Water Quality

5

Wastewater generated from Brookhaven National Laboratory (BNL) operations is discharged 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 vigilant operation of treatment facilities ensure that these discharges comply with all applicable requirements and that the public, employees, and environment are protected.

Analytical data for 2008 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. During 2008, tritium was detected in the STP effluent only once at a concentration just above the minimum detectable activity (280 pCi/L vs. 250 pCi/L). The average concentration was slightly lower than in 2007, resulting in a decrease in releases to the Peconic River. The maximum concentration of tritium released was less than 2 percent of the drinking water standard. Tritium was also detected once in the influent, but again at levels barely above the minimum detectable activity. Analysis of the STP effluent continued to show no detection of cesium-137, strontium-90, or other gamma-emitting nuclides attributable to BNL operations. Similarly, there were no radionuclides detected along the Peconic River in 2008 that were attributable to BNL operations.

Nonradiological monitoring of the STP effluent showed that all discharges complied with State Pollutant Discharge Elimination System effluent limitations or other applicable standards. Inorganic data from Peconic River samples collected upstream, downstream, and at control locations demonstrated that elevated amounts of aluminum, iron, and vanadium detected in the river are associated with natural sources.

Examination of analytical data for discharges to recharge basins shows that the average concentrations of gross alpha and beta activity were within typical ranges and that neither tritium nor gamma-emitting radionuclides were detected in 2008. Review of organic data shows that disinfection byproducts are detected in discharges to recharge basins due to the use of chlorine and bromine for the control of algae and bacteria in potable and cooling water systems. Inorganics (i.e., metals) are also detected in these discharges, primarily from sediment run-off in storm water discharges.

5.1 SURFACE WATER MONITORING PROGRAM

Treated wastewater from the BNL 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 wastewater discharge on the quality of the river, surface water is monitored at several locations upstream and downstream of the discharge point. Monitoring Station HY (see Figure 5-8), on site but upstream of all Laboratory 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 operations at BNL or within the Peconic River watershed.

On the Laboratory site, the Peconic River is an intermittent stream. Off-site flow occurs only during periods of sustained precipitation, typically in the spring. Off-site flow in 2008 was only persistent through early June, due to a dry spring. When flow ceased, standing water was continuous throughout the year in several of the deeper sections of the river. The following sections describe BNL's surface water monitoring and surveillance program.

5.2 SANITARY SYSTEM EFFLUENTS

The STP effluent (Outfall 001) is a discharge point authorized under a SPDES permit issued by NYSDEC. Figure 5-1 shows a schematic of the STP and its sampling locations. The Laboratory's STP treatment process includes four principal steps: 1) aerobic oxidation for secondary removal of biological matter and nitrification of ammonia, 2) secondary clarification, 3) sand filtration for final solids removal, and 4) 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 (Step 1), 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. Limit-

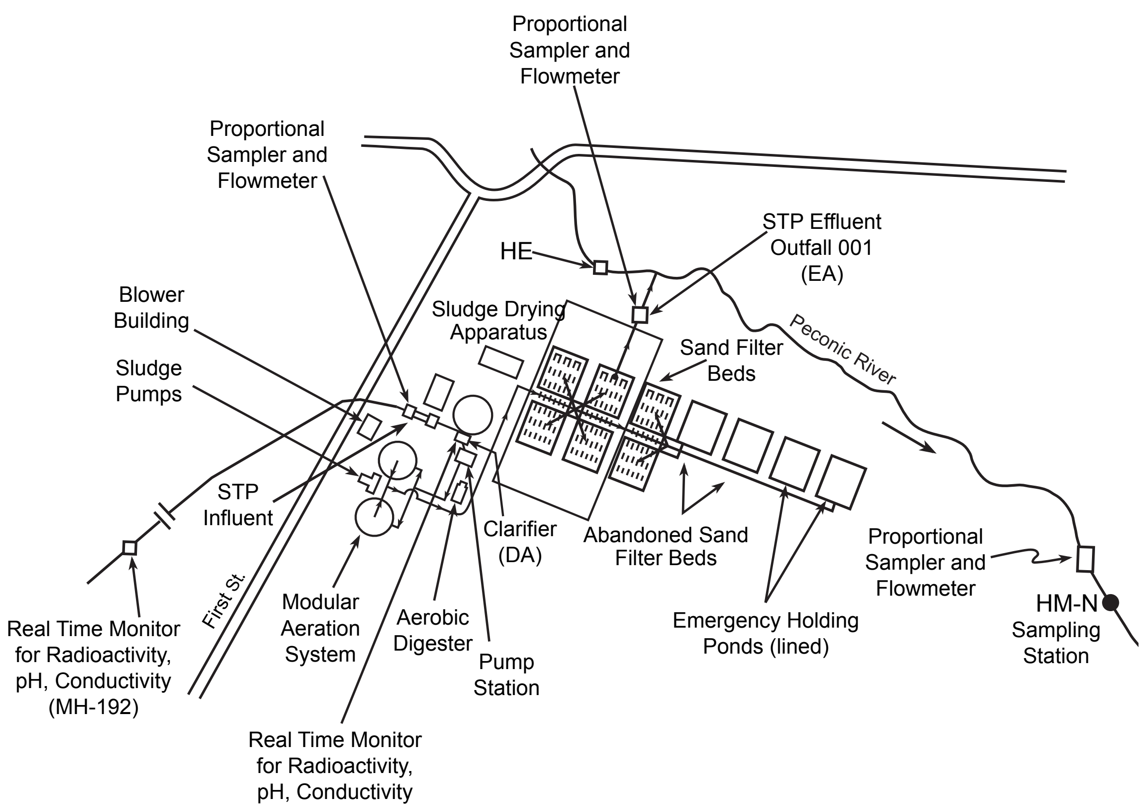

Figure 5-1. Schematic of BNL's Sewage Treatment Plant (STP).

ing 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 en route 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 treatment process, as shown in Figure 5-1.

Based on the data collected by the real-time monitoring systems, any influent to the STP that may not meet SPDES limits or BNL effluent release criteria (whichever is more stringent) is diverted to two double-lined holding ponds. The total combined capacity of the two holding ponds exceeds 6 million gallons, or approximately 18 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 and then reintroduced into the STP at a rate that ensures compliance with SPDES permit limits for non-radiological parameters or BNL effluent release criteria for radiological parameters. In 2008, there were no instances that required diversion of the waste water to the hold-up ponds. Waste water contained in the ponds from a diversion of chilled water in 2007, was processed through the addition of coagulants and discharged back through the head of the treatment plant for re-processing. Solids separated during this activity were collected for off-site disposal.

Solids separated in the clarifier are pumped to aerobic digesters for continued biological solids reduction and sludge thickening. Until 2007, the thickened sludge was periodically emptied into solar/heat lamp-powered drying beds, where it was dried to a solid cake. The dried sludge historically contained very low levels (less than 0.5 pCi/g) of radioactivity, such as residual levels of cobalt-60 (Co-60: half-life 5.2 years) from sewage releases. Consequently, the dried sludge was dispositioned as low-level radioactive waste. In an effort to reduce a high inventory of sludge stored in the aerobic digesters, in 2007 BNL retained the services of Mineral Processing Services to process the sludge for drying and eventual off-site disposal. The sludge was processed in late 2007 and placed into Geotubes (large filter bags) and left to dry throughout 2008. Disposal is being planned for the summer of 2009. The dried sludge will be mixed with sand from the sand filter beds and dispositioned off site at a landfill authorized by NYSDEC. With the clean-out of the digesters, newly generated sludge was analyzed and found to be free of radiological contamination. In 2008, authorization was received from the local County authority to transfer waste sludge directly from the aerobic digester to the County-operated sewage treatment facility. In May 2008, approximately 50,000 gallons of sludge were released to the County sewage works.

5.2.1 Sanitary System Effluent–Radiological Analyses

Wastewater at the STP is sampled at the inlet to the treatment process, Station DA (see Figure 5-1) 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 for tritium concentrations. In 2008, 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: half-life 29 years).

Although the Peconic River is not used as a direct source of potable water, the Laboratory applies the stringent Safe Drinking Water Act (SDWA) standards for comparison purposes when monitoring the effluent, in lieu of DOE wastewater criteria. Under the SDWA, water standards are based on a 4 mrem (40 µSv) dose limit. The SDWA specifies that no individual

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

		Flow (a) (Liters)	**Tritium** (pCi/L)		**Gross Alpha** (pCi/L)		**Gross Beta** (pCi/L)	
			max.	avg.	max.	avg.	max.	avg.
January	*influent*	3.19E+7	< 350	-24.6 ± 68.9	1.2 ± 0.8	0.1 ± 0.2	5.6 ± 1.1	4.8 ± 0.5
	effluent	2.48E+7	< 360	2.6 ± 53.4	< 1.4	0.4 ± 0.1	7.4 ± 1.4	4.8 ± 1.0
February	*influent*	3.75E+7	< 360	48.3 ± 81.8	< 1.6	0.4 ± 0.2	5.5 ± 1.2	4.3 ± 0.5
	effluent	2.85E+7	< 280	-29.2 ± 77.4	< 1.9	0.2 ± 0.2	6.2 ± 1.3	4.4 ± 0.7
March	*influent*	3.80E+7	< 370	-7.2 ± 62.5	< 2.2	0.7 ± 0.3	5.4 ± 1.3	4.0 ± 0.5
	effluent	3.88E+7	< 340	2.2 ± 75.9	4.6 ± 1.5	0.8 ± 0.7	9.4 ± 1.5	4.8 ± 1.0
April	*influent*	4.22E+7	< 350	80.8 ± 40.8	< 1.5	0.2 ± 0.2	6.0 ± 1.3	4.4 ± 0.5
	effluent	4.00E+7	< 350	31.5 ± 38	1.4 ± 0.9	0.5 ± 0.3	6.4 ± 1.3	4.9 ± 0.6
May	*influent*	3.29E+7	< 300	-0.8 ± 53.1	1.3 ± 1.0	0.3 ± 0.3	6.2 ± 1.2	4.8 ± 0.7
	effluent	2.70E+7	< 300	-29.2 ± 53.9	1.7 ± 1.1	0.2 ± 0.4	6.4 ± 1.3	5.2 ± 0.5
June	*influent*	5.40E+7	< 380	-43.8 ± 55	< 1.7	0.2 ± 0.4	7.4 ± 1.4	5.3 ± 0.8
	effluent	3.73E+7	< 360	-56.9 ± 59.1	2.3 ± 1.5	0.6 ± 0.4	8.2 ± 1.7	5.2 ± 0.9
July	*influent*	6.54E+7	< 310	120.7 ± 39	< 1.2	0.4 ± 0.2	7.7 ± 2.7	4.9 ± 0.6
	effluent	3.81E+7	280 ± 170	100.8 ± 62.1	2.4 ± 2.4	0.8 ± 0.5	11.7 ± 2.8	5.0 ± 1.3
August	*influent*	5.85E+7	< 290	94.6 ± 34.4	1.5 ± 1.1	0.5 ± 0.2	6.7 ± 1.3	5.1 ± 0.5
	effluent	2.49E+7	< 290	90 ± 43.3	< 1.4	0.3 ± 0.3	7.4 ± 1.4	4.7 ± 0.8
September	*influent*	5.26E+7	< 290	68.8 ± 45.4	< 1.8	0.4 ± 0.2	6.2 ± 1.5	4.3 ± 0.5
	effluent	2.46E+7	< 280	66.2 ± 28.5	2.2 ± 1.7	0.9 ± 0.3	6.4 ± 1.5	4.8 ± 0.6
October	*influent*	4.88E+7	< 280	70 ± 47.4	1.1 ± 1.1	0.4 ± 0.2	6.9 ± 1.3	4.8 ± 0.6
	effluent	2.74E+7	< 300	20.6 ± 28.3	< 1.5	0.4 ± 0.2	7.3 ± 1.4	5.2 ± 0.7
November	*influent*	5.04E+7	< 300	115.5 ± 32.7	< 0.8	0.2 ± 0.1	6.0 ± 1.3	4.9 ± 0.4
	effluent	2.62E+7	< 300	77.3 ± 25.8	1.2 ± 0.9	0.4 ± 0.3	6.9 ± 1.3	4.6 ± 0.8
December	*influent*	3.76E+7	290 ± 170	-3.1 ± 79.9	3.5 ± 1.5	0.7 ± 0.5	5.1 ± 1.2	3.4 ± 0.5
	effluent	2.60E+7	< 250	-6.9 ± 73.8	1.9 ± 1.0	0.7 ± 0.3	6.5 ± 1.3	4.3 ± 0.8
Annual Avg.	*influent*	4.58E+7		21.5 ± 17		0.5 ± 0.1		4.8 ± 0.2
	effluent	3.03E+7		42 ± 17.8		0.4 ± 0.1		4.6 ± 0.2
Total Release		5.50E+8		11.8 mCi		0.27 mCi		3.3 mCi
Average MDL (pCi/L)				322.4		1.5		1.3
SDWA Limit (pCi/L)				20,000		15		(b)

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) Effluent values greater than influent values occur when water that had been diverted to the holding ponds is tested, treated (if necessary), and released.
(b) The drinking water standards were 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 cannot be calculated for the values in the table.

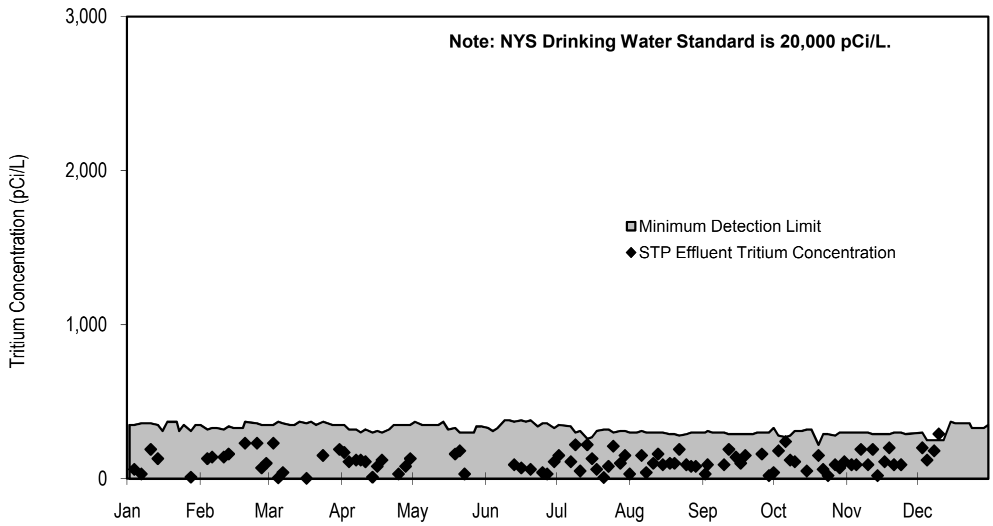

Figure 5-2. Tritium Concentrations in Effluent from the BNL Sewage Treatment Plant (2008).

may receive an annual dose greater than 4 mrem from radionuclides that are beta or photon emitters, which includes up to 168 individual radioisotopes. The Laboratory 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: half-life 1,600 years), but excluding radon and uranium. Other SDWA-specified drinking water limits are 20,000 pCi/L for tritium (H-3: half-life 12.3 years), 8 pCi/L for Sr-90, 5 pCi/L for Ra-226 and radium-228 (Ra-228: half-life 5.75 years), 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 2008. Annual average gross alpha and beta activity levels in the STP effluent were 0.4 ± 0.1 pCi/L and 4.6 ± 0.2 pCi/L, respectively. These concentrations remain essentially unchanged from year to year. Control location data (Carmans River Station HH; see Figure 5-8) show average gross alpha and beta levels of 0.87 ± 0.64 pCi/L and 3.34 ± 4.02 pCi/L, respectively (see Table 5-7). The average concentrations of gross alpha and beta activity in Peconic River water samples collected upstream of BNL were 0.68 ± 0.21 pCi/L and 1.23 ± 1.09 pCi/L, respectively.

Tritium detected at the STP originates from either High Flux Beam Reactor (HFBR) sanitary system releases, or from small, infrequent batch releases that meet BNL discharge criteria from other facilities. Although the HFBR is no longer operating, tritium continues to be released from the facility at very low concentrations due to off-gassing. When the HFBR was operating, air within the reactor building contained higher 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 in these wastewater streams. To minimize the quantity of tritium released to the STP, efforts have been made to capture most of the air compressor condensate collected in the equipment areas of the structure. A plot of the 2008 tritium concentrations recorded in 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.

In 2008, with the exception of a single low-level reported value, tritium was not detected in the discharge of the STP (EA, Outfall 001) for

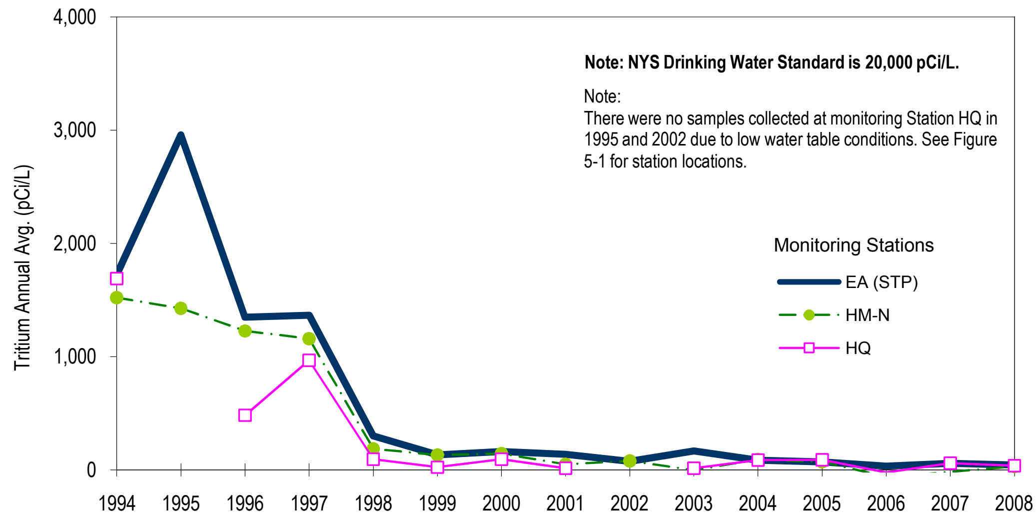

Figure 5-3. Sewage Treatment Plant/Peconic River Annual Average Tritium Concentrations (1994–2008).

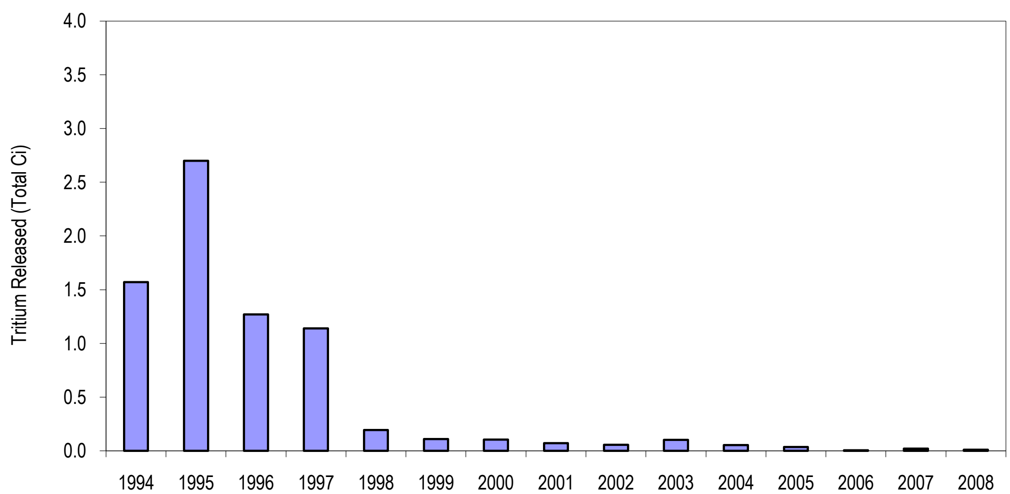

Figure 5-4. Tritum Released to the Peconic River, 15-Year Trend (1994–2008).

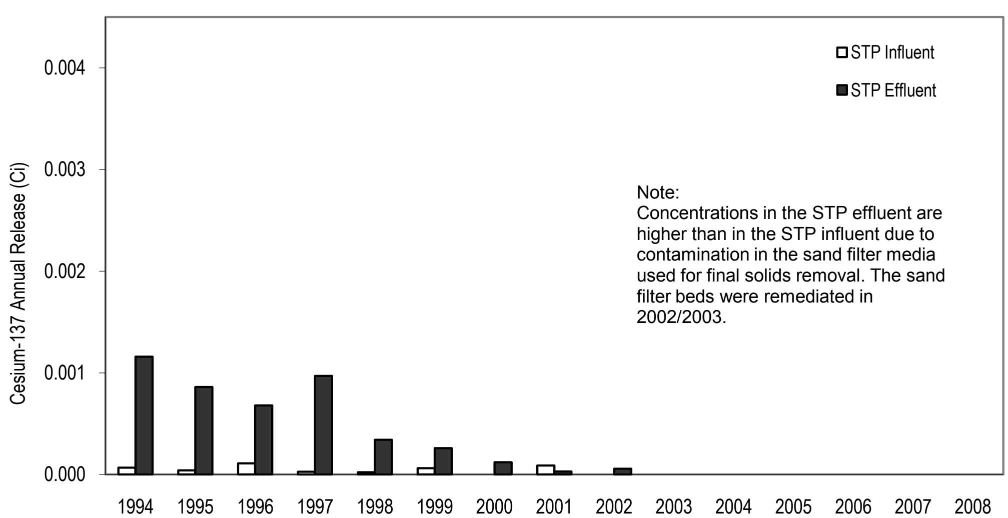

Figure 5-5. Cesium-137 in the BNL Sewage Treatment Plant Influent and Effluent (1994–2008).

the entire year. The concentration measured in the single sample of the STP discharge (see Figure 5-2) was 290 ± 170 pCi/L (December 12). Due to the low level of detection and the high uncertainty, this concentration is indistinguishable from the minimum detection limit (MDL). The annual average tritium concentration, as measured in the STP effluent, was 42 ± 17.8 pCi/L, which is only 13 percent of the average MDL, 322 pCi/L. Since both the maximum and average values were so low and were reported with high uncertainty, all releases should be considered near or below background values. Using the annual average concentration and the flow recorded for the year, a total of 0.012 Ci (11.8 mCi) of tritium was released during the year (see Figure 5-4). Total tritium released for 2008 was 40 percent less than that recorded for 2007. Tritium was also detected in a single sample of STP influent at a similar low-concentration (280 ± 170 pCi/L), in July. Again, this concentration is indistinguishable from the MDL due to the low level of detection and the uncertainty. Both positive detections were reported as estimates by the contract analytical laboratory.

Table 5-2 presents the gamma spectroscopy data for anthropogenic radionuclides historically detected in the monthly STP wastewater composite samples. In 2008, there were no gamma-emitting nuclides detected in the STP effluent, which is consistent with data reported for 2003–2007 (see Figure 5-5). Similarly there was no Sr-90 detected in 2008.

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. Composite samples of the STP effluent are collected using a flow-proportional refrigerated sampling device (ISCO Model 3700RF) and are then analyzed by contract analytical laboratories. Samples are analyzed for 23 inorganic elements and for 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 effluent 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). Only total aluminum and zinc were detected in the effluent at concentrations exceeding the SPDES permit limits or ambient water quality standards. Unlike the data reported in Chapter 3, there were no exceedances for nitrogen reported for the environmental surveillance program, which supports the fact that the concentrations reported under the compliance program were isolated incidents. Aluminum was detected in a single sample in February at a concentration greater than 100 ppb. All other concentrations were less than 50 ppb. Due to very high concentrations of aluminum in native soils, the February data is likely skewed due to the presence of sediment in the sample. Aluminum is also regulated in the ionic (i.e., dissolved) form. All data reported in Table 5-3 are for "total recoverable," which includes suspended and dissolved fractions; consequently, the data are conservative (err on the side of caution). Zinc concentrations in February and December were also higher than the permit limit of 100 μg/L, with concentrations of 120 and 122 μg/L, respectively. These data are consistent with the compliance data reported in Chapter 3. The SPDES permit limit is represented as 0.1 mg/L; thus, with standard rounding, these values do not constitute violations of the limit.

In 2008, five VOCs were detected in the STP effluent, but at very low concentrations. Methyl chloride, chloroform, and toluene were detected on several occasions, at concentra-

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

		Flow (Liters)	Co-60	Cs-137	Be-7 (pCi/L)	Na-22	Sr-90
January	*influent*	3.19E+7	ND	ND	ND	ND	ND
	effluent	2.48E+7	ND	ND	ND	ND	ND
February	*influent*	3.75E+7	ND	ND	ND	ND	ND
	effluent	2.85E+7	ND	ND	ND	ND	ND
March	*influent*	3.80E+7	ND	ND	ND	ND	ND
	effluent	3.88E+7	ND	ND	ND	ND	ND
April	*influent*	4.22E+7	ND	ND	ND	ND	ND
	effluent	4.00E+7	ND	ND	ND	ND	ND
May	*influent*	3.29E+7	ND	ND	ND	ND	ND
	effluent	2.70E+7	ND	ND	ND	ND	ND
June	*influent*	5.40E+7	ND	ND	ND	ND	ND
	effluent	3.73E+7	ND	ND	ND	ND	ND
July	*influent*	6.54E+7	ND	ND	ND	ND	ND
	effluent	3.81E+7	ND	ND	ND	ND	ND
August	*influent*	5.85E+7	ND	ND	ND	ND	ND
	effluent	2.49E+7	ND	ND	ND	ND	ND
September	*influent*	5.26E+7	ND	ND	ND	ND	ND
	effluent	2.46E+7	ND	ND	ND	ND	ND
October	*influent*	4.88E+7	ND	ND	ND	ND	ND
	effluent	2.74E+7	ND	ND	ND	ND	ND
November	*influent*	5.04E+7	ND	ND	ND	ND	ND
	effluent	2.62E+7	ND	ND	ND	ND	ND
December	*influent*	3.76E+7	ND	ND	ND	ND	ND
	effluent	2.60E+7	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 2008.
To convert values from pCi to Bq, divide by 27.03.
DCG = Derived Concentration Guide
EDE = Effective Dose Equivalent
ND = Not Detected

tions estimated at less than 1 µg/L and much less than the NYS AWQS of 5 µg/L. Acetone and methylene chloride were also detected, at concentrations ranging from less than 1 µg/L to a maximum of 5.8 µg/L. Acetone and methylene chloride are common solvents used in the contract analytical laboratory and are routinely detected due to cross-contamination within the laboratory.

5.3 PROCESS-SPECIFIC WASTEWATER

Wastewater that may contain constituents above SPDES permit limits or ambient water quality discharge standards must be held by

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

		STP Influent				STP Effluent					
ANALYTE	Units	N	Min.	Max.	Avg.	N	Min.	Max.	Avg.	SPDES Limit or AWQS (1)	Comment or Qualifier
pH	SU	CM	6.5	8	NA	CM	6	7.6	NA	5.8 - 9.0	
Conductivity	µS/cm	CM	NR	NR	NR	174(a)	175	630	349.6	SNS	
Temperature	°C	CM	NR	NR	NR	174(a)	4.2	26.5	15	SNS	
Dissolved Oxygen	mg/L	NM	NM	NM	NM	174(a)	6.4	13.3	9.6	SNS	
Chlorides	mg/L	12	40.2	92.3	62.6	12.0	48.3	76.4	57.1	SNS	
Nitrate (as N)	mg/L	12	0.1	2.1	1.0	12.0	2.8	8.2	5.0	10	Total N
Sulfates	mg/L	12	13.0	20.7	17.5	12.0	13.9	21.4	18.3	250	GA
Aluminum	µg/L	12	47.0	831.0	216.3	12.0	15.8	113.0	33.7	100	Ionic
Antimony	µg/L	12	0.4	< 5	< 5	12.0	0.3	< 5	< 5	3	GA
Arsenic	µg/L	12	2.6	< 5	< 5	12.0	< 5	< 5	< 5	150	Dissolved
Barium	µg/L	12	28.8	182.0	56.6	12.0	15.8	24.6	18.9	1000	GA
Beryllium	µg/L	12	< 2	< 10	< 10	12.0	< 2	< 10	< 10	11	Acid Soluble
Cadmium	µg/L	12	0.2	1.8	0.6	12.0	0.2	0.6	0.4	1.1	Dissolved
Calcium	mg/L	12	10.4	15.6	12.8	12.0	10.2	14.7	12.9	SNS	
Chromium	µg/L	12	2.2	< 10	< 10	12.0	2.8	< 10	< 10	34.4	Dissolved
Cobalt	µg/L	12	0.5	3.1	1.1	12.0	0.4	< 5	< 5	5	Acid Soluble
Copper	µg/L	12	49.1	424.0	125.3	12.0	31.6	55.5	41.9	150	SPDES
Iron	mg/L	12	0.5	2.7	1.1	12.0	0.1	0.3	0.1	0.37	SPDES
Lead	µg/L	12	2.3	29.7	9.5	12.0	0.7	4.2	1.5	19	SPDES
Magnesium	mg/L	12	3.0	5.0	3.7	12.0	3.1	4.3	3.6	SNS	
Manganese	µg/L	12	29.1	90.2	53.3	12.0	1.7	16.1	4.3	300	GA
Mercury	µg/L	12	0.1	0.6	< 0.2	12.0	0.1	< 0.2	< 0.2	0.8	SPDES
Nickel	µg/L	12	3.3	34.1	10.3	12.0	5.6	10.9	8.0	110	SPDES
Potassium	mg/L	12	4.9	7.2	6.1	12.0	4.0	5.5	5.0	SNS	
Selenium	µg/L	12	0.5	< 5	< 5	12.0	0.5	< 5	< 5	4.6	Dissolved
Silver	µg/L	12	0.4	2.1	< 2	12.0	0.7	4.4	1.7	15	SPDES
Sodium	mg/L	12	32.2	63.3	43.2	12.0	32.5	60.0	39.2	SNS	
Thallium	µg/L	12	0.2	< 5	< 5	12.0	0.2	< 5	< 5	8	Acid Soluble
Vanadium	µg/L	12	2.1	15.4	< 5	12.0	2.1	6.3	< 5	14	Acid Soluble
Zinc	µg/L	12	39.5	375.0	117.2	12.0	39.0	122.0	65.5	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 Ambient Water Quality Standards (AWQS), the solubility state for the metal is provided.
(1) Unless otherwise provided, the reference standard is NYSDEC Class C Surface Water Ambient Water Quality Standards (AWQS).
(a) The conductivity, temperature, and dissolved oxygen values reported are based on analyses of daily grab samples.
AWQS = Ambient Water Qualty Standards
CM = Continuously monitored
GA = Class GA (groundwater) AWQS
N = Number of samples
NA = Not Applicable
NM = Not Monitored
NR = Not Recorded
NYSDEC = New York State Department of Environmental Conservation
SNS = Standard Not Specified
SPDES = State Pollutant Discharge Elimination System
SU = Standard Units

the generating facility and be 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 Laboratory's SPDES permit includes requirements for quarterly sampling and analysis of process-specific wastewater discharged from printed-circuit-board fabrication operations conducted in Building 535B, metal cleaning operations in Building 498, and cooling tower discharges from Building 902. These operations are monitored for contaminants such as metals, cyanide, VOCs, and SVOCs. In 2008, analyses of these waste streams showed that, although several operations contributed contaminants (principally metals) to the STP influent in concentrations exceeding SPDES-permitted levels, these discharges 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 purge water from groundwater sampling, wastewater from cleaning of heat exchangers, 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's effluent release criteria. If the concentrations were within limits, authorization for sewer system discharge was granted; if not, alternate means of disposal were used. Any waste that contained elevated levels of hazardous or radiological contaminants in concentrations that exceeded Laboratory effluent release criteria was sent to the BNL Waste Management Facility for proper management and off-site disposal.

BNL maintains a Central Chilled Water Facility that provides recirculated, refrigerated water for cooling processes, such as heat exchangers used at research facilities, chillers for computer equipment, and comfort cooling in buildings. To provide cost-effective cooling, the facility stores 3.2 million gallons of cold water. The cold water is generated during overnight hours when electricity rates are lower. In April 2007, the chilled water system underwent maintenance to remove accumulated sediment and provide access for inspection. The water was drained to the sanitary sewer. Due to high iron levels, the sewer was diverted and the water was collected in hold-up ponds for treatment and release. In 2008, the wastewater was processed by adding reagents to precipitate and coagulate the very fine iron particles into larger clumps of particles (called floc) for easier and quicker separation. The treated water was discharged to the sanitary sewer for further treatment and discharge, and the retained solids were concentrated and collected for off-site disposal.

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 the Laboratory'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 the Laboratory. Eleven 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).
- 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 former warehouse area, Basin CSF at the Central Steam Facility (CSF), Basin HW-M at the former Hazardous Waste Management Facility (HWMF), and Basin HZ near Building 902.

Each of the recharge basins is a permitted point-source discharge under the Laboratory'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 BNL's Environmental Surveillance Program for radioactivity, VOCs, metals, and anions. During 2008, water samples were collected from all basins listed above except recharge basin HX at the Water Treatment Plant (exempted by NYSDEC from sampling due to documented non-impact to groundwater) and the recharge basin at the former HWMF, as there are no longer any operations that could lead to the contamination of runoff.

Figure 5-6. BNL Recharge Basin/Outfall Locations.

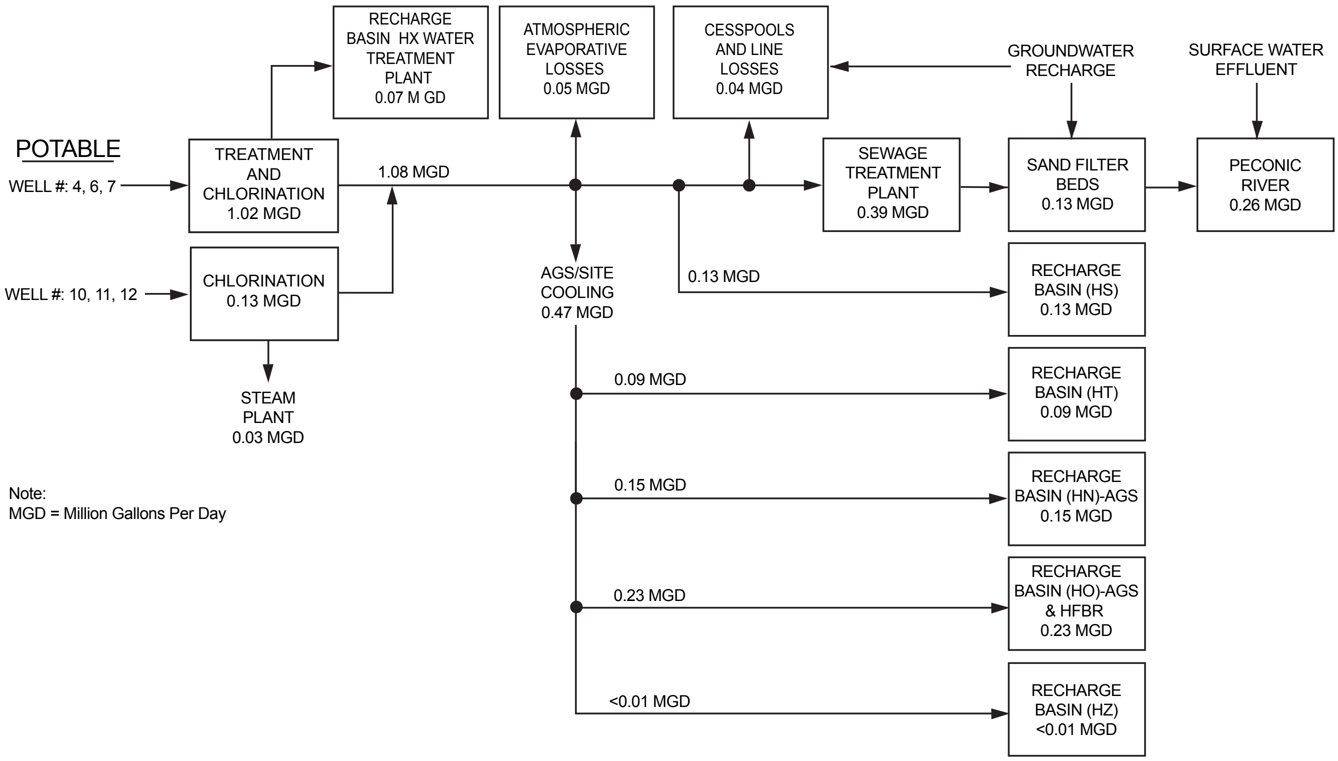

Figure 5-7. Schematic of Potable Water Use and Flow at BNL.

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 and show that low levels of alpha and beta activity were detected in most of the basins. Activities ranged from nondetectable to 2.7 ± 1.2 pCi/L for gross alpha activity, and from nondetectable to 4.8 ± 1.0 pCi/L for gross beta activity. Low-level detections of gross alpha and beta activity are attributable to very low levels of naturally occurring radionuclides, such as potassium-40 (K-40: half-life 1.3E+09 years). The contract analytical laboratory reported no gamma-emitting nuclides attributable to BNL operations in any discharges to recharge basins in 2008. Tritium was also not detected in samples collected at the basins in 2008.

5.4.2 Recharge Basins – Nonradiological Analyses

To determine the overall impact on the environment of discharges to the recharge basins, the nonradiological analytical results were compared to groundwater discharge standards promulgated under Title 6 of the New York Codes, Rules, and Regulations (NYCRR), Part 703.6. Samples were collected quarterly for water quality parameters, metals, and VOCs, and were analyzed by a contract analytical 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 periodically detected in discharges to several of the basins throughout the year. Sodium hypochlorite and bromine, used to control bacteria in the drinking water and algae in cooling towers, lead to the formation of VOCs, including bromoform, chloroform, dibromochloromethane, and dichlorobromomethane. All concentrations were less than 10 µg/L. Acetone was the only other analyte detected above the MDL for most recharge basins. The concentration of acetone ranged from nondetectable to a maximum of 39.0 µg/L. In most instances, acetone was also found as a contaminant in the contract analytical laboratory, as evidenced by detections in blank samples.

The analytical data in Tables 5-5 show that for 2008, the concentrations of all analytes were within effluent standards. A mild winter with little snow and ice resulted in less discharge of sodium and chlorides due to road salting. The data in Table 5-6 show that all parameters, except for aluminum, iron, cobalt, and lead, complied with the respective water quality or groundwater discharge standards (GDS). Due to the prevalence of metals in soils, the presence of these elements is likely due to suspended soil in the samples at the time of collection. Acidification of the samples (part of the analytical process) results in the dissolution of the element and its detection during analysis. This is supported by the observation that the concentrations of metals in all filtered samples were significantly less, and well below the discharge standard or NYS AWQS. As these metals are in particulate form in the discharge water, they pose no threat to groundwater quality because the recharge basin acts as a natural filter, trapping particles before they reach the groundwater.

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

Basin		Gross Alpha	Gross Beta	Tritium
		(pCi/L)		
	*No. of samples**	4	4	4
HN	*max.*	< 0.94	2.3 ± 1.1	< 300
	avg.	0.32 ± 0.28	1.55 ± 0.57	47.5 ± 172.06
HO	*max.*	2.8 ± 1.1	1.73 ± 0.81	< 280
	avg.	1.18 ± 1.3	0.95 ± 0.57	-12.5 ± 100.38
HS	*max.*	1.01 ± 0.71	3.9 ± 1.2	< 300
	avg.	0.58 ± 0.36	2.31 ± 1.19	115 ± 70.44
HT-E	*max.*	0.88 ± 0.64	2.8 ± 1.1	< 300
	avg.	0.62 ± 0.29	2.18 ± 0.59	50 ± 93.66
HT-W	*max.*	< 1.1	< 1.6	< 300
	avg.	0.24 ± 0.38	1.02 ± 0.42	119.9 ± 96.51
HW	*max.*	2.7 ± 1.2	4.8 ± 1	< 320
	avg.	1.91 ± 0.87	3.83 ± 1.15	-40 ± 68.37
HZ	*max.*	2.04 ± 0.9	< 1	< 250
	avg.	1.34 ± 0.71	0.46 ± 0.3	37.5 ± 120.12
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.
(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 adionuclides, a dose equivalent of this value cannot be calculated.
MDL = Minimum Detection Limit
SDWA = Safe Drinking Water Act
* Samples typically collected 4 times per year. HW only sampled 3 times in 2008.

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 Laboratory site. Basins HN, HZ, HT-W, and HT-E receive runoff from the Collider–Accelerator complex. Basin HO receives runoff from the Brookhaven Graphite Research Reactor (BGRR) and High Flux Beam Reactor (HFBR) areas. Basin CSF receives runoff from the CSF area and along Cornell Avenue east of Railroad Avenue on site. Basin HW receives runoff from the former warehouse area, and HW-M receives runoff from the fenced area at the former HWMF.

Stormwater runoff at the Laboratory typically has elevated levels of inorganics and low pH. The inorganics are attributable to high sediment content in stormwater (inorganics occur naturally in native soil). In an effort to further improve 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, conducting an aggressive maintenance and inspection program, implementing erosion control measures during soil disturbance activities, and restoring these areas when operations cease. Soil samples are also routinely collected from the recharge basins to ensure these discharges are not compromising the quality of the basins. These data are reported in Chapter 6.

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

ANALYTE		HN (RHIC)	HO (AGS)	HS (s)	HT-W (Linac)	HT-E (AGS)	HW (s)	CSF (s)	HZ (s)	NYSDEC Effluent Standard	Typical MDL
		Recharge Basin									
No. of samples		4	4	4	4	4	4	4	4		
pH (SU)	*min.*	7.2	7.2	7.1	7.4	7.5	7	7	7.1	6.5 - 8.5	NA
	max.	7.5	7.6	7.7	7.8	7.9	8.4	8.4	7.9		
Conductivity (µS/cm)	*min.*	59	103	60	101	63	38	20	54	SNS	NA
	max.	295	170	244	200	152	81	70	224		
	avg.	141	128	134	160	113	54	49	163		
Temperature (ºC)	*min.*	5.2	11.5	3.8	4.7	4.0	1.9	2.4	8.3	SNS	NA
	max.	10.5	27.8	17.2	11.4	11.2	24.1	23.5	24.1		
	avg.	7.0	18.6	7.4	7.3	7.6	12.2	13.7	14.0		
Dissolved oxygen (mg/L)	*min.*	10.3	7.7	8.9	8.6	9.3	8.2	8.1	8.1	SNS	NA
	max.	11.3	10.7	14.3	14.2	14.3	15.3	15.0	12.3		
	avg.	10.8	9.6	11.1	11.8	11.2	10.8	11.0	10.7		
Chlorides (mg/L)	*min.*	5.4	12.2	3.3	24.2	3.6	0.8	0.9	5.1	500	4
	max.	39.1	34.7	43.1	32.3	24.5	9.5	14.9	36.8		
	avg.	19.8	24.2	26.6	28.2	12.0	4.0	5.2	26.4		
Sulfates (mg/L)	*min.*	3.1	7.5	3.7	9.2	2.8	1.1	0.6	4.4	500	4
	max.	11.2	10.5	14.0	10.9	6.4	6.7	4.3	10.5		
	avg.	6.7	9.0	8.8	9.8	4.3	3.6	2.2	8.9		
Nitrate as nitrogen (mg/L)	*min.*	0.3	0.3	0.0	0.3	0.2	0.1	0.1	0.1	10	1
	max.	0.4	0.9	0.8	0.4	0.5	0.5	0.3	0.5		
	avg.	0.4	0.6	0.3	0.3	0.4	0.2	0.2	0.3		

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

5.5 PECONIC RIVER SURVEILLANCE

Several locations are monitored along the Peconic River to assess the overall water quality of the river and assess 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 regularly sampled in 2008. A sampling station along the Carmans River (HH) was also monitored as a geographic control location, not affected by Laboratory operations or within the Peconic River watershed. All locations were routinely monitored for radiological and nonradiological parameters. The sampling stations are located as follows:

Upstream sampling stations

- HY, on site immediately east of the William Floyd Parkway
- HV, on site just east of the 10:00 o'clock Experimental Hall in the RHIC Ring
- HE, on site approximately 20 feet upstream of the STP outfall (EA)

Downstream sampling stations

- HM-N, on site 0.5 mile downstream of the STP outfall

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

METAL		Recharge Basin: HN (RHIC)		HO (AGS)		HS (stormwater)		HT-E (AGS)		HT-W (Linac)		HW (stormwater)		CSF (stormwater)		HZ (stormwater)		NYSDEC Effluent Limit or AWQS	Typical MDL
	Total (T) or Filtered (F)	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F		
	No. of samples	4	3	4	2	4	3	4	3	4	3	4	2	4	3	4	3		
Ag Silver (µg/L)	*min.*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	50	2.0
	max.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
	avg.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
Al Aluminum (µg/L)	*min.*	<50.0	<50.0	<50.0	<50.0	143.0	<50.0	56.6	<50.0	<50.0	<50.0	122.0	70.3	109.0	<50.0	<50.0	<50.0	2000	50
	max.	194.0	<50.0	70.3	< 50.0	249.0	< 50.0	165.0	<50.0	57.1	< 50.0	12700.0	74.0	3710.0	66.8	< 50.0	< 50.0		
	avg.	92.4	<50.0	< 50.0	< 50.0	193.5	< 50.0	124.9	<50.0	<50.0	< 50.0	3682.4	72.2	1637.8	<50.0	< 50.0	< 50.0		
As Arsenic (µg/L)	*min.*	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	50	5.0
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Ba Barium (µg/L)	*min.*	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	2000	20
	max.	26.3	<20.0	24.4	24.2	32.2	29.9	<20.0	<20.0	24.4	21.9	129.0	<20.0	<20.0	<20.0	25.3	23.6		
	avg.	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	22.2	<20.0	33.8	<20.0	<20.0	<20.0	<20.0	<20.0		
Be Beryllium (µg/L)	*min.*	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	SNS	2.0
	max.	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	avg.	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
Cd Cadmium (µg/L)	*min.*	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	10	2.0
	max.	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	2.4	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	avg.	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
Co Cobalt (µg/L)	*min.*	0.3	0.7	< 5.0	0.3	< 5.0	0.5	2.3	0.6	0.8	0.6	0.8	3.5	0.9	2.0	< 5.0	0.5	5	0.1
	max.	< 5.0	1.9	< 5.0	2.2	< 5.0	1.9	< 5.0	2.1	< 5.0	2.4	7.4	< 5.0	3.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	1.1	< 5.0	1.2	< 5.0	1.1	< 5.0	1.2	< 5.0	1.2	< 5.0	< 5.0	1.7	< 5.0	< 5.0	< 5.0		
Cr Chromium (µg/L)	min.	<5.0	<5.0	<5.0	<5.0	<5.0	7.4	<5.0	<5.0	<5.0	6.7	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	100	5.0
	max.	< 10.0	7.7	< 10.0	< 10.0	16.0	16.2	< 10.0	< 10.0	< 10.0	< 10.0	24.5	< 10.0	7.4	< 10.0	< 10.0	< 10.0		
	avg.	< 10.0	<5.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	9.2	< 10.0	5.1	< 10.0	< 10.0	< 10.0		

(continued on next page)

Table 5-6. Metals Analysis of Water Samples from BNL On-Site Recharge Basins *(continued)*.

METAL		HN (RHIC)		HO (AGS)		HS (stormwater)		HT-E (AGS)		HT-W (Linac)		HW (stormwater)		CSF (stormwater)		HZ (stormwater)		NYSDEC Effluent Limit or AWQS	Typical MDL
	Total (T) or Filtered (F)	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F		
	No. of samples	4	3	4	2	4	3	4	3	4	3	4	2	4	3	4	3		
Cu Copper (µg/L)	*min.*	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	11.5	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	1000	10.0
	max.	19.3	14.7	25.6	22.0	<10.0	<10.0	15.2	<10.0	36.8	13.9	54.6	<10.0	16.0	<10.0	65.0	61.2		
	avg.	16.4	11.4	11.2	10.0	<10.0	<10.0	13.8	<10.0	22.2	<10.0	17.3	<10.0	10.1	<10.0	27.7	25.5		
Fe Iron (mg/L)	*min.*	0.2	<0.05	<0.05	<0.05	0.2	<0.05	0.2	0.1	0.1	<0.05	0.1	0.1	0.1	<0.05	<0.05	<0.05	0.6	0.05
	max.	0.4	0.1	0.2	0.1	0.6	0.2	0.4	0.1	0.1	< 0.05	15.4	0.1	3.9	0.1	0.1	0.1		
	avg.	0.3	0.1	0.1	< 0.05	0.3	0.1	0.3	0.1	0.1	< 0.05	4.3	0.1	1.8	0.1	0.1	<0.05		
Hg Mercury (µg/L)	*min.*	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	<0.2	1.4	0.2
	max.	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2		
	avg.	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2		
Mn Manganese (µg/L)	*min.*	11.3	5.9	<5.0	<5.0	9.5	<5.0	10.0	9.4	15.8	5.8	<5.0	12.8	6.3	<5.0	<5.0	<5.0	600	5.0
	max.	40.6	13.6	19.6	20.2	19.8	6.4	463.0	31.1	168.0	17.7	265.0	17.3	56.7	10.5	12.8	11.9		
	avg.	22.1	9.0	13.6	11.1	12.7	5.0	131.6	18.2	55.3	10.3	73.1	15.1	33.0	7.6	8.5	7.7		
Na Sodium (mg/L)	*min.*	4.3	3.9	8.7	9.8	2.8	2.5	3.3	4.2	14.7	15.0	0.9	2.0	1.3	1.2	3.1	3.1	SNS	0.25
	max.	31.3	17.5	31.2	29.9	27.6	28.4	17.3	11.3	29.7	26.0	7.1	3.4	10.8	3.3	21.2	20.9		
	avg.	16.9	10.3	17.1	17.6	16.7	15.8	10.9	8.9	19.5	20.0	3.0	2.7	3.5	2.2	16.1	15.8		
Ni Nickel (µg/L)	*min.*	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	200	10
	max.	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	13.7	<10.0	<10.0	<10.0	19.8	<10.0	<10.0	<10.0	<10.0	<10.0		
	avg.	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0		
Pb Lead (µg/L)	*min.*	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	< 3.0	< 3.0	<3.0	< 3.0	<3.0	< 3.0	< 3.0	50	3.0
	max.	4.1	< 3.0	< 3.0	< 3.0	<3.0	< 3.0	<3.0	< 3.0	7.1	< 3.0	129.0	<3.0	26.0	< 3.0	42.7	38.6		
	avg.	<3.0	< 3.0	< 3.0	< 3.0	<3.0	< 3.0	<3.0	< 3.0	< 3.0	< 3.0	33.1	<3.0	13.7	< 3.0	14.7	13.0		
Sb Antimony (µg/L)	*min.*	<5.0	<5.0	<5.0	< 5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6	5.0
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Se Selenium (µg/L)	*min.*	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	20	5.0
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		

(continued on next page)

Table 5-6. Metals Analysis of Water Samples from BNL On-Site Recharge Basins *(concluded).*

METAL		Recharge Basin: HN (RHIC)		HO (AGS)		HS (stormwater)		HT-E (AGS)		HT-W (Linac)		HW (stormwater)		CSF (stormwater)		HZ (stormwater)		NYSDEC Effluent Limit or AWQS	Typical MDL
	Total (T) or Filtered (F)	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F		
	No. of samples	4	3	4	2	4	3	4	3	4	3	4	2	4	3	4	3		
Tl Thallium (µg/L)	*min.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	SNS	5.0
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	<5.0	<5.0	<5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	<5.0	<5.0	<5.0	< 5.0	< 5.0		
V Vanadium (µg/L)	*min.*	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	SNS	5.0
	max.	11.2	< 5.0	10.7	16.9	< 5.0	< 5.0	16.4	< 5.0	16.3	< 5.0	34.0	< 5.0	14.8	10.2	< 5.0	9.0		
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	10.3	< 5.0	9.3	7.6	< 5.0	< 5.0		
Zn Zinc (µg/L)	*min.*	31.6	49.3	<10.0	<10.0	17.9	<10.0	28.3	18.8	15.3	10.3	< 10.0	11.4	<10.0	<10.0	18.4	19.0	5000	10
	max.	60.4	50.1	50.3	47.6	34.2	26.7	52.5	35.6	54.9	42.7	316.0	101.0	55.4	12.4	62.7	61.4		
	avg.	47.9	49.7	22.4	20.8	26.5	18.3	43.0	25.0	33.3	25.4	88.8	56.2	33.3	9.0	39.8	40.1		

Notes:
See Figure 5-6 for the locations of recharge basins/outfalls.
AGS = Alternating Gradient Synchrotron
AWQS = Ambient Water Quality Standards
CSF = Central Steam Facility
Linac = Linear Accelerator
MDL = Minimum Detection Limit
NYSDEC = New York State Department of Environmental Conservation
RHIC = Relativistic Heavy Ion Collider
SNS = Effluent Standard Not Specified

- HM-S, on site on a typically dry tributary of the Peconic River
- HQ, on site 1.2 miles downstream of the 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.
- Forge Pond, off site
- Swan Pond, off site, not within the influence of BNL discharges

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 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 2008 are summarized in Table 5-7. Radiological analysis of water samples collected both upstream and downstream of the STP discharge and from background locations had very low concentrations of gross alpha and gross beta activity. The maximum concentration

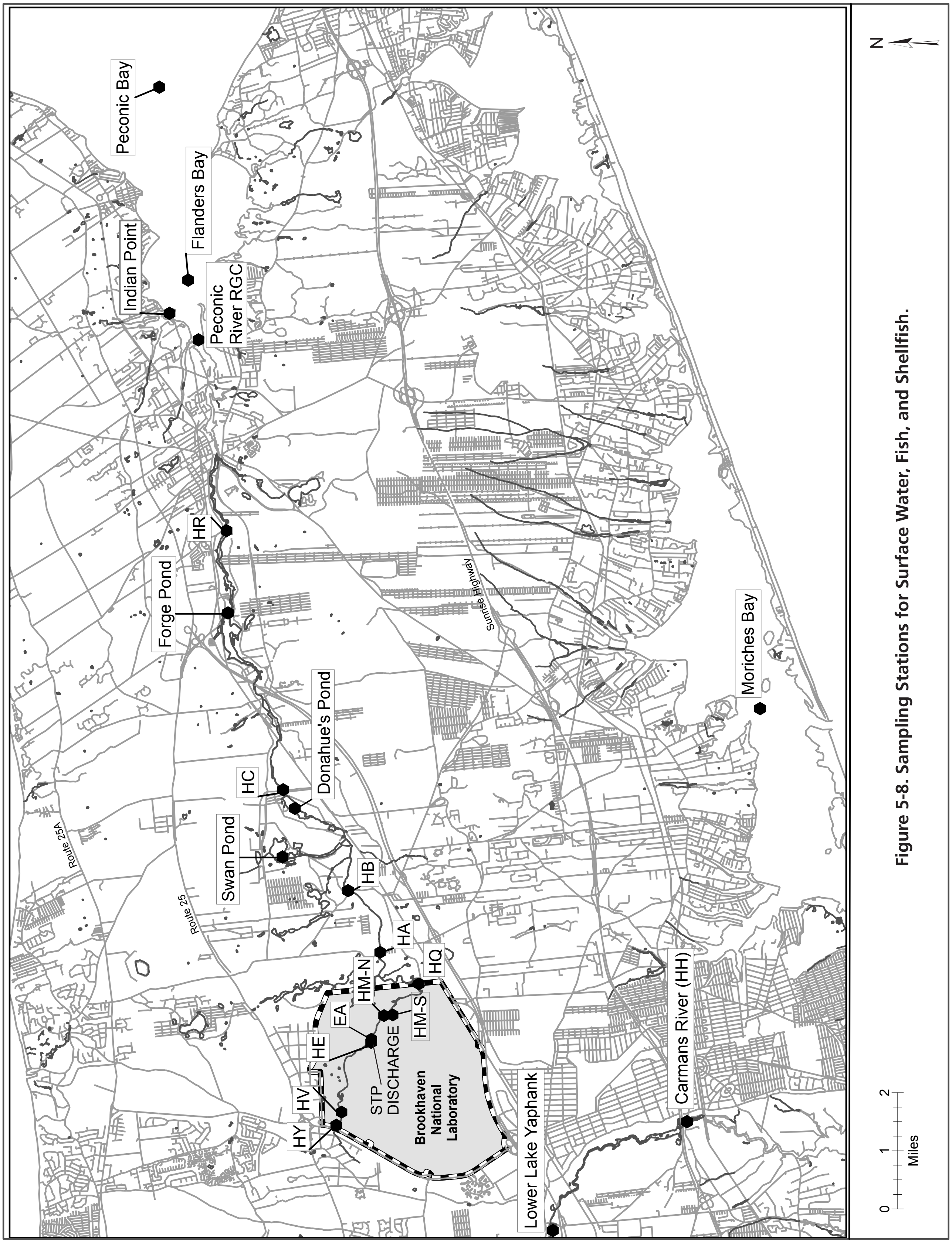

Figure 5-8. Sampling Stations for Surface Water, Fish, and Shellfish.

of gross alpha activity was found in the sections of the Peconic River upstream of the STP and the maximum gross beta was found at the off-site control location (Station HH). The average concentrations were similar at all locations. All detected levels were below the applicable New York State Drinking Water Status (NYS DWS). No gamma-emitting radionuclides attributable to Laboratory operations were detected either upstream or downstream of the STP. Tritium was detected in a single water sample collected at Swan Pond, an area of the Peconic not influenced by BNL's discharges, at a concentration of 540 ± 240 pCi/L. Due to the low level of detection and the high uncertainty, the data may be a false positive. Tritium was not detected in the upstream nor downstream sections of the Peconic, which is consistent with the fact that tritium was not detected in the STP discharge for the entire year.

Monitoring for strontium-90 (Sr-90) was performed at all Peconic River and Carmans River stations in 2008. Strontium-90 was detected in one of four samples collected at Stations HQ and at Donahue's Pond, at levels of 0.72 ± 0.38 and 3.87 ± 0.57 pCi/L, respectively. All concentrations detected were much less than the NYS DWS of 8 pCi/L.

5.5.2 Peconic River – Nonradiological Analyses

River water samples collected in 2008 were analyzed for water quality parameters (pH, temperature, conductivity, and dissolved oxygen), anions (chlorides, sulfates, and nitrates), metals, and VOCs. As with other surface water monitoring results, acetone was the only organic contaminant detected at concentrations above the MDL, in samples collected from the Peconic River and Carmans River. The maximum concentration of acetone reported for 2008 was 15 µg/L, which was found at station HE (i.e., upstream of the STP discharge). The inorganic analytical data for the Peconic River and Carmans River samples

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

Sampling Station		Gross Alpha (pCi/L)	Gross Beta	Tritium	Sr-90
Peconic River					
HY (headwaters) on site, west of the RHIC ring	*N*	4	4	4	4
	max.	< 3.3	2.7 ± 1.1	< 290	< 0.41
	avg.	0.68 ± 0.21	1.23 ± 1.09	27.5 ± 78.55	-0.12 ± 0.31
HV (headwaters) on site, inside the RHIC ring	*N*	4	4	4	NS
	max.	3.5 ± 1.3	2.72 ± 0.83	< 320	
	avg.	1.37 ± 1.4	2.2 ± 0.45	7.5 ± 91.36	
HE upstream of STP outfall	*N*	4	4	4	4
	max.	0.83 ± 0.58	2.2 ± 1	< 280	< 0.39
	avg.	0.6 ± 0.16	1.93 ± 0.36	22.5 ± 110.98	0.28 ± 0.11
HM-N downstream of STP, on site	*N*	12	12	12	4
	max.	3.5 ± 1.2	6.2 ± 1.3	< 320	< 0.34
	avg.	1.09 ± 0.5	5.25 ± 0.45	30 ± 63.28	-0.06 ± 0.15
HM-S tributary, on site	*N*	2	2	2	2
	max.	< 1	1.57 ± 0.71	< 330	< 0.43
	avg.	0.7 ± 0.08	1.2 ± 0.73	60 ± 19.6	0.1 ± 0.07
HQ downstream of STP, at BNL site boundary	*N*	5	5	5	3
	max.	1.08 ± 0.7	6.3 ± 1.3	< 340	0.72 ± 0.38
	avg.	0.58 ± 0.4	4.14 ± 1.12	36 ± 102.71	0.43 ± 0.3
HA off site	*N*	4	4	4	4
	max.	1.12 ± 0.78	1.73 ± 0.8	< 250	< 0.67
	avg.	0.55 ± 0.42	0.94 ± 0.54	44 ± 64.19	0.24 ± 0.15
Donahue's Pond off site	*N*	4	4	4	4
	max.	0.98 ± 0.59	1.81 ± 0.98	< 250	3.87 ± 0.57
	avg.	0.46 ± 0.4	1.2 ± 0.42	7.5 ± 92.06	1.09 ± 1.82
Forge Pond off site	*N*	4	4	4	4
	max.	< 0.81	3.2 ± 1.1	< 260	< 0.45
	avg.	0.2 ± 0.19	1.97 ± 1	17.5 ± 103.21	-0.02 ± 0.09
Carmans River					
HH control location, off site	*N*	4	4	4	4
	max.	1.76 ± 0.94	9.5 ± 9.7	< 250	< 0.44
	avg.	0.87 ± 0.64	3.34 ± 4.02	-10 ± 188.17	0.22 ± 0.18
Swan Pond control location, off site	*N*	4	4	4	4
	max.	< 1.1	3.2 ± 1.1	540 ± 240	< 0.49
	avg.	0.54 ± 0.23	2 ± 1.25	192.5 ± 232.93	0.17 ± 0.15
SDWA Limit (pCi/L)		15	(a)	20,000	8

Notes:
See Figure 5-8 for the locations of sampling stations.
All values reported with a 95% confidence interval.
Negative numbers occur when the measured values are lower than background (see Appendix B).
To convert values from pCi to Bq, divide by 27.03.
(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 cannot be calculated for the values in the table.
N = Number of samples analyzed
NS = Not Sampled for this analyte
RHIC = Relativistic Heavy Ion Collider
SDWA = Safe Drinking Water Act
STP = Sewage Treatment Plant

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

Analyte		Peconic River Station Locations						Donahue's Pond	Forge Pond	Swan Pond	(Control) HH	NYSDEC Effluent Standard	Typical MDL
		HY	HE	HM-N	HM-S	HQ	HA						
	No. of samples	4	4	12	2	5	4	4	4	4	4	6.5--8.5	NA
pH (SU)	*min.*	3.9	6.7	6	3.8	6.5	6.2	6.3	6.6	6.6	6.5		
	max.	7.2	7.9	7.2	4.6	7.6	6.9	7.2	7.1	6.9	7.2		
Conductivity (µS/cm)	*min.*	50	76	197	55	101	59	36	97	45	151	SNS	NA
	max.	672	126	499	84	266	64	70	132	89	189		
	avg.	215	103	285	70	188	62	58	116	76	173		
Temperature (ºC)	*min.*	3.8	5.2	4	3.0	3.1	3.1	4.1	5.0	2.2	3.9	SNS	NA
	max.	20.3	7.3	22	8.2	14.9	25.2	26.0	27.5	25.4	22.6		
	avg.	11.8	6.1	9.3	5.6	9.0	11.7	12.8	13.6	11.4	11.6		
Dissolved oxygen (mg/L)	*min.*	7.9	8.9	5.7	10.3	6.6	6.0	5.3	7.1	7.0	8.2	>4.0	NA
	max.	10.4	13.8	13	10.5	15.6	12.8	11.9	12.9	13.4	12.9		
	avg.	8.9	10.6	9.2	10.4	11.9	10.1	9.5	9.4	10.4	11.3		
Chlorides (mg/L)	*min.*	3.0	10.8	32.1	4.3	12.8	5.9	9.2	16.2	10.4	28.9	250(a)	4.0
	max.	215.0	15.6	101	6.3	55.2	9.5	10.4	21.0	12.2	31.5		
	avg.	58.0	13.4	52.29	5.3	32.6	7.7	10.0	18.2	11.1	30.4		
Sulfates (mg/L)	*min.*	1.4	4.9	12.8	2.5	6.5	3.7	<4	10.4	5.9	11.8	250(a)	4.0
	max.	7.2	17.9	20.4	7.3	11.8	7.4	7.1	12.2	9.1	13.0		
	avg.	4.1	9.9	15.88	4.9	10.2	5.6	4.8	11.1	7.8	12.3		
Nitrate as nitrogen (mg/L)	*min.*	<1.0	<1.0	0.83	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	10(a)	1.0
	max.	<1.0	<1.0	6.9	<1.0	5.4	<1.0	<1.0	<1.0	<1.0	2.0		
	avg.	<1.0	<1.0	3.54	<1.0	1.5	<1.0	<1.0	<1.0	<1.0	1.6		

Notes:
See Figure 5-6 for the locations of recharge basins/outfalls.
(a) Since there are no NYSDEC Class C surface Ambient Water Quality Standards (AWQS) for these compounds, the AWQS for groundwater is provided, if specified.
Donahue's Pond = Peconic River, off site
Forge Pond = Peconic River, off site
HA = Peconic River, off site
HE = Peconic River, upstream of STP Outfall
HH = Carmans River control location, off site
HM-N = Peconic River on site, downstream of STP
HM-S = Peconic River tributary, on site
HQ = Peconic River, downstream of STP at BNL site boundary
HY = Peconic River headwaters, on site, east of Wm Floyd Pkwy.
MDL = Minimum Detection Limit
NA = Not Applicable
NYSDEC = New York State Department of Environmental Conservation
SNS = Effluent Standard Not Specified

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

METAL		Peconic River Locations: HY		HE		HM-N		HM-S		HQ		HA		DP		Swan Pond		Forge Pond		Control HH		NYSDEC AWQS	Typical MDL
Total or Dissolved		T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D		
No. of samples		4	4	5	3	12	7	2	2	5	4	4	4	4	4	4	4	4	4	4	4		
Ag (I) Silver (µg/L)	*min.*	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	0.1	2
	max.	< 20.0	< 20.0	< 2.0	< 2.0	11.5	< 2.0	< 2.0	< 2.0	3.1	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	avg.	< 20.0	< 20.0	< 2.0	< 2.0	3.7	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
Al (I) Aluminum (µg/L)	*min.*	432.0	127.0	124.0	76.7	216.0	< 50.0	514.0	490.0	284.0	60.7	91.0	< 50.0	52.8	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	13.3	100	50
	max.	729.0	683.0	308.0	218.0	2110.0	116.0	630.0	587.0	1840.0	313.0	107.0	74.7	65.3	50.2	999.0	472.0	57.3	< 50.0	83.9	< 50.0		
	avg.	585.5	356.8	211.2	133.2	616.3	50.2	572.0	538.5	777.2	158.0	101.0	58.5	60.5	< 50.0	337.0	138.2	< 50.0	< 50.0	51.3	< 50.0		
As (D) Arsenic (µg/L)	*min.*	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	150	5
	max.	< 50.0	< 50.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 50.0	< 50.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Ba Barium (µg/L)	*min.*	5.1	3.2	17.7	17.4	14.8	12.0	10.6	10.4	9.6	7.4	7.3	6.5	9.1	8.2	7.5	5.8	11.8	10.2	30.8	29.1	SNS	1.8
	max.	32.4	33.3	25.1	26.2	47.2	18.3	12.2	11.8	23.7	9.3	14.7	12.8	20.5	18.3	13.6	9.7	28.1	24.6	39.3	33.0		
	avg.	15.1	13.7	20.4	21.8	24.7	15.1	11.4	11.1	13.6	8.6	10.2	9.2	12.8	11.4	10.4	8.0	18.3	16.6	34.1	31.3		
Be (AS) Beryllium (µg/L)	*min.*	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	11	2
	max.	< 20.0	< 20.0	< 2.0	< 2.0	< 10.0	< 10.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	avg.	< 20.0	< 20.0	< 2.0	< 2.0	< 10.0	< 10.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
Cd (D) Cadmium (µg/L)	*min.*	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	0.1	< 2.0	1.1	2
	max.	< 20.0	< 20.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	avg.	< 20.0	< 20.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
Co (AS) Cobalt (µg/L)	*min.*	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	5	5
	max.	< 50.0	< 50.0	< 5.0	< 5.0	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 50.0	< 50.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Cr (I) Chromium (µg/L)	*min.*	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	34	5
	max.	< 100.0	< 100.0	< 10.0	< 10.0	< 10.0	< 5.0	< 5.0	5.3	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
	avg.	< 100.0	< 100.0	< 10.0	< 10.0	< 10.0	< 5.0	< 5.0	< 5.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
Cu (D) Copper (µg/L)	*min.*	2.5	1.9	0.8	0.8	20.8	15.7	1.2	1.3	11.6	6.8	1.3	0.9	0.7	1.0	1.1	0.9	0.7	0.5	0.9	1.5	4	10
	max.	< 100.0	< 100.0	1.3	1.4	118.0	35.6	1.4	1.4	21.8	19.3	1.6	1.3	< 10.0	< 10.0	3.2	1.4	< 10.0	<10.0	< 10.0	< 10.0		
	avg.	< 100.0	< 100.0	1.0	1.1	51.1	25.9	1.3	1.4	17.7	11.1	1.5	1.1	< 10.0	< 10.0	2.1	1.1	< 10.0	< 10.0	< 10.0	< 10.0		
Fe (AS) Iron (mg/L)	*min.*	0.2	0.1	0.6	0.3	0.2	0.04	0.2	0.2	0.2	0.1	0.3	0.2	0.4	0.3	0.1	0.04	0.5	0.2	0.3	0.1	0.3	0.075
	max.	0.7	0.6	3.7	2.3	1.8	< 0.25	0.3	0.3	1.3	0.3	2.0	0.9	3.3	2.1	0.2	0.2	0.9	0.7	0.6	0.3		
	avg.	0.5	0.3	1.8	1.2	0.7	< 0.25	0.2	0.2	0.6	0.2	1.0	0.6	1.5	0.9	0.2	0.1	0.7	0.4	0.4	0.2		
Hg (D) Mercury (µg/L)	*min.*	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.2	0.2
	max.	< 0.2	< 0.2	< 0.2	< 0.2	1.1	< 0.2	< 0.2	< 0.2	0.4	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2		
	avg.	< 0.2	< 0.2	< 0.2	< 0.2	0.3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2		

(continued on next page)

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

METAL		Peconic River Locations														Swan Pond		Forge Pond		Control HH		NYSDEC AWQS	Typical MDL
		HY		HE		HM-N		HM-S		HQ		HA		DP									
Total or Dissolved		T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D		
No. of samples		4	4	5	3	12	7	2	2	5	4	4	4	4	4	4	4	4	4	4	4		
Mn Manganese (µg/L)	*min.*	8.1	2.7	40.7	49.3	4.0	2.6	33.0	35.0	15.6	11.2	24.3	22.2	30.0	26.6	36.1	14.3	22.9	14.6	55.9	52.5	SNS	2
	max.	59.6	64.1	355.0	361.0	314.0	36.5	54.0	57.4	56.6	37.9	104.0	90.9	305.0	274.0	140.0	76.8	106.0	48.2	118.0	118.0		
	avg.	31.8	32.8	134.5	171.1	52.7	17.0	43.5	46.2	34.0	23.8	46.5	43.2	106.2	97.0	76.2	39.9	57.9	37.0	78.1	73.3		
Na Sodium (mg/L)	*min.*	4.4	4.5	6.7	7.6	21.0	20.7	2.1	2.2	9.5	9.4	4.5	4.4	5.7	5.5	6.2	6.2	9.0	9.0	15.9	15.4	SNS	1
	max.	157.0	152.0	9.0	9.1	72.6	72.2	3.3	3.3	40.3	24.4	6.2	6.5	6.7	6.3	6.8	6.9	11.9	11.4	18.0	18.2		
	avg.	43.2	41.9	7.7	8.3	35.1	36.5	2.7	2.7	22.6	18.3	5.3	5.3	6.1	5.8	6.6	6.5	10.6	10.3	16.6	16.5		
Ni (D) Nickel (µg/L)	*min.*	<1.1	<1.1	<1.1	<1.1	5.0	4.3	<1.1	1.2	3.1	2.9	0.6	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	23	1.1
	max.	< 100.0	< 100.0	1.5	1.9	13.1	7.9	1.3	1.3	6.6	4.4	2.2	<1.1	< 10.0	1.1	2.2	1.1	< 10.0	<1.1	<1.1	<1.1		
	avg.	< 100.0	< 100.0	1.2	1.3	8.2	6.1	1.1	1.3	4.8	3.8	1.1	<1.1	< 10.0	<1.1	1.1	<1.1	< 10.0	<1.1	<1.1	<1.1		
Pb (D) Lead (µg/L)	*min.*	1.5	1.1	0.5	0.5	1.2	0.7	0.8	0.9	1.6	0.7	0.9	0.6	0.9	0.5	0.7	< 3.0	0.6	0.5	0.6	< 3.0	1.4	3
	max.	< 30.0	< 30.0	< 3.0	< 3.0	9.5	< 3.0	1.6	1.5	6.1	1.3	1.6	< 3.0	1.7	< 3.0	2.3	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0		
	avg.	< 30.0	< 30.0	< 3.0	< 3.0	3.3	< 3.0	1.2	1.2	2.7	0.9	1.1	< 3.0	1.2	< 3.0	1.5	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0		
Sb Antimony (µg/L)	*min.*	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	2.1	SNS	5
	max.	< 50.0	< 50.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 50.0	< 50.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Se (D) Selenium (µg/L)	*min.*	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	4.6	5
	max.	< 50.0	< 50.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 50.0	< 50.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Tl (AS) Thallium (µg/L)	*min.*	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	8	5
	max.	< 50.0	< 50.0	< 5.0	< 5.0	6.2	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 50.0	< 50.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
V (AS) Vanadium (µg/L)	*min.*	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	2.5	2.6	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	14	5
	max.	< 50.0	< 50.0	16.1	16.2	7.3	< 5.0	7.6	12.5	10.4	< 5.0	17.8	15.4	16.8	14.7	15.8	9.8	16.1	15.8	10.2	15.6		
	avg.	< 50.0	< 50.0	< 5.0	5.4	< 5.0	< 5.0	< 5.0	6.3	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Zn (D) Zinc (µg/L)	*min.*	12.6	10.8	< 10.0	11.1	35.0	22.5	11.3	12.2	24.1	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	34	10
	max.	< 100.0	< 100.0	16.8	17.3	133.0	76.7	20.5	18.4	83.0	34.6	11.9	< 10.0	< 10.0	< 10.0	36.4	18.8	< 10.0	< 10.0	< 10.0	10.5		
	avg.	< 100.0	< 100.0	11.2	14.0	62.1	46.3	15.9	15.3	42.5	24.9	< 10.0	< 10.0	< 10.0	< 10.0	17.4	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		

Notes:
See Figure 5-8 for the locations of sampling stations.
AWQS = Ambient Water Quality Standards
AS = Acid Soluble
AS = Acid Soluble
D = Dissolved
DP = Donahue's Pond
SNS = Effluent Standard Not Specified for these elements in Class C Surface Waters
T = Total

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. The data were also consistent with water samples collected 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 and sodium were highest at Station HY, which is immediately east of the William Floyd Parkway and likely impacted by road salting operations. There are no NYS AWQS imposed for chloride or sulfates in discharges to surface water; however, NYSDEC imposes a 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 3.8 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 2008, the BNL 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 from locations both upstream and downstream of the STP discharge showed that aluminum, iron, and vanadium were present in concentrations that exceeded NYS AWQS. Aluminum, iron, and vanadium are detected throughout the Peconic and Carmans Rivers at concentrations that exceed the NYS AWQS in both the filtered and unfiltered fractions. Iron and aluminum are found in high concentrations in native Long Island soil and, for iron, at high levels in groundwater. Vanadium also is found in soils. The low pH of groundwater and precipitation contribute to the dissolution of these elements. Copper, lead, silver, and zinc were also found in samples collected immediately downstream of the STP discharge (Station HM-N) at concentrations greater than the NYS AWQS. The concentrations detected were consistent with the concentrations found in the STP discharge and, in most instances, were within the BNL SPDES permit limits. The NYS AWQS limits for copper, lead, and zinc are very restrictive; consequently, the NYS-granted SPDES permit allows higher limits, provided toxicity testing shows no impact to aquatic organisms. Filtration of the samples reduced concentrations of most metals to below the NYS AWQS, indicating that most detections were due to sediment carryover. Mercury was detected in several samples collected downstream of the STP at concentrations greater than the MDL. Since the concentrations in the Peconic River were much higher than the levels detected in the STP discharge (see Table 5-3), the river is a contributor of mercury. Further discussion of mercury in the Peconic River sediment, water, and fish samples is found in Chapter 6.

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