Water Quality

5

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

Analytical data for 2004 show that the average gross alpha and beta activity levels in the STP discharge were within the typical range of historical levels and were well below drinking water standards. Tritium releases to the Peconic River returned to below 2002 levels and are expected to decline as the rate of off-gassing from the High Flux Beam Reactor slows. The maximum concentration of tritium released was approximately 2 percent of the drinking water standard. Analysis of the STP discharge continues to show no detection of cesium-137 or strontium-90 in the effluent; no other gamma-emitting radionuclides attributable to BNL operations were detected. While very low concentrations of tritium were occasionally detected at the STP outfall, there were no detections of tritium, or any other radionuclide attributable to BNL operations, above the minimum detection limit at any downstream monitoring station. Monitoring immediately downstream of the STP discharge was limited, due to interrupted downstream flow to permit excavation of river-bed sediments as part of the Peconic River Remediation project.

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 and iron detected in the Peconic River were a result of natural sources. In addition, the low pH of water samples collected at several sections of the river was also due to natural causes.

5.1 SURFACE WATER MONITORING PROGRAM

Treated wastewater from the STP is discharged into the headwaters of the Peconic River. This discharge is permitted under the New York State Department of Environmental Conservation (NYSDEC) State Pollutant Discharge Elimination System (SPDES) 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 discharge point. Monitoring Station HY (see Figure 5-8), located on site but upstream of all BNL operations, provides information on the “background” water quality of the Peconic River. The Carmans River

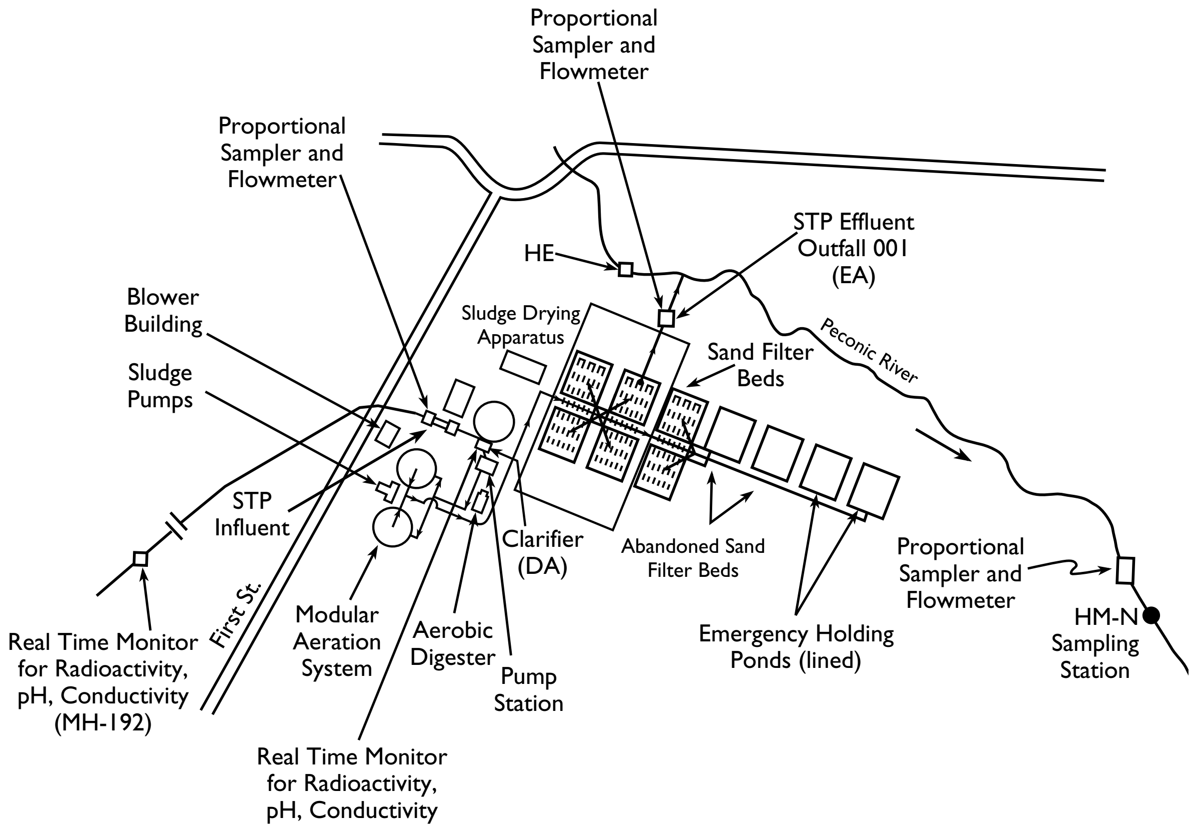

Figure 5-1. Schematic of BNL's Sewage Treatment Plant (STP).

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. Off-site flow was recorded from January through May, at which time the Peconic River remediation project started. The project diverted flow from immediately downstream of the STP discharge to just downstream of station HQ at the site boundary; consequently, there was no flow recorded at station HM-N or station HQ from June through November. Collection of samples resumed in December. The following sections describe BNL's surface water monitoring and surveillance program.

5.2 SANITARY SYSTEM EFFLUENT

The STP effluent (Outfall 001) is a discharge point operated under a SPDES permit issued by NYSDEC. Figure 5-1 shows a schematic of the STP and its sampling locations. The BNL STP treatment process includes five steps: 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 also is 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. During the night (when photosynthesis does not occur), aquatic plants use oxygen in the water. Too much oxygen uptake by aquatic vegetation deprives a water system of oxygen needed by fish and other aquatic organisms for survival. Limiting the concentration of nitrogen in the STP discharge helps keep plant growth in the Peconic River in balance with the nutrients provided by natural sources.

Real-time monitoring of the sanitary waste stream for radioactivity, pH, and conductivity takes place at two locations. The first site (MH-192, see Figure 5-1) is approximately 1.1 miles upstream of the STP, providing at least 30 minutes' warning to the STP operators if wastewater is enroute that may exceed SPDES limits or BNL effluent release criteria (which are more stringent than DOE-specified levels). The second site is at the point where the STP influent enters the primary clarifier, as shown in Figure 5-1. In addition to the monitoring that occurs at these two stations, as effluent leaves the primary clarifier it is also monitored for radioactivity.

Based on the data collected by the real-time monitoring systems, any influent to the clarifier that may not meet SPDES limits or BNL effluent release criteria is diverted to two double-lined holding ponds. The total combined capacity of the two holding ponds exceeds 7 million gallons, or approximately 21 days of flow. Diversion continues until the water quality of the effluent 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 (for nonradiological parameters) or BNL effluent release criteria (for radiological parameters). In 2004, the STP influent was diverted on one occasion due to the presence of fuel oil in the influent stream. Investigation revealed that a heat exchanger at the Central Steam Facility (CSF) had a leaking tube bundle, and a small volume of oil (< 2 gallons) was discharged to the STP. Approximately 400,000 gallons of water were diverted and treated to remove oil sheen before being reintroduced into the STP.

Solids separated in the clarifiers are pumped to an aerobic digester for solids reduction. Sludge is periodically emptied into solar/heat lamp-powered drying beds, where it is dried to a semisolid cake. The dried sludge contains very low levels (less than 2.0 pCi/g) of radioactivity, such as residual levels of cobalt-60 (Co-60) from historic sewage releases. The dried sludge is put into containers for off-site disposal at an authorized facility.

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; 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 2004, samples were collected three times weekly. Samples collected from these locations are also composited and analyzed monthly for gamma-emitting radionuclides and strontium-90 (Sr-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. EPA revised the SDWA limits for radionuclides in 2003. Under these revisions, the gross activity limit for beta emitters (50 pCi/L) was replaced with a 4 mrem (40 µSv) dose limit. The SDWA specifies that no individual may receive an annual dose greater than 4 mrem (40 µSv) from radionuclides that are beta or photon emitters. Beta/photon emitters include up to 168 individual radioisotopes. BNL performs radionuclide-specific gamma analysis to ensure compliance with this standard. The SDWA annual average gross alpha activity limit is 15 pCi/L, including radium-226 (Ra-226) but excluding radon and uranium. Other SDWA-specified drinking water limits are 20,000 pCi/L for tritium, 8 pCi/L for Sr-90, 5 pCi/L for Ra-226 and radium-228 (Ra-228), and 30 µg/L for uranium. Gross activity (alpha and beta) measurements are 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 2004. Annual average gross alpha and beta activity levels in the STP effluent were 0.7 ± 0.3 pCi/L and 4.6 ± 0.3 pCi/L, respectively. Control location data (Carmans River Station HH; see Figure 5-8) show average gross alpha and beta levels of 0.17 ± 0.39 pCi/L and 2.08 ± 1.18 pCi/L, respectively (see Table 5-7).

Tritium detected at the STP originates from either High Flux Beam Reactor (HFBR) sanitary system releases, or from small, infrequent

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

	Monthy Flow	Tritium Maximum	Tritium Average	Gross Alpha Maximum	Gross Alpha Average	Gross Beta Maximum	Gross Beta Average
	(Liters)	(pCi/L)					
STP Influent							
January	2.99E+07	< 344	22 ± 48	6.2 ± 2.4	3.8 ± 0.9	13.1 ± 4.7	6.5 ± 1.8
February	3.56E+07	260 ± 230	107 ± 61	< 2.1	0.4 ± 0.3	6.9 ± 1.6	5.4 ± 0.5
March	3.28E+07	360 ± 210	100 ± 80	< 1.8	0.4 ± 0.3	6.7 ± 1.2	5.4 ± 0.4
April	4.28E+07	560 ± 250	134 ± 98	< 1.9	0.5 ± 0.4	6.3 ± 1.5	5.1 ± 0.5
May	4.36E+07	300 ± 160	88 ± 58	2.3 ± 2.6	0.4 ± 0.4	15.0 ± 10.0	6.3 ± 1.9
June	4.41E+07	< 240	105 ± 40	< 1.7	0.2 ± 0.2	6.1 ± 1.3	4.4 ± 0.6
July	4.88E+07	570 ± 230	160 ± 91	1.4 ± 0.9	0.3 ± 0.2	4.8 ± 1.5	3.1 ± 0.5
August	4.72E+07	700 ± 240	253 ± 103	< 13.0	-0.2 ± 2.9	32.0 ± 13.0	7.7 ± 5.5
September	3.81E+07	< 280	85 ± 54	< 1.5	0.4 ± 0.2	6.3 ± 1.5	3.0 ± 1.1
October	3.07E+07	< 350	-11 ± 57	< 3.3	0.3 ± 0.3	7.0 ± 1.8	5.0 ± 0.8
November	3.26E+07	< 230	45 ± 43	< 1.8	0.4 ± 0.2	7.4 ± 1.4	5.1 ± 1.0
December	3.32E+07	< 300	-29 ± 66	< 2.8	0.7 ± 0.3	6.7 ± 1.5	5.7 ± 0.4
Annual Average			88 ± 23		0.6 ± 0.3		5.2 ± 0.6
STP Effluent							
January	4.27E+07	320 ± 195	99 ± 83	7.0 ± 2.5	5.3 ± 0.9	11.0 ± 4.2	7.2 ± 1.6
February	4.86E+07	290 ± 170	79 ± 48	4.3 ± 2.4	0.7 ± 0.7	6.6 ± 1.6	5.0 ± 0.4
March	4.42E+07	< 350	127 ± 43	< 2.5	0.5 ± 0.4	6.4 ± 1.2	5.0 ± 0.8
April	5.76E+07	< 310	54 ± 74	< 1.4	0.4 ± 0.2	6.1 ± 1.4	4.5 ± 0.6
May	5.20E+07	230 ± 150	102 ± 55	< 1.3	0.3 ± 0.3	11.2 ± 3.4	6.2 ± 1.4
June	5.53E+07	380 ± 280	67 ± 90	< 1.1	0.4 ± 0.2	6.1 ± 1.4	4.4 ± 0.5
July	4.66E+07	460 ± 220	160 ± 76	< 1.4	0.3 ± 0.2	4.5 ± 1.4	3.2 ± 0.5
August	4.20E+07	450 ± 200	229 ± 79	1.2 ± 0.8	0.2 ± 0.2	8.0 ± 1.7	3.5 ± 1.0
September	3.67E+07	260 ± 160	93 ± 55	< 1.4	0.2 ± 0.2	4.4 ± 1.2	2.8 ± 0.8
October	2.95E+07	< 240	20 ± 44	< 1.9	0.1 ± 0.3	6.2 ± 1.5	4.5 ± 0.7
November	3.13E+07	< 270	18 ± 44	< 2.0	0.2 ± 0.3	7.7 ± 1.4	4.5 ± 0.9
December	3.24E+07	< 330	1 ± 74	< 1.7	0.0 ± 0.2	6.7 ± 1.4	4.9 ± 0.5
Annual Average			86 ± 21		0.7 ± 0.3		4.6 ± 0.3
Total Release	5.19E+08		54.3 mCi		0.036 mCi		2.4 mCi
Average MDL (pCi/L)			312		2.1		5.8
SDWA Limit (pCi/L)			20,000		15		(a)

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

(a) The drinking water standards were changed from 50 pCi/L (concentration based) to 4 mrem/yr (dose based) in late 2003. Because gross beta activity does not identify specific radionuclides, a dose equivalent cannot be calculated for the values in the table.

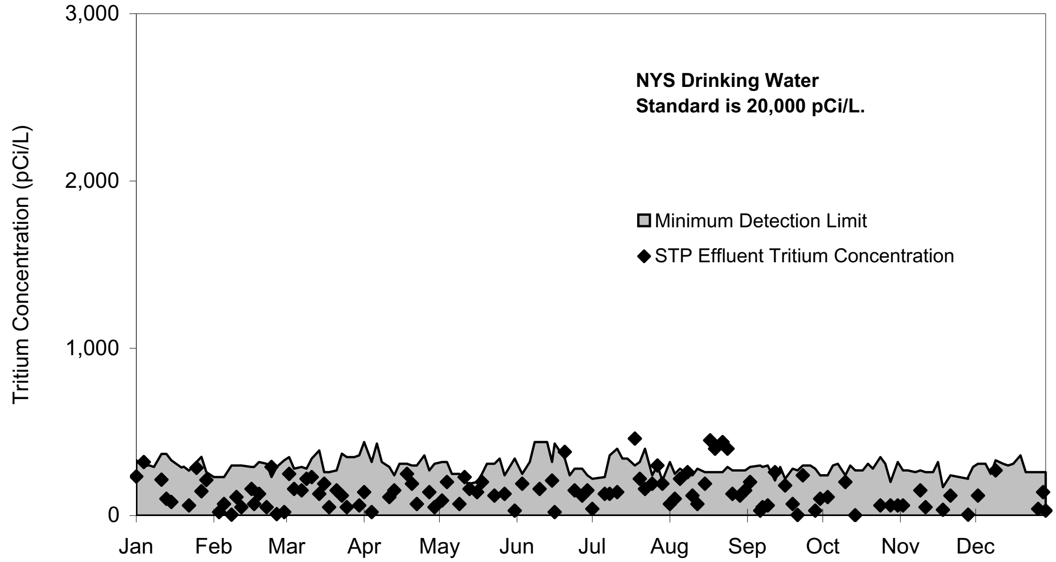

Figure 5-2. Tritium Concentrations in Effluent from the BNL Sewage Treatment Plant (2004).

batch releases from other facilities that meet BNL discharge criteria. Although the HFBR is no longer operating, tritium continues to be released from the facility at very low concentrations, due to off-gassing. During its operation, the air within the reactor building contained high levels of tritium in the form of water vapor. The water was absorbed by many porous surfaces and materials, which slowly liberate the tritiated moisture as it is replaced by untritiated water. 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 as sanitary wastewater. 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 2004 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. The annual average concentration trend has been declining since 1995.

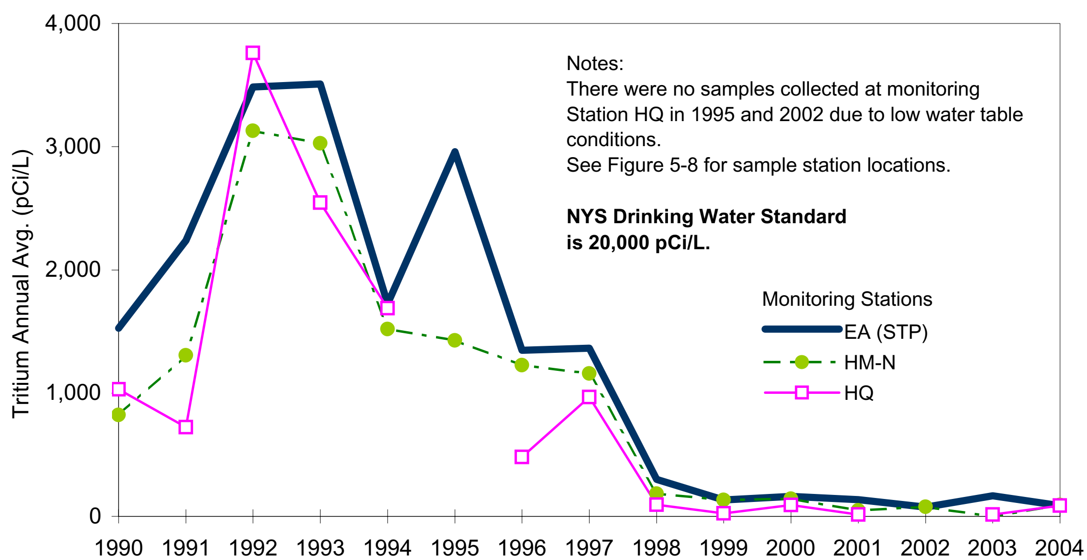

Figure 5-3. Sewage Treatment Plant/Peconic River Annual Average Tritium Concentrations (1990–2004).

In 2004, a total of 0.054 Ci of tritium was released during the year (see Figure 5-4). The annual average tritium concentration as measured in the STP effluent (EA, Outfall 001) was 86 ± 21 pCi/L, which is approximately half that recorded for 2003 and well below the drinking water standard (DWS) of 20,000 pCi/L. The 2004 value is approximately one-quarter the average minimum detection limit (MDL) of 293 pCi/L. The maximum concentration detected in the STP discharge (see Table 5-1) was 460 ± 220 pCi/L, approximately 65 percent of the maximum level in 2003 of 704 pCi/L. Tritium was detected above the MDL in samples collected from June through August (when discharges increase due to HFBR air conditioning condensate). These levels should continue to decrease, provided no additional work is conducted that could expose tritium contained in reactor components.

Table 5-2 presents the gamma spectroscopy analytical data for anthropogenic radionuclides historically detected in the monthly STP wastewater composite samples. During 2004, there were no gamma-emitting nuclides detected in the STP effluent, which is consistent with the data reported for 2003. In 2002/2003, under the BNL Environmental Restoration Program, 1,320 yd^3 of sand and debris containing low levels of radioactivity and heavy metals were removed from the STP sand filters; the source of continual low-level releases of cesium-137 (Cs-137) and Sr-90. With the source removed, all future discharges from the STP are assured to be free of these contaminants (see Figure 5-5).

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 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. Composite samples of the STP effluent are collected using a flow-proportional refrigerated sampling device (ISCO Model 3700RF) and are then analyzed by contract laboratories. Samples are analyzed for 21 inorganic elements, anions, semivolatile organic compounds (SVOCs), pesticides, and herbicides. 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 water quality and inorganic analytical results for the STP samples. Comparing the effluent data to the SPDES ef-

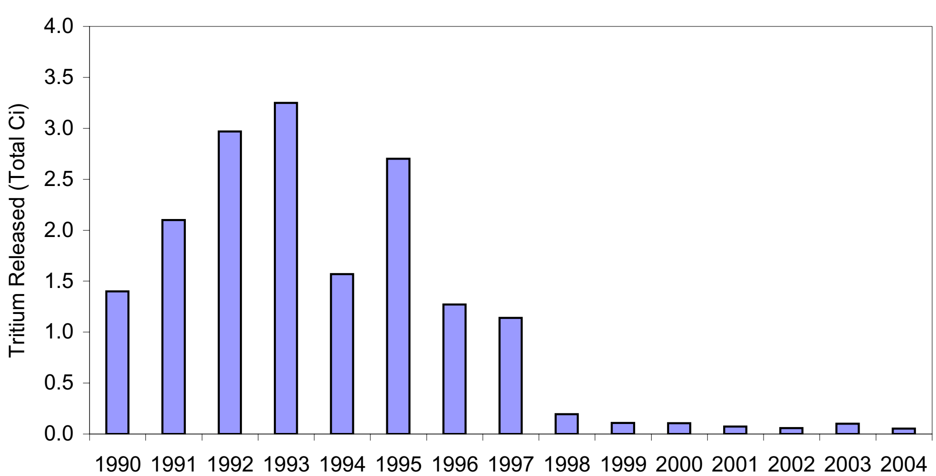

Figure 5-4. Tritium Released to the Peconic River, 15-Year Trend (1990–2004).

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

	Flow (Liters)	Co-60	Cs-137	Be-7 (pCi/L)	Na-22	Sr-90
STP Influent						
January	2.99E+07	ND	ND	ND	ND	ND
February	3.56E+07	ND	ND	ND	ND	ND
March	3.28E+07	ND	ND	ND	ND	ND
April	4.28E+07	ND	ND	ND	ND	ND
May	4.36E+07	ND	ND	ND	ND	ND
June	4.41E+07	ND	ND	ND	ND	ND
July	4.88E+07	ND	ND	ND	ND	ND
August	4.72E+07	ND	ND	ND	ND	ND
September	3.81E+07	ND	ND	ND	ND	ND
October	3.07E+07	ND	ND	ND	ND	ND
November	3.26E+07	ND	ND	ND	ND	ND
December	3.32E+07	ND	ND	ND	ND	ND
STP Effluent						
January	4.27E+07	ND	ND	ND	ND	ND
February	4.86E+07	ND	ND	ND	ND	ND
March	4.42E+07	ND	ND	ND	ND	ND
April	5.76E+07	ND	ND	ND	ND	ND
May	5.20E+07	ND	ND	ND	ND	ND
June	5.53E+07	ND	ND	ND	ND	ND
July	4.66E+07	ND	ND	ND	ND	ND
August	4.20E+07	ND	ND	ND	ND	ND
September	3.67E+07	ND	ND	ND	ND	ND
October	2.95E+07	ND	ND	ND	ND	ND
November	3.13E+07	ND	ND	ND	ND	ND
December	3.24E+07	ND	ND	ND	ND	ND
Total Release to the Peconic River (mCi)		0	0	0	0	0
DOE Order 5400.5 DCG (pCi/L)		5,000	3,000	50,000	10,000	1,000
Dose limit of 4 mrem EDE (pCi/L)		100	200	6,000	400	8

Notes:
No BNL-derived radionuclides were detected in the effluent to the Peconic River for 2004.
To convert values from pCi to Bq, divide by 27.03.

DCG = Derived Concentration Guide
EDE = Effective Dose Equivalent
ND = Not Detected

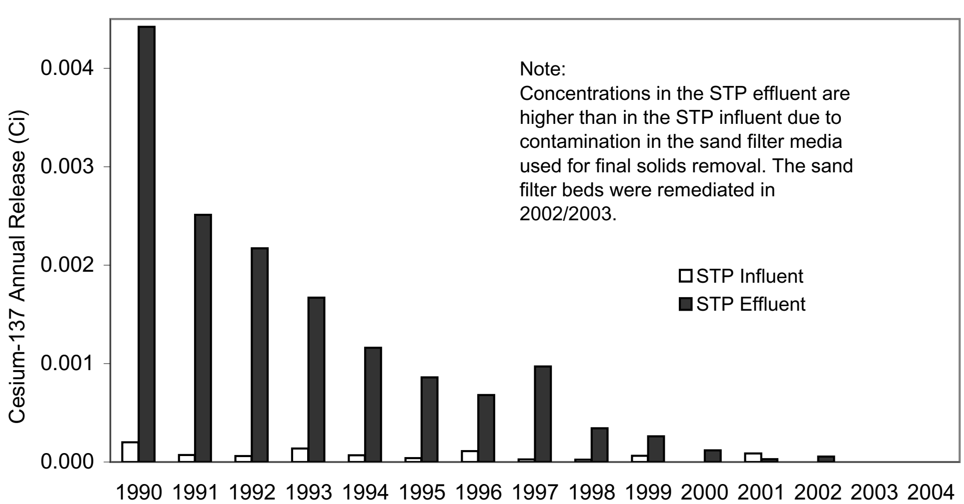

Figure 5-5. Cesium-137 in the BNL Sewage Treatment Plant Influent and Effluent (1990–2004).

fluent limits (or New York State Ambient Water Quality Standards [NYS AWQS], as appropriate) shows that most of the analytical parameters were within SPDES effluent permit limits (see also the compliance data in Chapter 3). During 2004, a single sample collected in October exhibited a nitrate concentration of 11 mg/L, exceeding the SPDES discharge limit of 10 mg/L. All other samples were well below the limit, with an average concentration of 6 mg/L for the year. Potential causes of the elevated nitrogen value include an outdoor source (e.g., animal), decaying organic matter in the flow channel, or too high an oxygen level through the treatment process.

There were three instances when aluminum exceeded the NYS AWQS, and one instance when iron was detected at a concentration exceeding the SPDES limits. Both aluminum and iron are components of native soil and are most likely attributable to fine particles of sand carried over in the effluent. In July 2004, an evaluation was performed to determine the cause of an iron excursion reported under the compliance sampling program (see Chapter 3). Placement of the sample collection probe along the bottom of the flow channel resulted in collection of sediment in the sample and consequently higher levels of iron and aluminum. Comparing the aluminum and iron concentrations in the effluent to the levels in samples from Peconic River upstream and off-site locations shows that the STP effluent levels are lower than in comparable streams. See Section 5.5 for further discussion of the Peconic River and other surface waters.

Except for a single detection (19 µg/L) of acetone, a common laboratory contaminant, no organic compounds were detected above the MDL in 2004. Although there are no SPDES limits or ambient water quality standards specified for acetone, NYSDEC imposes a generic limit of 50 µg/L for unlisted organic compounds.

5.3 PROCESS-SPECIFIC WASTEWATER

Wastewater that may contain constituents above SPDES permit limits or NYS AWQS standards must be 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 photographic developing operations in Building 197B, printed-circuit-board fabrication operations conducted in Building 535B, metal cleaning operations in Building 498, cooling tower discharges from Building 902, and boiler blowdown from satellite boilers in Buildings 244 and 423. These operations are monitored for contaminants such as metals, cyanide, VOCs, and SVOCs. Analyses of these waste streams in 2004 showed that, although several operations contributed contaminants to the STP in concentrations exceeding SPDES-permitted levels, these discharges did not affect the quality of the STP effluent. By the end of 2004, all wet photo-developing operations in Building 197B had been replaced with digital imaging systems and there are no longer any discharges from this facility that require monitoring.

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 primary closed-loop cooling water, heat exchanger cleaning wastewater, wastewater generated as a result of restoration activities, 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 release criteria. If the concentrations were within limits, authorization for sewer system discharge was granted; if not, alternate means of disposal were pursued. Any waste that contained elevated levels of hazardous or radiological contaminants in concentrations that exceeded BNL effluent release criteria was sent to the BNL Waste Management Facility for proper disposal.

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

	STP Influent				STP Effluent				
	No. of Samples	Min.	Max.	Avg.	No. of Samples	Min.	Max.	Avg.	SPDES Limit or AWQS(1)
pH (SU)	CM	5.6	11.9	NA	CM	5.9	7.7	NA	5.8 - 9.0
Conductivity (µS/cm)	CM	NR	NR	NR	162(2)	198	508	316	SNS
Temperature (°C)	CM	10	26	NA	162(2)	1.7	25.4	14.8	SNS
Dissolved Oxygen (mg/L)	NM	NM	NM	NM	162(2)	7.2	15.1	9.8	SNS
Chlorides (mg/L)	12	34.7	57.8	47.0	12	35.7	97.9	53.5	SNS
Nitrate (as N) (mg/L)	6	0.2	3.6	2.2	6	2.8	11.0	6.2	10 (Total N)
Sulfates (mg/L)	12	12.3	20.7	16.7	12	11.5	23.3	17.3	250 (GA)
Aluminum (µg/L)	12	79.5	425.0	194.8	12	23.6	136.0	50.2	100 (Ionic)
Antimony (µg/L)	12	1.3	< 5.0	< 5.0	12	1.5	< 5.0	< 5.0	3 (GA)
Arsenic (µg/L)	12	0.7	< 5.0	< 5.0	12	0.33	< 5.0	< 5.0	150 (Dissolved)
Barium (µg/L)	12	23.5	66.1	42.1	12	8.4	23.9	19.9	1000 (GA)
Beryllium (µg/L)	12	0.5	< 2.0	< 2.0	12	0.6	< 2.0	< 2.0	11 (Acid Soluble)
Cadmium (µg/L)	12	0.2	< 2.0	< 2.0	12	0.2	< 2.0	< 2.0	1.1 (Dissolved)
Calcium (µg/L)	12	9.2	12.4	10.7	12	8.4	13.3	11.0	SNS
Chromium (µg/L)	12	2.2	7.8	4.3	12	1.6	9.1	< 5.0	34.4 (Dissolved)
Cobalt (µg/L)	12	0.4	< 5.0	< 5.0	12	0.2	< 5.0	< 5.0	5 (Acid Soluble)
Copper (µg/L)	12	62.0	188.0	113.7	12	28.4	68.2	41.0	150 (SPDES)
Iron (mg/L)	12	0.7	2.8	1.6	12	0.1	0.4	0.2	0.37 (SPDES)
Mercury (µg/L)	12	0.18	0.69	0.43	12	0.08	0.23	< 0.20	0.8 (SPDES)
Manganese (µg/L)	12	14.1	79.4	38.9	12	2.1	12.8	4.2	300 (GA)
Magnesium (mg/L)	12	3.0	4.6	3.7	8	2.3	4.8	3.6	SNS
Nickel (µg/L)	12	2.4	54.0	12.0	12	3.2	15.8	5.9	110 (SPDES)
Lead (µg/L)	12	4.8	27.0	13.7	12	0.8	4.3	< 3.0	19 (SPDES)
Potassium (mg/L)	12	2.7	9.1	6.1	12	2.4	7.1	5.1	SNS
Selenium (µg/L)	12	1.4	< 5	< 5	12	0.79	< 5	< 5	4.6 (Dissolved)
Silver (µg/L)	12	0.6	2.7	1.5	12	0.6	3.3	1.8	15 (SPDES)
Sodium (mg/L)	12	26.2	64.0	39.6	12	27.4	66.3	40.4	SNS
Thallium (µg/L)	12	0.8	< 5.0	< 5.0	12	0.6	< 5.0	< 5.0	8 (Acid Soluble)
Vanadium (µg/L)	12	2.1	35.6	6.2	12	1.6	7.9	3.5	14 (Acid Soluble)
Zinc (µg/L)	12	38.9	220.0	91.4	12	22.2	88.8	44.4	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 AWQS, the solubility state for the metal is provided.
AWQS = Ambient Water Qualty Standards
CM = Continuously monitored
GA = Class GA (groundwater) Ambient Water Quality Standard
NA = Not Applicable
NM = Not Monitored
NR = Not Recorded
SNS = Standard Not Specified
SPDES = State Pollutant Discharge Elimination System
SU = Standard Units
(1) Unless otherwise provided, the reference standard is NYSDEC Class C Surface Water Ambient Water Quality Standards.
(2) The conductivity, temperature, and dissolved oxygen values reported are based on analyses of daily grab samples.

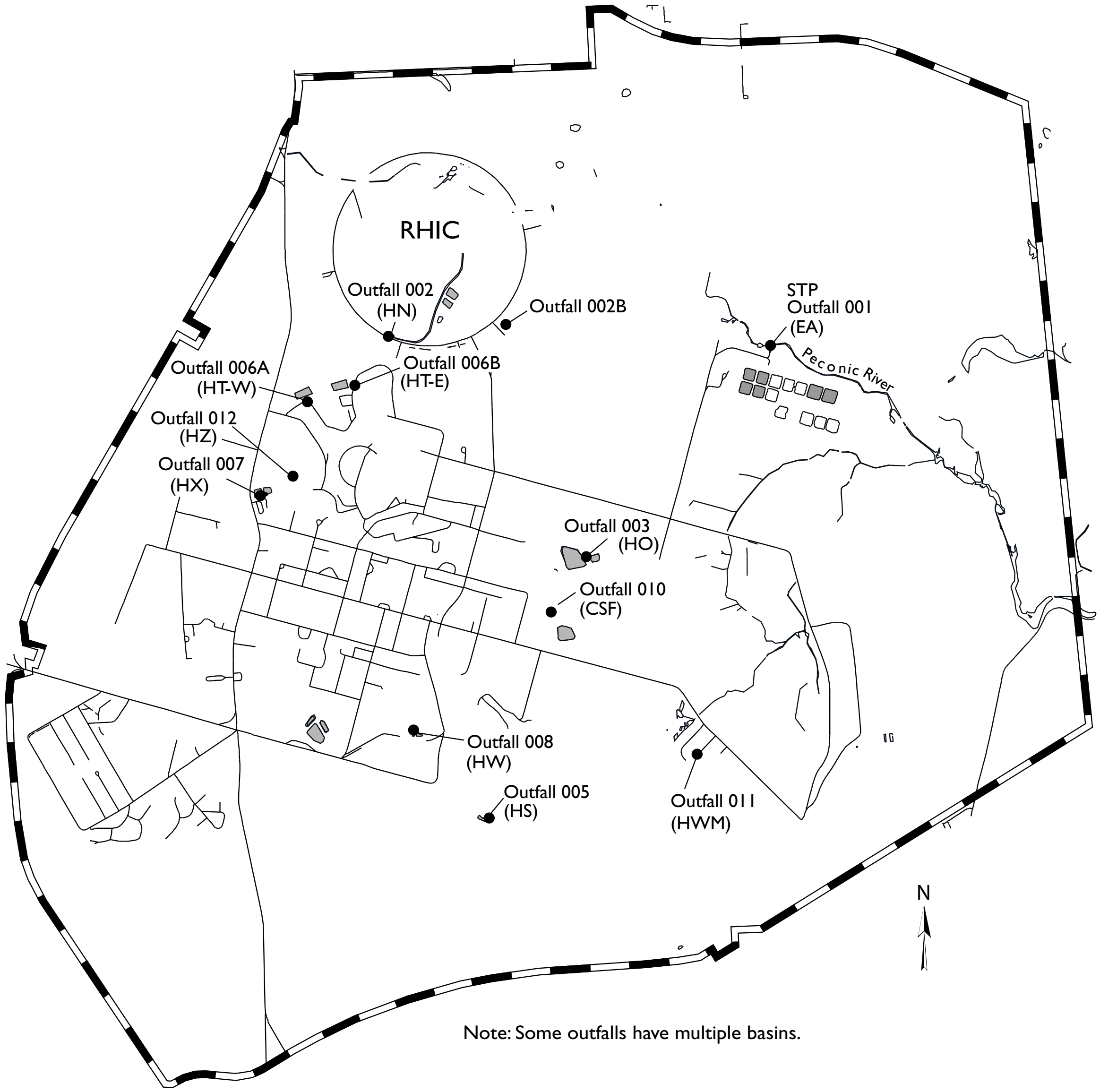

Figure 5-6. BNL Outfall Locations.

5.4 RECHARGE BASINS

Recharge basins are used for the discharge 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 5-6 shows the locations of BNL's discharges to recharge basins (also called "outfalls" under BNL's SPDES permit). Figure 5-7 presents an overall schematic of potable water use at BNL. Ten recharge basins are used for managing once-through cooling water, cooling tower blowdown, and stormwater runoff:

- 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 (NSLS).

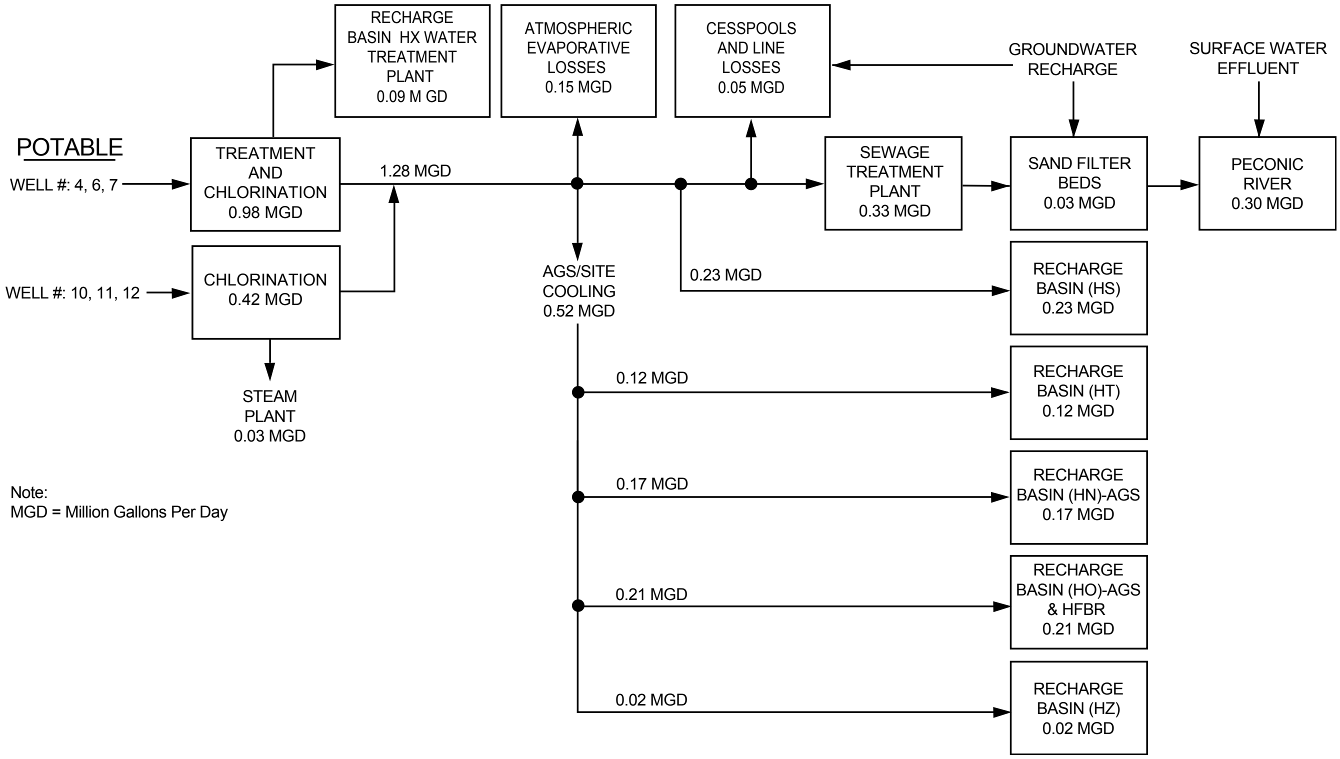

Figure 5-7. Schematic of Potable Water Use and Flow at BNL.

- 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 HFBR.
- Several other recharge areas are used exclusively for discharging stormwater runoff. These areas include Basin HW in the warehouse area, Basin CSF at the Central Steam Facility, Basin HW-M at the former Hazardous Waste Management Facility (HWMF), and Basin HZ near Building 902. In late 2004, the basin identified as HW-M was removed as the facility entered into remediation. The former HWMF will be excavated to remove contaminants deposited by past operations and the area will be restored to a natural state.

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; weekly recordings of flow are collected, along with measurements of pH. The specifics of the SPDES Compliance Monitoring Program are provided in Chapter 3. To supplement that monitoring program, samples are also routinely collected and analyzed under the environmental monitoring program for radioactivity, VOCs, metals, and anions. During 2004, water samples were collected from all the basins listed above except basin HX (at the Water Treatment Plant), which was exempted by NYSDEC from sampling due to documented nonimpact to groundwater, and basin HW-M, which is being monitored as part of the remediation of the former HWMF.

5.4.1 Recharge Basins - Radiological Analyses

Discharges to the recharge basins were sampled throughout the year for subsequent analyses for gross alpha and beta activity, gamma-emitting radionuclides, and tritium. These results are presented in Table 5-4. These data show that low levels of alpha and beta activity were detected in most of the basins. Activities ranged from nondetectable to 2.60 ± 1.30 pCi/L for gross alpha activity, and from nondetectable to 9.90 ± 1.30 pCi/L for gross beta activity. Low-level detections of gross alpha and

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

Basin		Gross Alpha	Gross Beta	Tritium
		(pCi/L)		
HN	N	4	4	4
	Max.	2.60 ± 1.30	7.90 ± 1.60	200 ± 120
	Avg.	1.02 ± 1.06	4.24 ± 3.03	68 ± 88
HO	N	4	4	4
	Max.	< 1.20	3.60 ± 1.10	290 ± 180
	Avg.	0.20 ± 0.33	2.23 ± 1.45	105 ± 133
HS	N	4	4	4
	Max.	< 1.40	2.10 ± 1.20	710 ± 260
	Avg.	0.40 ± 0.37	1.32 ± 0.76	239 ± 316
HT-E	N	4	4	4
	Max.	< 31*	< 18*	190 ± 120
	Avg.	2.26 ± 3.13	7.64 ± 6.99	85 ± 111
HT-W	N	4	4	4
	Max.	< 1.30	7.80 ± 1.60	< 200
	Avg.	0.19 ± 0.42	4.00 ± 3.37	75 ± 82
HW	N	4	4	4
	Max.	2.16 ± 0.90	< 34	260 ± 170
	Avg.	1.20 ± 1.16	7.83 ± 8.16	133 ± 100
HZ	N	4	4	4
	Max.	< 9.6	9.90 ± 1.30	< 170
	Avg.	0.79 ± 1.32	5.05 ± 4.01	48 ± 53
SDWA Limit		15	(a)	20,000

Notes:
See Figure 5-6 for the locations of recharge basins/outfalls.
All values reported with a 95% confidence interval.
Negative numbers occur when the measured value is lower than background (See Appendix B for description).
To convert values from pCi to Bq, divide by 27.03.
N = Number of samples analyzed
MDL = Minimum detection limit
SDWA = Safe Drinking Water Act
*A lower MDL could not be acheived due to the high solids content of the sample.
(a) The drinking water standard was changed from 50 pCi/L (concentration based) to 4 mrem/yr (dose based) in 2003.
As gross beta activity does not identify specific radionuclides, a dose equivalent of this value cannot be calculated.

beta activity are attributable to very low levels of naturally occurring radionuclides, such as potassium-40 (K-40). The contract analytical laboratory reported no gamma-emitting nuclides attributable to BNL operations for any discharges to recharge basins in 2004. Tritium was detected in a single sample collected at Basin HS at very low levels (710 ± 260 pCi/L). Since there is no known source of tritium upstream of this basin, this detection is attributed to laboratory error.

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 a contract 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 are periodically detected in several discharges. These VOCs included bromoform, chloroform, dibromochloromethane, and dichlorobromomethane. Concentrations ranged from nondetectable to a maximum of 5 µg/L. Sodium hypochlorite and bromine, used to control algae in cooling towers, were responsible for the formation of these compounds. Acetone and methylene chloride were the only analytes detected above minimum detection limits for most recharge basins and ranged from nondetectable to 20 µg/L. In most instances, acetone and methylene chloride were also found as contaminants in the contract analytical laboratory, as evidenced by detections in blank samples. Due to repeat detections of acetone and methylene chloride, an investigation of one of the contract analytical laboratories was conducted to determine if the detections were due to laboratory error during analysis. Blind blank samples (i.e., samples known to be free of contaminants) were shipped to the contract analytical laboratory for chemical analysis. All samples were returned with detections of methylene chloride and/or acteone. Assessment by the contract analytical laboratory revealed cross contamination between adjacent laboratory rooms. Corrective actions were implemented to prevent recurrence. The only other contaminant that was detected

Table 5-5. Water Quality Data for BNL 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 Nitrogen (mg/L)
HN (RHIC)	N	4	4	4	4	4	4	4
	Min.	6.9	137	1.8	9.6	< 0.2	5.5	0.28
	Max.	7.9	340	14.2	12.8	63.9	20.3	0.64
	Avg.	NA	233	8.4	10.9	39.9	13.1	0.46
HO (AGS/HFBR)	N	4	4	4	4	4	4	4
	Min.	7.3	87	13.3	8.5	26	9.3	0.24
	Max.	7.5	2103	21.5	10.3	766	23	0.32
	Avg.	NA	624	19.1	9.2	211.4	13.3	0.28
HS (stormwater)	N	4	4	4	4	4	4	4
	Min.	7.2	167	6.6	9.1	27.5	10.2	0.11
	Max.	7.9	1650	21.8	11.7	50.6	14.9	0.95
	Avg.	NA	574	12	10.6	36.2	11.6	0.47
HT-W (Linac)	N	4	4	4	4	4	4	4
	Min.	7.3	168	9	8.5	29.2	8.5	0.2
	Max.	7.5	254	19.3	10.6	38.2	18.9	0.45
	Avg.	NA	201	13.2	9.6	32.5	13.4	0.3
HT-E (AGS)	N	4	4	4	4	4	4	4
	Min.	7.3	214	4.5	8.5	22.3	17.5	0.15
	Max.	7.6	3560	18.5	12.3	1330	36.9	1.02
	Avg.	NA	1178	10.1	10.1	358.0	23.2	0.54
HW (stormwater)	N	4	4	4	4	4	4	4
	Min.	7.1	83	2.8	8.6	3.8	4.2	0.38
	Max.	8	9772	26.2	11.9	2810	107	1.23
	Avg.	NA	2547	14.7	10.1	705.5	34.5	0.86
CSF (stormwater)	N	4	4	4	4	4	4	4
	Min.	6.6	105	0.9	7.9	4.1	6.4	0.22
	Max.	7.7	293	27.1	13.6	80.7	19.4	0.92
	Avg.	NA	187	14.8	10.2	27.8	13.5	0.59
HZ (stormwater)	N	4	4	4	4	4	4	4
	Min.	7.2	210	2.4	8.3	37.5	14.7	0.3
	Max.	7.7	1375	22	13.6	601	37.1	0.88
	Avg.	NA	613	12.8	10.8	204.1	24.9	0.55
NYSDEC Effluent Standard		6.5 – 8.5	SNS	SNS	SNS	500	500	10
Typical MDL		NA	NA	NA	NA	4	4	1

Notes:
See Figure 5-6 for the locations of recharge basins.
AGS/HFBR = Alternating Gradient Synchrotron/High Flux Beam Reactor
CSF = Central Steam Facility
Linac = Linear Accelerator
MDL = Minimum Detection Limit
N = Number of samples analyzed
NA = Not Applicable
NYSDEC = New York State Department of Environmental Conservation
RHIC = Relativistic Heavy Ion Collider
SNS = Effluent Standard Not Specified

Table 5-6. Metals Analyses of BNL 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	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.	< 2.0	31.8	1.5	11.8	< 2.0	0.1	0.08	1.9	14.1	0.19	< 0.2	17.4	16.2	1.9	1.2	1.3	1.7	< 5.0	3	36.4
		Max.	< 2.0	1940	6.2	26.9	< 2.0	< 2.0	< 5.0	< 5.0	46.1	2.4	< 0.2	41	46.2	3.9	11	< 5.0	8	< 5.0	6.4	99.3
		Avg.	< 2.0	509.32	< 5.0	22.52	< 2.0	< 2.0	< 5.0	< 5.0	30.98	0.8	< 0.2	28.25	32.03	3.28	3.75	< 5.0	< 5.0	< 5.0	< 5.0	71.75
HN (filtered) (RHIC)	2	Min.	< 2.0	30.3	< 5.0	23.5	< 2.0	0.44	1.8	4.1	14.3	0.07	< 0.2	12.6	26.5	3.3	0.33	1.3	1.4	< 5.0	< 5.0	32.1
		Max	< 2.0	< 50.0	5.2	23.8	< 2.0	0.91	6.3	< 5.0	31.4	0.18	< 0.2	25.7	45.8	3.9	< 3.0	< 5.0	6.4	< 5.0	< 5.0	79.1
		Avg.	< 2.0	< 50.0	< 5.0	23.65	< 2.0	0.68	4.05	< 5.0	22.85	0.13	< 0.2	19.15	36.15	3.6	<3.0	< 5.0	3.9	< 5.0	< 5.0	55.6
HO (total) (AGS)	4	Min.	< 2.0	< 30.0	< 5.0	16.5	0.71	0.08	0.07	1.8	1.4	0.08	< 0.2	3.1	17	0.69	2.3	< 5.0	< 5.0	< 5.0	1.7	4.9
		Max.	< 2.0	426	< 5.0	36.2	< 2.0	< 2.0	< 5.0	< 5.0	21.1	0.59	< 0.2	156	410	3.8	3.8	< 5.0	< 5.0	< 5.0	< 5.0	75.1
		Avg.	< 2.0	163.25	< 5.0	24.1	< 2.0	< 2.0	< 5.0	< 5.0	6.68	0.34	< 0.2	48.22	116.05	1.88	<3.0	< 5.0	< 5.0	< 5.0	< 5.0	28.68
HO (filtered) (AGS)	2	Min.	< 2.0	< 30.0	< 5.0	15.5	< 2.0	< 2.0	1.2	< 5.0	0.79	0.03	< 0.2	2.4	18.6	0.71	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	3.5
		Max.	< 2.0	< 30.0	< 5.0	15.5	< 2.0	< 2.0	1.2	< 5.0	0.79	0.03	< 0.2	2.4	18.6	0.71	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	3.5
		Avg.	< 2.0	< 30.0	< 5.0	15.5	< 2.0	< 2.0	1.2	< 5.0	0.79	0.03	< 0.2	2.4	18.6	0.71	<3.0	< 5.0	< 5.0	< 5.0	< 5.0	3.5
HS (total) (stormwater)	4	Min.	< 2.0	< 50.0	< 5.0	12.1	< 2.0	< 2.0	0.09	1	2.8	0.09	< 0.2	7	18.9	1.6	2.6	< 5.0	1.2	< 5.0	0.72	12.9
		Max.	< 2.0	307	< 5.0	26.4	< 2.0	< 2.0	< 5.0	6.1	< 10.0	0.47	< 0.2	11.6	28.9	< 10.0	3.1	< 5.0	< 5.0	< 5.0	< 5.0	24.9
		Avg.	< 2.0	214.25	< 5.0	19.05	< 2.0	< 2.0	< 5.0	< 5.0	<10.0	0.31	< 0.2	8.98	22.63	<10.0	<3.0	< 5.0	< 5.0	< 5.0	< 5.0	20.92
HS (filtered) (stormwater)	2	Min.	< 2.0	28.9	0.94	14.8	< 2.0	< 2.0	1.9	3.7	2.2	0.04	< 0.2	5.2	18.8	1.5	1	0.57	0.7	< 5.0	< 5.0	14
		Max.	< 2.0	< 50.0	< 5.0	24	< 2.0	< 2.0	8.9	< 5.0	4	0.08	< 0.2	17.3	23.6	2.3	< 3.0	< 5.0	1.2	< 5.0	< 5.0	17
		Avg.	< 2.0	< 50.0	< 5.0	19.4	< 2.0	< 2.0	5.4	< 5.0	3.1	0.06	< 0.2	11.25	21.2	1.9	<3.0	< 5.0	0.95	< 5.0	< 5.0	15.5
HT-E (total) (AGS)	4	Min.	< 2.0	39.5	< 5.0	21.1	0.48	1.1	0.1	1.7	16.7	0.35	< 0.2	20.9	23.6	3	2.5	< 5.0	< 5.0	0.49	3.3	45
		Max.	< 2.0	3480	16.6	39.6	< 2.0	< 2.0	1.9	6.3	42.1	3.51	< 0.2	92.9	1030	6.8	16.1	< 5.0	25.1	< 5.0	11.4	151
		Avg.	< 2.0	929	8.88	26.52	< 2.0	< 2.0	0.65	< 5.0	33.58	1.25	< 0.2	44.1	284.27	4.32	6.08	< 5.0	12.65	< 5.0	< 5.0	86.55
HT-E (filtered) (AGS)	2	Min.	< 2.0	< 50.0	9.9	19	< 2.0	1.1	1.6	1.5	34.5	0.23	< 0.2	13.5	35.2	2.3	1.6	1.3	11.8	< 5.0	2.8	41.6
		Max.	< 2.0	56.5	14.2	21.6	< 2.0	1.4	6.6	2.5	36.3	0.46	< 0.2	40.5	48.5	3.4	1.6	< 5.0	12.5	< 5.0	< 5.0	58.4
		Avg.	< 2.0	< 50.0	12.05	20.3	< 2.0	1.25	4.1	2	35.4	0.35	< 0.2	27	41.85	2.85	1.6	< 5.0	12.15	< 5.0	< 5.0	50
HT-W (total) (Linac)	4	Min.	< 2.0	56.4	0.77	12.3	0.14	0.11	0.15	1.8	11.7	0.12	< 0.2	5.4	19.8	2	0.62	< 5.0	1.7	< 5.0	2	17
		Max.	< 2.0	214	< 5.0	23.8	< 2.0	3.3	< 5.0	< 5.0	271	0.41	< 0.2	36.2	30.8	< 10.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	84.4
		Avg.	< 2.0	103.35	< 5.0	19.88	< 2.0	< 2.0	< 5.0	< 5.0	87.52	0.22	< 0.2	24.45	22.98	<10.0	<3.0	< 5.0	< 5.0	< 5.0	< 5.0	40.78

(continued on next page)

Table 5-6. Metals Analyses of BNL 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	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se µg/L	Tl µg/L	V µg/L	Zn µg/L
HT-W (filtered) (Linac)	2	Min.	< 2.0	< 50.0	3.6	19.7	< 2.0	0.12	2	3.9	8	0.12	< 0.2	11.7	19.1	2.6	0.52	< 5.0	1.7	< 5.0	< 5.0	36.2
		Max.	< 2.0	67.6	< 5.0	25.7	< 2.0	3	7.3	< 5.0	250	0.12	< 0.2	31.9	30.6	3.5	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	69.5
		Avg.	< 2.0	< 50.0	< 5.0	22.7	< 2.0	1.56	4.65	< 5.0	129	0.12	< 0.2	21.8	24.85	3.05	<3.0	< 5.0	< 5.0	< 5.0	< 5.0	52.85
HW (total) (stormwater)	3	Min.	0.29	379	1.3	12.6	< 2.0	0.46	0.5	2.5	15.9	0.56	0.13	28	3.74	3.3	6.8	0.64	< 5.0	< 5.0	7.3	46.1
		Max.	< 2.0	4880	< 5.0	43.8	< 2.0	3.6	2.5	10.4	77.1	5.85	< 0.2	65.1	4.48	10.6	110	< 5.0	< 5.0	< 5.0	17.6	275
		Avg.	< 2.0	2299.67	< 5.0	23.67	< 2.0	1.51	1.21	5.2	37.33	2.64	< 0.2	41.23	4.15	6.37	42.87	< 5.0	< 5.0	< 5.0	11.03	123.7
HW (filtered) (stormwater)	2	Min.	< 2.0	74.3	0.67	7.4	< 2.0	0.28	1.8	1.4	10.4	0.04	< 0.2	8	3.96	2.5	1.6	0.76	< 5.0	< 5.0	1.9	15.6
		Max.	< 2.0	81.4	< 5.0	8.3	< 2.0	0.3	8.5	3	13.6	0.07	< 0.2	25.6	4.37	4.8	1.7	< 5.0	< 5.0	< 5.0	6.8	34.7
		Avg.	< 2.0	77.85	< 5.0	7.85	< 2.0	0.29	5.15	2.2	12	0.06	< 0.2	16.8	4.16	3.65	1.65	< 5.0	< 5.0	< 5.0	4.35	25.15
CSF (total) (stormwater)	3	Min.	< 2.0	499	1.1	10.3	< 2.0	0.12	1.2	2.2	7.7	1.01	< 0.2	22.3	4.68	10.3	5.2	0.59	0.75	1.5	5.1	54.4
		Max.	< 2.0	1020	1.4	20.4	< 2.0	0.23	2.9	3.2	14.2	1.77	< 0.2	77.9	25.2	42.1	6.6	< 5.0	< 5.0	< 5.0	27.5	233
		Avg.	< 2.0	712	1.2	15.2	< 2.0	0.18	1.93	2.63	10.23	1.39	< 0.2	42.7	11.68	23.67	5.9	< 5.0	< 5.0	< 5.0	15.43	120.03
CSF (filtered) (stormwater)	2	Min.	< 2.0	44.4	0.71	5.1	< 2.0	0.09	2.6	2.9	3.8	0.04	< 0.2	12.2	4.51	7.3	1.7	4.5	< 5.0	< 5.0	2.2	41.9
		Max.	< 2.0	47.5	< 5.0	14.9	< 2.0	0.12	8.9	< 5.0	3.8	0.08	< 0.2	31.2	25.4	13.3	< 3.0	< 5.0	< 5.0	< 5.0	7.9	50.4
		Avg.	< 2.0	45.95	< 5.0	10	< 2.0	0.1	5.75	< 5.0	3.8	0.06	< 0.2	21.7	14.96	10.3	<3.0	< 5.0	< 5.0	< 5.0	5.05	46.15
HZ (total) (stormwater)	4	Min.	< 2.0	28.6	1.5	22	0.45	0.53	0.24	4.2	10	0.14	< 0.2	33.7	24.1	3.7	4.9	< 5.0	0.97	0.89	< 5.0	63.1
		Max.	< 2.0	2790	9.2	45.2	< 2.0	2.8	< 5.0	6.9	86	2.96	< 0.2	68.2	347	6.4	151	< 5.0	9.1	< 5.0	10.6	132
		Avg.	< 2.0	714.12	< 5.0	34.22	< 2.0	< 2.0	< 5.0	< 5.0	45.28	0.97	< 0.2	56.03	128.33	4.82	51.9	< 5.0	< 5.0	< 5.0	< 5.0	105.78
HZ (filtered) (stormwater)	2	Min.	< 2.0	18.2	< 5.0	24.9	0.06	0.48	1.2	4	25.3	0.09	< 0.2	15.5	24.3	3.8	3.1	< 5.0	1.2	< 5.0	< 5.0	55.1
		Max.	< 2.0	< 30.0	9.8	39.9	< 2.0	2.7	8.3	< 5.0	46.4	0.3	< 0.2	75.1	80.5	5.2	24.8	< 5.0	10.8	< 5.0	< 5.0	60.6
		Avg.	< 2.0	< 30.0	< 5.0	32.4	< 2.0	1.59	4.75	< 5.0	35.85	0.19	< 0.2	45.3	52.4	4.5	13.95	< 5.0	6	< 5.0	< 5.0	57.85
NYSDEC Effluent Limitation or AWQS			50	2000	50	2000	SNS	10	5	100	1000	0.6	1.4	600	SNS	200	50	6	20	SNS	SNS	5000
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	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.
AGS = Alternating Gradient Synchrotron
AWQS = Ambient Water Quality Standards
CSF = Central Steam Facility
Linac = Linear Accelerator
MDL = Minimum Detection Limit
NYSDEC = New State Department of Environmental Conservation
RHIC = Relativistic Heavy Ion Collider
SNS = Effluent Standard Not Specified

above the method detection limit was hexanone, in a single sample collected at the CSF. The source of this contaminant is unknown and is likely due to cross contamination of samples in the contract analytical laboratory.

The analytical data in Tables 5-5 and 5-6 show that all parameters, except for aluminum and iron, complied with the respective groundwater discharge or water quality standards. Chlorides were found to be higher in discharge samples collected during the winter and are attributed to road salt used to control snow and ice buildup. Iron and aluminum are natural components of soil and readily dissolve when water samples are acidified for preservation. Iron is also naturally present in Long Island groundwater at concentrations that exceed the New York State Groundwater Discharge Standard (GDS). Filtration of samples resulted in aluminum and iron concentrations that were less than the NYS AWQS or GDS, as appropriate. When the aluminum and iron are in particulate form, they pose no threat to groundwater quality, because the recharge basin acts as a natural filter, trapping the particles before they reach groundwater.

Lead at the CSF outfall continued to be evaluated in 2004. Installing a geotextile fabric at the spillway of the CSF outfall eliminated all instances of SPDES noncompliance. However, sediment is slowly accumulating on top of the fabric. These sediments have been tested and found to contain elevated levels of lead. The remedial plan previously in place was revised and resubmitted to the regulatory agencies in March 2004. The review is pending.

5.4.3 Stormwater Assessment

All recharge basins receive stormwater runoff. Stormwater at BNL 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 HS receives most of the stormwater runoff from the central, developed portion of the BNL site. Basins HN, HZ, HT-W, and HT-E receive runoff from the Collider–Accelerator Complex; Basin HO receives runoff from the areas around the Brookhaven Graphite Research Reactor (BGRR) and HFBR; Basin CSF receives runoff from the area around the CSF and areas along Cornell Avenue east of Railroad Avenue; Basin HW receives runoff from the warehouse area; and HWM receives runoff from the fenced area at the former HWMF.

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 soil. In an effort to further protect the quality of stormwater runoff, BNL has finalized formal procedures for managing and maintaining outdoor work and storage areas. The requirements include covering areas to prevent contact with stormwater, an aggressive maintenance and inspection program, and formal restoration of these areas when operations cease.

5.5 PECONIC RIVER SURVEILLANCE

Several locations are monitored along the Peconic River to assess the overall water quality of the river and any impact from BNL discharges. Sampling points along the Peconic River are identified in Figure 5-8. In total, 10 stations (three upstream and seven downstream of the STP) were scheduled for monitoring in 2004, although additional locations were sampled by field personnel. A sampling station along the Carmans River (HH) was also monitored as a geographic control location, not affected by BNL operations. All locations were routinely monitored for radiological and nonradiological parameters. The sampling stations are located as follows:

Upstream sampling stations

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

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

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

STP outfall at the site boundary
- HA, first station downstream of the BNL boundary, 3.1 miles from the STP outfall
- Donahue's Pond, off site, 4.3 miles downstream of the STP outfall (Note: In 2004, some samples were collected at former station HC, due to access problems at Donahue's Pond. The two sites are near one another.)
- Forge Pond, off site

Control location
- HH, Carmans River
- Swan Pond, off site

5.5.1 Peconic River - Radiological Analyses

Radionuclide measurements were performed on surface water samples collected from the Peconic River at all 10 locations. Routine samples at Stations HM-N and HQ were collected once per month; all other stations were sampled quarterly unless conditions (such as no water flow) prevented collection. 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 by collecting instantaneous grab samples, as flow allowed.

The radiological data from Peconic River surface water sampling in 2004 are summarized in Table 5-7. Radiological analysis of upstream water samples showed that gross alpha and beta activity was detected at most Peconic River and Carmans River locations. The highest concentrations of gross beta were detected upstream of the BNL STP discharge at location HV, which is located on site just inside the RHIC ring. However, the average concentrations from off-site and control locations are indistinguishable. The beta activity for all locations is therefore attributed to natural sources. Samples collected downstream of the STP discharge showed concentrations typical of STP releases and historical values. All detected levels were below the applicable DWS. Detections of gross alpha activity have high levels of error, indicating that these detections are indistinguishable from the minimum detection limit. No gamma-emitting radionuclides attributable to BNL operations were detected either upstream or downstream of the STP.

Tritium results for water samples collected upstream and downstream of the STP discharge were below detectable levels at all stations, except for a single detection of 370 ± 180 pCi/L at station HA, downstream of the BNL site boundary. The New York State DWS for tritium is 20,000 pCi/L.

Monitoring for Sr-90 was performed at nine of the 10 stations sampled in 2004. In 2004, the only positive detection for Sr-90 was at Station HY, upstream of all BNL operations, at a concentration of 0.96 ± 0.27 pCi/L. This concentration is consistent with historical levels and has been attributed to worldwide fallout. Cross contamination in the contract analytical laboratory resulted in high detection limits being reported for Sr-90 samples collected in February 2004. All results, both upstream and downstream of BNL, were similar, leading to the conclusion that there was no contribution from BNL operations.

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) onsite, west of the RHIC ring	N	4	4	4	4
		Max.	< 2.9	7.20 ± 1.50	< 220	0.96 ± 0.27
		Avg.	1.08 ± 0.53	3.49 ± 2.47	83 ± 116	0.56 ± 0.41
HV	Peconic River (headwaters) onsite, inside the RHIC ring	N	4	4	4	NS
		Max.	< 5.3	9.50 ± 1.60	300 ± 160	
		Avg.	1.78 ± 2.20	5.18 ± 3.09	109 ± 130	

(continued on next page)

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

Sample Station	Geographic Location		Gross Alpha	Gross Beta	Tritium	Sr-90
			(pCi/L)			
HE	Peconic River, upstream of STP Outfall	N	4	4	4	3
		Max.	1.51 ± 0.86	4.70 ± 1.30	< 180	< 1.6
		Avg.	0.84 ± 0.50	3.15 ± 1.20	-5 ± 67	0.56 ± 0.68
HM-N	Peconic River, downstream of STP, on site	N	6	6	6	2
		Max.	2.30 ± 1.20	6.10 ± 1.30	< 261	< 0.41
		Avg.	0.81 ± 0.64	3.84 ± 1.10	91 ± 71	0.23 ± 0.27
HM-S	Peconic River tributary, on site	N	2	2	2	1
		Max.	< 0.83	6.00 ± 1.30	< 250	< 0.56
		Avg.	0.43 ± 0.58	4.15 ± 3.63	125 ± 29	NA
HQ	Peconic River, downstream of STP, at BNL site boundary	N	5	5	5	1
		Max.	< 1.30	3.70 ± 1.40	< 259	< 0.74
		Avg.	0.44 ± 0.36	3.15 ± 0.48	86 ± 108	NA
HA	Peconic River, off site	N	4	4	4	4
		Max.	< 0.73	4.10 ± 1.10	370 ± 180	< 2.53
		Avg.	0.07 ± 0.37	2.55 ± 1.30	89 ± 185	0.78 ± 1.15
HC	Peconic River, off site	N	3	3	3	3
		Max.	< 0.94	2.63 ± 0.92	200 ± 140	< 2.26
		Avg.	0.74 ± 0.25	1.78 ± 0.69	20 ± 177	0.87 ± 1.37
Donahue's Pond	Peconic River, off site	N	1	1	1	1
		Value	2.1 ± 5.0	1.1 ± 3.6	< 270	< 0.62
Forge Pond	Peconic River, off site	N	4	4	4	4
		Max.	< 1.0	2.40 ± 1.40	< 200	< 2.82
		Avg.	0.47 ± 0.21	1.43 ± 1.53	23 ± 95	0.85 ± 1.29
Swan Pond	Control location, off site	N	4	4	4	4
		Max.	1.45 ± 0.86	6.70 ± 1.50	< 310	< 2.39
		Avg.	0.64 ± 0.65	3.73 ± 2.27	83 ± 122	0.78 ± 1.07
HH	Carmans River Control location, off site	N	4	4	4	4
		Max.	< 1.0	3.00 ± 1.30	200 ± 140	< 2.30
		Avg.	0.17 ± 0.39	2.08 ± 1.18	28 ± 113	0.82 ± 0.98
SDWA Limit (pCi/L)			15	(a)	20,000	8

Notes:
See Figure 5-8 for sample station locations.
All values reported with a 95% confidence interval.
Negative numbers occur when the measured values are lower than background (See Appendix B for description).
To convert values from pCi to Bq, divide by 27.03.
N = Number of samples analyzed
NS = Not Sampled for this analyte
SDWA = Safe Drinking Water Act
(a) The drinking water standard was changed from 50 pCi/L (concentration based) to 4 mrem/yr (dose based) in 2003. Because gross beta activity does not identify specific radionuclides, a dose equivalent can not be calculated for the values in the table.

5.5.2 Peconic River - Nonradiological Analyses

Peconic River samples collected in 2004 were analyzed for water quality parameters (pH, temperature, conductivity, and dissolved oxygen), anions (chlorides, sulfates, and nitrates), metals, and VOCs. No VOCs above the MDL were detected in river water samples. The inorganic analytical data for the Peconic River and Carmans River samples are summarized in Tables 5-8 (water quality) and 5-9 (metals).

Peconic River water quality data collected upstream and downstream showed that water quality was consistent throughout the river system. These data were also consistent with that from the Carmans River control location (HH). 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 highest at upstream Station HY. A sample collected from Station HY in April measured 258 mg/L, most probably due to road salting and surface runoff and that station's proximity to William Floyd Parkway. There are no ambient water quality standards imposed for chloride discharges to surface water; however, NYSDEC imposes a discharge limit of 500 mg/L 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 spring rains mix with decaying matter, these acids decrease the already low pH of precipitation, resulting in a pH as low as 4.2 Standard Units. A discussion of precipitation monitoring is provided in Chapter 6 (see Section 6.7 for more detail).

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 2004, the BNL Environmental Monitoring Program continued to assess water samples for both the dissolved and particulate form. Dissolved concentrations were determined by filtering the samples prior to acid preservation and analysis. Examination of the metals data showed that aluminum, cobalt, copper, iron, lead, silver, and zinc were present in concentrations at some locations that exceeded ambient water quality standards both upstream

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 Nitrogen (mg/L)
HY	Peconic River (headwaters) on site, east of Wm. Floyd Pkwy.	N	4	4	4	4	4	4	4
		Min.	4.4	36	0.4	5.5	7.4	1.7	< 0.02
		Max.	11.2	762	21.4	8.6	258	8.9	0.19
		Avg.	NA	237	12.7	7.1	71.2	4.6	0.08
HE	Peconic River, upstream of STP Outfall	N	4	4	4	4	4	4	4
		Min.	5.1	81	3.6	8.8	10.1	1.8	< 0.02
		Max.	7.1	232	11	11.8	51.2	5.3	0.08
		Avg.	NA	131	7.9	10.2	22.6	3.4	0.02
HM-N	Peconic River, downstream of STP, on site	N	6	6	6	6	6	6	6
		Min.	6.1	142	0.2	9.6	23.6	7.8	2.01
		Max.	6.8	286	9	13.4	62.5	20.3	4.99
		Avg.	NA	208	4.9	11.1	40.1	12.0	3.53

(continued on next page)

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

Sample Station	Geographic Location		pH (SU)	Conductivity (µS/cm)	Temp. (°C)	Dissolved Oxygen (mg/L)	Chlorides (mg/L)	Sulfates (mg/L)	Nitrates as Nitrogen (mg/L)
HM-S	Peconic River tributary, on site	N	2	2	2	2	2	2	2
		Min.	4.2	47	0.1	3.1	4.9	1.4	< 0.05
		Max.	4.5	77	18.7	9.8	5.3	4.1	< 0.05
		Avg.	NA	62	9.4	6.5	5.1	2.8	< 0.05
HQ	Peconic River, downstream of STP, at BNL site boundary	N	5	5	5	5	5	5	6
		Min.	6.1	123	0.1	3.2	20	6.5	0.16
		Max.	6.8	219	19.5	9.6	42.5	12.2	4.19
		Avg.	NA	172	7.2	6.7	30.5	9.0	1.77
HA	Peconic River, off site	N	4	4	4	4	4	4	4
		Min.	5.7	57	0.1	4.1	10.6	4.2	< 0.05
		Max.	7.2	161	24	8.8	24.9	10.9	1.49
		Avg.	NA	93	13.1	6.7	14.6	6.2	0.44
HC	Peconic River, off site	N	2	2	2	2	2	2	2
		Min.	5.8	73	1.6	5.2	11.5	3.2	< 0.05
		Max.	6.6	74	23.2	6.2	11.7	7.4	0.19
		Avg.	NA	74	12.4	5.7	11.6	5.3	0.09
Donahue's Pond	Peconic River, off site	N	1	1	1	1	1	1	1
		Value	6.4	74	11.7	8.5	10.9	5.1	< 0.02
Forge Pond	Peconic River, off site	N	4	4	4	4	4	4	4
		Min.	6.2	95	2.4	8.4	14.6	7.8	< 0.05
		Max.	8.5	136	25.8	10.3	18.9	12.9	0.36
		Avg.	NA	121	15.9	9.5	17.7	10.8	0.18
Swan Pond	Control location, off site	N	4	4	4	4	4	4	4
		Min.	5.4	63	2	2.3	9.8	10	< 0.02
		Max.	6.9	107	24.7	9.6	19.6	13.3	0.14
		Avg.	NA	81	14.4	6.4	13.9	11.6	< 0.05
HH	Carmans River control location, off site	N	4	4	4	4	4	4	4
		Min.	6.4	175	6.9	8.4	0.11	0.22	1.18
		Max.	6.8	195	21.3	10.1	43	13.5	1.74
		Avg.	NA	185	14.2	9.3	23.5	8.9	1.47
NYSDEC AWQS			6.5 – 8.5	SNS	SNS	> 4.0	250 (a)	250 (a)	10 (a)
Typical MDL			NA	NA	NA	NA	4.0	4.0	1.0

Notes:
See Figure 5-8 for sample station locations.
AWQS = Ambient Water Quality Standards
MDL = Minimum Detection Limit
N = Number of samples analyzed
NA = Not Applicable
NYSDEC = New York State Department of Environmental Conservation
SNS = Standard Not Specified
(a) Since there are no NYSDEC Class C Surface AWQS for these compounds, the AWQS for groundwater is provided, if specified.

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

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	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)	4	Min.	0.08	707	2.1	11.4	0.06	0.15	0.37	2.3	3.1	0.73	< 0.2	16.5	6.35	1.6	2.7	1.6	1.8	0.84	1.1	15.1
		Max.	< 2.0	1260	< 5.0	18.6	< 2.0	< 2.0	1.1	5.6	< 10.0	0.88	< 0.2	181	149	2.3	7.3	< 5.0	< 5.0	< 5.0	4.3	49.1
		Avg.	< 2.0	944	< 5.0	14.3	< 2.0	< 2.0	0.72	< 5.0	< 10.0	0.84	< 0.2	74.82	43.56	1.88	4.78	< 5.0	< 5.0	< 5.0	2.9	31.05
HY (dissolved)	2	Min.	< 2.0	606	0.61	11.4	< 2.0	0.12	3.4	2	4.4	0.59	< 0.2	49.3	6.09	2	2.4	< 5.0	1.2	< 5.0	2.1	21.4
		Max.	< 2.0	943	< 5.0	15.3	< 2.0	< 2.0	6.1	< 5.0	< 10.0	0.64	< 0.2	179	9.27	2.7	3.4	< 5.0	< 5.0	< 5.0	< 5.0	32.5
		Avg.	< 2.0	774.5	< 5.0	13.35	< 2.0	< 2.0	4.75	< 5.0	< 10.0	0.61	< 0.2	114.15	7.68	2.35	2.9	< 5.0	< 5.0	< 5.0	< 5.0	26.95
HV (total)	1	Value	< 2.0	793	< 5.0	19.8	0.13	< 2.0	1	2.7	3.4	1.27	< 0.2	77.2	253	4.5	7.2	< 5.0	1.7	< 5.0	3	48.5
HV (dissolved)	1	Value	< 2.0	149	< 5.0	15	0.31	< 2.0	2.2	0.97	2.9	0.24	< 0.2	59.9	246	2.7	2.6	< 5.0	< 5.0	< 5.0	0.85	32.7
HE (total)	4	Min.	0.05	265	1	10	0.13	0.04	0.38	0.71	0.98	0.6	< 0.2	56	8.67	1.2	1.3	< 5.0	< 5.0	0.5	2.4	6.3
		Max.	< 2.0	390	< 5.0	17.1	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	6.32	< 0.2	147	28.5	< 10.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	14.5
		Avg.	< 2.0	322.25	< 5.0	12.92	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	3.8	< 0.2	105.08	14.32	< 10.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	10.8
HE (dissolved)	2	Min.	< 2.0	190	< 5.0	9.2	0.13	< 2.0	2.3	4.7	0.73	1.45	< 0.2	99.7	9.02	1.5	0.88	< 5.0	< 5.0	< 5.0	< 5.0	10.3
		Max.	< 2.0	312	< 5.0	10.7	< 2.0	< 2.0	8.8	< 5.0	< 10.0	2.12	< 0.2	120	9.71	2.4	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	22.5
		Avg.	< 2.0	251	< 5.0	9.95	< 2.0	< 2.0	5.55	< 5.0	< 10.0	1.78	< 0.2	109.85	9.36	1.95	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	16.4
	6	Min.	1.3	98.7	0.86	14	0.11	0.15	0.62	1.9	18	0.18	0.1	7.7	17.9	2	1.5	< 5.0	0.87	< 5.0	1.4	20.2
		Max.	3.6	569	< 5.0	25.2	< 2.0	< 2.0	< 5.0	5.1	34.4	1.07	< 0.2	71.4	39.8	13.6	3.9	< 5.0	< 5.0	< 5.0	4.1	64.6
HM-N (total)		Avg.	1.98	348.45	< 5.0	17.62	< 2.0	< 2.0	< 5.0	< 5.0	26.3	0.68	< 0.2	31.98	31	< 10.0	< 3.0	< 5.0	< 5.0	< 5.0	2.6	39.67
HM-N	3	Min.	0.27	149	1.1	11.7	< 2.0	0.11	0.46	1.2	13.8	0.25	< 0.2	20.6	17	2	0.97	< 5.0	0.61	< 5.0	1.5	24.9
(dissolved)		Max.	0.61	253	< 5.0	25	< 2.0	< 2.0	8.6	4.4	32.3	0.74	< 0.2	48.1	41.1	2.8	2.2	< 5.0	< 5.0	< 5.0	< 5.0	78.4
		Avg.	0.46	185	< 5.0	16.63	< 2.0	< 2.0	3.79	2.5	21.8	0.44	< 0.2	33.13	28.03	2.47	1.42	< 5.0	< 5.0	< 5.0	< 5.0	44.5
HM-S (total)	2	Min.	< 2.0	443	< 5.0	7	0.08	0.08	0.23	< 5.0	< 10.0	0.24	< 0.2	23.8	2.79	3	1.6	< 5.0	0.77	< 5.0	0.89	18.5
		Max.	< 2.0	1010	< 5.0	16.4	< 2.0	< 2.0	< 5.0	5.1	< 10.0	1.93	< 0.2	32	2.85	< 10.0	2	< 5.0	< 5.0	< 5.0	1.4	65.7
		Avg.	< 2.0	726.5	< 5.0	11.7	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	1.08	< 0.2	27.9	2.82	< 10.0	1.8	< 5.0	< 5.0	< 5.0	1.14	42.1
HM-S (dissolved)	1	Value	< 2.0	951	< 5.0	13.3	0.05	0.13	10.2	6	2.2	1.85	< 0.2	35.6	3.07	3.6	2.1	< 5.0	0.91	< 5.0	< 5.0	87.4
HQ (total)	5	Min.	0.46	91.5	1.5	9.1	0.06	0.17	0.52	0.99	11.8	0.26	0.04	4.4	16.5	2.2	1.3	< 5.0	0.82	< 5.0	1.7	21.9
		Max.	1.3	392	< 5.0	14.6	< 2.0	< 2.0	< 5.0	5.2	25.1	0.88	< 0.2	49.6	28.9	< 10.0	2.2	< 5.0	< 5.0	< 5.0	4.3	47.2
		Avg.	0.81	201.5	< 5.0	11.1	< 2.0	< 2.0	< 5.0	2.34	15.82	0.49	< 0.2	34.84	23.28	< 10.0	1.66	< 5.0	< 5.0	< 5.0	2.42	35.54

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

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	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se µg/L	Tl µg/L	V µg/L	Zn µg/L
HQ (dissolved)	3	Min.	0.33	76.2	1.3	7.1	< 2.0	0.12	1.3	2	9.9	0.18	< 0.2	6.4	16.4	3.2	0.79	< 5.0	0.54	< 5.0	1.1	22.4
		Max.	< 2.0	202	< 5.0	13.6	< 2.0	< 2.0	7.7	5.1	24.3	0.61	< 0.2	46	28.7	3.7	1.5	< 5.0	< 5.0	< 5.0	1.9	45.5
		Avg.	< 2.0	132.4	< 5.0	9.43	< 2.0	< 2.0	3.7	3.13	15.7	0.35	< 0.2	32.6	23.93	3.43	1.16	< 5.0	< 5.0	< 5.0	1.57	30.4
HA (total)	4	Min.	0.28	< 50.0	2.3	7.1	0.43	0.07	0.19	0.99	1.3	0.56	0.01	19.8	6.55	0.98	0.75	< 5.0	0.86	0.71	1.7	4.9
		Max.	< 2.0	121	< 5.0	10.2	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	1.96	< 0.2	45.4	21.4	< 10.0	< 3.0	11.9	< 5.0	< 5.0	< 5.0	14.4
		Avg.	< 2.0	70.68	< 5.0	8.72	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	1.13	< 0.2	34.7	11.46	< 10.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	9.4
HA (dissolved)	2	Min	0.19	24.8	0.8	8.2	< 2.0	0.07	2	1.7	2.8	0.61	< 0.2	21.4	8.17	1.3	0.62	< 5.0	0.7	< 5.0	< 5.0	10.1
		Max.	< 2.0	119	2	8.6	< 2.0	< 2.0	2.4	< 5.0	4.4	0.75	< 0.2	44.8	21.4	2.9	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	13.3
		Avg.	< 2.0	71.9	1.4	8.4	< 2.0	< 2.0	2.2	< 5.0	3.6	0.68	< 0.2	33.1	14.78	2.1	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	11.7
HC (total)	2	Min.	< 2.0	< 50.0	< 5.0	11	< 2.0	< 2.0	0.13	< 5.0	0.9	1.1	< 0.2	50.7	7.29	0.66	1.2	< 5.0	< 5.0	0.87	0.63	7.5
		Max.	< 2.0	75.6	< 5.0	13.8	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	2.17	< 0.2	186	8.24	< 10.0	2.5	< 5.0	< 5.0	< 5.0	< 5.0	10
		Avg.	< 2.0	< 50.0	< 5.0	12.4	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	1.64	< 0.2	118.35	7.76	< 10.0	1.85	< 5.0	< 5.0	< 5.0	< 5.0	8.75
Donohue's Pond (total)	1	Value	< 2.0	< 50.0	1.6	9.6	< 2.0	< 2.0	0.08	< 5.0	0.86	0.91	< 0.2	39.2	8.21	0.54	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10.0
Donohue's Pond (dissolved)	1	Value	< 2.0	< 50.0	0.9	8.5	< 2.0	< 2.0	2.5	< 5.0	0.54	0.72	< 0.2	42.2	8.03	0.89	< 3.0	1.2	< 5.0	< 5.0	< 5.0	6.1
Swan Pond (total)	4	Min.	< 2.0	< 50.0	0.78	8.4	< 2.0	< 2.0	0.05	1.7	1.3	0.09	< 0.2	64.9	6.72	0.64	1.3	< 5.0	0.64	< 5.0	0.89	4.9
		Max.	< 2.0	144	< 5.0	14.5	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	0.81	< 0.2	442	11.6	< 10.0	3	< 5.0	< 5.0	< 5.0	< 5.0	13
		Avg.	< 2.0	84.45	< 5.0	11.1	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	0.34	< 0.2	208.88	9.34	< 10.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	7.25
Swan Pond (dissolved)	2	Min.	< 2.0	38.1	< 5.0	7.1	< 2.0	0.05	3.6	1.5	1.3	0.04	< 0.2	33.7	6.8	1	< 3.0	< 5.0	0.67	< 5.0	< 5.0	13.4
		Max.	< 2.0	< 50.0	< 5.0	10.5	< 2.0	< 2.0	7.5	< 5.0	2.7	0.2	< 0.2	384	9.7	1.5	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	14.5
		Avg.	< 2.0	< 50.0	< 5.0	8.8	< 2.0	< 2.0	5.55	< 5.0	2	0.12	< 0.2	208.85	8.25	1.25	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	13.95

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

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	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se µg/L	Tl µg/L	V µg/L	Zn µg/L
Forge Pond (total)	4	Min.	< 2.0	46.7	0.77	16.1	0.53	< 2.0	0.06	0.76	1.1	0.23	< 0.2	15.5	9.76	0.49	0.72	< 5.0	1.6	1.5	0.97	3.7
		Max.	< 2.0	81.7	< 5.0	21.2	< 2.0	< 2.0	0.95	< 5.0	< 10.0	1.05	< 0.2	146	13.7	< 10.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10.0
		Avg.	< 2.0	< 50.0	< 5.0	18.02	< 2.0	< 2.0	0.32	< 5.0	< 10.0	0.75	< 0.2	65.4	12.07	< 10.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10.0
Forge Pond (dissolved)	2	Min.	< 2.0	< 50.0	1	14.3	< 2.0	< 2.0	2.6	1.5	0.64	0.16	< 0.2	19.3	9.71	1.1	0.57	< 5.0	< 5.0	< 5.0	< 5.0	9
		Max.	< 2.0	75.5	1.6	15.3	< 2.0	< 2.0	7.1	< 5.0	2	0.74	< 0.2	75.9	13.2	1.3	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	9.4
		Avg.	< 2.0	< 50.0	1.3	14.8	< 2.0	< 2.0	4.85	< 5.0	1.32	0.45	< 0.2	47.6	11.46	1.2	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	9.2
Carmans River (control locations)																						
HH (total)	4	Min.	< 2.0	< 50.0	0.89	30.9	0.38	< 2.0	0.08	2.3	0.4	0.38	< 0.2	41	17.6	0.64	1.5	< 5.0	1.7	< 5.0	1.8	5.6
		Max.	< 2.0	610	< 5.0	40.9	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	1.41	< 0.2	131	24.5	< 10.0	6.2	< 5.0	< 5.0	< 5.0	< 5.0	15.1
		Avg.	< 2.0	194.55	< 5.0	37.08	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	0.78	< 0.2	92.1	19.8	< 10.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10.0
HH (dissolved)	2	Min.	< 2.0	31	0.94	28.7	< 2.0	< 2.0	2.4	1.5	0.43	0.16	< 0.2	59.3	16.6	1	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	9.3
		Max.	< 2.0	< 50.0	< 5.0	29.2	< 2.0	< 2.0	6.9	< 5.0	< 10.0	0.23	< 0.2	84.5	18.4	1.1	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	16.2
		Avg.	< 2.0	< 50.0	< 5.0	28.95	< 2.0	< 2.0	4.65	< 5.0	< 10.0	0.19	< 0.2	71.9	17.5	1.05	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	12.75
NYSDEC AWQS			0.1	100	150	SNS	11	1.1	5	34	4	0.3	0.2	SNS	SNS	23	1.4	SNS	4.6	8	14	34
Solubility State			I	I	D		AS	D	AS	D	D	AS	D			D	D		D	AS	AS	D
Typical MDL			2	50	5	1.8	2	2	5	5	10	0.075	0.2	2	1	1.1	3	5	5	5	5	10

Notes:
See Figure 5-8 for sample station locations.
AWQS = Ambient Water Quality Standards
AS = Acid Soluble
D = Dissolved
I = Ionic
MDL = Minimum Detection Limit
N = Number of samples analyzed
NYSDEC = New York State Department of Environmental Conservation
SNS = Standard Not Specified for these elements for Class C Surface Waters

and downstream of the STP discharge, and/or at the control location HH. Aluminum and iron are detected throughout the Peconic and Carmans Rivers at concentrations that exceed the NYS AWQS in both the filtered and unfiltered fractions. Both are found in high concentrations in native Long Island soil and, for iron, at high levels in groundwater. The low pH of groundwater and precipitation contribute to the dissolution of these elements. Lead was detected at the highest levels in samples collected at the upstream station (HY). Upstream levels of lead are likely the result of stormwater runoff from nearby William Floyd Parkway. This is most likely due to historic use of leaded gasoline. Copper, silver, and zinc were at their highest concentrations immediately downstream of the STP discharge (HM-N). Although the NYS AWQS limits for copper, silver, and zinc are extremely restrictive, the NYS-granted SPDES permit allows higher STP discharge limits. All concentrations found at the downstream location were within the SPDES limits. Cobalt was detected only in filtered samples and is likely due to contamination by the filter media itself. With the exception of aluminum and iron, filtering the samples reduced concentrations of most metals to below the NYS AWQS, indicating that most detections were due to sediment carryover.

In 2004, BNL embarked on an extensive project to remediate Peconic River sediments containing contaminants such as mercury and silver. The goal of the project is to remove metal deposits, predominantly mercury, that could move into the food-chain and pose a risk for human consumption. The project began immediately downstream of the STP discharge and continued off site into the county parks immediately east of BNL's site boundary. The project includes excavation of between 6 and 12 inches of sediment from the river bottom. Once remediation is completed, future monitoring of river water, sediment, vegetation, and fish samples will determine the effectiveness of this project.

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