Water Quality 5

Wastewater generated from Brookhaven National Laboratory 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 the environment are protected.

Analytical data for 2011 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 New York State Drinking Water Standards (NYS DWS). During 2011, tritium was detected in the STP effluent only once at a concentration just above the minimum detectable activity (320 ± 130 pCi/L), which is less than 2 percent of the drinking water standard. Analysis of the STP effluent continued to show no detection of cesium-137, strontium-90, or other gamma-emitting nuclides attributable to Laboratory operations. Similarly, there were no radionuclides detected along the Peconic River in 2011 that were attributable to BNL operations.

Nonradiological monitoring of the STP effluent showed that, except for isolated incidents of noncompliance, organic and inorganic parameters were within State Pollutant Discharge Elimination System (SPDES) effluent limitations or other applicable standards.

Examination of radiological analytical data for discharges to recharge basins showed that the average concentrations of gross alpha and beta activity were within typical ranges and no gamma-emitting radionuclides were detected in 2011. Tritium was detected in a single sample collected at Basin HT-W at a very low level, (520 ± 160 pCi/L). This basin receives discharges from the Collider-Accelerator complex. Review of organic data shows that disinfection byproducts are detected at very low concentrations, just above the contract analytical laboratory's method detection limit, 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) were detected; however, their presence is due primarily to sediment run-off in stormwater discharges.

Radiological data from Peconic River surface water sampling in 2011 show that the average concentrations of gross alpha and gross beta activity from off-site locations and control locations were indistinguishable from BNL on-site levels, and all detected levels were below the applicable NYS DWS. Tritium was detected in a single water sample collected downstream of the STP discharge at Station HM-N (380 ± 150 pCi/L). Due to the low level of detection, high uncertainty, and the fact that tritium was not detected in the STP discharge during this same period, the detection is questionable. Inorganic data from Peconic River samples collected upstream, downstream, and at control locations demonstrated that elevated amounts of aluminum and iron detected in the river are associated with natural sources. Concentrations of silver, copper, lead, and zinc detected were consistent with concentrations found in the STP discharge and were within BNL SPDES permit limits.

5.1 SURFACE WATER MONITORING PROGRAM

Treated wastewater from the Laboratory's STP is discharged into the headwaters of the Peconic River. This discharge is permitted under the New York State Department of Environmental Conservation (NYSDEC) SPDES Program. Effluent limits are based on water quality standards established by NYSDEC, as well as historic 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 5-7), 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. There was very little off-site flow in 2011. Flow was only persistent from early March to the end of May. 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 BNL's SPDES permit. 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

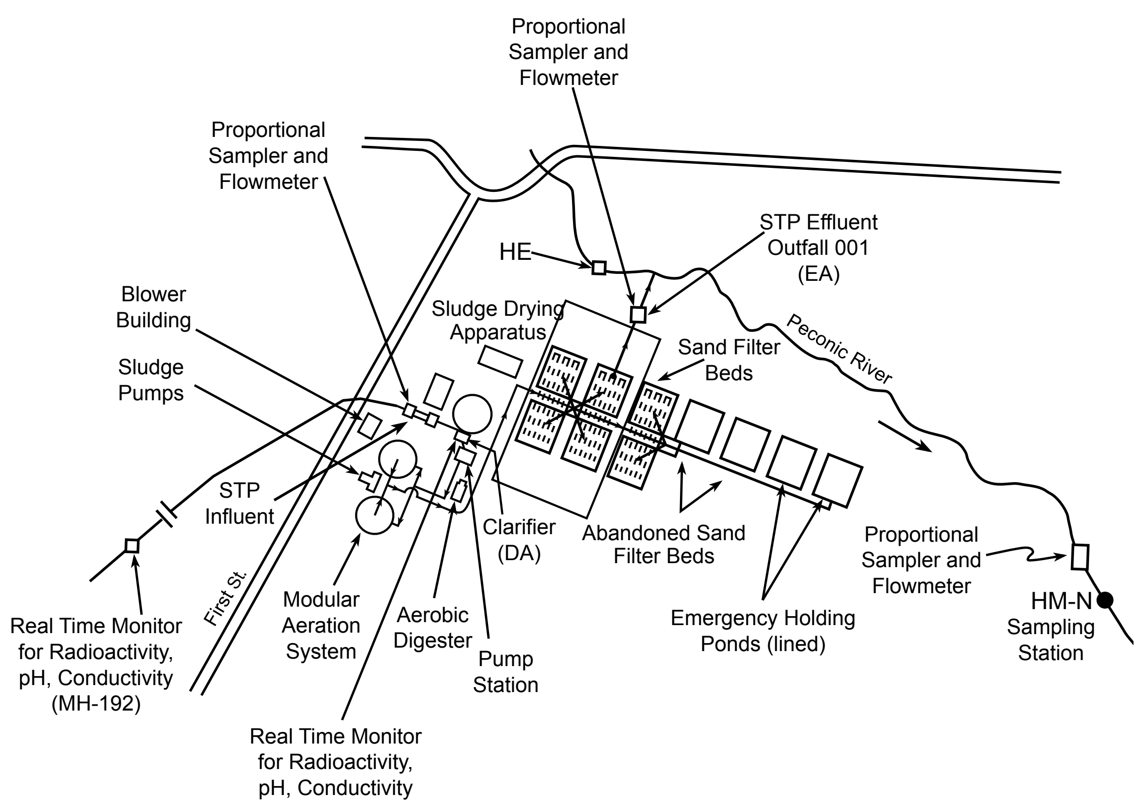

Figure 5-1. Schematic of BNL's Sewage Treatment Plant (STP).

aeration process, 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 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.

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 2011, there were no instances that required diversion of wastewater to the hold-up ponds.

Solids separated in the clarifier are pumped to aerobic digesters for continued biological solids reduction and sludge thickening. Once the sludge in the aerobic digester reaches a solids content of 6 percent, the sludge is sampled to ensure it meets the waste acceptance criteria for disposal at the Suffolk County Department of Public Works Sewage Treatment Facility at Bergen Point, in West Babylon, New York.

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 2011, 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 may receive an annual dose greater than 4 mrem from radionuclides that are beta or photon emitters, which includes 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: 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

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	3.73E+07	< 110	<MDL	35.6 ± 5.2	8.7 ± 5.7	34.9 ± 3.4	10.0 ± 4.7
	effluent	2.39E+07	< 99	<MDL	3.6 ± 1.6	0.9 ± 0.5	23.4 ± 2.5	5.8 ± 2.9
February	influent	3.28E+07	< 110	<MDL	12.4 ± 6.9	3.2 ± 2.2	12.8 ± 4.0	6.9 ± 1.7
	effluent	2.72E+07	< 82	<MDL	< 1.9	0.6 ± 0.2	8.4 ± 1.3	5.0 ± 0.8
March	influent	3.59E+07	< 230	<MDL	8.8 ± 3.8	3.5 ± 1.5	15.2 ± 3.2	7.7 ± 2.0
	effluent	2.69E+07	< 220	<MDL	2.9 ± 1.7	1.0 ± 0.6	8.5 ± 1.3	6.3 ± 0.7
April	influent	4.37E+07	< 180	<MDL	7.8 ± 3.5	2.2 ± 1.3	12.1 ± 2.2	6.2 ± 1.5
	effluent	2.82E+07	< 170	<MDL	1.6 ± 1.7	0.6 ± 0.3	5.8 ± 1.1	4.8 ± 0.3
May	influent	3.88E+07	< 200	<MDL	12.6 ± 3.7	2.4 ± 2.0	21.7 ± 3.0	6.6 ± 3.0
	effluent	2.93E+07	< 200	<MDL	< 2.2	0.6 ± 0.2	7.0 ± 1.3	4.6 ± 0.6
June	influent	4.24E+07	< 170	<MDL	5.7 ± 2.3	1.8 ± 1.1	12.3 ± 6.2	6.6 ± 1.7
	effluent	2.51E+07	< 160	<MDL	1.8 ± 1.6	0.9 ± 0.3	7.6 ± 1.2	5.4 ± 0.7
July	influent	5.34E+07	< 200	<MDL	2.2 ± 1.5	0.7 ± 0.5	6.6 ± 1.2	4.0 ± 0.8
	effluent	3.75E+07	< 200	<MDL	< 2.4	0.2 ± 0.2	6.6 ± 1.4	4.4 ± 0.7
August	influent	7.18E+07	470 ± 150	<MDL	2.8 ± 1.8	0.5 ± 0.5	6.7 ± 1.2	4.7 ± 0.6
	effluent	4.73E+07	320 ± 130	<MDL	1.7 ± 1.1	0.5 ± 0.4	6.7 ± 1.3	4.7 ± 0.5
September	influent	5.26E+07	< 140	<MDL	< 2.4	0.2 ± 0.3	5.5 ± 1.6	4.6 ± 0.4
	effluent	3.29E+07	< 170	<MDL	< 2.2	0.3 ± 0.2	5.0 ± 1.3	4.1 ± 0.4
October	influent	4.50E+07	< 130	<MDL	33.4 ± 10.0	4.4 ± 4.8	33.9 ± 6.0	10.8 ± 4.1
	effluent	2.95E+07	< 180	<MDL	< 1.5	0.4 ± 0.3	7.6 ± 1.4	5.6 ± 0.5
November	influent	4.42E+07	< 220	<MDL	< 2.6	0.7 ± 0.3	6.0 ± 1.2	4.6 ± 0.7
	effluent	2.57E+07	< 190	<MDL	2.3 ± 1.4	0.7 ± 0.4	5.8 ± 1.2	4.0 ± 0.6
December	influent	3.65E+07	< 190	<MDL	< 1.6	0.5 ± 0.2	8.3 ± 1.5	4.6 ± 1.0
	effluent	2.61E+07	< 180	<MDL	2.4 ± 1.2	0.2 ± 0.4	5.6 ± 1.2	4.1 ± 0.5
Annual Avg.	influent			<MDL		2.4 ± 0.8		6.5 ± 0.7
	effluent			<MDL		0.6 ± 0.1		4.9 ± 0.3
Total Release		**3.60E+08**		**15.1 mCi**		**0.2 mCi**		**1.7 mCi**
Average MDL (pCi/L)				**180**		**1.8**		**1.1**
SDWA Limit (pCi/L)				**20000**		**15**		**50**

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.

alpha and beta activity data and tritium concentrations for the STP influent and effluent during 2011. Annual average gross alpha and beta activity levels in the STP effluent were 0.6 ± 0.1 pCi/L and 4.9 ± 0.3 pCi/L, respectively. These concentrations remain essentially unchanged from year to year. Control location data from the Carmans River Station HH (see Figure 5-7)

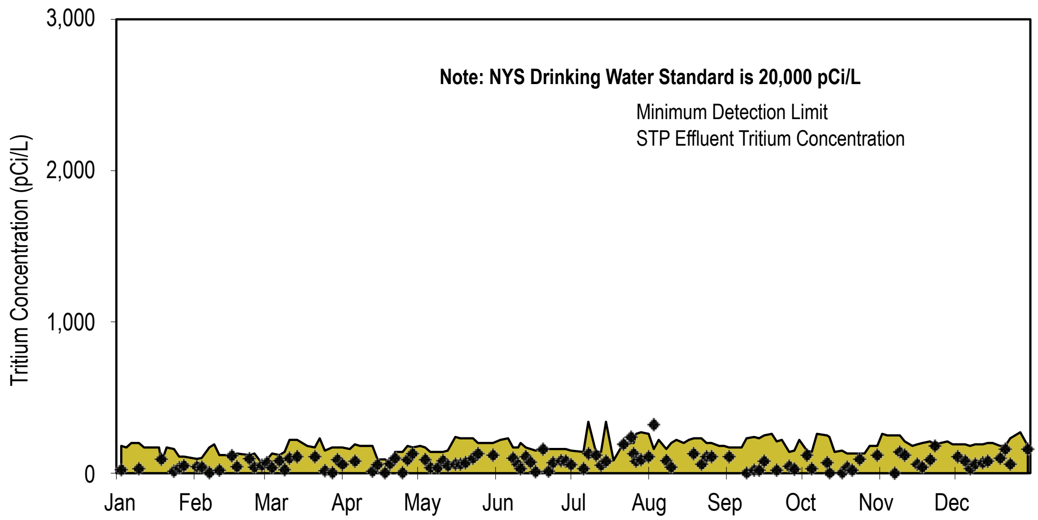

Figure 5-2. Tritium Concentrations in Effluent from the BNL Sewage Treatment Plant (2011).

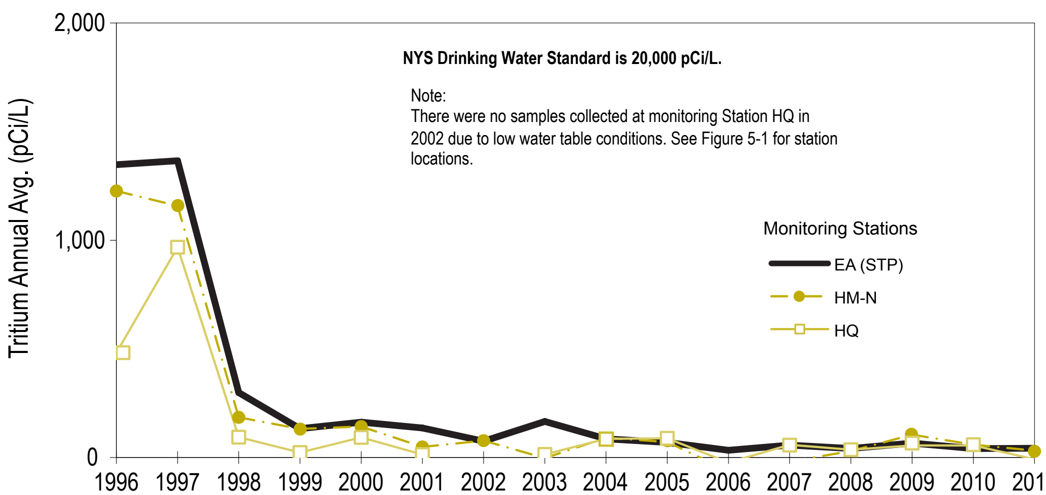

Figure 5-3. Sewage Treatment Plant/Peconic River Annual Average Tritium Concentrations (1996–2011).

show average gross alpha and beta levels of 0.67 ± 0.10 pCi/L and 0.65 ± 0.11 pCi/L, respectively (see Table 5-6). The average concentrations of gross alpha and beta activity in Peconic River water samples collected upstream of the STP outfall were 0.78 ± 0.54 pCi/L and 1.15 ± 0.34 pCi/L, respectively.

A plot of the 2011 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 consistently less than 1 percent of the NYS DWS since 2000.

In 2011, with the exception of a single low-level reported value, tritium was not detected in the discharge of the STP (EA, Outfall 001) for the entire year. A concentration measured in the single sample of the STP discharge in August (see Figure 5-2) was 320 ± 130 pCi/L. Due to the low level of detection and the high uncertainty (≈50 percent), this concentration is indistinguishable from the typical minimum detection limit. The annual average tritium concentration, as measured in the STP effluent, was 43 ± 11 pCi/L, which is only 24 percent of the average minimum detection level (MDL), 180 pCi/L, and well below the NYS DWS of 20,000 pCi/L.

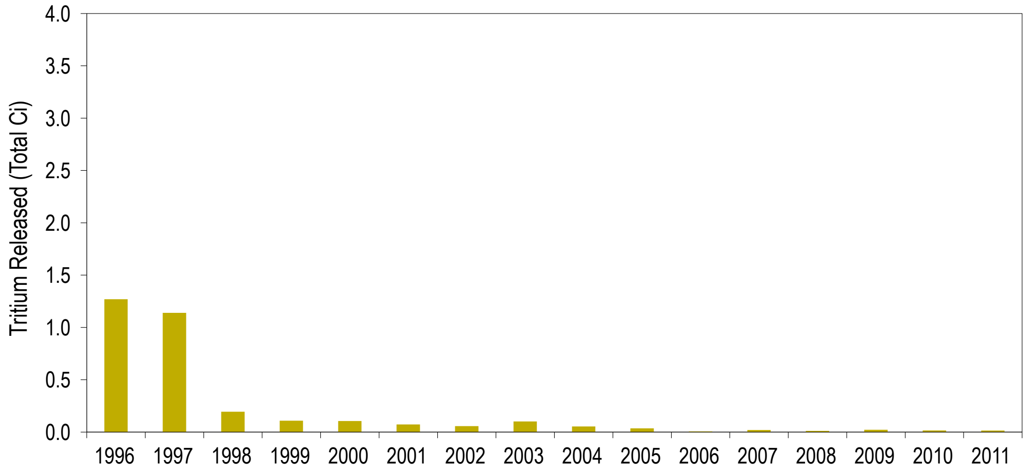

Figure 5-4. Tritum Released to the Peconic River, 15-Year Trend (1996–2011).

Using the annual average concentration and the flow recorded for the year, a total of 0.015 Ci (15.1 mCi) of tritium was released during the year, which is consistent with total releases of tritium over the past 5 years (see Figure 5-4). In 2011, there were no gamma-emitting nuclides detected in the STP effluent, which is consistent with data reported since 2003. Sr-90 was also not detected in any samples during 2011.

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. Composite samples of the STP effluent are collected using a flow-proportional refrigerated sampling device (ISCO Model 3700RF) and are analyzed by contract analytical laboratories. Samples are analyzed for 23 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 5-2 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 effluent permit limits (see also the compliance data in Chapter 3). Aluminum, iron, lead, and mercury were detected in the effluent at concentrations exceeding the SPDES permit limits or ambient water quality standards. All data reported in Table 5-2 are for "total recoverable" concentrations of the analyte, which includes suspended and dissolved fractions. Consequently, the data are conservative (err on the side of caution) for many of the analytes. Aluminum was detected in samples collected in January and February at a concentration of 110 µg/L, which is just above the NYS AWQS standard of 100 µg/L. Aluminum is regulated in the ionic (i.e., dissolved) form. Iron was detected in samples collected in January and February at concentrations of 0.47mg/L and 0.51 mg/L, respectively, which is consistent with the data reported in Chapter 3. Lead was detected in a sample collected in April at a concentration of 25.8 µg/L, which is above the SPDES limit of 19 µg/L. Although review of the analytical data package associated with this sample indicates that all applicable quality control procedure requirements were

Table 5-2. BNL Sewage Treatment Plant (STP) Water Quality and Metals Analytical Results.

ANALYTE	Units	STP Influent N	Min.	Max.	Avg.	STP Effluent N	Min.	Max.	Avg.	SPDES Limit or AWQS (1)	Comment or Qualifier
pH	SU	CM	6.8	7.4	NA	CM	6.5	7.6	NA	5.8 - 9.0	
Conductivity	µS/cm	CM	NR	NR	NR	170(a)	167	789	403.5	SNS	
Temperature	°C	CM	NR	NR	NR	170(a)	2.5	26.2	15.4	SNS	
Dissolved Oxygen	mg/L	NM	NM	NM	NM	170(a)	5.8	14.3	9.9	SNS	
Chlorides	mg/L	12	56.1	145	74.5	12	41.8	76.2	63.4	SNS	
Nitrate (as N)	mg/L	12	0.03	3.0	1.1	12	1.2	6.8	4.6	10	Total N
Sulfates	mg/L	12	5.5	20.0	14.5	12	11.6	19.5	17.1	250	GA
Aluminum	µg/L	12	78	11700	2039	12	26.6	110	56.3	100	Ionic
Antimony	µg/L	12	1.8	8.2	< 5	12	< 5	< 5	< 5	3	GA
Arsenic	µg/L	12	1.1	31	5.5	12	1.0	2.1	1.5	150	Dissolved
Barium	µg/L	12	29.2	2530	404.8	12	17.2	28.1	21.9	1000	GA
Beryllium	µg/L	12	0.4	< 2	< 2	12	0.5	< 2	< 2	11	Acid Soluble
Cadmium	µg/L	12	0.1	8.1	< 2	12	0.1	< 2	< 2	1.1	Dissolved
Calcium	mg/L	12	12.0	127.0	27.4	12	13.0	16.6	14.2	SNS	
Chromium	µg/L	12	4.5	80.6	11.7	12	< 10	< 10	< 10	34.4	Dissolved
Cobalt	µg/L	12	0.3	18.6	3.3	12	0.3	0.8	0.5	5	Acid Soluble
Copper	µg/L	12	48.0	4170	676.4	12	12.6	64.3	37.9	150	SPDES
Iron	mg/L	12	0.5	26.4	4.6	12	0.1	0.5	0.3	0.37	SPDES
Lead	µg/L	12	5.2	470	68.4	12	1.0	25.8	5.0	19	SPDES
Magnesium	mg/L	12	3.2	12.6	5.0	12	3.2	4.1	3.7	SNS	
Manganese	µg/L	12	27.2	197	59.3	12	2.0	< 15	< 15	300	GA
Mercury	µg/L	12	0.1	1.4	0.4	12	0.06	0.26	< 0.2	0.2	SPDES
Nickle	µg/L	12	2.7	208	32.0	12	2.7	5.0	3.7	110	SPDES
Potassium	mg/L	12	3.7	10.8	7.1	12	4.3	7.8	5.4	SNS	
Selenium	µg/L	12	1.6	11.9	< 5	12	< 5	< 5	< 5	4.6	Dissolved
Silver	µg/L	12	0.1	48.1	7.4	12	1.0	3.8	2.3	15	SPDES
Sodium	mg/L	12	36.4	89	50.2	12	28.7	51.2	43.0	SNS	
Thallium	µg/L	12	1.1	< 5	< 5	12	0.7	< 5	< 5	8	Acid Soluble
Vanadium	µg/L	12	< 5	124.0	18.2	12	2.5	< 5	< 5	14	Acid Soluble
Zinc	µg/L	12	66.1	2910	512.6	12	23.9	80	51.3	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
NR = Not Recorded
CM = Continuously monitored
NYSDEC = New York State Department of Environmental Conservation
GA = Class GA (groundwater) AWQS
SNS = Standard Not Specified
N = Number of samples
SPDES = State Pollutant Discharge Elimination System
NA = Not Applicable
SU = Standard Units
NM = Not Monitored

met, this detection of lead is questionable. The average lead concentration of samples collected from the STP effluent over the past 10 years is 2 µg/L, which is a typical concentration observed from samples collected as part of BNL's SPDES monitoring program. The average concentration of lead from samples collected from the STP effluent just prior to and after this sample was collected was 1.5 µg/L, indicating that this was a one-time event. Mercury was detected in a sample collected in February at a concentration of 0.26 µg/L, which is above the SPDES limit of 0.2 µg/L. The detected mercury concentration may be false-positive or biased since the associated method blank sample analyzed by the contract analytical laboratory for these analytes on the day of analysis exhibited reportable levels of the analyte, indicating a potential for cross-contamination. The concentrations of metals in all other samples were below the applicable standard. There were no VOCs detected in the STP effluent above method detection limits in 2011.

5.3 PROCESS-SPECIFIC WASTEWATER

Wastewater that may contain constituents above SPDES permit limits or ambient water quality discharge 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 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 2011, 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.

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 5-5 shows the locations of the Laboratory's discharges to recharge basins (also called "outfalls" under BNL's SPDES permit). Figure 5-6 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

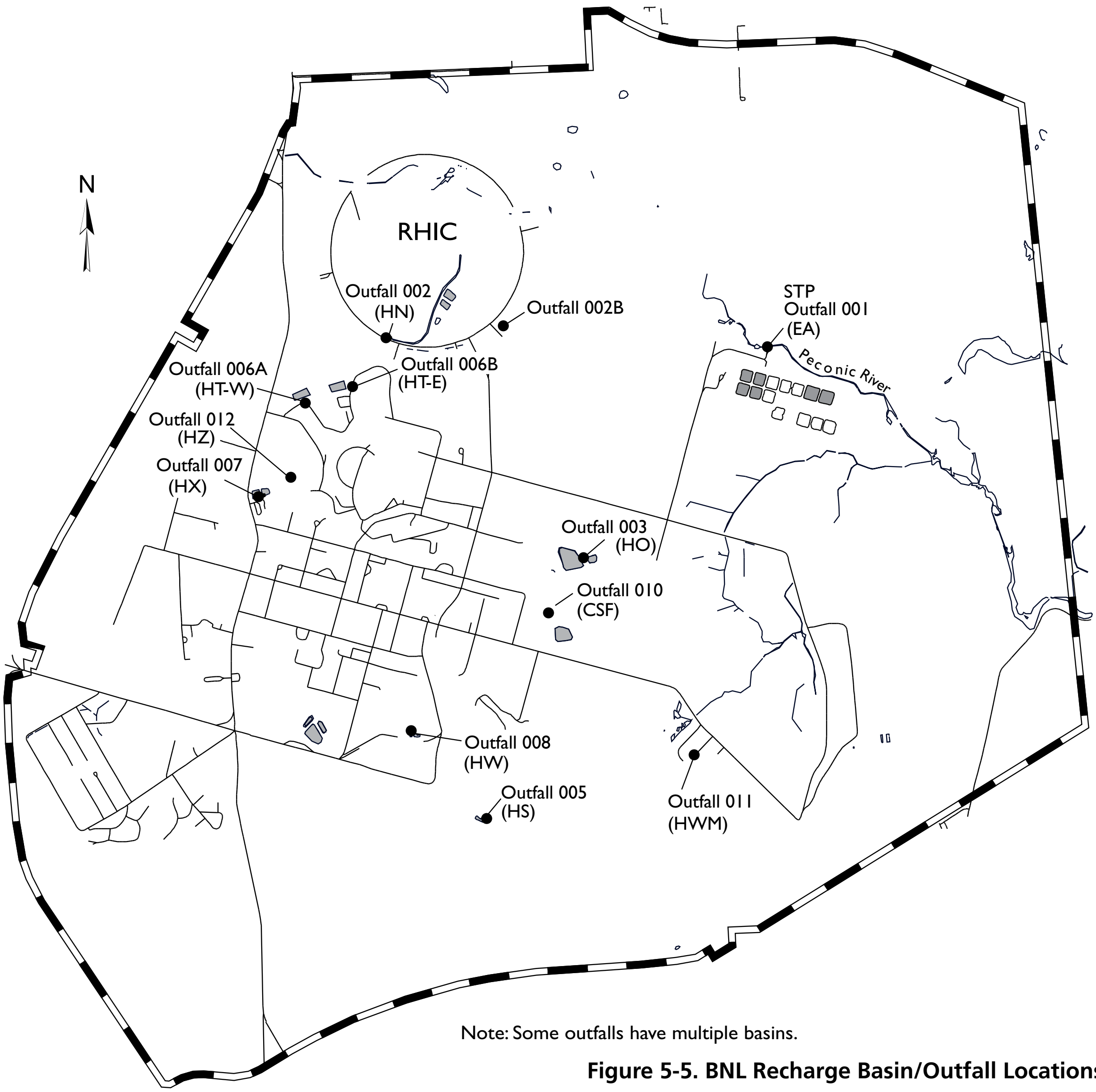

Figure 5-5. BNL Recharge Basin/Outfall Locations.

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 near the National Synchrotron Light Source II (NSLS-II) construction site, 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 the monitoring program, samples are also routinely collected and analyzed under BNL's Environmental Surveillance

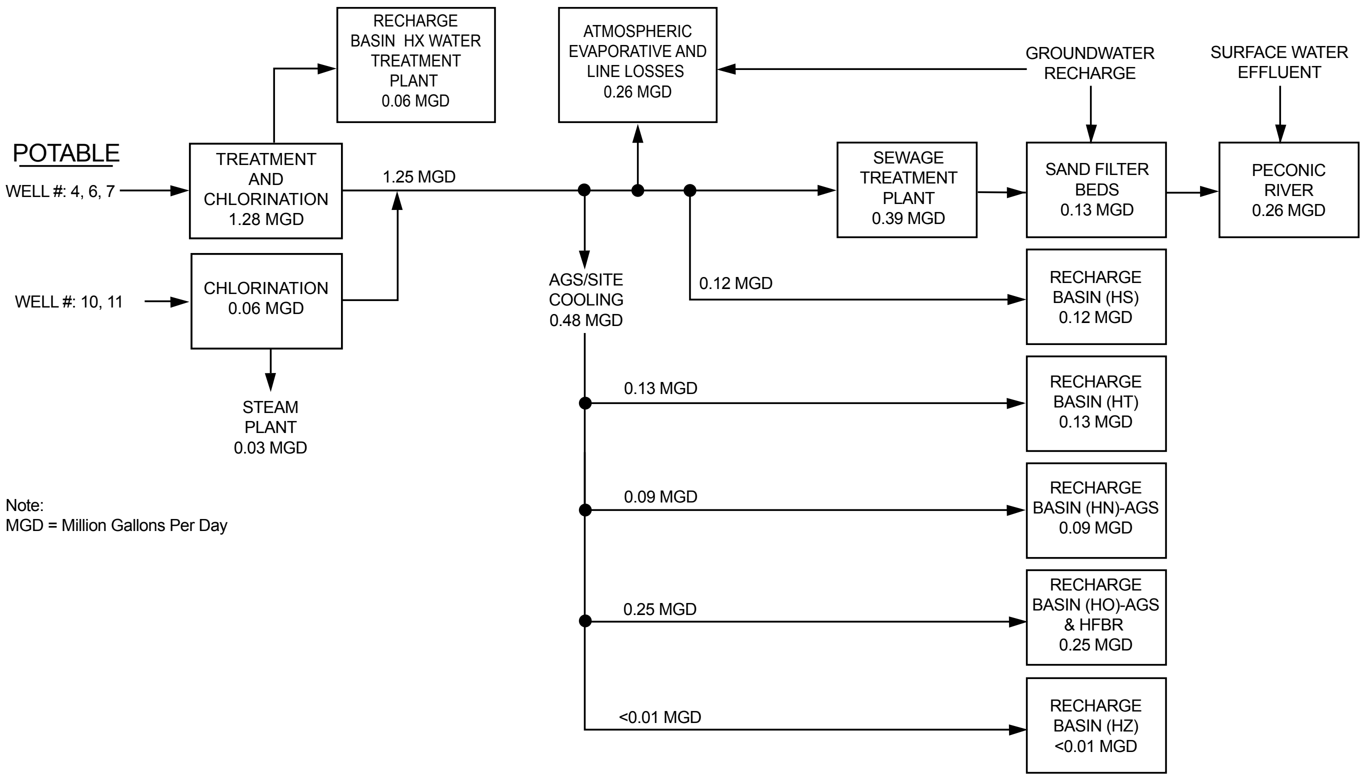

Figure 5-6. Schematic of Potable Water Use and Flow at BNL.

Program for radioactivity, VOCs, metals, and anions. During 2011, 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.

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 5-3 and show that low levels of alpha and beta activity were detected in most of the basins. Typically, 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). Similar to 2010, surface samples collected from Basin HW exhibited much higher than normal gross alpha/beta results (29.1 ± 8.6 pCi/L and 28.2 ± 4.7 pCi/L, respectively) with increased uncertainty and MDL. These elevated results continue to be due to the presence of high sediment and dissolved solids in the water samples. Significant clearing and other soil disturbance activities associated with the construction of the NSLS-II project have contributed to much higher than normal sediment content in the stormwater runoff reaching Basin HW, resulting in false-positive results for gross alpha/beta activity. Filtered water samples from this location have been collected in the past and analyzed for gross alpha/beta to confirm that observed elevated results are due to mass loading and not BNL-derived radiological contamination. Sample results for filtered samples have shown gross alpha/beta activity within normal ranges.

The contract analytical laboratory reported no gamma-emitting nuclides attributable to BNL operations in any discharges to recharge basins in 2011. Tritium was detected in a single sample collected at Basin HT-W at a very low level (520 ± 160 pCi/L). This basin receives discharges from the Collider-Accelerator complex.

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 5-4 and 5-5.

Low concentrations of disinfection byproducts were detected just above the contract laboratory's MDL of 1 µg/L in the discharge to Basin HN in July 2011. 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. Methylene chloride and ethylbenzene were detected just above the MDL in Basin HW in September and November 2011. The methylene chloride was estimated at 2.9 µg/L and is attributed to cross-contamination within the contract analytical laboratory. Ethylbenzene was estimated at 1.2 µg/L, which is much less than the NYS AWQS of 5 µg/L.

The analytical data in Table 5-4 show that for 2011, the concentrations of all analytes were within effluent standards, except for a high detection of chlorides in Basin HT-E and an elevated pH in Basin HW. Chlorides are found to be higher in samples collected during the winter and are attributed to road salt used to control snow and ice buildup. A sample from Basin HT-E, collected in February, showed high concentrations of sodium; it was confirmed that road salt was the source of the chlorides. It was determined that the elevated pH observed in Basin HW was most likely due to construction activities associated with the NSLS-II (concrete forming/washout activities and construction of road/parking lot base using recycled concrete aggregate). This outfall only receives flow during heavy rain events, and the only source of stormwater to this outfall is from the NSLS-II construction site.

The data in Table 5-4 show that all parameters, except for aluminum, cobalt, iron 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 results in the dissolution of the element and its detection during analysis.

Table 5-3. 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.*	6.4 ± 2.4	10.4 ± 1.6	<160
	avg.	1.7 ± 3.11	4.04 ± 4.36	<MDL
HO	*max.*	< 1.4	1.22 ± 0.7	< 160
	avg.	0.58 ± 0.54	0.98 ± 0.23	<MDL
HS	*max.*	2.8 ± 1.4	3.3 ± 0.9	<170
	avg.	1.14 ± 1.09	1.92 ± 1.13	<MDL
HT-E	*max.*	< 4.5	7.8 ± 1.6	< 190
	avg.	1.28 ± 0.6	4.67 ± 3.14	<MDL
HT-W	*max.*	< 1.4	1.94 ± 0.73	520 ± 160
	avg.	0.06 ± 0.4	1.2 ± 0.64	< MDL
HW	*max.*	29.1 ± 8.6	28.2 ± 4.7	< 180
	avg.	12.12 ± 11.36	14.98 ± 8.67	<MDL
HZ	*max.*	3.8 ± 1.3	1.83 ± 0.79	<160
	avg.	1.32 ± 1.7	0.83 ± 0.94	<MDL
SDWA Limit		15	(a)	20,000

Notes:
See Figure 5-5 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 radionuclides, a dose equivalent of this value cannot be calculated.
MDL = Minimum Detection Limit
SDWA = Safe Drinking Water Act

Table 5-4. Water Quality Data for BNL On-Site Recharge Basin Samples.

ANALYTE		Recharge Basin HN (RHIC)	HO (AGS)	HS (s)	HT-W (Linac)	HT-E (AGS)	HW (s)	CSF (s)	HZ (s)	NYSDEC Effluent Standard	Typical MDL
	No. of samples	4	4	4	4	4	4	4	4		
pH (SU)	*min.*	6.8	7.2	7.8	7.8	7.8	7.1	7.2	6.3	6.5 - 9.0	NA
	max.	8.5	8.1	8.4	8.2	8.2	9.4	8.6	8.0		
Conductivity (µS/cm)	*min.*	100	117	102	140	85	99	58	20	SNS	NA
	max.	725	246	367	255	447	203	433	184		
	avg.	348	204	256	210	300	150	172	128		
Temperature (ºC)	*min.*	3.4	12.7	1.8	4.5	4.0	6.2	7.3	6.8	SNS	NA
	max.	7.1	18.8	25.2	15.2	7.4	21.9	23.4	22.6		
	avg.	5.1	16.2	14.2	8.2	5.5	14.5	15.1	14.5		
Dissolved oxygen (mg/L)	*min.*	11.0	9.8	7.6	10.1	12.7	7.5	7.2	9.5	SNS	NA
	max.	13.0	11.0	18.9	13.2	18.2	12.4	11.6	12.1		
	avg.	11.7	10.3	12.3	11.1	14.5	10.5	9.8	10.4		
Chlorides (mg/L)	*min.*	12.1	40.4	40.2	34.3	7.6	1.5	3.4	17.0	500	4
	max.	100.0	43.8	79.0	45.8	8160.0	11.0	108.0	40.4		
	avg.	56.2	42.0	53.1	40.3	2097.6	5.3	30.9	30.4		
Sulfates (mg/L)	*min.*	4.5	9.3	10.2	9.9	3.4	6.5	1.9	7.1	500	4
	max.	23.5	10.3	18.6	10.7	43.0	15.9	4.9	10.2		
	avg.	13.2	9.9	13.5	10.2	23.3	9.1	3.4	8.5		
Nitrate as nitrogen (mg/L)	*min.*	0.2	0.2	0.1	0.2	0.2	0.3	0.2	0.2	10	1
	max.	0.7	0.3	0.9	0.3	1.0	0.6	0.5	0.9		
	avg.	0.5	0.3	0.6	0.3	0.5	0.4	0.3	0.5		

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

This is supported by the observation that the concentrations in all filtered samples were significantly less and well below the discharge standard or AWQS. As these metals 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.

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 above-grade 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 Central Steam Facility (CSF) area and along Cornell Avenue east of Renaissance Road. Basin HW receives runoff from

Table 5-5. 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	2	4	2	4	3	4	2	4	2	4	3	4	3	4	2		
Ag 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	50	2.0
	max.	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 10.0	< 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	< 10.0	< 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	120.0	< 50.0	58.3	< 50.0	< 50.0	< 50.0	4620.0	153.0	502.0	67.9	< 50.0	< 50.0	2,000	50
	max.	253.0	< 50.0	62.6	< 50.0	775.0	65.1	107.0	< 50.0	< 50.0	< 50.0	59900.0	317.0	6200.0	94.2	57.4	< 50.0		
	avg.	89.2	< 50.0	< 50.0	< 50.0	477.8	< 50.0	76.9	< 50.0	< 50.0	< 50.0	25130.0	252.0	3145.5	83.8	< 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.	17.1	5.6	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	14.6	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	6.2	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	6.9	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Ba Barium (µg/L)	*min.*	<20	<20	<20	<20	21.7	28.0	<20	21.1	<20	<20	28.5	<20	<20	<20	<20	<20	2,000	20
	max.	54.5	39.6	29.3	20.3	34.9	32.0	165.0	50.9	26.6	21.4	183.0	<20	32.2	<20	24.7	24.5		
	avg.	31.6	26.0	20.8	<20	29.6	30.0	62.5	36.0	20.8	<20	84.5	<20	20.8	<20	<20	<20		
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	< 10.0	< 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	< 10.0	< 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	< 2.0	< 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		
Co Cobalt (µg/L)	*min.*	0.2	0.5	< 5.0	1.0	0.2	1.3	1.0	0.3	< 5.0	2.9	1.8	0.3	0.2	1.0	< 5.0	0.7	5	0.1
	max.	< 5.0	1.7	< 5.0	1.6	< 5.0	1.9	< 5.0	2.9	< 5.0	< 5.0	16.4	3.8	3.3	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	1.1	< 5.0	1.3	< 5.0	1.6	< 5.0	1.6	< 5.0	< 5.0	7.4	1.7	1.7	< 5.0	< 5.0	< 5.0		
Cr Chromium (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	100	10.0
	max.	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	56.8	< 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	26.8	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
Cu Copper (µg/L)	*min.*	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	13.6	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	1,000	10.0
	max.	57.9	24.3	< 10.0	< 10.0	< 10.0	< 10.0	33.3	24.8	< 10.0	< 10.0	52.6	< 10.0	22.3	< 10.0	127.0	< 10.0		
	avg.	31.1	13.2	< 10.0	< 10.0	< 10.0	< 10.0	16.5	16.5	< 10.0	< 10.0	27.2	< 10.0	15.1	< 10.0	45.6	< 10.0		

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

METAL		Recharge Basin																NYSDEC Effluent Limit or AWQS	Typical MDL
		HN (RHIC)		HO (AGS)		HS (stormwater)		HT-E (AGS)		HT-W (Linac)		HW (stormwater)		CSF (stormwater)		HZ (stormwater)			
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	2	4	2	4	3	4	2	4	2	4	3	4	3	4	2		
Fe Iron (mg/L)	*min.*	0.06	<0.05	0.05	<0.05	0.24	<0.05	0.09	0.29	<0.05	<0.05	4.05	0.11	<0.05	0.07	0.05	<0.05	0.6	0.05
	max.	0.42	0.14	0.22	0.07	0.68	0.08	1.12	0.49	0.11	<0.05	49.00	0.21	7.31	0.08	0.08	0.09		
	avg.	0.27	0.09	0.11	0.06	0.45	0.06	0.63	0.39	0.06	<0.05	20.84	0.18	3.53	0.07	0.07	0.06		
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.	0.3	< 0.2	0.3	< 0.2	0.3	< 0.2	0.3	< 0.2	0.3	< 0.2	0.7	< 0.2	< 0.2	< 0.2	0.3	< 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.*	<5.0	<5.0	<5.0	<5.0	10.4	7.1	5.5	9.6	<5.0	<5.0	63.8	7.5	7.2	<5.0	<5.0	<5.0	600	5.0
	max.	21.2	9.1	9.2	< 15.0	13.0	9.2	295.0	19.9	7.5	6.9	550.0	14.6	103.0	<5.0	18.9	< 15.0		
	avg.	15.2	6.4	5.5	< 15.0	11.6	8.2	84.3	14.8	4.8	5.4	254.7	10.9	52.3	<5.0	< 15.0	< 15.0		
Na Sodium (mg/L)	*min.*	8.2	23.0	23.4	23.3	25.0	25.3	6.5	43.6	23.0	23.4	2.7	2.2	4.0	3.8	11.5	23.4	SNS	0.25
	max.	64.4	54.6	26.3	25.9	38.3	38.8	4540.0	105.0	27.2	24.0	10.2	6.1	74.8	8.6	24.7	24.2		
	avg.	38.0	38.8	24.6	24.6	29.8	32.1	1171.9	74.3	24.4	23.7	6.0	4.2	23.5	6.3	18.5	23.8		
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	< 10.0	< 10.0	< 10.0	< 10.0	36.2	< 10.0	10.6	< 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	16.7	< 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	8.8	< 3.0	4.0	< 3.0	< 3.0	< 3.0	50	3.0
	max.	3.2	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 15.0	< 3.0	< 3.0	< 3.0	80.9	< 3.0	36.6	< 3.0	73.0	4.5		
	avg.	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 15.0	< 3.0	< 3.0	< 3.0	35.1	< 3.0	21.7	< 3.0	23.1	< 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	6	5.0
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25.0	< 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	< 25.0	< 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		
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	< 25.0	< 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	< 25.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		

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

METAL		Recharge Basin																NYSDEC Effluent Limit or AWQS	Typical MDL
		HN (RHIC)		HO (AGS)		HS (stormwater)		HT-E (AGS)		HT-W (Linac)		HW (stormwater)		CSF (stormwater)		HZ (stormwater)			
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	2	4	2	4	3	4	2	4	2	4	3	4	3	4	2		
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	15.7	< 5.0	7.5	< 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	96.5	8.0	23.3	6.0	< 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	44.0	< 5.0	14.0	< 5.0	< 5.0	< 5.0		
Zn Zinc (µg/L)	*min.*	< 10.0	10.4	< 10.0	< 10.0	< 10.0	< 10.0	20.6	15.5	< 10.0	< 10.0	46.5	< 10.0	14.8	8.6	18.5	15.1	5000	10
	max.	106.0	38.8	< 10.0	< 10.0	37.3	25.5	60.9	23.6	20.8	12.3	178.0	< 10.0	92.2	13.6	113.0	22.3		
	avg.	55.3	24.6	< 10.0	< 10.0	13.1	12.8	33.7	19.6	11.7	< 10.0	93.3	< 10.0	51.0	< 10.0	60.7	18.7		

Notes:
See Figure 5-5 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

the NSLS-II construction site, 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 has 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. Basin sediment sampling is conducted on a 5-year testing cycle to ensure these discharges are not compromising the quality of the basins. Samples were last collected in 2007 and results were presented in the 2007 Site Environmental Report in Chapter 6. The next sampling event will occur in 2012.

5.5 PECONIC RIVER SURVEILLANCE

Several locations are monitored along the Peconic River to assess the overall water quality of the river and to assess any impact from BNL discharges. Sampling points along the Peconic River are identified in Figure 5-7. In total, 10 stations (three upstream and seven downstream of the STP) were regularly sampled in 2011. 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

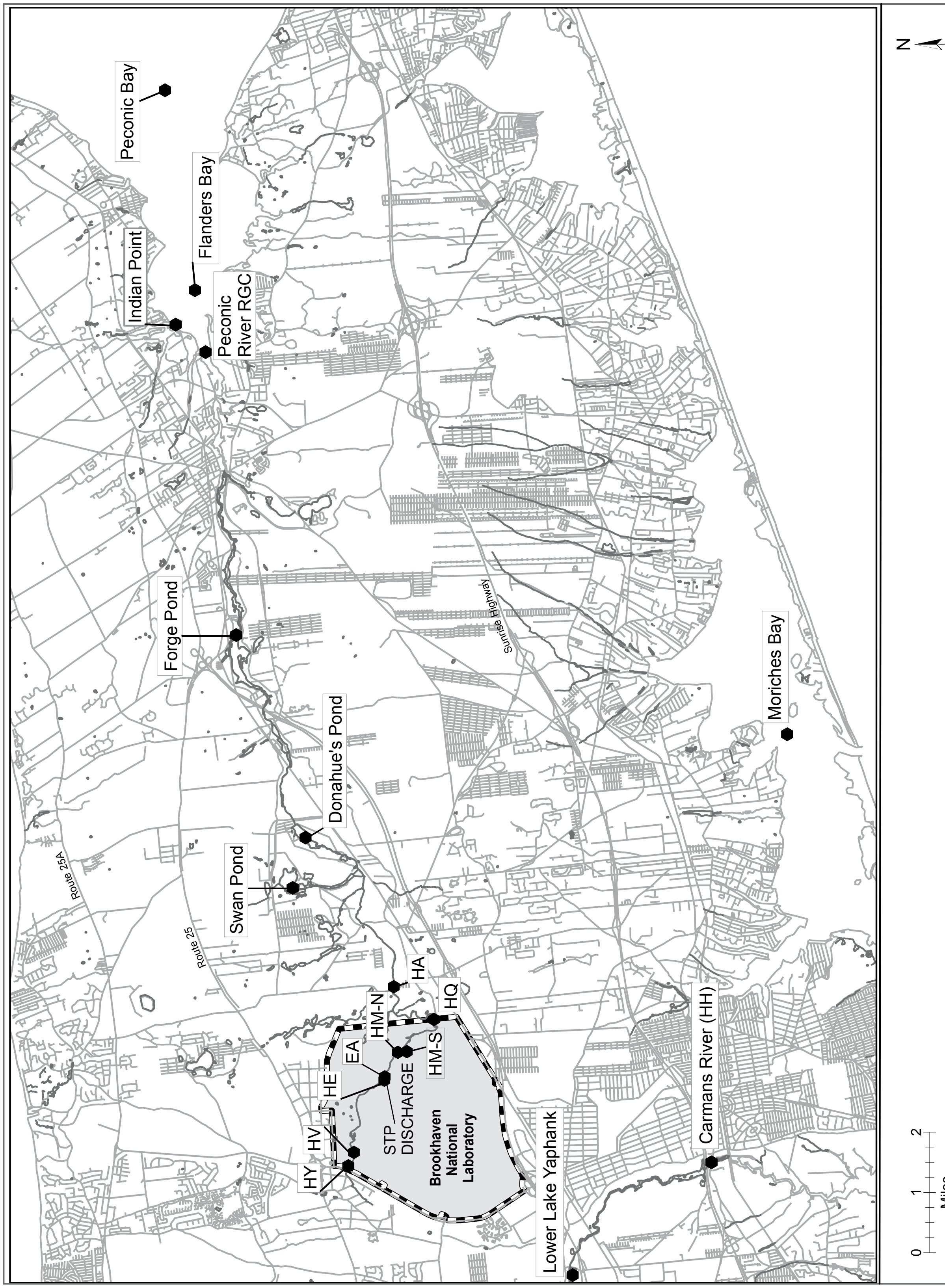

Figure 5-7. Sampling Stations for Surface Water, Fish, and Shellfish.

- 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 sampling locations, plus the control location. Routine samples at stations HM-N and HQ were collected once per month, as flow allowed. 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 2011 are summarized in Table 5-6. 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 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 station HM-N, located downstream of the STP Outfall. The average concentrations from off-site and control locations were indistinguishable from BNL on-site levels. The beta activity for all locations is therefore attributed to natural sources. All detected levels were

Table 5-6. Radiological Results for Surface Water Samples from the Peconic and Carmans Rivers.

Sampling Station		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Sr-90 (pCi/L)
Peconic River					
HY (headwaters) on site, west of the RHIC ring	*N*	4	4	4	4
	max	1.22 ± 0.74	2.34 ± 0.87	< 180	< 3.3
	avg	1.23 ± 0.62	1.9 ± 0.36	<MDL	0.43 ± 0.57
HV (headwaters) on site, inside the RHIC ring	*N*	4	4	4	NS
	max	2.6 ± 1.2	5.3 ± 1.1	< 180	
	avg	1.92 ± 0.77	2.7 ± 1.75	<MDL	
HE upstream of STP outfall	*N*	4	4	4	4
	max	1.55 ± 0.98	1.67 ± 0.71	< 170	0.46 ± 0.16
	avg	0.78 ± 0.54	1.15 ± 0.34	<MDL	0.3 ± 0.12
HM-N downstream of STP, on site	*N*	12	12	12	3
	max	< 1.8	7.1 ± 1.3	380 ± 150	< 0.23
	avg	0.75 ± 0.28	3.94 ± 0.72	32 ± 80.12	0.06 ± 0.2
HM-S tributary, on site	*N*	1	1	1	1
	max	< 0.81	< 1.1	< 120	< 1.4
	avg	NA	NA	NA	NA
HQ downstream of STP, at BNL site boundary	*N*	4	4	4	2
	max	1.52 ± 0.97	3.65 ± 0.89	< 140	< 0.49
	avg	0.79 ± 0.6	3 ± 0.45	<MDL	0.24 ± 0.3
HA off site	*N*	4	4	4	4
	max	< 1.3	1.06 ± 0.62	< 240	< 2.9
	avg	0.41 ± 0.18	0.94 ± 0.12	<MDL	0.52 ± 0.64
Donahue's Pond off site	*N*	4	4	4	4
	max	< 1.1	2.13 ± 0.78	< 240	0.33 ± 0.17
	avg	0.36 ± 0.18	1.27 ± 0.64	<MDL	0.27 ± 0.19
Forge Pond off site	*N*	4	4	4	4
	max	< 1.3	1.89 ± 0.77	< 250	0.33 ± 0.2
	avg	0.36 ± 0.16	1.2 ± 0.61	<MDL	0.4 ± 0.43
Carmans River HH control location, off site	*N*	4	4	4	4
	max	< 2	< 1	< 200	< 0.3
	avg	0.67 ± 0.1	0.65 ± 0.11	<MDL	0.13 ± 0.09
Swan Pond control location, off site	*N*	4	4	4	4
	max	< 1.2	2.96 ± 0.78	< 150	< 2.8
	avg	0.64 ± 0.38	2.24 ± 1.05	<MDL	0.58 ± 0.73
SDWA Limit (pCi/L)		**15**	**(a)**	**20,000**	**8**

Notes:
See Figure 5-7 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.
MDL = Method Detection Limit
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 5-7. Water Quality Data for Surface Water Samples Collected along the Peconic and Carmans Rivers.

Analyte		Peconic River Station Locations HY	HE	HM-N	HM-S	HQ	HA	Donahue's Pond	Forge Pond	Swan Pond	(Control) HH	NYSDEC Effluent Standard	Typical MDL
No. of samples		4	4	12	1	4	4	4	4	4	4		
pH (SU)	*min.*	4.2	6.2	6.0	NA	6.6	6.5	6.4	6.4	6.3	6.6	6.5-8.5	NA
	max.	7.3	7.5	8.2	4.3	8.3	7.1	7.2	7.3	7.1	7.3		
Conductivity (µS/cm)	*min.*	65	55	6	NA	144	28	45	67	76	200	SNS	NA
	max.	371	110	389	91	273	97	117	199	135	282		
	avg.	182	84	231	NA	199	66	78	131	104	231		
Temperature (ºC)	*min.*	1.2	1.4	2.4	NA	6.3	0.1	1.1	2.9	1.3	2.7	SNS	NA
	max.	22.4	10.9	24.1	3.6	20.7	23.5	26.1	28.5	26.3	22.5		
	avg.	13.0	7.4	8.9	NA	13.3	14.0	14.1	15.6	15.2	14.1		
Dissolved oxygen (mg/L)	*min.*	6.8	10.1	8.3	NA	9.9	2.8	5.7	7.9	6.7	8.4	>4.0	NA
	max.	10.8	13.2	14.9	12.0	11.5	15.3	16.5	17.0	9.5	17.1		
	avg.	8.3	11.4	12.1	NA	10.7	9.1	11.2	12.0	7.6	11.8		
Chlorides (mg/L)	*min.*	8.0	7.1	26.0	NA	35.0	6.3	10.0	17.7	10.0	27.2	250(a)	4.0
	max.	101.0	18.5	68.5	5.6	59.0	8.1	10.9	22.3	14.8	36.2		
	avg.	36.3	14.4	57.1	NA	48.4	6.9	10.5	20.2	11.5	31.8		
Sulfates (mg/L)	*min.*	<4.0	5.1	11.8	NA	10.1	<4.0	<4.0	9.3	<4.0	10.1	250(a)	4.0
	max.	19.0	21.7	19.0	6.1	15.2	4.6	6.0	11.3	9.5	14.5		
	avg.	6.5	10.6	15.6	NA	12.6	<4.0	4.1	10.3	5.9	12.0		
Nitrate as nitrogen (mg/L)	*min.*	<1.0	<1.0	<1.0	NA	< 0.02	<1.0	<1.0	<1.0	<1.0	1.3	10(a)	1.0
	max.	<1.0	<1.0	5.3	<1.0	2.2	<1.0	<1.0	<1.0	<1.0	2.3		
	avg.	<1.0	<1.0	3.3	NA	1.1	<1.0	<1.0	<1.0	<1.0	1.8		

Notes:
See Figure 5-5 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

below the applicable 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 downstream of the STP discharge at Station HM-N (380 ± 150 pCi/L). Due to the low level of detection and the high uncertainty (~50 percent), the concentration was indistinguishable from the typical minimum detection limit. Also, because tritium was not detected in the STP discharge during this period, the detection was considered a false-positive result. Monitoring for Sr-90 was performed at all Peconic River and Carmans River stations in 2011. Low-level detections were found at Stations HE, Donahue's Pond, and Forge Pond at very consistent levels of 0.46 ± 0.16, 0.33 ± 0.17, 0.33 ± 0.2 pCi/L, respectively. All concentrations detected were much less than the NYS DWS of 8 pCi/L, are consistent with historical levels, and can be attributed to worldwide fallout.

5.5.2 Peconic River – Nonradiological Analyses

River water samples collected in 2011 were analyzed for water quality parameters (pH, temperature, conductivity, and dissolved oxygen), anions (chlorides, sulfates, and nitrates), metals, and VOCs. The analytical data for the Peconic River and Carmans River samples are summarized in Tables 5-7 (water quality) and 5-8 (metals). There were no VOCs detected above the contract analytical laboratory's method detection limits from any of the Peconic River sampling stations in 2011.

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, since the Peconic River recharges to groundwater, the AWQS for groundwater (250 mg/L) for these substances is used for comparison purposes.

The pH measured at some 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 2011, the BNL monitoring program continued to assess water samples for both the dissolved and particulate form. Dissolved

Table 5-8. Metals Analysis in Surface Water Samples Collected along the Peconic and Carmans Rivers.

METAL		Peconic River Locations																Control		NYSDEC AWQS	Typical MDL
		HY		HE		HM-N		HM-S		HQ		HA		DP		Swan Pond		Forge Pond		HH			
	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	3	5	3	12	6	1		4	2	4	2	4	2	4	2	4	2	4	2		
Ag (I) Silver (µg/L)	*min.*	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	NA	-	< 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.	< 2.0	< 2.0	< 2.0	< 2.0	4.7	< 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		
	avg.	< 2.0	< 2.0	< 2.0	< 2.0	2.2	< 2.0	NA	-	< 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.*	436.0	143.0	192.0	89.7	< 50.0	< 50.0	NA	-	255.0	164.0	51.7	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	100	50
	max.	2350.0	693.0	741.0	148.0	991.0	178.0	1980.0	-	580.0	286.0	90.4	73.1	55.0	< 50.0	319.0	< 50.0	< 50.0	< 50.0	149.0	< 50.0		
	avg.	1064.0	506.0	361.6	127.2	296.1	63.8	NA	-	371.0	225.0	75.0	51.2	< 50.0	< 50.0	102.7	< 50.0	< 50.0	< 50.0	62.8	< 50.0		
As (D) Arsenic (µg/L)	*min.*	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	NA	-	< 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.	< 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		
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	NA	-	< 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.*	14.7	3.3	14.4	12.7	15.6	11.9	NA	-	7.6	8.3	7.1	6.3	9.2	9.2	5.6	4.7	13.9	18.0	31.8	33.0	SNS	1.8
	max.	25.6	25.7	45.4	15.1	35.5	30.2	15.8	-	12.6	9.9	21.9	17.0	16.8	16.1	22.4	21.6	24.4	23.6	50.4	43.6		
	avg.	21.3	18.0	28.0	13.8	23.0	19.5	NA	-	10.7	9.1	11.2	11.7	12.0	12.7	11.5	13.2	18.3	20.8	39.2	38.3		

(continued on next page)

Table 5-8. Metals Analysis in Surface Water Samples Collected along the Peconic and Carmans Rivers *(continued).*

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	3	5	3	12	6	1		4	2	4	2	4	2	4	2	4	2	4	2		
Be (AS) Beryllium (µg/L)	*min.*	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	NA	-	< 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.	< 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		
	avg.	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	NA	-	< 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	NA	-	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	1.1	2
	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	< 2.0	< 2.0	< 2.0		
	avg.	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	NA	-	< 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	NA	-	< 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.	< 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		
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	NA	-	< 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.*	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	NA	-	< 10.0	< 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.	< 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	< 10.0	< 10.0	< 10.0		
	avg.	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	NA	-	< 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.*	< 10.0	< 10.0	< 10.0	< 10.0	15.3	< 10.0	NA	-	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	4	10
	max.	12.0	< 10.0	< 10.0	< 10.0	78.9	39.0	< 10.0	-	20.7	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
	avg.	< 10.0	< 10.0	< 10.0	< 10.0	33.0	20.8	NA	-	11.4	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
Fe (AS) Iron (mg/L)	*min.*	0.4	0.2	0.5	0.6	0.1	0.1	NA	-	0.2	0.1	0.7	0.4	0.7	0.7	0.1	0.1	0.5	0.4	0.3	0.2	0.3	0.075
	max.	1.7	0.8	8.2	1.2	1.2	0.4	1.1	-	0.5	0.3	6.3	2.0	3.1	2.6	0.4	0.3	1.1	0.5	1.4	0.2		
	avg.	0.9	0.5	2.7	0.8	0.5	0.2	NA	-	0.4	0.2	2.2	1.2	1.6	1.6	0.3	0.2	0.9	0.4	0.7	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
	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	< 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	< 0.2	< 0.2	< 0.2		
Mn Manganese (µg/L)	*min.*	13.9	8.9	70.8	55.5	5.9	3.4	NA	-	11.2	< 5.0	15.0	48.4	32.0	105.0	50.5	47.4	28.3	147.0	33.6	32.0	SNS	2
	max.	107.0	106.0	297.0	91.5	43.7	27.9	28.6	-	29.9	19.1	380.0	314.0	341.0	325.0	1810.0	1770.0	315.0	310.0	158.0	108.0		
	avg.	50.2	56.5	145.4	70.5	17.3	11.4	NA	-	19.9	9.6	114.0	181.2	130.4	215.0	543.5	908.7	143.3	228.5	90.4	70.0		
Na Sodium (mg/L)	*min.*	9.0	8.7	7.5	8.4	20.1	33.5	NA	-	26.7	32.2	4.6	4.7	6.6	6.8	5.8	5.7	11.4	12.7	18.0	18.2	SNS	1
	max.	55.2	58.0	12.1	12.3	45.6	44.8	3.4	-	36.7	36.5	6.6	5.4	8.1	7.1	8.9	9.0	12.8	12.7	20.0	19.6		
	avg.	24.3	27.1	9.4	10.7	37.8	39.5	NA	-	31.9	34.4	5.2	5.0	7.1	7.0	7.0	7.3	12.1	12.7	19.1	18.9		

(continued on next page)

Table 5-8. 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	3	5	3	12	6	1		4	2	4	2	4	2	4	2	4	2	4	2		
Ni (D) Nickel (µg/L)	*min.*	1.1	<1.1	<1.1	<1.1	2.5	2.3	NA	-	2.6	3.8	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	< 10.0	<1.1	<1.1	<1.1		
	max.	2.3	2.2	2.7	1.6	5.0	4.1	1.5	-	3.9	4.1	< 10.0	2.1	< 10.0	<1.1	< 10.0	<1.1	< 10.0	<1.1	< 10.0	<1.1	23	1.1
	avg.	1.9	1.7	1.7	1.3	3.5	3.3	NA	-	3.2	4.0	< 10.0	1.4	< 10.0	<1.1	< 10.0	<1.1	< 10.0	<1.1	< 10.0	<1.1		
Pb (D) Lead (µg/L)	*min.*	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	NA	-	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0		
	max.	5.8	3.0	4.0	<3.0	6.1	<3.0	1.5	-	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	4.3	<3.0	<3.0	<3.0	<3.0	<3.0	1.4	3
	avg.	3.7	<3.0	<3.0	<3.0	3.0	<3.0	NA	-	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<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	NA	-	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 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	< 5.0	< 5.0	< 5.0	SNS	5
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	NA	-	< 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	NA	-	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 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	< 5.0	< 5.0	< 5.0	4.6	5
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	NA	-	< 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	NA	-	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 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	< 5.0	< 5.0	< 5.0	8	5
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	NA	-	< 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	NA	-	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	max.	7.5	< 5.0	7.0	< 5.0	< 5.0	< 5.0	< 5.0	-	5.4	5.2	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	14	5
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	NA	-	< 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.*	24.3	< 10.0	< 10.0	< 10.0	19.1	13.9	NA	-	14.6	15.2	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
	max.	50.8	125.0	54.1	< 10.0	75.1	56.4	18.8	-	35.6	24.3	< 10.0	19.5	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	13.0	< 10.0	38.4	34	10
	avg.	33.1	61.7	22.8	< 10.0	44.0	37.9	NA	-	24.2	19.8	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	11.5	< 10.0	19.2		

Notes:
See Figure 5-7 for the locations of sampling stations.
AWQS = Ambient Water Quality Standards
AS = Acid Soluble
D = Dissolved
DP = Donahue's Pond
NA = Not Applicable
SNS = Effluent Standard Not Specified for these elements in Class C Surface Waters
T = Total

concentrations were determined by filtering the samples prior to acid preservation and analysis. Examination of the total (i.e., particulate form) metals data showed that silver, aluminum, copper, iron, lead, and zinc were present in concentrations at some locations that exceeded NYS AWQS. The highest concentrations of aluminum and iron were found at upstream locations, indicating a natural source of these elements. 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. Iron and aluminum are found in high concentrations in native Long Island soil and, for iron, at high levels in groundwater. The highest levels for silver, copper, lead, and zinc were 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 were within the BNL SPDES permit limits. The NYS AWQS limits for silver, 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.

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