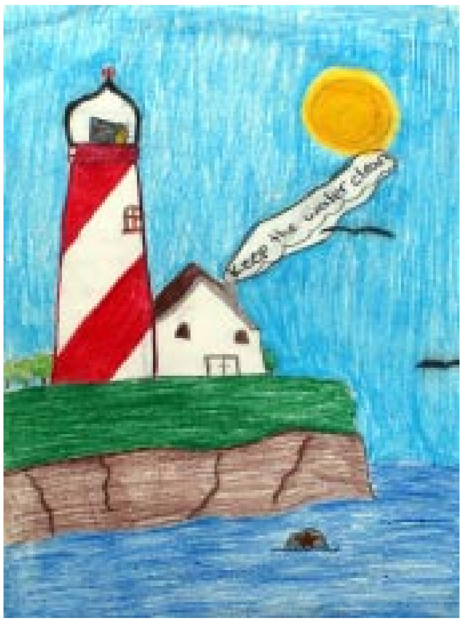
BROOKHAVEN
NATIONAL
LABORATORY

2001 SITE ENVIRONMENTAL REPORT



Chapter 5

Water Quality

Some BNL operations discharge, or have the potential to discharge, wastewater containing very low levels of radiological, organic, and/or inorganic contaminants to surface waters or to groundwater recharge basins. 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 2001 showed that the average gross alpha and beta activity levels in the Sewage Treatment Plant discharge were within the range typical of background surface waters. Tritium releases to the Peconic River continued to drop and were the lowest since monitoring began in 1966. Cesium-137 and strontium-90 were detected infrequently in the effluent at levels significantly less than the drinking water standard. No other gamma-emitting nuclides in the effluent that were possibly attributable to BNL operations were detected throughout 2001. Nonradiological monitoring of the effluent showed that, with the exception of isolated incidents of noncompliance, organic and inorganic parameters were within New York 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, silver, iron, and zinc detected within the Peconic River are a result of natural geology. The low pH detected within several sections of the river was due to natural causes. Based upon the 2001 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. Low concentrations of tritium were detected at the Sewage Treatment Plant outfall, but only sporadic detections were found at the first downstream monitoring station. The maximum tritium concentration downstream of the treatment plant discharge was approximately 4 percent of the drinking water standard.

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 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 heavier than average rain in March and June of 2001 (see Figure 1-11), off-site flow was recorded from February through August. Figure 5-1 shows an on-site portion of the Peconic River downstream of the STP discharge.

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

Figure 5-1. Peconic River West of Monitoring Station HMn.

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 5-2 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) intermittent 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, liberating nitrogen gas and consequently reducing 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 2001, 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 just before the point where the influent enters the primary clarifier. In addition to the two full monitoring stations, effluent leaving the primary clarifier is monitored a third time 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 12 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. In 2001, a discharge of heat exchange fluid from the Building 902 cryogenic system cooling tower resulted in diversion of the STP influent for approximately one day. Although the discharge of heat exchange fluid did not violate SPDES permit requirements, the STP influent was diverted until the potential impact to aquatic organisms could be assessed. There were no other diversions of the STP influent in 2001.

Solids separated in the clarifiers are pumped to a digester, where they are reduced in volume by anaerobic 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 containerized for off-site disposal at an authorized facility.

In 2001, BNL continued a third and final phase of STP upgrades. These upgrades include replacement of the anaerobic digester with a digester that uses aerobic organisms to degrade the sludge, 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. By the

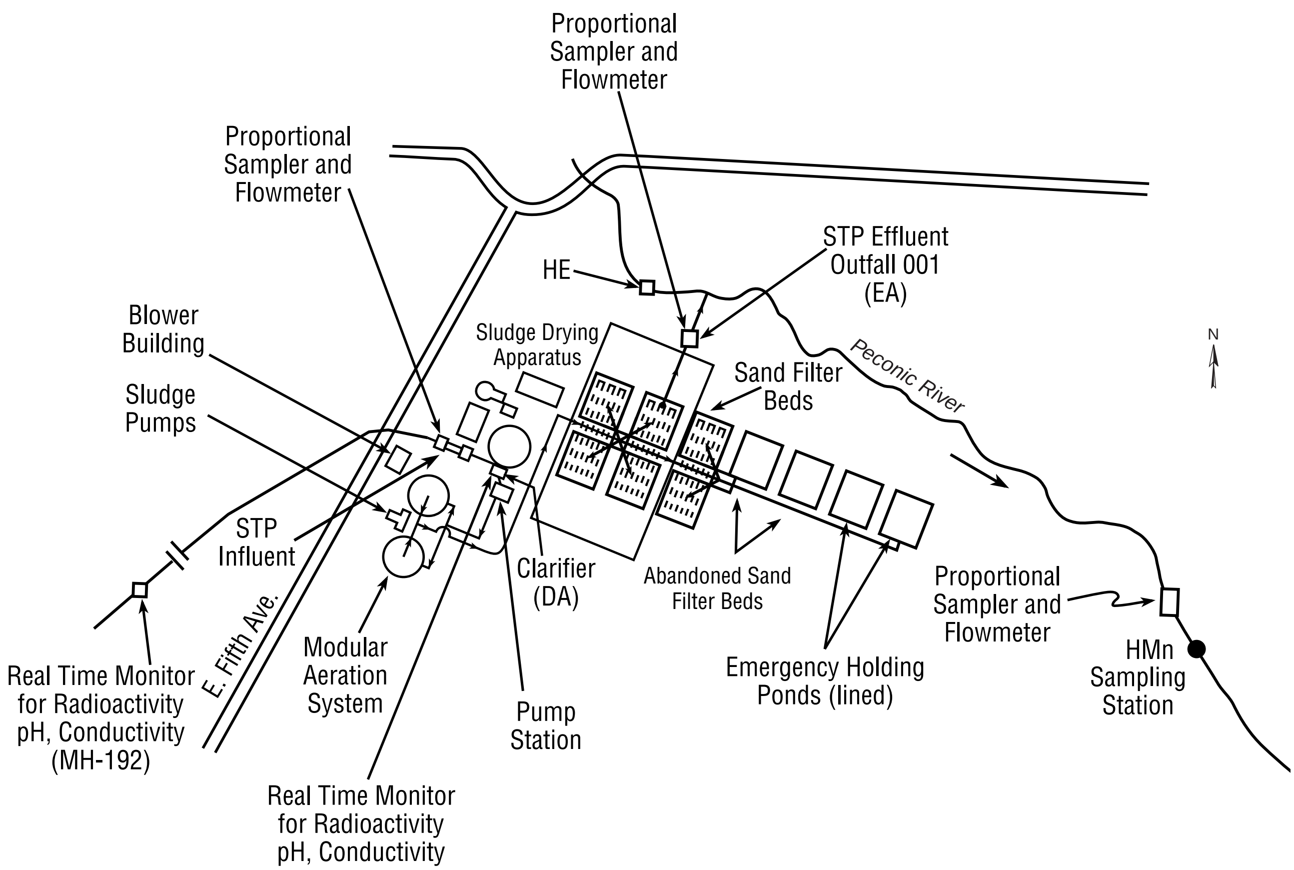


Figure 5-2. Schematic of BNL's Sewage Treatment Plant (STP).

end of 2001, all piping repairs, holding pond relining, and filter work was completed. Construction of the aerobic digester will be completed in February 2002.

5.2.1 Sanitary System Effluent – Radiological Analyses

The STP effluent 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. Samples collected from these locations are also analyzed monthly for gamma-emitting radionuclides and strontium-90. During 2001, the frequency of sample collection was decreased from every 24 hours to every 48 hours. This decrease in sample collection frequency was based upon limited detection of contaminants in the STP discharge and the reduced potential for discharge resulting from the shutdown of the High Flux Beam Reactor (HFBR) and Brookhaven Medical Research Reactor (BMRR).

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 effluent, in lieu of DOE wastewater criteria. The SDWA specifies that no individual may receive an annual dose greater than 4 mrem (40 μSv) per 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 1990) 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 μSv).

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 2001. Annual average gross alpha and beta activity in the STP effluent has remained consistent with, or lower than, levels at control locations for many years. This continued to be the case in 2001. Annual average gross alpha and beta activity of the STP effluent was 1.6 ± 0.2 pCi/L (0.06 ± 0.01 Bq/L) and 7.2 ± 0.5 pCi/L (0.27 ± 0.02 Bq/L), respectively. Control location data showed average gross alpha and beta levels of 5.75 ± 9.59 pCi/L (0.21 ± 0.36 Bq/L) and 6.57 ± 10.22 pCi/L (0.24 ± 0.38 Bq/L), respectively.

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. Tritium continues to be released from the HFBR 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 air conditioning condensate generated at the HFBR. A plot of the 2001 tritium concentrations recorded in the STP effluent is presented in Figure 5-3. A 15-year trend plot of annual average tritium concentrations measured in the STP discharge is shown in Figure 5-4. Annual average concentrations have been declining since 1995.

In 2001, the annual average tritium concentration measured in the STP effluent (EA, Outfall 001) was 136 pCi/L (4.1 Bq/L). This value is below the average minimum detection limit (MDL) for the BNL Analytical Services Laboratory of 329 pCi/L (13.0 Bq/L) and well below

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

	Monthy Flow (L)	Tritium Maximum (pCi/L)	Tritium Average (pCi/L)	Gross Alpha Maximum (pCi/L)	Gross Alpha Average (pCi/L)	Gross Beta Maximum (pCi/L)	Gross Beta Average (pCi/L)
STP Clarifier							
January	5.25E + 07	< 307	69 ± 50	3.7 ± 1.8	1.0 ± 0.4	13.9 ± 5.6	5.9 ± 1.2
February	3.57E + 07	529 ± 239	113 ± 62	4.5 ± 2.2	1.0 ± 0.5	26.9 ± 6.7	10.1 ± 3.3
March	4.59E + 07	983 ± 246	366 ± 106	4.3 ± 2.1	1.3 ± 0.6	32.9 ± 7.1	12.9 ± 4.1
April	5.12E + 07	< 341	54 ± 41	4.7 ± 2.2	1.0 ± 0.7	32.2 ± 6.8	9.6 ± 3.3
May	4.81E + 07	479 ± 210	111 ± 52	7.0 ± 2.8	1.2 ± 0.7	12.6 ± 5.8	7.6 ± 1.1
June	6.04E + 07	< 234	26 ± 45	8.0 ± 3.1	2.2 ± 1.0	13.6 ± 5.5	8.2 ± 1.2
July	6.91E + 07	518 ± 399	127 ± 58	5.3 ± 2.6	2.4 ± 0.7	12.2 ± 6.0	6.7 ± 1.1
August	7.17E + 07	< 300	95 ± 43	4.3 ± 2.1	2.2 ± 0.5	12.5 ± 5.8	6.4 ± 1.2
September	4.68E + 07	< 389	61 ± 51	4.3 ± 2.2	1.5 ± 0.7	11.6 ± 5.5	6.9 ± 1.2
October	6.97E + 07	< 347	25 ± 56	5.0 ± 2.5	1.5 ± 0.5	15.4 ± 5.9	7.1 ± 1.3
November	5.93E + 07	< 295	-25 ± 60	5.0 ± 2.4	2.6 ± 0.7	14.3 ± 5.7	8.4 ± 1.7
December	4.81E + 07	287 ± 193	89 ± 69	4.4 ± 2.7	1.2 ± 0.8	13.4 ± 6.0	8.0 ± 1.2
Annual Average			97 ± 21		1.6 ± 0.2		8.1 ± 0.7
STP Outfall							
January	4.53E + 07	317 ± 208	101 ± 41	2.3 ± 1.6	1.0 ± 0.4	11.4 ± 5.7	4.2 ± 1.4
February	3.54E + 07	570 ± 227	176 ± 64	7.0 ± 2.7	1.7 ± 0.8	16.0 ± 6.2	6.9 ± 1.6
March	4.15E + 07	940 ± 241	329 ± 74	4.5 ± 2.2	1.3 ± 0.7	29.2 ± 6.9	7.7 ± 2.3
April	5.45E + 07	410 ± 188	120 ± 43	3.2 ± 2.1	1.0 ± 0.5	17.2 ± 6.2	7.1 ± 1.3
May	4.28E + 07	407 ± 195	153 ± 39	3.5 ± 2.4	0.9 ± 0.5	16.4 ± 6.2	8.8 ± 1.3
June	6.22E + 07	498 ± 207	82 ± 58	6.2 ± 2.8	1.4 ± 0.6	15.2 ± 5.8	7.2 ± 1.4
July	5.17E + 07	425 ± 255	131 ± 56	3.1 ± 2.0	1.7 ± 0.3	15.8 ± 5.9	7.6 ± 1.6
August	5.44E + 07	401 ± 225	135 ± 44	4.9 ± 2.4	1.6 ± 0.6	13.4 ± 5.8	6.7 ± 1.3
September	3.08E + 07	< 389	87 ± 53	5.5 ± 2.4	2.7 ± 0.7	10.6 ± 5.4	7.1 ± 1.2
October	3.84E + 07	495 ± 256	70 ± 62	7.5 ± 2.6	2.4 ± 0.9	12.0 ± 5.6	7.0 ± 1.2
November	2.81E + 07	< 295	40 ± 52	4.3 ± 2.3	1.6 ± 0.9	14.6 ± 5.7	9.1 ± 1.6
December	3.09E + 07	426 ± 239	180 ± 72	5.0 ± 2.8	2.0 ± 0.8	13.7 ± 5.7	7.9 ± 1.7
Annual Average			136 ± 19		1.6 ± 0.2		7.2 ± 0.5
Total Release	5.16E + 08		72.9 mCi		0.8 mCi		3.7 mCi
SDWA Limit			20,000 (pCi/L)		15.0 (pCi/L)		50.0 (pCi/L)
Average MDL			329 (pCi/L)		3.2 (pCi/L)		8.7 (pCi/L)

Notes:
All values shown with a 95% confidence interval.
To convert values from pCi to Bq, divide by 27.03.
MDL = Minimum Detection Limit
SDWA = Safe Drinking Water Act

the NYS drinking water standard of 20,000 pCi/L. A total of 0.073 Ci (2.7 million Bq) of tritium was released during the year. This level is almost 30 percent less than the discharge recorded for 2000 and is the lowest annual release of tritium to the Peconic River observed since routine measurements began in 1966, and is less than 2 percent of the peak values released in the late 1980s (see Figure 5-5). Tritium was detected in only 10 percent of the samples collected at the STP discharge to the Peconic River. The maximum concentration of tritium was 940 pCi/L (35 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 has very high concentrations of tritium, was drained from the reactor and shipped off site. The reactor was subsequently partially filled with tap water. This significantly reduced the inventory

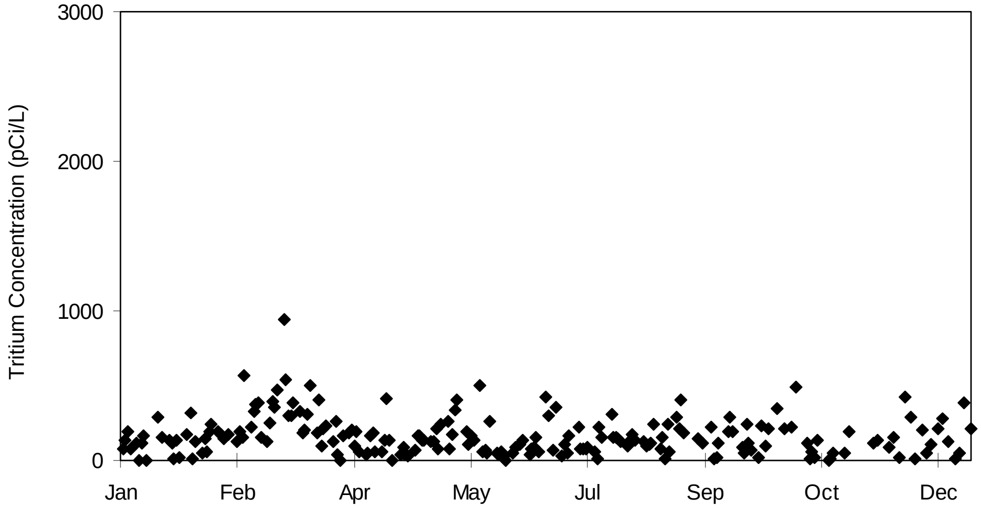


Figure 5-3. Tritium Concentrations in Effluent from the Sewage Treatment Plant (CY 2001).

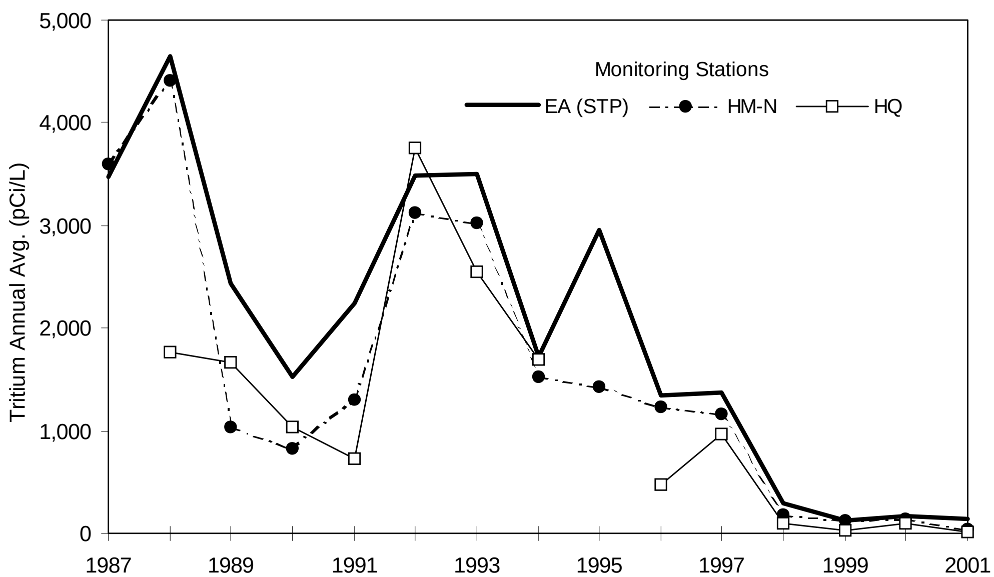


Figure 5-4. Average Tritium Concentrations at BNL's Sewage Treatment Plant, nearby Peconic River Locations (1987–2001).

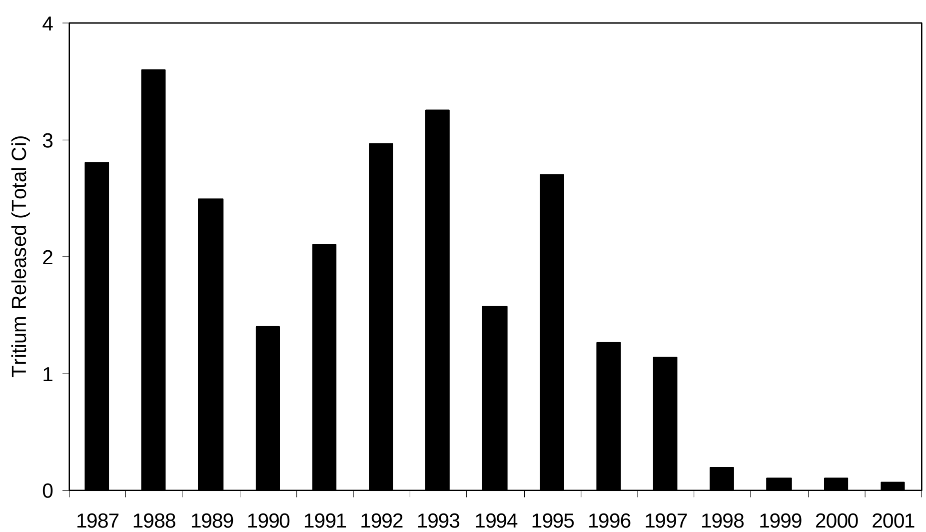


Figure 5-5. Tritium Released to the Peconic River, 15-Year Trend (1987–2001).

of tritium at the HFBR, resulting in declining levels from 2000 to 2001. These levels will continue to decline as the HFBR moves into permanent decommissioning.

Table 5-2 presents the gamma spectroscopy analytical data of the monthly STP composite samples for radionuclides. During 2001, the samples showed the presence of cesium-137, once in the STP effluent and once in the influent. The concentration of cesium-137 detected in the effluent was approximately 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

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

	Flow (Liters)	Co-60 (pCi/L)	Cs-137 (pCi/L)	Be-7 (pCi/L)	Na-22 (pCi/L)	Sr-90 (pCi/L)
STP Clarifier						
January	5.25E+07	ND	ND	ND	ND	< 0.18
February	3.57E+07	ND	ND	ND	ND	< 0.19
March	4.59E+07	ND	ND	ND	ND	< 0.22
April	5.12E+07	ND	1.72 ± 1.41	ND	ND	< 0.27
May	4.81E+07	ND	ND	ND	ND	< 0.17
June	6.04E+07	ND	ND	ND	ND	< 0.16
July	6.91E+07	ND	ND	ND	ND	< 0.16
August	7.17E+07	ND	ND	ND	ND	< 0.17
September	4.68E+07	ND	ND	ND	ND	< 0.22
October	6.97E+07	ND	ND	ND	ND	< 0.25
November	5.93E+07	ND	ND	ND	ND	0.28 ± 0.11
December	4.81E+07	ND	ND	ND	ND	< 0.21
STP Outfall						
January	4.53E+07	ND	ND	ND	ND	0.26 ± 0.10
February	3.54E+07	ND	ND	ND	ND	< 1.0
March	4.15E+07	ND	ND	ND	ND	< 0.19
April	5.45E+07	ND	ND	ND	ND	< 0.15
May	4.28E+07	ND	ND	ND	ND	< 0.22
June	6.22E+07	ND	ND	ND	ND	0.24 ± 0.10
July	5.17E+07	ND	ND	ND	ND	< 0.21
August	5.44E+07	ND	ND	ND	ND	< 0.21
September	3.08E+07	ND	ND	ND	ND	< 0.18
October	3.84E+07	ND	ND	ND	ND	< 0.21
November	2.81E+07	ND	1.22 ± 0.69	ND	ND	< 0.17
December	3.09E+07	ND	ND	ND	ND	< 0.16
Total Release		0 (mCi)	0.03 (mCi)	0 (mCi)	0 (mCi)	0.03 (mCi)
DOE Order 5400.5 DCG		5,000 (pCi/L)	3,000 (pCi/L)	50,000 (pCi/L)	10,000 (pCi/L)	1,000 (pCi/L)
Dose Limit of 4 mrem EDE		100 (pCi/L)	200 (pCi/L)	6,000 (pCi/L)	400 (pCi/L)	8 (pCi/L)

Notes:
All values shown with a 95% confidence interval.
DCG = Derived Concentration Guide
EDE = Effective Dose Equivalent
ND = Not Detected

system. The cesium-137 concentrations in the STP influent and effluent have been steadily decreasing since 1990, as shown in Figure 5-6. Total releases for 2001 were approximately one-quarter of 2000 levels. Upgrades to the sewer system—specifically, cleaning and relining or repairing the piping systems—have most likely assisted in the decline in cesium-137 releases.

Strontium-90 was detected at very low levels in both the STP influent and effluent monthly composite samples on three occasions in 2001 (once in the influent and twice in the effluent). The largest single value of strontium-90 recorded for the STP influent was 0.28 ± 0.1 pCi/L (0.01 ± 0.004 Bq/L), which is 3.5 percent of the drinking water standard of 8 pCi/L (0.3 Bq/L). The largest strontium-90 value for an STP effluent sample was 0.26 ± 0.1 pCi/L (0.01 ± 0.004 Bq/L), or 3.5 percent of the drinking water standard. The highest strontium-90 concentration detected in the STP effluent was approximately 20 percent of the highest level recorded in 2000. Effluent concentrations are significantly less than previous years. Strontium-90 was discharged from BNL facilities in the 1950s and 1960s and has remained in the sludge within the sanitary piping system. One goal of the sanitary sewer-cleaning project was to remove this residual activity, thus reducing concentrations in STP influent and effluent.

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 analytical laboratory. Composite samples of the STP effluent are collected using a flow-proportional refrigerated sampling device (ISCO Model 1600™). The BNL Analytical Services Laboratory analyzes these composite samples for 21 inorganic elements. 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 effluent data to the SPDES effluent limits (or other applicable standard) shows that the major-

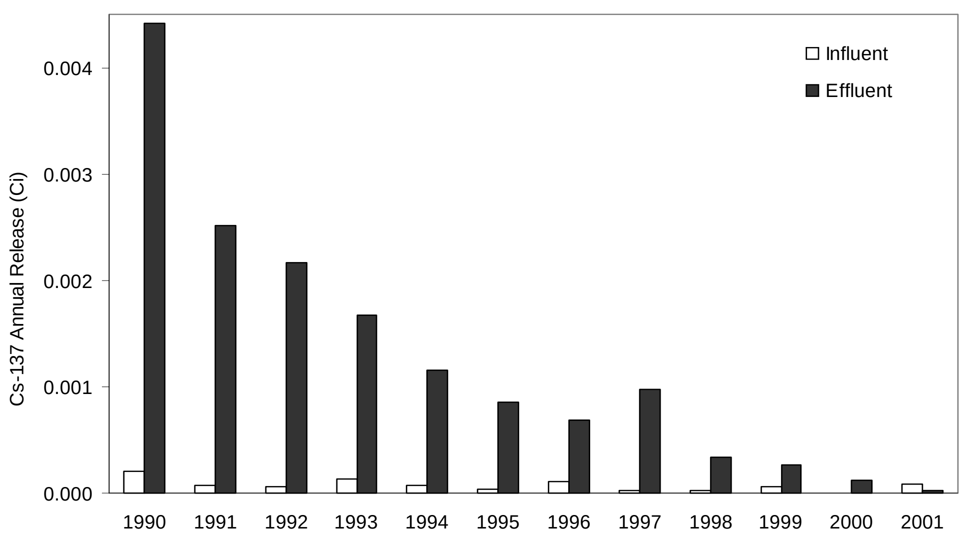


Figure 5-6. Cesium-137 in the Sewage Treatment Plant Influent and Effluent (1990–2001).

Table 5-3. Average Water Quality and Analysis of Metals in Water at the Sewage Treatment Plant.

	STP Influent				STP Effluent				
	No. of Samples	Min.	Max.	Avg.	No. of Samples	Min.	Max.	Avg.	SPDES Limit or Ambient Water Quality Standard(1)
pH (SU)(2)	232	5.8	7.6	NA	261	5.4	7.8	NA	5.8 - 9.0
Conductivity (µmhos/cm)(2)	NA	NA	NA	NA	261	153	404	280	SNS
Temperature (°C)(2,3)	NA	NA	NA	NA	261	3.7	26.5	15.0	SNS
Dissolved Oxygen (mg/L)	NA	NA	NA	NA	261	5.5	14.0	9.0	SNS
Chlorides (mg/L)	12	26.5	75.0	42.3	12	29.8	51.8	36.8	SNS
Nitrate (as N) (mg/L)	12	< 1	3.0	1.5	12	3.7	7.1	5.7	10 (Total N)
Sulfates (mg/L)	12	12.6	16.8	14.7	12	11.4	17.2	14.7	250 (GA)
Aluminum (µg/L)	13	37.6	1086.6	464.5	18	25.9	90.8	45.8	100 (Ionic)
Antimony (µg/L)	13	< 1.8	3.7	< 8.8	18	< 0.9	5.9	< 1.8	3 (GA)
Arsenic (µg/L)	13	< 3.0	12.4	< 6.0	18	< 3.0	11.2	< 6.0	150 (Dissolved)
Barium (µg/L)	13	15	72.9	43.1	18	11.5	39.3	23.4	1000 (GA)
Beryllium (µg/L)	13	< 0.7	1.1	< 6.0	18	< 0.7	3.9	< 1.3	11 (Acid Soluble)
Cadmium (µg/L)	13	< 2.2	< 11.0	< 11.0	18	< 1.1	1.8	< 2.2	1.1 (Dissolved)
Chromium (µg/L)	13	< 1.0	27.5	6.4	18	< 1.0	2.4	1.1	34.4 (Dissolved)
Cobalt (µg/L)	13	< 1.2	1.9	0.9	18	0.3	4.6	0.6	5 (Acid Soluble)
Copper (µg/L)	13	23.4	376.4	180.9	18	30.8	60.1	43.5	150 (SPDES)
Iron (mg/L)	13	0.4	2.6	1.27	14	< 0.1	0.77	0.19	0.37 (SPDES)
Mercury (µg/L)	12	< 0.1	1.3	0.3	12	< 0.1	0.2	< 0.1	0.8 (SPDES)
Manganese (µg/L)	13	33.8	92.5	50.4	18	< 2.0	19.6	8.1	300 (GA)
Molybdenum (µg/L)	13	< 5.0	< 50.0	< 50.0	18	< 5.0	8.9	< 10.0	SNS
Nickel (µg/L)	13	< 2.2	31.1	7.3	18	2.8	31.7	5.4	110 (SPDES)
Lead (µg/L)	13	1.9	48.8	21.3	18	< 1.3	11.1	< 2.6	19 (SPDES)
Selenium (µg/L)	13	< 5.0	18.0	< 10.0	18	< 5.0	16.7	< 10.0	4.6 (Dissolved)
Silver (µg/L)	13	< 1.0	10.4	3.0	18	< 1.0	3.6	1.0	15 (SPDES)
Sodium (mg/L)	12	24	46.8	31.0	13	24.5	44.9	32.4	SNS
Thallium (µg/L)	13	< 0.7	2.3	< 6.6	18	< 0.7	7.8	< 1.3	8 (Acid Soluble)
Vanadium (µg/L)	13	< 5.5	< 55.0	< 55.0	18	< 5.5	30.6	< 11.0	14 (Acid Soluble
Zinc (µg/L)	13	18.3	160.5	77.3	18	19.0	147.0	73.8	100 (SPDES)

Notes:
See Figure 5-2 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.
SPDES = State Pollutant Discharge Elimination System
NA = Not Applicable
SNS = Standard Not Specified
GA = Class GA (groundwater) Ambient Water Quality Standard
(1) Unless otherwise provided, the reference standard is 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.

ity of the analytical parameters were within SPDES effluent permit limits (see also the compliance data in Chapter 3). Iron and zinc were detected on several occasions at concentrations exceeding SPDES limits. Between January and March 2001, zinc was detected at concentrations exceeding SPDES limits on five occasions. Concentrations ranged from 102 to 147 µg/L; the SPDES limit is 100 µg/L. As discussed in Chapter 3, cleaning of residual sludge from the sewer lines was the most likely cause for increased levels of zinc in the STP effluent. Iron was detected in March and September at 0.49 and 0.77 mg/L, respectively, which exceed the SPDES limit of 0.37 mg/L. There were no violations of iron SPDES limits identified under the regulatory compliance sampling program. Review of influent data shows slightly higher levels of iron in the STP influent in March but typical levels in September. There were no sources defined which would explain these elevated levels.

Acetone, methylene chloride, and disinfection byproducts (*e.g.*, chloroform) were detected at trace levels (< 2.0 µg/L) sporadically throughout the year in grab samples collected from the STP effluent. Methylene chloride was also detected at elevated concentrations of 8.7 and 6.9 µg/L in grab samples collected on March 13 and August 9, 2001. The ambient water quality standard for methylene chloride in waters such as the Peconic is 200 µg/L. However, as the BNL discharge also recharges the groundwater aquifer, BNL is held to a strict standard of 5 µg/L. Acetone was detected at a concentration of 3.8 µg/L in a sample collected in November. The water quality standard for acetone is 50 µg/L. Both acetone and methylene chloride are ubiquitous in the analytical laboratory and may be present due to cross-contamination of samples or sampling equipment. No other organic compounds were detected above minimum detection limits in the STP discharge during 2001.

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 located at Buildings 244 and 423. These operations were monitored for contaminants such as metals, cyanide, VOCs, and semiVOCs. Analyses of these waste streams showed that, although several operations contributed contaminants to the STP in concentrations exceeding SPDES-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 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 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.

In 2001, as part of BNL's commitment to pollution prevention, the Laboratory continued to revise and finalize its administrative authorization criteria for wastewater containing low levels of radionuclides. This revision is based upon the Environmental As Low As Reasonably Achievable (also known as E-ALARA) concept, whereby BNL strives to minimize emissions and effluents to the lowest levels technically achievable and economically acceptable. The revised criteria are set at a fraction of the drinking water standards. Effluents that do not meet these stringent criteria are managed off site or reviewed by senior management for consideration of institutional risk. The authorization criteria were finalized and documented in Laboratory-wide standard operating procedures in May 2001 (BNL 2001). This practice is much more stringent than industry standards and supports BNL's commitment to maintaining a clean environment.

5.4 RECHARGE BASINS

Recharge basins are used for the disposal of "clean" wastewater streams, including once-through cooling water, stormwater 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 5-7 shows the locations of BNL's discharges to recharge basins. An overall schematic of water use at BNL is presented in Figure 5-8. 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 blowdown from the National Synchrotron Light Source.

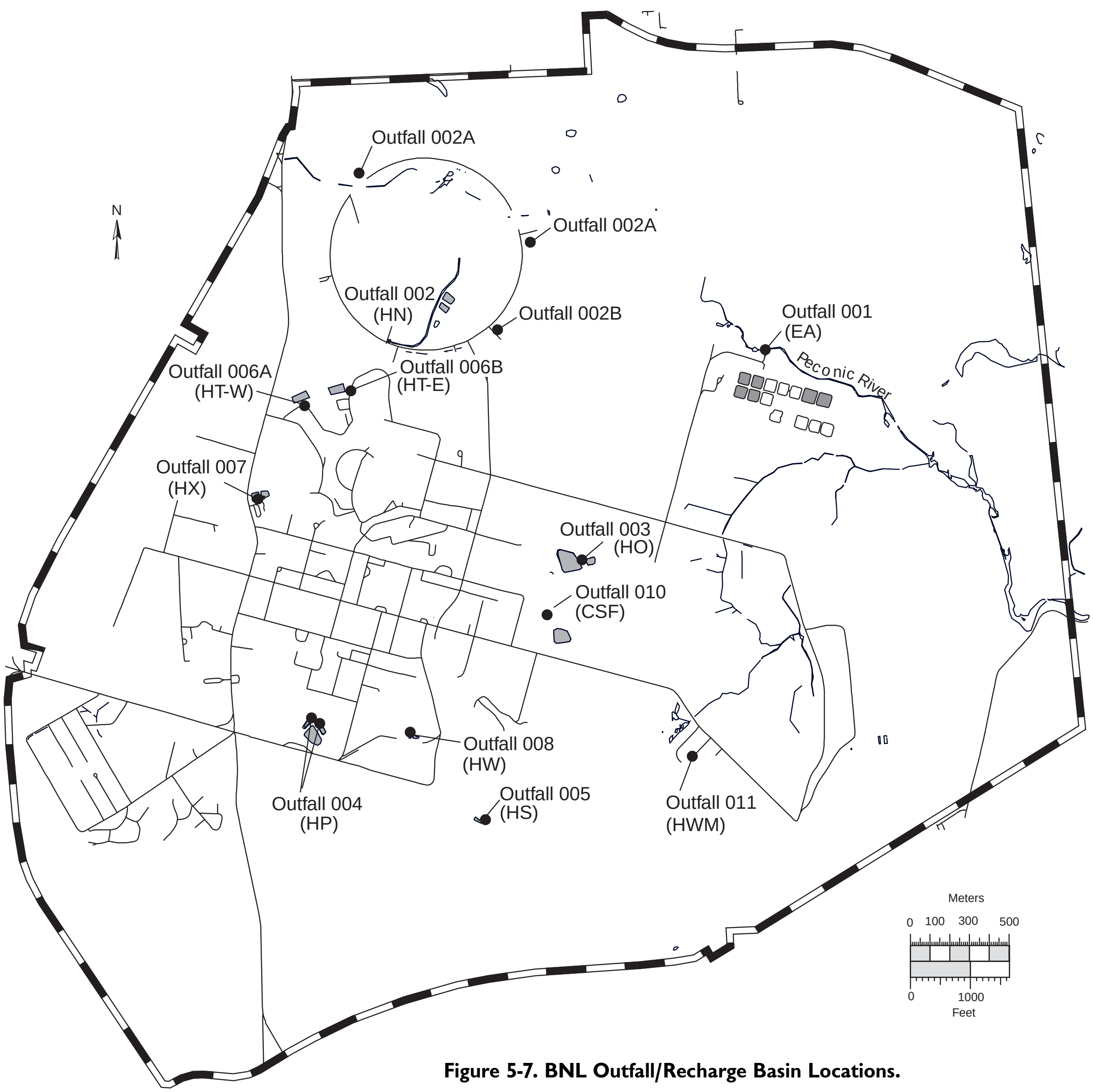


Figure 5-7. BNL Outfall/Recharge Basin Locations.

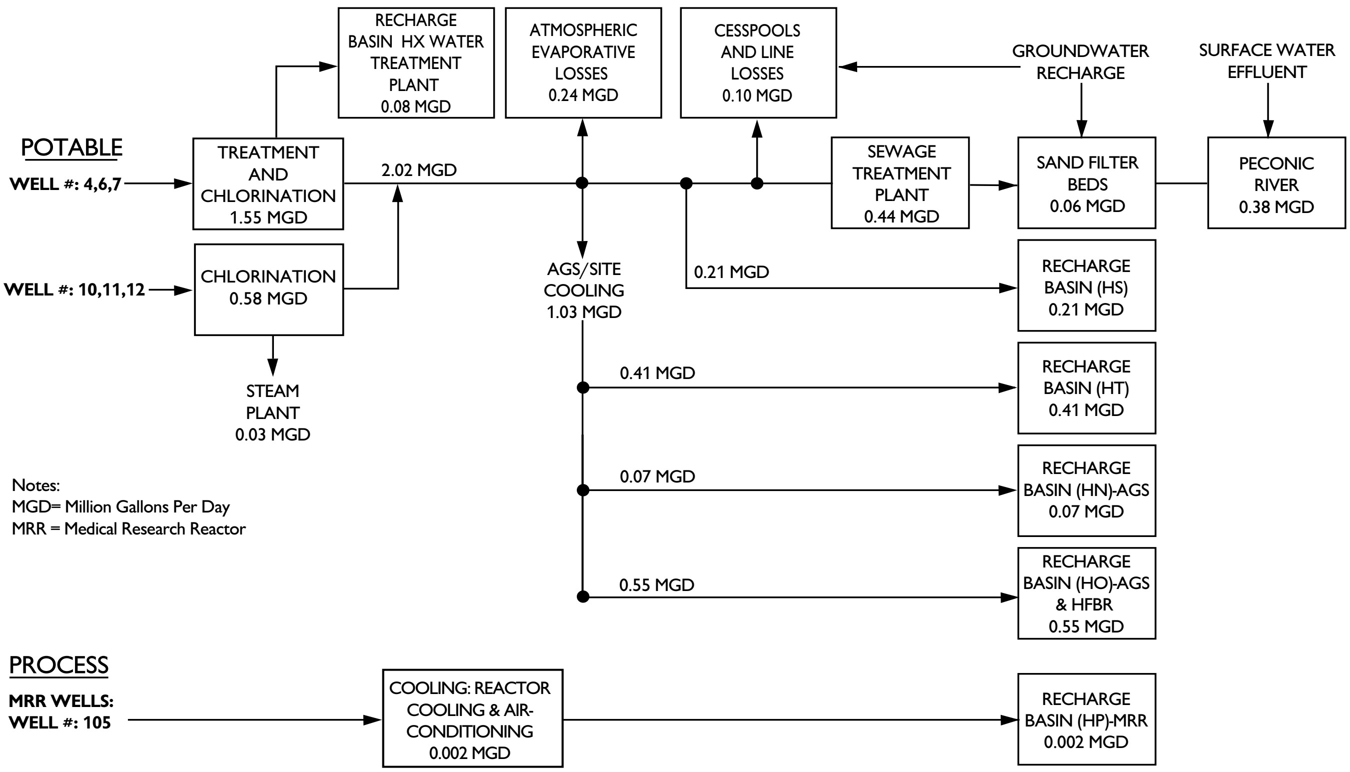


Figure 5-8. Schematic of Water Use and Flow at BNL.

- Basin HX receives Water Treatment Plant filter backwash water.
- Basin HP receives once-through cooling water from the Brookhaven Medical Research Reactor.
- Basin HO receives cooling water and cooling tower discharges from the AGS, and stormwater runoff from the area around the HFBR.
- 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, and Basin HWM at the former Hazardous Waste Management Facility.

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, along with records 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 the Environmental Monitoring Program for radioactivity, VOCs, metals, and anions. During 2001, water samples were collected from Basins HN, HO, HP, HS, HT-E, HT-W, HW, HX, and 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 collected at the recharge basins are presented in Table 5-4. Review of the data shows 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 18.5 ± 1.8 pCi/L (0.7 ± 0.07 Bq/L), which is less than 40 percent of the drinking water standard. The accompanying gamma analysis of water samples collected from all basins showed that only potassium-40, lead-212, and beryllium-7 were detectable in these water samples. All

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

Basin		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Sr-90 (pCi/L)
HN	N	4	4	4	1
	Max.	< 0.7	3.2 ± 1.4	< 374	0.17 ± 0.09
	Avg.	-0.1± 0.2	1.2 ± 1.4	79 ± 89	NA
HO	N	4	4	4	1
	Max.	< 0.7	< 2.1	< 374	< 0.19
	Avg.	-0.1± 0.3	-0.1 ± 1.1	29 ± 60	NA
HP	N	2	2	2	NS
	Max.	< 0.9	3.3 ± 1.4	< 317	
	Avg.	0.1 ± 0.3	2.1 ± 1.6	-4 ± 51	
HS	N	4	4	4	1
	Max.	< 0.7	< 2.3	< 374	< 0.19
	Avg.	0.1 ± 0.3	1.1 ± 0.8	1 ± 35	NA
HT-E	N	4	4	4	1
	Max.	4.2± 2.3	2.7 ± 1.4	< 361	< 0.27
	Avg.	1.1± 1.8	0.9 ± 1.1	2 ± 44	NA
HT-W	N	4	4	4	1
	Max.	< 0.8	3.4 ± 1.4	< 374	< 0.19
	Avg.	0.4± 0.1	1.0 ± 1.7	39 ± 92	NA
HW	N	4	4	4	NS
	Max.	8.6± 1.1	18.5 ± 1.8	< 364	
	Avg.	2.8± 3.3	7.0 ± 7.4	-77 ± 52	
SDWA Limit		15	50	20,000	8

Notes:
Figure 5-7 provides the locations of outfall/recharge basins.
No gamma-emitting anthropogenic radionuclides were detected in BNL discharges to outfalls/recharge basins in 2001.
All values reported with a 95% confidence interval.
Recharge basins HX and CSF were not sampled for radiological parameters in 2001.
N = Number of samples collected for analysis
NA = Not Applicable
NS = Samples not collected for this analysis
SDWA = Safe Drinking Water Act

detected gamma-emitting nuclides are attributed to natural or cosmic sources. No gamma-emitting radionuclides attributable to BNL operations were detected in any of the recharge basins. Tritium was not detected in any basin above minimum detection limits during 2001.

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 3.3 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 a single sample collected from Recharge Basin HW in January at a concentration of 5.9 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. Aluminum and iron are natural components of soil and readily dissolve when water is acidified for sample preservation. Iron is present naturally in Long Island groundwater at concentrations that exceed the New York State groundwater effluent limit. The pH measured at several of the recharge basins was outside the groundwater effluent standard of 6.5 to 8.5 Standard Units. The pH of local groundwater and precipitation is lower than the standard, which contributed to the low pH observations. The high pH observations are attributed to sodium hydroxide or calcium hydroxide additions to the domestic water system. Periodically, the pH of the domestic water is greater than 8.5, due to chemical over-addition.

Investigation of lead concentrations in soil samples collected at the CSF outfall continued in

Table 5-5. Water Quality Data for Samples from On-Site Recharge Basins.

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	19	6	19	6	4	4	4
(RHIC)	Min.	6.7	119	8.0	6.9	21.1	7.5	< 1
	Max.	8.1	673	25.2	11.6	154.2	18.3	< 1
	Avg.	NA	257	17.3	9.3	60.7	13.0	< 1
HO	N	17	4	17	4	4	4	4
(AGS/HFBR)	Min.	6.4	45	7.8	8.2	20.7	9	< 1
	Max.	7.8	154	25.7	13.0	26.9	11.4	< 1
	Avg.	NA	119	18.4	9.8	23.5	10.1	< 1
HP	N	3	3	3	3	2	2	2
(BMRR)	Min.	5.8	151	12.7	6.2	19.3	13.3	1
	Max.	6.2	213	13.0	6.2	33.0	18.6	1.1
	Avg.	NA	182	12.8	6.2	26.2	16.0	1
HS	N	20	8	20	8	4	4	4
(Stormwater)	Min.	6.9	177	3.7	8.3	24.5	11.3	< 1
	Max.	8.7	618	31.1	16.1	138.9	14.7	< 1
	Avg.	NA	301	16.4	11.2	58.9	13.1	< 1
HT-E	N	21	9	21	9	4	4	4
(AGS)	Min.	6.7	77	5.8	8.7	23.1	9.6	< 1
	Max.	8.1	476	19.7	12.9	281.0	18.6	< 1
	Avg.	NA	199	13.7	10.4	89.9	12.4	< 1
HT-W	N	21	9	21	9	4	4	4
(LINAC)	Min.	6.9	132	7.1	7.5	< 4	< 4	< 1
	Max.	8.0	536	23.3	12.4	117.9	11.3	< 1
	Avg.	NA	231	18.2	9.2	39.7	7.5	< 1
HW	N	14	4	14	4	4	4	4
(Weaver Road)	Min.	6.0	57	1.7	9.0	< 4	< 4	< 1
	Max.	7.8	94	21.9	13.3	11.2	5.6	< 1
	Avg.	NA	74	11.6	11.2	5.23	1.4	< 1
CSF	N	11	4	11	4	4	4	4
(Stormwater)	Min.	6.1	52	3.3	8.4	< 4	< 4	< 1
	Max.	7.6	74	22.4	13.6	33.2	6.4	< 1
	Avg.	NA	63	13.3	10.7	9.6	1.6	< 1
HX	N	9	NS	9	NS	NS	NS	NS
(WTP Backwash)	Min.	6.5	NS	9.2	NS	NS	NS	NS
	Max.	7.3	NS	17.1	NS	NS	NS	NS
	Avg.	NA	NS	12.4	NS	NS	NS	NS
Outfall 002B	N	4	NS	4	NS	NS	NS	NS
(RHIC)	Min.	6.7	NS	11.1	NS	NS	NS	NS
	Max.	7.9	NS	21.3	NS	NS	NS	NS
	Avg.	NA	NS	18.0	NS	NS	NS	NS
NYSDEC Effluent Standard		**6.5 to 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 5-7 for the locations of recharge basins.
AGS/HFBR = Alternating Gradient Synchrotron/High Flux Beam Reactor
BMRR = Brookhaven Medical Research Reactor
CSF = Central Steam Facility
MDL = Minimum Detection Limit
N = No. of samples
NA = Not Applicable
NS = Not Sampled
NYSDEC = New York State Department of Environmental Conservation
RHIC = Relativistic Heavy Ion Collider
SNS = Effluent Standard Not Specified

Table 5-6. Analysis of Metals in Samples from On-Site Recharge Basins.

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)	4	Min.	< 1.0	24.4	< 3.0	24.4	< 0.7	< 1.1	0.2	< 1.0	42.7	0.1	< 0.1	11.9	< 5.0	< 1.0	1.6	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	64.9
		Max.	< 2.0	685.2	< 6.0	32.3	< 1.3	< 1.1	0.8	3.4	110.0	0.8	< 0.1	40.2	< 10.0	99.5	3.1	11.2	< 1.7	< 10.0	< 1.3	< 11.0	134.4
		Avg.	< 2.0	352.8	< 6.0	27.8	< 1.3	< 1.1	0.4	0.9	70.6	0.5	< 0.1	26.5	< 10.0	35.4	2.4	5.6	< 1.7	< 10.0	< 1.3	< 11.0	93.6
HO (AGS/HFBR)	4	Min.	< 1.0	6.6	< 3.0	21.0	< 0.7	< 1.1	< 0.1	< 1.0	3.2	< 0.1	< 0.1	11.0	< 5.0	14.6	< 1.1	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	10.2
		Max.	< 1.0	17.4	< 3.0	25.3	< 0.7	< 1.1	0.4	< 1.0	12.0	0.3	< 0.1	33.4	< 5.0	18.1	1.2	2.9	< 0.9	< 5.0	< 0.7	< 5.5	46.5
		Avg.	< 1.0	11.5	< 3.0	23.0	< 0.7	< 1.1	0.2	< 1.0	6.2	0.1	< 0.1	17.5	< 5.0	15.7	0.9	0.7	< 0.9	< 5.0	< 0.7	< 5.5	23.7
HP (BMRR)	2	Min.	< 1.0	29.2	< 3.0	4.9	< 0.7	< 1.1	0.2	< 1.0	2.5	0.3	< 0.1	29.7	< 5.0	14.5	< 1.1	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	< 4.0
		Max.	< 1.0	55.8	< 3.0	48.3	< 0.7	< 1.1	0.7	< 1.0	4.8	0.4	< 0.1	100.2	< 5.0	18.6	< 1.1	1.9	< 0.9	< 5.0	< 0.7	< 5.5	15.6
		Avg.	< 1.0	42.5	< 3.0	26.6	< 0.7	< 1.1	0.5	< 1.0	3.6	0.3	< 0.1	64.9	< 5.0	16.6	< 1.1	1.0	< 0.9	< 5.0	< 0.7	< 5.5	7.8
HS (Stormwater)	4	Min.	< 1.0	26.8	< 3.0	5.6	< 0.7	< 1.1	0.2	< 1.0	6.3	< 0.1	< 0.1	7.7	< 5.0	16.2	< 1.1	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	11.8
		Max.	< 2.0	818.0	6.2	29.6	< 1.3	< 2.2	1.5	< 2.0	34.8	0.4	< 0.1	61.4	< 10.0	81.7	3.0	5.5	< 1.8	14.1	< 1.3	< 11.0	75.7
		Avg.	< 2.0	234.4	1.6	22.9	< 1.3	< 2.2	0.5	< 2.0	17.6	0.1	< 0.1	30.4	< 10.0	35.1	1.2	1.4	< 1.8	< 5.0	< 1.3	< 11.0	30.1
HT-E (AGS)	5	Min.	< 1.0	12.7	< 3.0	21.2	< 0.7	< 1.1	0.2	< 1.0	5.0	< 0.1	< 0.1	15.5	< 5.0	11.0	1.1	1.6	< 0.9	< 5.0	< 0.7	< 5.5	9.7
		Max.	< 2.0	566.8	3.2	47.2	< 1.3	< 2.2	0.8	22.2	133.8	0.9	< 0.1	139.0	< 10.0	186.7	5.0	9.3	< 1.8	< 10.0	< 1.3	< 11.0	137.2
		Avg.	< 2.0	175.7	0.6	30.7	< 1.3	< 2.2	0.4	5.4	58.6	0.3	< 0.1	45.8	< 10.0	53.2	2.9	4.4	< 1.8	< 10.0	< 1.3	< 11.0	76.3
HT-W (LINAC)	4	Min.	< 1.0	19.0	< 3.0	22.6	< 0.7	< 2.2	0.2	< 1.0	118.0	< 0.1	< 0.1	10.0	< 5.0	< 1.0	< 1.1	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	8.5
		Max.	3.2	4756.0	7.6	36.5	3.7	< 2.2	4.1	4.4	87.6	2.7	< 0.1	67.2	< 10.0	74.6	4.1	12.3	2.2	16.9	1.8	< 11.0	52.7
		Avg.	< 1.0	1304.6	< 3.0	26.8	0.9	< 2.2	1.4	2.0	43.7	0.8	< 0.1	36.7	< 10.0	27.9	2.2	4.3	1.0	< 5.0	0.4	< 11.0	36.9
HW (Total) (Stormwater)	4	Min.	< 1.0	75.7	< 3.0	4.4	< 0.7	< 1.1	< 0.5	< 1.0	3.9	< 0.1	< 0.1	4.1	< 5.0	1.3	< 4.4	1.7	< 1.8	< 5.0	< 0.7	< 5.5	33.3
		Max.	< 4.0	836.8	< 12.0	12.9	< 2.6	< 4.4	0.6	2.2	432.0	0.9	< 0.1	23.6	< 20.0	20.8	4.6	20.3	1.0	< 20.0	0.7	< 22.0	86.1
		Avg.	< 4.0	415.7	< 12.0	8.3	< 2.6	< 4.4	0.3	< 4.0	121.5	0.4	< 0.1	11.3	< 20.0	8.1	1.8	9.9	< 3.5	< 20.0	< 2.6	< 22.0	56.8
HW (Filtered) (Stormwater)	1	Value	1.1	50.9	< 3.0	10.4	1.1	1.6	1.3	1.6	10.5	< 0.1	< 0.1	11.7	< 5.0	1.7	3.3	2.5	1.7	< 5.0	1.1	< 5.5	57.4
CSF (Total) (Stormwater)	4	Min.	< 1.0	152.5	< 3.0	4.8	< 1.3	< 2.2	0.5	< 1.0	6.2	< 0.1	< 0.1	4.0	< 5.0	1.9	2.6	< 2.6	< 0.9	< 5.0	< 0.7	< 11.0	11.7
		Max.	< 4.0	1222.4	10.4	17.4	< 2.6	< 4.4	1.7	2.2	677.6	1.5	< 0.1	51.1	< 20.0	26.4	19.8	31.0	< 3.5	10.9	< 2.6	15.1	51.4
		Avg.	< 4.0	528.4	2.6	9.8	< 2.6	< 2.2	0.8	0.6	192.5	0.5	< 0.1	19.7	< 20.0	9.8	8.6	14.9	< 3.5	2.7	< 2.6	< 11.0	36.7
CSF (Filtered) (Stormwater)	1	Value	< 1.0	38.2	< 3.0	8.1	< 0.7	< 1.1	1.0	< 1.0	8.7	0.1	< 0.1	33.7	< 5.0	2.1	14.7	2.2	< 0.9	< 5.0	< 0.7	7.5	49.5
NYSDEC Effluent Limitation or AWQS			100	2,000	50	2,000	SNS	10	5	100	1,000	0.6	1.4	600	SNS	SNS	200	50	6	20	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 5-7 for locations of recharge basins.
Recharge basin HX was not sampled for metals during CY 2001.
AGS/HFBR = Alternating Gradient Synchrotron/High Flux Beam Reactor
AWQS = Ambient Water Quality Standard
BMRR = Brookhaven Medical Research Reactor
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

2001. A significant area of soils containing lead in concentrations greater than 10,000 mg/Kg is still under investigation. Historical operations of the Central Steam Facility, specifically the combustion of waste oils and the washing of boiler ash to this outfall, are the most likely cause. This investigation will continue in 2002. Monitoring this outfall for lead will most likely become a condition of the SPDES permit for this discharge; BNL will continue to monitor it under the surveillance program.

5.4.3 Stormwater Assessment

With the exception of Recharge Basins HP and HX, all recharge basins receive stormwater runoff. At BNL, stormwater is managed by collecting runoff from paved surfaces, roofs, and other impermeable surfaces and directing it to the recharge basins via underground piping and abovegrade vegetated swales. Recharge Basin 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 and HT-E receive runoff from the AGS and portions of the RHIC complex; Basin HO receives runoff from the BGRR and HFBR areas. As previously indicated, Basins HW, CSF, and HWM receive only stormwater runoff.

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 stormwater runoff, BNL has drafted 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 will become part of the revised *Storage and Transfer of Hazardous and Nonhazardous Materials Subject Area*, currently in draft.

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 5-9. In total, ten 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.

The sampling stations are located as follows:

Downstream sampling stations

- HMn, on site and 0.5 miles downstream of the STP outfall
- HMs, on site (a typically dry tributary of the Peconic River)
- HQ, on site and 1.2 miles downstream of the STP outfall
- HA and HB, 3.1 miles downstream of the STP outfall
- HC, 4.3 miles downstream of the STP outfall
- HR, 13 miles downstream of the STP outfall (in Riverhead)

Upstream locations

- HE, on site, located approximately 20 feet upstream of the STP
- HV, on site, located just east of the 10 o'clock Experimental Hall in the RHIC ring
- HY, on site, located 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 all ten locations. Routine samples at Stations HMn and HQ were collected three times per week, as flow permitted. Station HE was collected quarterly in 2001. Since February 1995, these three locations 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 2001 are summarized

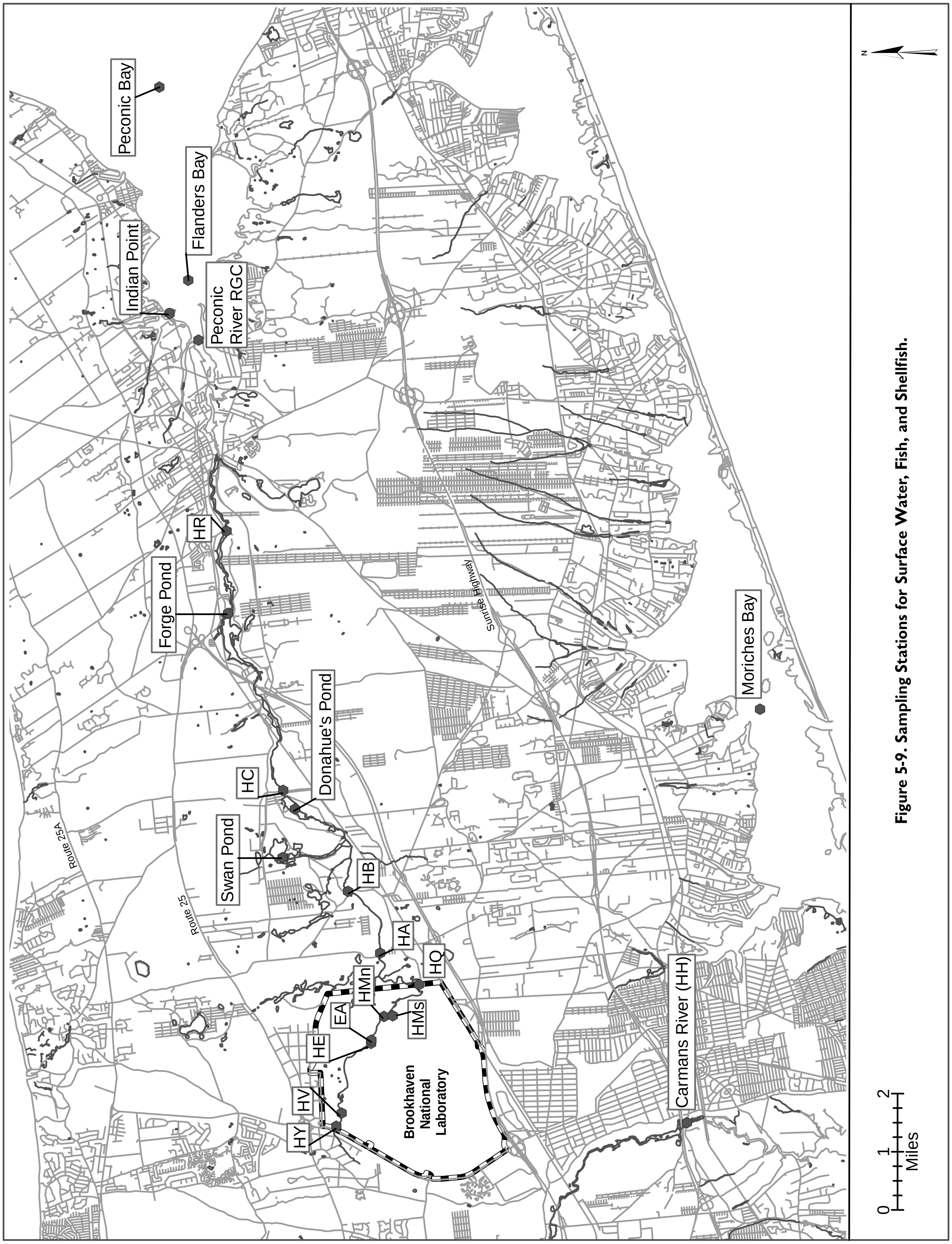


Figure 5-9. Sampling Stations for Surface Water, Fish, and Shellfish.

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 but were less than the samples collected at Station HH, on the Carmans River. With the exception of a single detection of Cs-137 at Station HB, there were no gamma-emitting radionuclides attributable to BNL operations detected either upstream or downstream of the STP. Approximately 2.5 pCi/L of Cs-137 was detected in a grab sample collected in January from Station HB. Because Cs-137 was not detected at other locations and because of the high turbidity of water samples associated with this sampling station, Cs-137 is being attributed to sediment entrained in the water sample. The concentration detected was only 1.3 percent of the drinking water standard.

Tritium analysis of water samples collected upstream and downstream from the STP discharge showed detectable levels only at Stations HMn and HQ. The maximum concentration (830 ± 278 pCi/L [30.7 ± 10.3Bq/L]), detected at Station HMn, was consistent with the levels discharged from the BNL STP. Tritium was detected only once at Station HQ, at a concentration of 397 ± 241 pCi/L (14.7 ± 8.9 Bq/L), which is much less than the drinking water standard of 20,000 pCi/L.

Monitoring for strontium-90 was performed at Stations HE, HMn, and HQ. 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 0.31 ± 0.1 pCi/L (0.01 ± 0.004 Bq/L), which is approximately 4 percent of the drinking water standard and equivalent to the levels detected in 2000.

5.5.2 Peconic River - Nonradiological Analyses

Samples collected in 2001 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, although low concentrations were reported for acetone (5.8 µg/L or less) and methylene chloride (2 µg/L or less) at several locations. Due to the low level of detection and the ubiquitous nature of these compounds in the analytical laboratory, the presence of these compounds is questionable. Trace concentrations of 1,1,1-trichloroethane and 1,1-dichloroethylene were detected in water samples collected at Station HR. Due to the location of this station (Riverhead) and the absence of these compounds at locations closer to BNL, these compounds are not expected to be the result of BNL operations, but may be the result of roadway runoff or other off-site sources. There were single detections of 1,2,3-trichlorobenzene (2 µg/L) and naphthalene (7 µg/L) at Station HM-N in May 2001. No other organic compounds were detected above the minimum detection limit upstream or downstream of the STP discharge.

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 HMn and HQ) and were consistent with the concentrations in the STP discharge. Chlorides were, however, highest at upstream Station HY. The sample collected from Station HY in January measured 157 mg/L, most probably due to road salting and surface run-off, due to its proximity to William Floyd Parkway.

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 mix with the decaying matter, these acids decrease the already low pH of precipitation, resulting in a pH as low as 3.9 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

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

Sample Station	Geographic Location		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Sr-90 (pCi/L)
HY	Peconic River (headwaters), on site, west of the RHIC ring	N	4	4	4	2
		Max.	0.98 ± 0.51	3.47 ± 1.44	< 375	<0.21
		Avg.	0.50 ± 0.36	1.29 ± 1.81	-135 ± 132	< 0.21
HV	Peconic River (headwaters), on site, inside the RHIC ring	N	4	4	4	NS
		Max.	1.13 ± 0.57	3.68 ± 1.37	< 375	
		Avg.	0.63 ± 0.43	1.90 ± 1.16	-95 ± 113	
HE	Peconic River, upstream of STP Outfall	N	4	4	4	3
		Max.	1.45 ± 0.59	< 2.10	<329	0.31 ± 0.10
		Avg.	0.60 ± 0.55	1.97 ± 0.21	-5 ± 124	0.27 ± 0.03
HMn	Peconic River, 0.4 mi from STP, on site	N	132	132	132	3
		Max	5.58 ± 3.17	15.50 ± 5.77	830 ± 278	0.22 ± 0.11
		Avg.	1.72 ± 0.28	5.46 ± 0.48	49 ± 28	0.06 ± 0.16
HMs	Peconic River tributary, on site	N	2	2	2	2
		Max.	1.03 ± 0.55	< 2.29	< 321	0.30 ± 0.11
		Avg.	0.72 ± 0.43	1.31 ± 0.46	-199 ± 10	0.29 ± 0.004
HQ(1)	Peconic River, BNL site boundary	N	84	84	84	3
		Max.	4.84 ± 2.87	18.80 ± 6.17	397 ± 241	0.24 ± 0.11
		Avg.	1.27 ± 0.28	6.37 ± 0.91	14 ± 34	0.14 ± 0.09
HA	Peconic River, off site	N	4	4	4	NS
		Max.	< 0.71	< 2.10	< 374	
		Avg.	0.06 ± 0.21	0.53 ± 0.70	-33 ± 1	
HB	Peconic River, off site	N	4	4	4	NS
		Max.	< 0.76	< 2.10	< 375	
		Avg.	0.04 ± 0.22	0.91 ± 1.06	47 ± 51	
HC	Peconic River, off site	N	4	4	4	NS
		Max.	< 0.75	2.35 ± 1.32	< 375	
		Avg.	0.06 ± 0.16	1.01 ± 0.79	-25 ± 61	
HR	Peconic River, Riverhead	N	4	4	4	NS
		Max.	< 0.71	2.31 ± 1.43	< 329	
		Avg.	0.10 ± 0.18	1.71 ± 0.81	-10 ± 68	
HH	Carmans River, (control location)	N	4	4	4	NS
		Max.	22.70 ± 0.71	24.60 ± 2.06	< 329	
		Avg.	5.75 ± 9.59	6.57 ± 10.22	-17 ± 53	
SDWA Limit			15	50	20,000	8

Notes:
See Figure 5-9 for sample station locations.
All values shown with 95% confidence interval.
Negative numbers occur when the measured value is lower than background.
For Stations HM-N and HQ, Sr-90 analysis results are based on composite samples; all others collected as grab samples.
N = Number of samples analyzed
NS = Not Sampled for this analyte
SDWA = Safe Drinking Water Act
(1)Station HQ was dry for 6 months during 2001.

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 2001, the BNL monitoring program assessed water samples for both the dissolved and particulate forms. Dissolved

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

Sample Station	Geogrphic Location		pH (SU)	Conductivity (μS/cm)	Temp. (°C)	Dissolved Oxygen (mg/L)	Chlorides (mg/L)	Sulfates (mg/L)	Nitrates as N (mg/L)
HV	Peconic River (headwaters),	N	4	4	4	4	NS	NS	NS
	on site, inside the RHIC ring	Min.	4.3	71	1.0	1.6	NS	NS	NS
		Max.	7.0	310	15.6	13.2	NS	NS	NS
		Avg.	NA	174	9.9	7.8	NS	NS	NS
HY	Peconic River,	N	4	4	4	4	4	4	4
	(headwaters), on site,	Min.	4.3	44	1.6	1.6	< 4	< 4	< 1
	east of Wm. Floyd Pkwy.	Max.	7.2	587	15.6	12.6	156.8	5.6	< 1
		Avg.	NA	227	8.5	8.5	52.7	2.5	< 1
HE	Peconic River,	N	8	8	8	8	4	4	4
	upstream of STP Outfall	Min.	4.3	38	0.9	3.7	7.1	< 4	< 1
		Max.	7.3	80	21.3	11.5	12.3	6.8	< 1
		Avg.	NA	59	11.0	7.9	9.1	4.2	< 1
HMn	Peconic River,	N	141	141	141	141	12	12	12
	0.4 mi from STP, on site	Min.	4.6	52	0.2	4.2	10.8	5.0	1.0
		Max.	7.3	343	26.9	16.8	43.6	15.5	6.6
		Avg.	NA	195	12.8	8.5	29.2	12.2	4.0
HMs	Peconic River,	N	2	2	2	2	2	2	2
	tributary, on site	Min.	4.0	43	0.4	7.5	4.0	< 4	< 1
		Max.	4.3	66	5.3	12.1	5.3	4.6	< 1
		Avg.	NA	55	2.8	9.8	4.7	2.3	< 1
HQ	Peconic River,	N	90	90	90	90	7	7	7
	BNL site boundary	Min.	4.9	58	1.4	0.3	10.2	5.0	< 1
		Max.	7.5	238	25.6	14.4	45.8	19.3	5.9
		Avg.	NA	143	14.7	5.7	26.5	10.0	1.7
HA	Peconic River,	N	4	4	4	4	4	4	4
	off site	Min.	3.9	48	1.4	5.6	7.0	< 4	< 1
		Max.	6.1	65	22.2	15.6	9.7	4.5	< 1
		Avg.	NA	54	11.8	9.4	7.8	1.1	< 1
HB	Peconic River,	N	4	4	4	4	4	4	4
	off site	Min.	5.2	49	0.3	3.0	7.7	< 4	< 1
		Max.	6.2	66	21.8	16.4	9.9	5.1	< 1
		Avg.	NA	58	11.2	8.3	8.6	3.5	< 1
HC	Peconic River,	N	4	4	4	4	4	4	4
	off site	Min.	5.7	56	1.8	7.8	8.0	< 4	< 1
		Max.	6.4	79	23.9	9.7	10.8	6.6	< 1
		Avg.	NA	64	11.1	9.0	9.5	4.3	< 1
HR	Peconic River,	N	4	4	4	4	4	4	4
	off site, Riverhead	Min.	6.3	81	4.2	8.5	11.5	7.8	< 1
		Max.	7.0	131	27.3	12.6	17.3	10.8	< 1
		Avg.	NA	110	14.6	10.6	15.3	8.9	< 1
HH	Carmans River,	N	4	4	4	4	4	4	4
	(control location)	Min.	6.4	149	4.8	8.6	23.1	9.6	1.1
		Max.	7.2	177	20.9	12.5	30.4	11.7	1.6
		Avg.	NA	161	12.3	10.2	26.7	10.7	1.3
NYS AWQS			6.5 - 8.5	SNS	SNS	< 4.0	250 (a)	250 (a)	10 (a)
Typical MDL			NA	10	NA	NA	4.0	4.0	1.0

Notes:
See Figure 5-9 for sample station locations.
N = No. of samples
NA = Not Applicable
NS = Not Sampled
MDL = Minimum Detection Limit

SNS = Standard Not Specified
(a) Since there are no Class C Surface Water Ambient Water Quality Standards (AWQS) for these compounds, the AWQS for groundwater is provided, if specified.

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

River	Sample 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	HY (Total)	4	Min.	< 2.0	386.6	< 6.0	9.4	< 1.3	< 2.2	0.3	< 2.0	15.1	0.1	< 0.1	12.4	< 10.0	4.2	< 2.2	< 2.6	< 1.8	< 10.0	< 1.3	< 11.0	17.0
			Max.	2.4	1738.0	< 6.0	21.2	< 1.3	< 2.2	1.1	4.3	75.8	4.0	< 0.1	141.8	< 10.0	114.4	3.4	12.1	< 1.8	20.8	< 1.3	< 11.0	51.2
			Avg.	< 2.0	734.3	< 6.0	14.6	< 1.3	< 2.2	0.6	2.8	42.4	1.3	< 0.1	52.5	< 10.0	39.1	2.4	6.0	< 1.8	8.3	< 1.3	< 11.0	30.1
	HY (Dissolved)	1	Value	< 2.0	285.6	< 6.0	18.5	< 1.3	< 2.2	< 1.0	< 2.0	5.3	1.7	< 0.1	138.3	< 10.0	32.8	< 2.2	< 2.6	< 1.8	< 10.0	< 1.3	< 11.0	21.3
	HE (Total)	4	Min.	< 1.0	191.7	< 3.0	9.6	< 0.7	< 1.1	0.8	< 1.0	< 4.0	0.4	< 0.1	63.7	< 5.0	4.3	< 2.2	<1.3	< 0.9	< 5.0	< 0.7	< 5.5	14.1
			Max.	< 2.0	483.8	< 6.0	19.3	< 1.3	< 2.2	1.1	2.1	36.7	2.0	< 0.1	146.5	< 10.0	10.5	2.4	5.6	< 1.8	< 10.0	< 1.3	< 11.0	115.3
			Avg.	< 2.0	340.7	< 6.0	14.8	< 1.3	< 2.2	0.9	0.5	15.0	1.4	< 0.1	90.8	< 10.0	6.6	0.9	1.4	< 1.8	< 10.0	< 1.3	< 11.0	42.6
	HE (Dissolved)	1	Value	< 2.0	229.8	< 6.0	10.9	< 1.3	< 2.2	0.7	< 2.0	4.1	0.9	< 0.1	59.2	< 10.0	8.8	< 2.2	< 2.6	< 1.8	< 10.0	< 1.3	< 11.0	14.6
	HMn (Total)	12	Min.	< 1.0	36.0	< 3.0	9.9	< 0.7	< 1.1	0.3	< 1.0	22.3	< 0.1	< 0.1	8.3	< 5.0	7.6	< 2.2	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	16.3
			Max.	6.4	586.6	3.1	28.9	< 1.3	< 2.2	0.7	28.5	174.2	1.5	0.4	62.1	< 10.0	36.7	5.1	7.8	< 1.8	< 10.0	< 1.3	< 11.0	101.0
			Avg.	< 2.0	309.3	< 3.0	19.6	< 1.3	< 2.2	0.5	4.0	64.0	0.5	0.03	22.9	< 10.0	25.3	3.2	2.8	< 1.8	< 10.0	< 1.3	< 11.0	52.3
	HMn (Dissolved)	4	Min.	< 1.0	34.5	< 3.0	11.7	< 0.7	< 1.1	0.2	< 1.0	19.8	< 0.1	< 0.1	2.5	< 5.0	18.5	2.4	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	13.6
			Max.	< 2.0	186.3	3.9	17.7	< 1.3	< 2.2	1.4	2.7	30.0	0.7	0.3	20.7	< 10.0	37.5	3.4	2.8	< 1.8	14.8	< 1.3	< 11.0	45.2
			Avg.	< 2.0	81.0	< 3.0	15.3	< 1.3	< 2.2	0.6	0.7	26.0	0.2	0.1	8.0	< 10.0	28.6	2.8	0.7	< 1.8	3.7	< 1.3	< 11.0	27.8
	HMs	2	Min.	< 2.0	570.1	< 6.0	9.5	< 1.3	< 2.2	0.5	< 2.0	< 20.0	0.3	< 0.1	29.5	< 10.0	2.0	< 2.2	< 2.6	< 8.8	< 10.0	< 1.3	< 11.0	< 40.0
			Max.	< 10.0	579.4	24.7	13.7	< 6.6	< 11.0	0.7	< 10.0	8.5	0.3	< 0.1	36.3	< 50.0	3.8	< 11.0	< 13.2	< 8.8	114.0	< 6.0	< 55.0	25.1
	HQ (Total)	7	Min.	< 2.0	75.9	< 6.0	6.7	< 0.7	< 1.1	< 0.2	< 2.0	10.1	0.1	< 0.1	8.8	< 5.0	6.4	< 2.2	< 2.6	< 0.9	< 5.0	< 0.7	< 5.5	< 8.0
			Max.	2.9	395.0	6.9	20.9	2.0	2.5	2.2	19.6	83.2	0.9	< 0.1	72.6	< 20.0	27.9	4.8	5.1	2.2	13.0	2.1	< 11.0	98.8
			Avg.	< 2.0	208.6	< 6.0	13.3	< 1.3	< 2.2	0.6	3.4	41.4	0.5	< 0.1	27.0	< 20.0	17.9	2.6	2.5	0.3	1.9	0.3	< 11.0	40.9
	HQ (Dissolved)	1	Value	< 2.0	199.2	< 6.0	15.3	< 1.3	< 2.2	0.3	2.0	48.5	0.8	< 0.1	14.8	< 10.0	18.1	3.7	4.7	< 1.8	< 10.0	< 1.3	< 11.0	28.5
	HA (Total)	4	Min.	<1.0	34.0	< 3.0	9.0	< 0.7	< 1.1	0.3	< 1.0	< 2.0	0.3	< 0.1	25.5	< 5.0	4.8	< 1.1	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	6.7
			Max.	2.3	247.2	< 6.0	13.7	< 1.3	< 2.2	0.6	< 2.0	32.4	1.8	< 0.1	78.5	< 10.0	8.3	< 2.2	3.6	< 1.8	< 10.0	< 1.3	< 11.0	32.6
			Avg.	< 2.0	114.7	< 6.0	11.1	< 1.3	< 2.2	0.5	< 2.0	13.6	0.8	< 0.1	50.5	< 10.0	5.8	< 2.2	0.9	< 1.8	< 10.0	< 1.3	< 11.0	17.8
	HA (Dissolved)	1	Value	< 2.0	60.1	< 6.0	13.5	< 1.3	< 2.2	0.6	< 2.0	< 4.0	0.8	< 0.1	78.7	< 10.0	7.1	< 2.2	< 2.6	< 1.8	< 10.0	< 1.3	< 11.0	< 8.0
	HB (Total)	4	Min.	< 1.0	24.9	< 3.0	9.4	< 0.7	< 1.1	0.3	< 1.0	< 2.0	0.5	< 0.1	31.4	< 5.0	5.4	< 1.1	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	< 8.0
			Max.	< 2.0	155.8	< 6.0	13.4	< 1.3	< 2.2	0.5	< 2.0	8.7	3.7	< 0.1	70.5	< 10.0	7.3	< 2.2	< 2.6	< 1.8	< 10.0	< 1.3	< 11.0	34.1
			Avg.	< 2.0	79.5	< 6.0	11.5	< 1.3	< 2.2	0.5	< 2.0	2.2	1.5	< 0.1	54.4	< 10.0	6.2	< 2.2	< 2.6	< 1.8	< 10.0	< 1.3	< 11.0	3.1
	HB (Dissolved)	1	Value	2.6	51.8	< 6.0	14.6	< 1.3	< 2.2	0.6	< 2.0	9.7	1.8	< 0.1	61.2	< 10.0	7.4	< 2.2	< 2.6	< 1.8	< 10.0	< 1.3	< 11.0	< 8.0
	HC (Total)	4	Min.	< 1.0	35.1	< 3.0	11.5	< 0.7	< 1.1	0.3	< 1.0	< 2.0	0.5	< 0.1	31.4	< 5.0	5.1	< 1.1	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	< 8.0
			Max.	< 2.0	153.1	< 6.0	17.4	< 1.3	< 2.2	0.5	2.7	31.3	3.1	< 0.1	191.6	< 10.0	8.4	< 2.2	4.0	< 1.8	< 10.0	< 1.3	< 11.0	32.5
			Avg.	< 2.0	84.2	< 6.0	13.6	< 1.3	< 2.2	0.4	0.7	16.5	1.3	< 0.1	108.8	< 10.0	7.0	< 2.2	1.0	< 1.8	< 10.0	< 1.3	< 11.0	17.6

(continued on next page)

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

River	Sample 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
HC (Dissolved)		1	Value	< 2.0	49.4	< 6.0	14.2	< 1.3	< 2.2	0.4	< 2.0	9.5	2.1	< 0.1	93.6	< 10.0	6.9	< 2.2	< 2.6	< 1.8	< 10.0	< 1.3	< 11.0	10.8
	HR (Total)	4	Min.	< 1.0	17.6	< 3.0	9.8	< 0.7	< 1.1	0.3	< 1.0	< 2.0	0.4	< 0.1	61.3	< 5.0	7.6	< 1.1	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	< 8.0
			Max.	< 2.0	188.4	< 6.0	25.6	< 1.3	< 2.2	0.3	2.1	60.7	1.7	< 0.1	185.8	< 10.0	13.0	2.6	7.3	< 1.8	< 10.0	< 1.3	< 11.0	37.9
			Avg.	< 2.0	75.9	< 6.0	19.5	< 1.3	< 2.2	0.3	0.5	23.1	0.8	< 0.1	123.7	< 10.0	11.0	0.7	1.8	< 1.8	< 10.0	< 1.3	< 11.0	15.3
	HR (Dissolved)	1	Value	< 1.0	28.6	< 3.0	21.0	< 0.7	< 1.1	0.7	< 1.0	< 2.0	1.2	< 0.1	116.8	< 5.0	11.5	1.1	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	13.3
Carmans (control location)	HH (Total)	4	Min.	< 1.0	13.6	< 3.0	27.9	< 0.7	< 1.1	< 0.5	< 1.0	3.3	0.2	< 0.1	28.2	< 5.0	16.4	< 1.1	< 1.3	< 0.9	< 5.0	< 0.7	< 5.5	< 4.0
			Max.	< 4.0	141.9	< 12.0	34.7	< 2.6	1.5	0.1	< 4.0	74.0	0.5	< 0.1	102.7	< 20.0	18.9	5.9	5.3	< 3.5	< 20.0	< 2.6	< 22.0	179.5
			Avg.	< 4.0	65.7	< 12.0	31.7	< 2.6	< 1.1	0.1	< 4.0	23.5	0.3	< 0.1	72.4	< 20.0	17.2	1.5	1.3	< 3.5	< 20.0	< 2.6	< 22.0	47.2
	HH (Dissolved)	1	Value	< 1.0	17.0	< 3.0	34.1	< 0.7	< 1.1	0.2	< 1.0	4.3	0.2	< 0.1	54.7	< 5.0	17.0	< 1.1	< 1.3	< 0.9	< 5.0	< 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	37
Solubility State				I	I	D		AS	D	AS	D	D	AS	D			D	D	D	AS	AS	D		
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 5-9 for sample station locations.
*The concentration of selenium detected in several samples analyzed in July 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 = Number 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 2001.

concentrations were determined by first filtering the samples prior to acid preservation and analysis. Examination of the metals data showed that aluminum, copper, lead, mercury, iron, selenium, silver, and zinc were present in concentrations that exceeded ambient water quality standards at upstream, downstream and, in some instances, the Carmans River stations. Aluminum, lead, iron, and zinc were at the highest concentrations in water samples collected upstream from the STP. The concentration of selenium was highest in a water sample collected at Station HMs, a tributary not impacted by STP operations. Copper, silver, and mercury were highest in water samples collected immediately downstream at Station HMn. These elements were routinely detected in the STP discharge and, with the exception of copper, were detected in the STP discharge in similar concentrations and were within SPDES permit limits. Copper exceeded SPDES permit limits in samples collected in November (174 µg/L) and December (124 µg/L). 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. Contaminated sediments have been identified in the Operating Unit V assessment, and remedial pilot studies have been initiated to determine the best method for removing the contaminated sediments. Further discussion of Operating Unit V activities for 2001 is provided in Chapter 2. BNL will continue to assess filtered samples to support this observation.

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