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Site Environmental Report for Calendar Year 1992

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May 1993

SAFETY AND ENVIRONMENTAL PROTECTION DIVISION

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Preface

The U. S. Department of Energy (DOE) Order 5400.1,"General Environmental Protection Program", establishes the requirement for environmental protection programs. These programs ensure that DOE operations comply with applicable federal, state, and local environmental laws and regulations, executive orders, and department policies. Brookhaven National Laboratory (BNL) has established a plan for implementing this Order, Environmental Protection Implementation Plan, (EPIP); this plan is updated annually.

The BNL Site Environmental Report (SER) is prepared annually pursuant to DOE Order 5400.1 to summarize environmental data, characterize the BNL Site, demonstrate compliance status, provide an assessment of the impact of BNL's operations on the Environment, and document the efforts made by BNL Management to mitigate environmental impacts. More detailed environmental compliance, monitoring, surveillance, and study reports may be of value; therefore, to the extent practical, these additional reports have been referenced in the text.

This report is prepared for DOE by the Safety and Environmental Protection Division (SEPD) at BNL. The document is the responsibility of the Environmental Protection Section (EPS) of the SEPD. Within this Section, the Environmental Monitoring Group (EMG) is responsible for preparing the sampling plan, collecting environmental and facility samples, interpretation of the results, performing impact analysis of the emissions from BNL, and compiling this information presented here. In this effort, other groups of the Section: Compliance, Analytical, Ground Water, and Quality Assurance played key roles in addressing the regulatory aspects, and the analysis and documentation of the data.

Although this report is written to meet DOE requirements and guidelines, it is also intended to meet the needs of the public. The Executive Summary has been written with a minimum of technical information. In addition, the Appendices provides a list of acronyms, abbreviations, and other useful information. Also, the accompanying tables in the text represents a summary of corresponding data, whereas the 1992 BNL SER Compendium presents the analytical data in full detail for those who need to review the data <u>in toto</u>.

Inquiries regarding this report may be directed to the Public Affairs Office, BNL, Upton, New York 11973 (516 282-2345).

Abstract

This report documents the results of the Environmental Monitoring Program at BNL and presents summary information about environmental compliance for 1992. To evaluate the effect of BNL operations on the local environment, measurements of direct radiation, and a variety of radionuclides and chemical compounds in ambient air, soil, sewage effluent, surface water, ground water and vegetation were made at the BNL site and at sites adjacent to the Laboratory.

Brookhaven National Laboratory's compliance with all applicable guides, standards, and limits for radiological and nonradiological emissions to the environment were evaluated. Among the permitted facilities, only the discharge from the Sewage Treatment Plant (STP) to the Peconic River exceeded, on occasion only, the fecal and total coliform concentration limits at the discharge point. This was later attributed to off-site Contractor Laboratory quality assurance problems.

The environmental monitoring data has continued to demonstrate, besides the site specific contamination of ground water and soil resulting from past operations, that compliance was achieved with environmental laws and regulations governing emission and discharge of materials to the environment, and that the environmental impacts at BNL are minimal and pose no threat to the public or to the environment.

This report meets the requirements of DOE Orders 5484.1, Environmental Protection, Safety, and Health Protection Information reporting requirements and 5400.1, General Environmental Protection Programs.

Acknowledgement

There are many individuals who assisted in the collection of data, and preparation of this report. The editors express their gratitude to all these individuals. However, the following individual efforts require special acknowledgement.

Monitoring and surveillance data were obtained through the combined efforts of the EMG, and the Analytical Groups, (Radiological and Nonradiological). Special recognition is reserved for the dedication and professionalism of the Environmental Monitoring Technicians: R. Lagattolla, L. Lettieri, M. Bero, and A. Meier; the Analytical Technicians: R. Gaschott, M. Heine, C. Decker, P. Hayde, and M. Surico.

The editors further want to extend their particular appreciation for the authors of the main sections of this report, which has included review of data, preparation of text, and in some cases, even participating in the collection of data. These individuals are:

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Finally, the Editors would like to extend a special thanks to B. Cox for her infinite patience and quality of work in typing, reviewing, and finalizing this report.

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Executive Summary

The Environmental Monitoring (EM) Program is conducted by the Environmental Protection Section (EPS) of the Safety and Environmental Protection Division (SEPD) to determine whether operation of BNL facilities have met the applicable environmental standards and effluent control requirements and assess impact of BNL operations on the environment. This program includes monitoring for both radiological and nonradiological parameters. This report summarizes the data for external radiation levels; radioactivity in air, rain, potable water, surface water, ground water, soil, vegetation, and aquatic biota; water quality, metals, organic compounds in ground water, surface water, and potable water.

Analytical results are reviewed by the SEPD staff and when required by permit conditions are transmitted to the appropriate regulatory agencies through DOE. The data were evaluated using the appropriate environmental regulatory criteria. Data summaries for Calendar Year (CY) 1992 are presented in the text. Detailed information on analytical results, both radiological and nonradiological, are given in the 1992 BNL SER Compendium.

Airborne Effluents

Most of the airborne radioactive effluents at BNL originate from the High Flux Beam Reactor (HFBR), Brookhaven Linac Isotope Production (BLIP) Facility, and the Medical Research Reactor (MRR). Argon-41, oxygen-15, and tritium were the predominant radionuclides. In 1992, 1,490 Ci (55.13 TBq) of argon-41 were released from the MRR stack; a combined total of 797 Ci (29.49 TBq) of oxygen-15 were released from BLIP, and the Alternating Gradient Synchrotron (AGS) Booster which became operational in 1992; and 70 Ci (2.59 TBq) of tritium in the form of water vapor was released from the HFBR stack. Much smaller quantities of airborne radioactive effluents were released from the Chemistry Building, Bldg. 801 Hot Laboratory, and the Hazardous Waste Management Facility (HWMF).

Liquid Effluents

Liquid discharge limits for radiological and nonradiological parameters are subject to conditions listed in the BNL State Pollutant Discharge Elimination System (SPDES) Permit No. NY-0005835 as issued by the New York State Department of Environmental Conservation (NYSDEC). Radiological release concentrations for gross beta, radium, and Sr-90 are also prescribed by the SPDES permit limitations. Other radionuclide discharge concentrations are governed by the U.S. DOE specified Derived Concentration Guides (DCGs).[1] Since such liquid discharges have the potential of contaminating the "Sole Source Aquifer"[2] underlying the Laboratory site, administrative controls are in place to maintain all liquid discharges at or below concentrations prescribed by the Safe Drinking Water Act (SDWA)[3] are made by use of administrative controls.

Operations at the STP were generally (99.9%) within the limits specified by the SPDES permit. Gross beta and Cs-137 concentrations in chlorine house effluent remained higher than concentrations found in the influent. This condition is the result of continued low-level leaching of material adsorbed on the sand filter beds as a result of a 1988 unplanned release of Cs-137 and Sr-90 to the sanitary system. In 1992, discharges to the Peconic River met all radioactive discharge limits of the SPDES program. The principle radionuclides released to the Peconic River from liquid effluents discharged from the STP were:

2.96 Ci (109.8 GBq) of tritium, 2.17 mCi (80.3 MBq) of Cs-137, and 0.067 mCi (2.47 MBq) of Co-60. The annual average Cs-137 concentration was 0.09% of the DCG (1.41% of the SDWA). Releases of Co-60 were 0.001% of the DCG, 0.02% of the SDWA limit. The annual average tritium concentration at the discharge point to the Peconic River was 0.17% of the DCG and 34.6% of the SDWA limit. This represents a factor of 1.5 increase in the tritium releases to the Peconic River from 1991 values. This increase in source term was the result of HFBR operations during the summer of 1992.

Nonradiological parameters are monitored at the effluent of the STP in accordance with the conditions of the SPDES permit. These parameters include residual chlorine, metals, 1,1,1-trichloroethane (TCA), pH, temperature, Biochemical Oxygen Demand (BOD_5), flow, suspended and settleable solids, fecal and total coliform, and ammonia-nitrogen. Although the compliance rate exceeded 99.9%, there were two permit deviations; one each for fecal and total coliform. These observations resulted in an investigation to identify the source or sources of coliform which indicated that these deviations were found to be the result of analytical problems with the contractor laboratory. This investigation is described in more detail in Section 2.3.1.2.

Liquid effluent discharged to the on-site recharge basins contained only trace quantities of radioactivity that were all small fractions of the applicable guides or standards. If the recharge basin water were to be used as the sole source of drinking water, the resultant dose from direct ingestion at the concentrations detected would be equivalent to a dose of 0.019 mrem (0.00019 mSv) per year. The recharge basins function as conduits to the underlying aquifer system (i.e., ground water recharge). Consequently the nonradiological water quality parameters used in assessing the discharges were the NYSDEC Ground Water Effluent Standards as promulgated by 6 New York Code of Rules and Regulations (NYCRR) Part 703.6.[4] With the exception of Recharge Basin HO, discharges to the recharge basins met the NYSDEC Effluent Standards. Samples collected from Recharge Basin HO exhibited iron concentrations which exceeded the Standard and pH values which were slightly below the acceptable range. This basin receives storm water run-off from paved areas and ground water used for non-contact cooling at the AGS. Discharge of precipitation, which has a natural pH that typically is around 5.0, and ground water used for non-contact cooling, which has a pH ranging from 5.9 to 6.8, are contributing causes to the low pH. Elevated iron concentrations are also due to the high ambient concentration of iron in ground water. Iron concentrations at Recharge Basin HO ranged from non-detectable (<0.075 mg/L) to 1.69 mg/L (approximately 2.8 times the NYSDEC Effluent Standard of 0.6 ppm).

Brookhaven National Laboratory continued to collect samples from the recharge basins for organic analyses during 1992. The analytical data for these samples showed all organic compounds to be below the NYSDEC Effluent Standard.

External Radiation Monitoring

Thermoluminescent dosimeters were used to monitor the external exposure at on-site and off-site locations. The average annual on-site integrated dose for 1992 was 71.4 ± 6.9 mrem (0.71 ± 0.069 mSv), while the off-site integrated dose was 67.4 ± 5.8 mrem (0.67 ± 0.058 mSv). These values are much lower than ambient exposure rates typically reported for the New York City area by the Environmental

Protection Agency (EPA) which predict an annual dose of about 80 mrem (0.80 mSv).[5-8] These doses are about 19% higher than those measured in 1991. The increase is the result of changes in processing methods and does not result in an increased impact of BNL operations on the environment. The difference between the on-site and off-site integrated exposure is attributable to the higher terrestrial component of the natural background on site,[9] not BNL activities.

Atmospheric Radioactivity

Tritium was the radioactive effluent detected most frequently in environmental air samples. The maximum annual average tritium concentration at the site boundary was 2.7 pCi/m^3 (0.10 Bq/m^3). This concentration would result in a committed effective dose equivalent of 0.0021 mrem (0.000021 Msv) to the maximally exposed individual residing at the site boundary for the entire year. The Cs-137 was detected at Stations 16T2.1, 11T2.1, 6T2.8, and S6 at least once during 1992. Cobalt was also detected at least twice at Station 6T2.8. The Cesium-137 may be attributed to atmospheric fallout and the cobalt may have been identified in these samples due to background fluctuations in the detection equipment.

Radioactivity in Precipitation

In rainfall, only Be-7, Cs-137, and Sr-90 were detected. The measured concentrations were consistent with typical washout values associated with atmospheric scrubbing[10] and are comparable with the 1991 and 1992 data published by EPA for Yaphank, New York.[5-8]

Soil and Vegetation

Soil samples were principally collected from on-site locations and results obtained from analysis, in general, were consistent with values typically seen in soil samples collected through out Suffolk County for radioactivity assay. An area adjacent to the NEXRAD balloon launch site was found to have elevated Cs-137 concentrations. Soil was removed from this area until concentrations reached ambient levels. The removed soil was placed near the current landfill, and will be disposed of or treated in a manner that is consistent with methods used to handle soil in the Operable Unit (OU) that addresses this area. Nonradiological analyses were also performed, and except for the Polychlorinated Biphenyls (PCB) contamination investigation at a PCB spill site, the parameters tested for and concentrations observed were typical of values noted in background soil samples on site. Vegetation samples were collected only in areas where contamination is known or expected to be found. Concentrations of radioactivity found were thus predictable and above background ambient soil concentration levels. The off-site soil and vegetation sampling program is a cooperative effort between BNL and Suffolk County Department of Health Services (SCDHS). Local farms situated adjacent to BNL were sampled in June 1992. No nuclides attributable to Laboratory operations were detected in any of these samples.

Terrestrial Ecology

A special fauna collection program for radioactive assay was initiated in 1992. Species endemic to the Laboratory and adjacent to fresh water bodies receiving Laboratory effluents, and known contaminated areas were sampled along with fauna from background areas, and analyzed for radioactivity. The principal radionuclides detected were Cs-137 and Sr-90, and were present in concentrations above background in those species collected from the Hazardous Waste Management Area (HWMA) and recharge basins. As these fauna were not part of the food pathway for man, dose assessments were not performed.

Surface Water

Radiological Analyses

Radiological results from samples collected at the former site boundary (Location HM) indicate that the annual average gross beta concentration was 7.28 pCi/L (0.28 Bq/L) or 15% of the New York State Drinking Water Standards (NYS DWS); the average Sr-90 concentration was -0.25 pCi/L (-0.008 Bq/L) or <1% of the NYS DWS; the average Cs-137 concentration was 1.39 pCi/L (0.052 Bq/L) or 1% of the SDWA; and the average tritium concentration was 3129 pCi/L (115 Bq/L) or 15.6% of the NYS DWS. At the current site boundary (Location HQ), the annual average gross beta concentration was 8.84 pCi/L (0.32 Bq/L) or 18% of the NYS DWS and the average tritium concentration was 3759 pCi/L (139 Bq/L) or 19% of the NYS DWS. Nuclide specific gamma analyses were performed at this location. Cesium-137 was the principal isotope detected at a concentration of 0.28 pCi/L (0.01 Bq/L) or 0.3% of the SDWA.

The Carmans River at Yaphank and the Peconic River at Riverhead were sampled in the second and fourth quarters of 1992. While the other off-site locations, in the Peconic River, were sampled during the second, third, and fourth quarter. In the Carmans River water samples, the average gross beta concentration was 1.08 pCi/L (0.034 Bq/L) and the average Sr-90 concentration was less than 0.1 pCi/L (0.041 Bq/L). These values represent ambient background. Average gross beta concentrations in the Peconic River were uniform and ranged from 1.14 pCi/L to 2.02 pCi/L (0.042 Bq/L to 0.076 Bq/L) or 4% of the NYS DWS. Tritium concentrations decrease with distance from BNL with the closest off-site sampling point (Location HA) having an average concentration of -22 pCi/L (-0.81 Bq/L), while the sample collected at the Riverhead sampling point (Location HR) had an average concentration of -68 pCi/L (-2.5 Bq/L). Nuclide specific analyses indicated that average Sr-90 concentrations were consistent with ambient levels and ranged from 0.10 pCi/L to 0.24 pCi/L (0.004 Bq/L to 0.006 Bq/L). Cesium-137 was detected periodically in downstream water samples. The observations did not follow site release patterns. The average Cs-137 concentrations detected ranged from below detection limits to 0.25 pCi/L (0.094 Bq/L), or 0.1 of the SDWA. Direct ingestion for one year of 2 liters of water per day containing the maximum observed Cs-137, Sr-90, and tritium concentration would result in a committed effective dose equivalent of 0.01 mrem (0.0001 mSv) at all locations.

Nonradiological Analyses

Surface water samples were collected from the Peconic River and from the Carmans River as an off-site control location. These samples were analyzed for water quality parameters (i.e., pH, temperature, conductivity, and dissolved oxygen), anions (i.e., chlorides, sulfates, and nitrates), metals, and Volatile Organic Compounds (VOCs) during CY 1992.

Review of this data indicates all water quality parameters to be consistent with the off-site control location and with historical data. Analytical data for metals showed all parameters to be consistent with historical data and all concentrations, with the exception of iron, to be below the NYS DWS. Iron is prevalent at or above the drinking water standard in all locations due to the high concentration of iron within native soils and ground water. Volatile Organic Compounds were not detected in any samples collected from the surface waters during CY 1992.

Aquatic Biological Surveillance

Fish samples were collected along the Peconic River at Donahue's Pond, and Forge Pond, at the upstream location of Swan Pond and at a control location along Carmans River, and Searington and Hall Ponds (Hempstead, NY). In CY 1992, only gamma spectroscopy analysis was performed on these samples. Strontium-90 analyses were not performed but are scheduled for 1993, at which time the results will be reported in the SER. For dose assessment purposes the Cs-137 to Sr-90 ratio was calculated from past data from the same area and from endemic fish. These ratios varied with the type of fish and their feeding habits. This was taken into consideration to estimate the Sr-90 component of the fish-ingestion pathway. The Peconic River fish contained Cs-137 concentrations which ranged from near background levels at Donahue's Pond (74 - 157 pCi/kg-wet [2.8-16 Bq/kg-wet]) to 630 pCi/kg-wet (23 Bq/kg-wet) at Forge Pond. The corresponding Sr-90 concentrations, as determined by using the Cs-137: Sr-90 ratio, were 62 to 155 pCi/kg-wet (2.3 to 5.7 Bq/kg-wet) for fishes collected in Donahue's Pond and 715 pCi/kg-wet (26 Bq/kg-wet) in fishes collected from Forge Pond. Average concentrations found in control aquatic biota were subtracted from concentrations found in the Peconic River fish samples. Only fish collected at off-site locations were used to calculate the maximum individual and collective doses. Based on these results, the maximum individual dose was estimated to be 0.87 mrem (0.0087 mSv) and the collective dose was estimated to be 0.4 person-rem (0.004 person-Sv). Nonradiological analyses were not performed on these samples. No sediment or aquatic vegetation samples were collected in 1992.

Potable Water Supply

The Laboratory's potable water supply wells are screened from a depth of about 15m to about 46m, in the Upper Glacial aquifer. During 1992, Well Nos. 4, 6, 7, 10, 11, and 12 were used to supply drinking water at BNL. Water samples collected from these wells were analyzed for radioactivity, metals, organics, and water quality. These results are discussed in the following sections.

Radiological Analyses

Gross alpha, gross beta, and tritium concentrations in samples collected from on-site potable wells were generally at or below the Minimum Detection Limit (MDL). The daily grab sample of potable water collected from a central building on site exhibited the same results. Average tritium concentrations in on-site potable well water were at or below the MDL of 300 pCi/L (11 Bq/L). Strontium-90 concentrations ranged from below the MDL of 0.1 pCi/L (0.004 Bq/L) to 4.57 pCi/L (0.17 Bq/L). Cobalt-60 was also detected above MDL levels at an annual average concentration of 0.13 pCi/L (0.048 Bq/L). These concentrations, if consumed for one year at a rate of two liters per day, would correspond to a committed effective dose equivalent to the on-site resident of 0.003 mrem (0.0003 mSv). These doses represent an upper limit to the dose actually received because the concentrations used to derive these doses were obtained from analyzing samples collected at individual well heads, and does not account for mixing that would occur when the water is distributed throughout the site.

Nonradiological Analyses

Metals analyses performed on potable water samples indicate that silver, cadmium, chromium, copper, and mercury were not detected in any sample analyzed. Trace quantities of lead (range <0.002 - 0.004 mg/L), manganese (range <0.05 - 0.14 mg/L) and zinc (range <0.02 - 0.05 mg/L) were detected in potable well water collected at the well heads. All observed values of lead, manganese, and zinc were below their respective NYS DWS of 0.015 mg/L, 0.3 mg/L, and 5.0 mg/L, respectively. Iron was detected in water collected at the well head from Well Nos. 4, 6, and 7. Water from these wells is treated to remove excess Fe at the BNL Water Treatment Plant (WTP) prior to use in the domestic water distribution system. Sodium was detected in all potable wells in concentrations ranging from 8.7 to 13.1 mg/L.

In order to demonstrate compliance with federal and state Drinking Water Standards for organic compounds, potable water is sampled quarterly and sent to an off-site New York State Department of Health (NYSDOH) certified laboratory for principal organic compound (POC) analysis. The POC analysis includes halogenated as well as nonhalogenated organic compounds. With the exception of TCA detected in Potable Wells 4, 10, and 11, all organic compounds were below their respective NYS DWS in CY 1992. Historical analysis of Potable Wells 4, 10, and 11 have shown concentrations of TCA to exceed the NYS DWS[11] of 5 μg/L. In order to abate the concentration of volatile organics found in water obtained from Wells 10 and 11, activated carbon adsorption systems were installed at these locations during CY 1992. Water samples treated using activated carbon have shown TCA to be below the NYS DWS. The WTP process includes flocculation and aeration which aids in the removal of iron. The aeration process coincidentally reduces the concentration of TCA in water obtained from Well 4 to below the NYS DWS.

Ground Water Surveillance

Ground water surveillance data are compared to both DCGs and NYS DWS values in this report. The DCG for a given radionuclide represents the concentration which would yield a committed effective dose equivalent of 100 mrem (1 mSv) if an individual were to consume two liters of the liquid per day for one year. Comparison of data to these concentrations permits evaluation of discharge limit impacts and provides a historic framework to evaluate past practices. Comparison of surveillance well data to EPA, NYSDEC, and NYSDOH reference levels provides a mechanism to evaluate the radiological and nonradiological levels of contamination relative to current standards.

Radiological Analyses

In 1992, 153 wells were sampled for radiological analysis. For ease of interpretation of the radiological activity in ground water, the BNL site has been divided into sectors. In the east sector of the site (Meadow Marsh-Upland Recharge Area; Peconic River on site including STP sand filter bed area and the Peconic River off-site), radionuclide concentrations in ground water wells were at or below background levels except for tritium and Sr-90 being at 23% and 15% of the NYS DWS concentration limit,[12] respectively.

Along the north, northwest, west, south boundary of the site, and the Supply and Materiel areas, the only activity above background or significantly in excess of the system MDL was detected at Well 18-03. This is a north boundary well, where Sr-90 activity was observed.

In the center of the site, radionuclides detected in ground water samples that were attributable to BNL operations were found in the vicinity of AGS, Building 811, Building 830, Major Petroleum Facility (MPF), Central Steam Facility (CSF) and National Synchrotron Light Source (NSLS). The highest annual average concentrations detected for this area expressed as a percent of the NYS DWS concentration limit were: 19% gross beta; 3.1% tritium; and 15% Sr-90. Radionuclides that are not regulated by concentration are regulated by dose. The highest annual average concentration detected for the remaining radionuclides expressed in percent of the drinking water dose limit were: 0.9% Na-22; 1.2% Cs-137; and 6.3% Co-60.

At the landfill areas (Current, Former, and Ashfill), the single highest average gross beta concentration observed was 45% of the applicable standard; the single highest average tritium concentration and strontium-90 concentration observed were 97% and 49%, respectively of the NYS DWS. Other radionuclides were detected at small fractions of the NYS DWS concentration limit. The tritium concentration in Well 87-06 at the Current Landfill exceeded the NYS DWS for one sampling period. No other monitoring wells that were sampled exhibited concentrations that exceeded the NYS DWS. Given the distance to the site boundary, decay and mixing that will occur in transit, the resulting radionuclide concentrations at the site boundary are expected to be substantially below the applicable standard. This area is subject to a Remedial Investigation/Feasibility Study (RI/FS) as part of the Interagency Agreement (IAG).

The data from ground water surveillance wells monitored in the vicinity of the HWMF indicated the presence of tritium, fission, and activation products. The single highest average concentration of tritium and Sr-90 was 67% and 2009%, respectively of the NYS DWS. The highest average annual concentration for the remaining radionuclides detected expressed in percent of the NYS DWS dose derived concentration limits were: 0.38% Co-60, 0.72% Na-22 and 0.28% Cs-137. Three of the monitoring wells that were sampled in this area exhibited concentrations that exceeded the NYS DWS for Sr-90; (Well Nos. 88-04; 98-04; and 98-30). Given the distance to the site boundary decay and mixing that will occur in transit, the resulting radionuclide concentrations at the site boundary are expected to be substantially below the applicable standard. This area is subject to a RI/FS as part of the IAG.

In addition to the BNL on-site surveillance wells, 14 off-site private potable wells and four locations along the Peconic River near the site boundary were sampled and analyzed for gross alpha, gross beta, Sr-90, tritium, and gamma emitting radionuclides as part of a cooperative program with the SCDHS. Detectable quantities of tritium were found in four off-site sampling locations: three private potable wells and one Peconic River sampling point. The annual average tritium concentrations at the three private well locations ranged from 2 - 6% of the NYS DWS.[13] Except for naturally occurring K-40 and Cs-137, no other gamma emitting radionuclides were detected in the private well water samples. Strontium-90 values ranged between <0.01 and 0.2 pCi/L (<0.0004 and 0.007 Bq/L) in private potable well water, which is typical for Long Island.

Nonradiological Analyses

During 1992, a total of 153 ground-water surveillance wells were sampled during 336 individual sampling events for nonradiological analyses. The nonradiological analyses consist of: 1) determining water quality parameters such as pH and conductivity, chloride, sulfate, and nitrate concentrations; 2) metals concentrations; and 3) VOCs concentrations. Water quality analyses conducted on ground-water samples collected site wide indicate that the pH of ground water is typically within the range of 5.5 to 6.5 which is below the NYS DWS of 6.5 to 8.5. Additionally, chloride, sulfate, and nitrate concentrations in most areas of the site were typically below the NYS DWS. Metals and VOCs in ground water, however, exceed NYS DWS in a number of areas across the site, and are usually traceable to known spill or chemical waste storage and former disposal areas. In several areas of the site, iron is detected at levels above NYS DWS. However, in some cases these high iron levels may be the result of natural background (or ambient) iron concentrations within the Upper Glacial aquifer. In other areas (such as the Sewage Treatment Plant/Peconic River area), high iron, zinc, and copper levels are likely to be related to materials used to construct older wells that were installed in the 1950's and 1960's (i.e., carbon steel casings and brass screens). A summary of nonradiological analyses of ground-water samples collected during 1992 is described below.

East Sector: In the east sector of the site (Meadow Marsh-Upland Recharge area; Sewage Treatment Plant/Peconic River area) ground-water samples were collected from 24 surveillance wells for water quality, metals, and VOC analyses. The pH readings for ground water were typically below the NYS DWS of 6.5 to 8.5, but were consistent with values observed at upgradient locations. Other water quality parameters were below the applicable NYS DWS except for nitrate-nitrogen concentration of 10.5 mg/L observed in a single well located downgradient of the Meadow Marsh-Upland Recharge area. Metals analyses indicate that iron and copper concentrations exceeded NYS DWS in seven wells, with maximum concentrations ranging from 0.42 to 14.7 mg/L and 1.46 to 17.5 mg/L, respectively. Cadmium and zinc were also observed in one well at levels above NYS DWS, with maximum concentrations of 0.01 mg/L for cadmium and 10.8 mg/L for zinc. Volatile organic compounds were not detected in any samples.

Southeast-South Central Sector: In the southeast and south-central areas of the site, four contaminant source areas are monitored: the Hazardous Waste Management Facility, the Current Landfill, the Former Landfill, and Ash Repository area.

In the HWMF, and associated Spray Aeration Project areas, twenty-one ground water surveillance wells were monitored for water quality, metals, and VOCs, and five ground water extraction wells were monitored for metals and VOCs. The pH readings for ground water were typically below the NYS DWS of 6.5 - 8.5, but were consistent with values observed at upgradient (background) locations. Other water quality parameters were below the applicable NYS DWS. Conductivity values generally ranged from 40 - 180 μmhos/cm. Results of metals analyses performed on ground water from this area indicated that all compounds were below the applicable NYS DWS except for elevated iron concentrations detected in two wells. Analysis for VOCs in ground-water samples collected from the surveillance wells indicate that TCA, trichloroethylene (TCE), tetrachloroethylene (PCE), dichloroethane (DCA), dichloroethylene (DCE), chloroform, and toluene were detected at concentrations that exceeded the NYS DWS during at least one sampling event. The TCA was detected above NYS DWS in fourteen surveillance wells with maximum concentrations ranging from 6 to 220 μg/L; TCE was detected above the NYS DWS at two wells with maximum concentrations of 16 μg/L each; PCE was detected at or above NYS DWS in five surveillance wells with maximum concentrations ranging from 5 to 38 μg/L; DCA was detected in two wells above NYS DWS at maximum concentrations of 9 and 10 μg/L; DCE was detected in two wells above NYS DWS at maximum concentrations of 6 and 24 μg/L; chloroform was detected above NYS DWS in one well at 110 μg/L; and toluene was detected in two wells at or above NYS DWS at maximum concentrations of 5 and 7 μg/L. The ground-water extraction wells are part of the Aquifer Restoration Spray Aeration Project which was initiated in 1986. After having been removed from service in the Spring of 1990, due to regulatory concerns regarding spray efficiency and operational procedures, a pilot study under the guidance of the EPA, NYSDEC, and DOE was initiated to test the efficiency of the spray system, examine ground-water flow directions during operation, and to better delineate the contaminant plume(s) emanating from the HWMF. The Spray Aeration System was reactivated in November 1991 and remained in service through February 1992. During 1992, one sample round of pre- and post-spray ground-water samples were collected from each extraction well and spray field. Pre-spray samples collected from four of five extraction wells had detectable concentrations of VOC contamination, with three of the five extraction wells having pre-spray VOC concentrations at or above NYS DWS. The TCA was detected in two extraction wells at concentrations of 9 and 15 μg/L, and DCA was observed in a third well at the NYS DWS of 5 μg/L. In no instance did post-spray samples have VOC concentrations above NYS DWS. In 1992, BNL entered into a cooperative ground-water investigation project with the SCDHS in an effort to determine the vertical and horizontal extent of VOC contamination along the BNL southeast boundary in areas downgradient of the HWMF and Current Landfill. During this effort, 23 temporary ground-water surveillance wells were installed by the SCDHS near the southeast BNL property boundary and off site, south of the Long Island Expressway. Both TCA and PCE were detected at concentrations that exceeded the NYS DWS in the on-site temporary wells installed downgradient of the HWMF and near the southern boundary. The TCA was detected above NYS DWS in three temporary wells at concentrations up to 23 μg/L, and PCE was detected above NYS DWS at one temporary well at a maximum concentration of 11 μg/L. Analyses of ground-water samples collected off site during this study indicate that VOCs emanating from the HWMF (and the Current Landfill, discussed below) appear to have migrated beyond the BNL southeastern boundary, to areas south of the Long Island Expressway. In two temporary off-site wells (Wells A and C) installed downgradient of the HWMF, TCA and PCE were detected at concentrations that exceeded NYS DWS. In temporary Well A, TCA and PCE were detected at maximum concentrations of 14 μg/L and 7 μg/L, respectively. In temporary Well C, TCA was detected at a maximum concentration of 6 μg/L. The full extent of VOC contamination in these areas will be evaluated during the OU I RI/FS.

At the Current Landfill, water quality, metals, and VOC analyses were performed on ground-water samples collected from 22 surveillance wells. The pH readings for ground water were typically below the NYS DWS of 6.5 to 8.5, but were consistent with values observed at upgradient (background) locations. Although most other water quality parameters were within NYS DWS, conductivity and chloride measurements in wells located directly downgradient of the Current Landfill reflect the landfill's impact. Conductivity values directly downgradient of the Current Landfill ranged from 169 - 1,216 μmhos/cm whereas the maximum conductivity value in upgradient Well 87-09 was 113 μmhos/cm. Maximum observed chloride values in wells downgradient of the Current Landfill ranged from 16 to 237 mg/L whereas the maximum upgradient value was 31.4 mg/L. At the Current Landfill, iron concentrations exceeded NYS DWS in eleven wells ranging from 0.35 mg/L to 201 mg/L, lead in one well with a concentration of 0.1 mg/L, and zinc in two wells at concentrations of 4.6 mg/L and 9.1 mg/L. All other metals concentrations were below the NYS DWS. Volatile organic compound data for the Current Landfill area indicates that DCA was detected at concentrations above the NYS DWS at four wells, with maximum observed concentrations ranging from 6 to 200 μg/L; DCE was detected above NYS DWS at two wells, with maximum observed concentration of 5 and 12 μg/L; TCA was detected above NYS DWS at three wells, with maximum concentrations ranging from 6 to 13 μg/L; benzene was detected in five wells above the NYS DWS at maximum concentrations ranging from 5 to 8 μg/L; ethylbenzene was detected at or above NYS DWS in two wells at maximum concentrations of 8 and 10 μg/L; toluene was detected above NYS DWS in one well at a maximum concentration of 7 μg/L; chloroethane was detected above NYS DWS in three wells at a maximum concentration of 6μg/L; and cis 1,2-dichloroethene was detected at the NYS DWS in one well at a maximum concentration of 5 μg/L. During the SCDHS cooperative ground-water investigation discussed previously, seven temporary wells were installed on site along the BNL southeast boundary and downgradient of the Current Landfill. Nine VOCs were detected at concentrations above the NYS DWS. Chloroethane was detected at concentrations exceeding NYS DWS in five temporary wells at a maximum concentration of 110 μg/L; DCA was detected in six wells at a maximum concentration of greater than 870 μg/L; DCE in six wells at a maximum concentration of 37 μg/L; TCA in six wells at a maximum concentration of 150 μg/L; TCE in five wells at a maximum concentration of 10 μg/L; cis 1,2-dichloroethene in five wells at a maximum concentration of 20 μg/L; methylene chloride in two wells at a maximum concentration of 7 μg/L; 1,2-dichloropropane in one well at 7 μg/L; and vinyl chloride in one well at 11 μg/L. Analysis of ground-water samples collected from three temporary wells installed off site, south of the Long Island Expressway, indicate that VOCs emanating from the Current Landfill appear to have migrated beyond the BNL southeastern boundary. In one temporary off-site well (Well O), DCA and TCA were detected at maximum concentrations of 18 μg/L and 10 μg/L, respectively. The full extent of VOC contamination in these areas will be evaluated during the OU I RI/FS.

Eleven ground water surveillance wells that monitor the Former Landfill were sampled during 1992. The pH readings for ground water were typically below the NYS DWS of 6.5 - 8.5, but were consistent with the values observed at upgradient (background) locations. All other water quality parameters were below the applicable NYS DWS. All metals concentrations were below the applicable NYS DWS, except for lead which was detected in one downgradient well at a maximum concentration of 0.1 mg/L. Volatile organic compounds were detected above NYS DWS in two wells; with TCA observed in one well at a maximum concentration of 6 μg/L, and PCE detected in a second well at a maximum concentration of 6 μg/L.

The Ash Repository is monitored by a single downgradient surveillance well. Water quality data indicate that the values were below the NYS DWS of 6.5 - 8.5, but were consistent with the values observed in upgradient areas. All other water quality parameters, metals, and VOC concentrations were below the NYS DWS.

Central Sector: In the central part of the site, ten known or suspected contaminant source areas were monitored; the CSF/MPF, AGS area, Photography and

Graphic Arts (PG&A) area, Supply and Material (S&M) area, Building 479, Waste Concentration Facility (WCF), Building 830, Linac, and Relativistic Heavy Ion Collider (RHIC). Areas where contaminant concentrations exceeded NYS DWS are discussed below.

At the CSF/MPF sixteen ground-water surveillance wells were monitored for water quality, metals, and VOCs. The pH readings of ground water were typically below the NYS DWS of 6.5 - 8.5, but were consistent with the values observed at upgradient (background) locations. All other water quality parameters were below the applicable NYS DWS. Results from metals analyses of ground water from this area indicated that all compounds were below the applicable NYS DWS except for iron observed at a concentration of 1.3 mg/L in an upgradient well, and in three wells near the 1977 spill site with maximum iron concentrations ranging from 1.3 to 8.5 mg/L. Volatile organic compound analyses for ground water samples collected from the CSF/MPF area indicate that TCA, TCE, PCE, ethylbenzene, toluene, and xylene were detected at concentrations that exceeded the NYS DWS. The maximum observed concentration for each of these compounds was: 83 μg/L for TCA; 110 μg/L for TCE; 88 μg/L for PCE; 1,400 μg/L for ethylbenzene; 9,100 μg/L for toluene, and 5,100 μg/L for xylene. As required by the MPF license, the five surveillance wells that monitor the MPF were examined for floating products (i.e., petroleum hydrocarbons) on a monthly basis. As with previous years, no floating product was observed during 1992.

Within the AGS area, seven surveillance wells were monitored for water quality, metals, and VOCs. The pH readings for ground water were typically below the NYS DWS of 6.5 - 8.5, but were consistent with the values observed at upgradient (background) locations. All other water quality parameters were below the applicable NYS DWS. Results from metals analyses of ground water from this area indicated that all compounds were below the applicable NYS DWS except for metals concentrations in one well in which iron was observed at a maximum concentration of 1.1 mg/L, cadmium at 0.03 mg/L, and zinc at 18.7 mg/L. Volatile organic compound analyses indicate that the NYS DWS for TCA was exceeded in two downgradient surveillance wells at maximum concentrations of 10 μg/L and 50 μg/L.

Within the S&M area, five ground-water surveillance wells were monitored for water quality, metals, and VOCs during 1992. The pH readings for ground water were typically below the NYS DWS of 6.5 - 8.5, but were consistent with the values observed at upgradient (background) locations. All other water quality parameters were below the applicable NYS DWS. Results from metals analyses of ground water from this area indicated that all compounds were below the applicable NYS DWS. Analysis of the ground-water samples for VOCs indicate that TCA was detected at concentrations above NYS DWS in two wells at 9 μg/L and 53 μg/L.

The P&GA area is monitored by two ground-water surveillance wells. The pH readings for ground water were typically below the NYS DWS of 6.5 - 8.5, but were consistent with the values observed at upgradient (background) locations. All other water quality parameters were below the applicable NYS DWS. Results from metals analyses of ground water from this area indicated that all compounds were below the applicable NYS DWS. Analysis of the ground-water samples for VOCs indicate that TCA was detected at the NYS DWS of 5 μg/L.

North Boundary, West Sector, and South Boundary: In the north, west, and southwestern parts of the site, 16 surveillance wells were monitored for water quality parameters, metals, and VOCs.

The North Boundary area surveillance well network consists of seven wells designed to monitor background or ambient ground-water quality. Ground-water contaminants released from off-site source areas would enter the BNL site along the northern boundary. The pH readings for ground water were typically below the NYS DWS of 6.5 - 8.5, and reflect the pH of ground water entering the site from off-site areas. Other water quality parameters were below the applicable NYS DWS. Conductivity values are in the 50 - 170 μmhos/cm range. Results from metals analyses of ground water from this area indicated that all metals except iron and zinc were below the applicable NYS DWS. Iron was detected in two wells at maximum concentrations of 3.7 mg/L and 2.3 mg/L, and zinc was detected in one well at 7 mg/L. Analysis of the ground-water samples for VOCs indicate that TCA and DCA were detected above NYS DWS in a single deep Upper Glacial aquifer well. The maximum concentration for TCA was 8 μg/L, and for DCA the maximum concentration was 6 μg/L. These contaminants are likely to have migrated on to BNL from an upgradient source area.

In the West Sector, six surveillance wells were monitored for water quality, metals, and VOCs. The pH readings of ground water were typically below the NYS DWS of 6.5 -8.5, but within the values observed in upgradient areas. Iron exceeded NYS DWS at one well, with a maximum concentration of 0.6 mg/L. Volatile organic results for ground-water samples collected from the West Sector area indicate that only TCA was detected in concentrations that exceeded NYS DWS. The TCA was observed at a concentration of 26 μg/L at a well designed to assess the impact of past operations at the BNL Paint Shop, and TCA was also detected at a concentration of 17 μg/L at a well located near Process Supply Wells 104 and 105, which have been out of service due to TCA contamination.

The South Boundary wells (excluding those monitoring the HWMF and Current Landfill) consists of six surveillance wells designed to monitor ground water that is migrating off site. The pH readings of ground water were typically below the NYS DWS of 6.5 - 8.5, but within the values observed in upgradient areas. Other water quality parameters were below the applicable NYS DWS. Results from metals analyses of ground water from this area indicated that all compounds were below the applicable NYS DWS. Analyses for VOCs in the South Boundary wells indicate that TCA and DCA were detected at or above NYS DWS in one well (Well 130-02), at maximum concentrations of 14 μg/L and 5 μg/L, respectively.

<u>Off-site Dose Estimates</u>

For the year 1992, the collective committed effective dose-equivalent attributable to Laboratory operations, for the population up to a distance of 80 Kilometers (Km), was calculated to be 2.6 person-rem (0.026 person-Sv). This can be compared to a collective dose-equivalent to the same population of approximately 290,000 person-rem (2900 person-Sv) due to natural sources.

The committed effective dose-equivalent to the maximally exposed individual resident at the site boundary (NNE Sector) from the air pathway is 0.1 mrem (0.001 mSv). The maximum individual committed effective dose-equivalent from drinking water pathway is 0.04 mrem (0.0004 mSv). The maximum individual committed effective dose-equivalent from the fish pathway is 0.87 mrem (0.0087 mSv). The combined maximum individual dose equivalent is 1.01 mrem (0.01 mSv). This dose represents 1.01% of the maximum individual annual dose limit of 100 mrem (1 mSv) and 1.7% of the annual cosmic plus terrestrial external dose of about 60 mrem (0.60 mSv).

Quality Assurance Program

Brookhaven National Laboratory has implemented DOE Order CH 5700.6C[14] by developing policies, responsibilities, and providing generic guidance procedures for the development of Quality Assurance (QA) programs that are appropriate to ensure the achievement of Laboratory objectives.[15] The elements of this program have been adopted and adapted, as necessary, by the S&EP Division in the development of the Division's QA program.[16] Established protocols that document the specific activities of the EM program are described in the S&EP EPS QA Manual. A designated QA Officer, with environmental expertise, reviews all activities within the EPS that are involved with the generation, collection, analysis, evaluation, and reporting of environmental data to ensure they comply with the S&EP, BNL, and DOE QA objectives.

The level of quality control and quality assurance activities depend on the nature of measurements and the intended use of the data. Checks on sample collection techniques, analysis methods, and instrument performance are incorporated into Standard Operating Procedures (SOP) and include the use of blanks, replicates, and spikes. In addition, the QA officer is responsible for establishing a program of internal assessments and external audits to verify the effectiveness of Environmental Protection (EP) sampling, analysis, and data base activities and their adherence to the QA program. The analytical laboratories participate in interlaboratory QA programs organized by DOE, EPA, and NYSDEC. Contract laboratories used to augment the capabilities of the in-house laboratory are required to maintain a comprehensive QA program and are subject to audits by S&EP personnel to ensure its implementation.

1.0 INTRODUCTION

1.1 Site Mission

Brookhaven National Laboratory is managed by Associated Universities Inc. (AUI), under DOE Contract No. DE-AC02-76CH00016. Associated Universities, Inc. was formed in 1946 by a group of nine universities whose purpose was to create and manage a laboratory in the Northeast in order to advance scientific research in areas of interest to universities, industry, and government. On January 31, 1947, the contract for BNL was approved by the Manhattan District of the Army Corp of Engineers and BNL was established on the former Camp Upton Army camp.

The Laboratory carries out basic and applied research in the following fields: high-energy nuclear and solid state physics; fundamental material and structural properties and the interactions of matter; nuclear medicine, biomedical and environmental sciences; and selected energy technologies. In conducting these research activities, it is Laboratory policy to protect the health and safety of employees and the public, and to minimize the impact of BNL operations on the environment.

1.2 Site Characteristics

Brookhaven National Laboratory is a multidisciplinary scientific research center located close to the geographical center of Suffolk County on Long Island, about 97 km east of New York City. Its location with regard to the metropolitan area and local communities are shown in Figures 1 and 2, respectively. About 1.32 million persons reside in Suffolk County[17] and about 0.41 million persons reside in Brookhaven Township, within which the Laboratory is situated. Approximately eight thousand persons reside within a half km of the Laboratory boundary. The distribution of the resident population within 80 km of the BNL site is shown in Figure 1 and 1992 BNL SER Compendium, Table 1. The population distribution within 0.5 km of the BNL site is shown in Figure 2. Although much of the land area within a 16 km radius remains either forested or cultivated, there has been an increase in residential housing development in the rural areas surrounding BNL, though there have been no major construction projects in the vicinity since 1978. However, detailed plans for two shopping centers, a corporate park, and several thousand single and multiple family dwellings are proposed within a 15 km area of BNL, predominately on the north, south, and west boundaries.

The Laboratory site is shown in Figure 3. It consists of 21.3 square kilometers (2,130 hectares [ha]), most of which is wooded, except for a developed area of about 6.7 square kilometers (670 ha). The site terrain is gently rolling, with elevations varying between 36.6 and 13.3 m above sea level. The land lies on the western rim of the shallow Peconic River water shed. The marshy areas in the north and eastern sections of the site are a portion of the Peconic River headwaters. The Peconic River both recharges to, and receives water from, the ground water aquifer depending on the hydrological potential. In times of drought the river water typically recharges to ground water (i.e., an influent

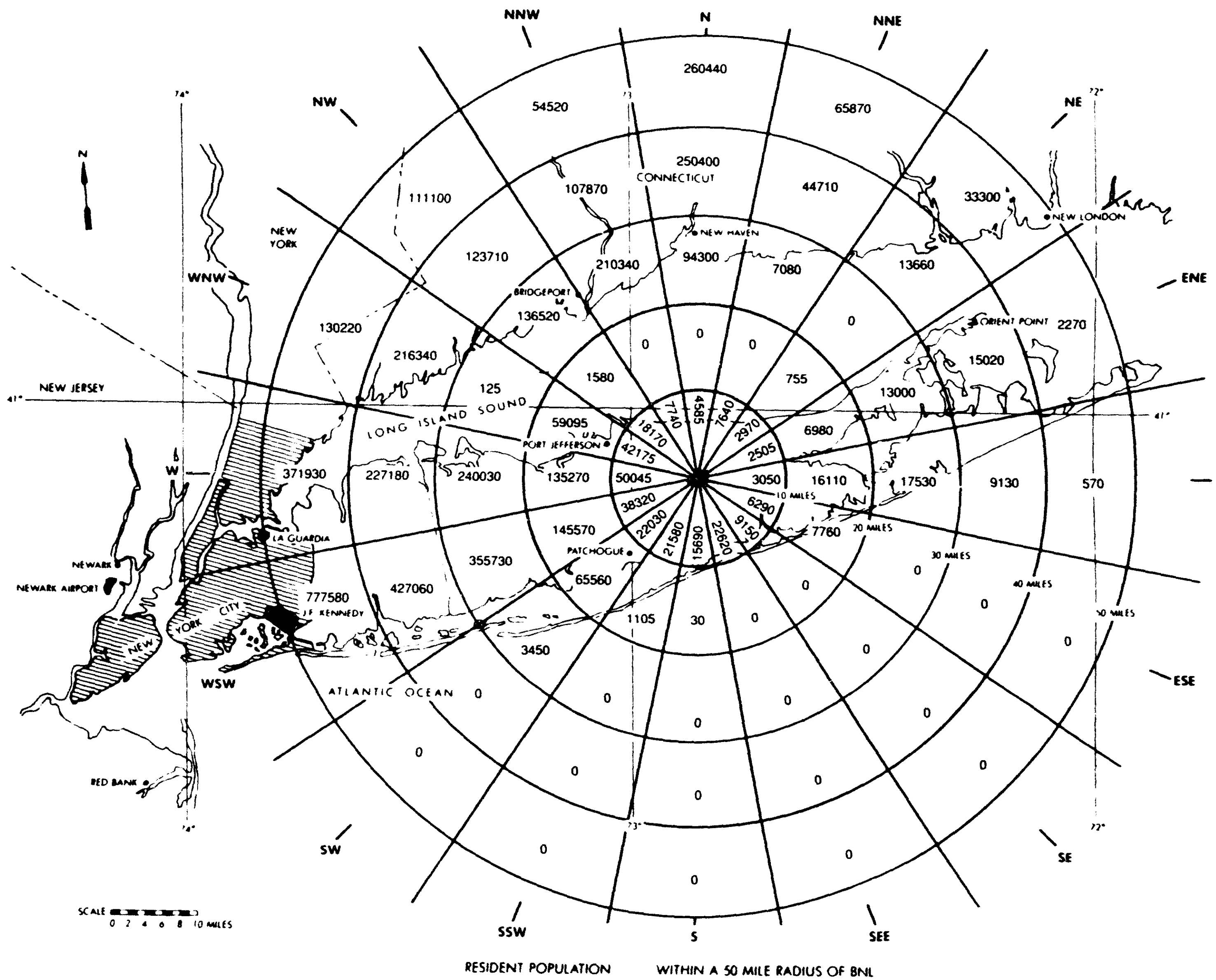


Figure 1: Resident Population within an 80 km Radium of BNL - 1992.

BROOKHAVEN NATIONAL LABORATORY
LOCAL AND ON-SITE POPULATION DISTRIBUTION

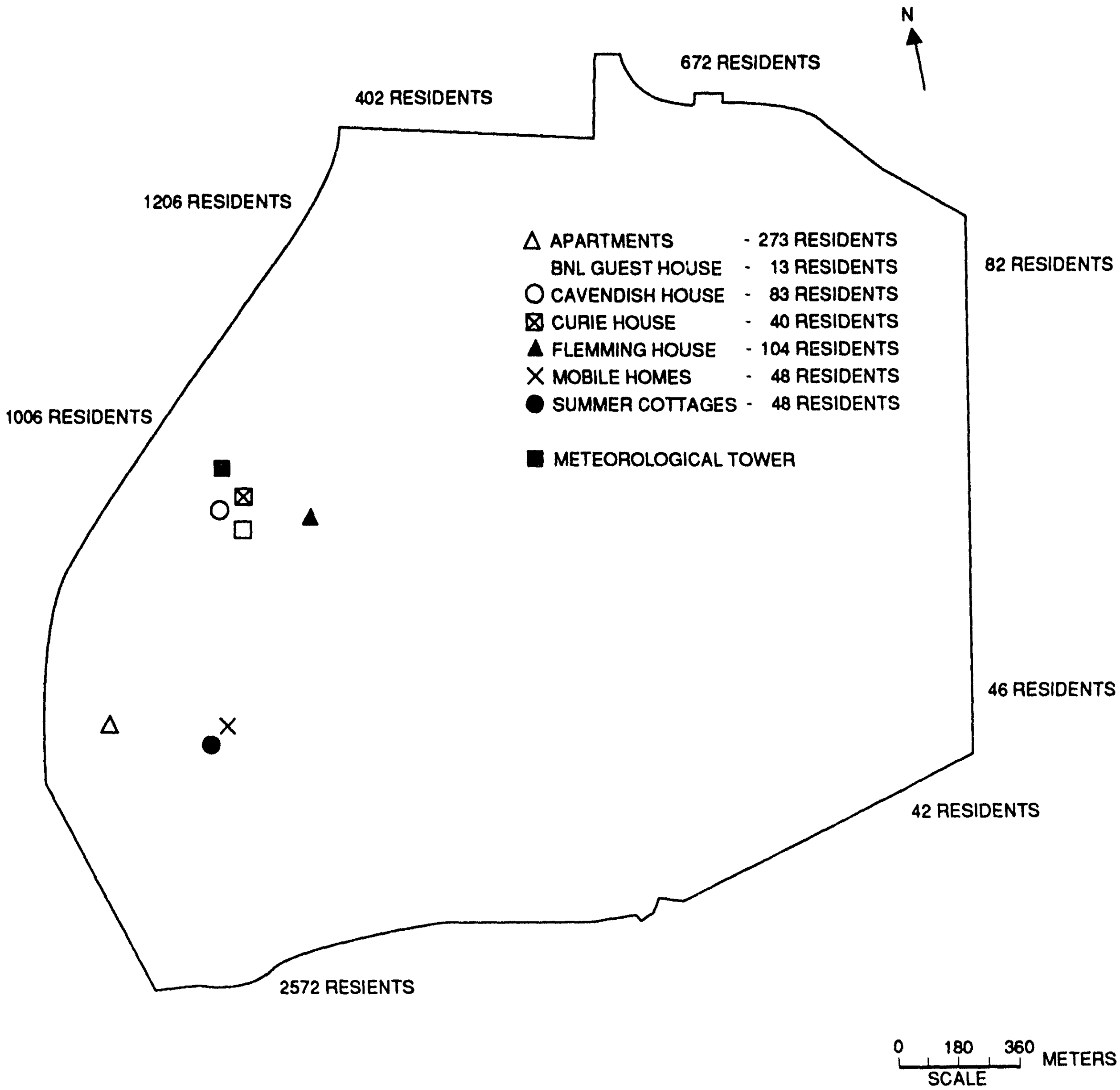


Figure 2: Brookhaven National Laboratory - Local and On-site Population Distribution.

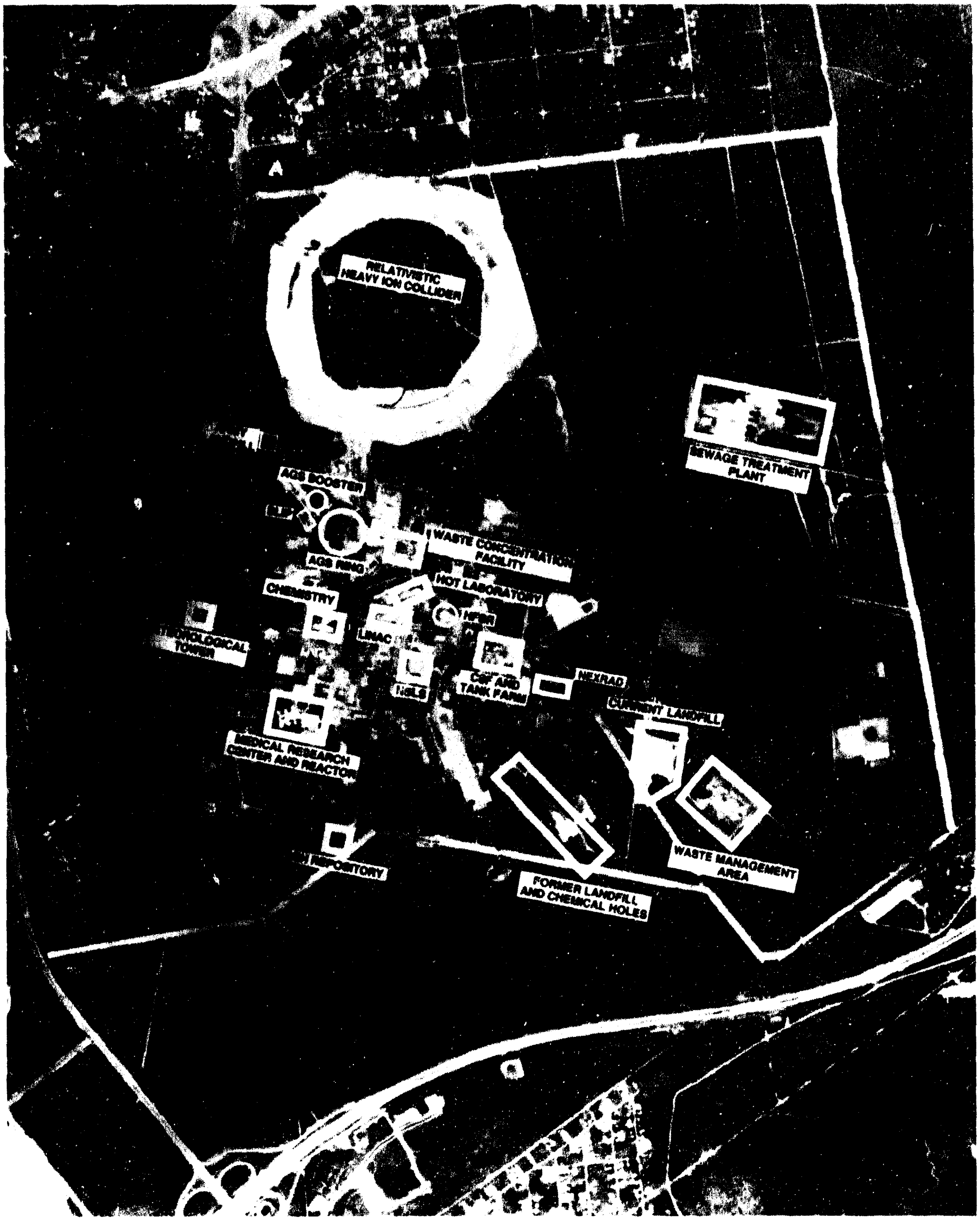


Figure 3: Major Facilities.

stream) while in times of normal to above normal precipitation, the river receives water from the aquifer (i.e., an effluent stream). In 1992, for a significant period of the year, the Peconic River bed on site was in a recharge mode. Consequently, virtually no flow left the site.

The Laboratory uses approximately 16.0 million liters of ground water per day to meet potable water plus heating and cooling requirements. Approximately 33% of the total pumpage was returned to the aquifer through on-site recharge basins. About 14% is discharged into the Peconic River. Human consumption utilizes 4% of the total pumpage while evaporation (cooling tower and wind losses), cesspool plus line losses account for 30% and 10%, respectively. These latter percentages are estimates based on mass balance. Accuracy in such estimations is expected to be increased when flow measurement systems at the recharge basins are installed as part of the Environmental Monitoring upgrades.

In terms of meteorology, the Laboratory can be characterized, like most eastern seaboard areas, as a well-ventilated site. The prevailing ground level winds are from the southwest during the summer, from the northwest during the winter, and about equally from these two directions during the spring and fall.[18,19] The 1992 annual wind rose for BNL is presented in Figure 4. The joint frequency distribution data for the period 1981 to 1991 is presented in the 1992 BNL SER Compendium, Table 2. The average temperature in 1992 was 9.71° C and the range was -15.64° C to 33.10° C. Monthly minimum, maximum, and average temperature data are presented in the Compendium, Table 3 and shown graphically in Figure 5.

Studies of Long Island hydrology and geology[20-23] in the vicinity of the Laboratory indicate that the uppermost Pleistocene deposits, which are between 31 - 61 m thick, are generally composed of highly permeable glacial sands and gravels. Water penetrates these deposits readily and there is little direct run off irto surface streams, except during periods of intense precipitation. The total precipitation for 1992 was 114.7 cm, which is about 9 cm below the 40 year annual average. The historic and 1992 monthly precipitation data are presented in Figure 6 and 7, respectively. The monthly and annual precipitation data are also presented in the Compendium, Table 4. On the average, about half of the annual precipitation is lost to the atmosphere through evapotranspiration and the other half percolates through the soil to recharge ground water. Run offs form a very insignificant portion of the total rainfall, usually less than 2%.[24]

Ground water flow in the vicinity of BNL is controlled by many factors. The main ground water divide lies approximately 2 - 3 Km north of BNL, and runs parallel to the Long Island Sound. This divide is known to shift 1 - 2 km, north to south.[22] East of BNL is a secondary ground water divide that defines the southern boundary of the area contributing ground water to the Peconic River.

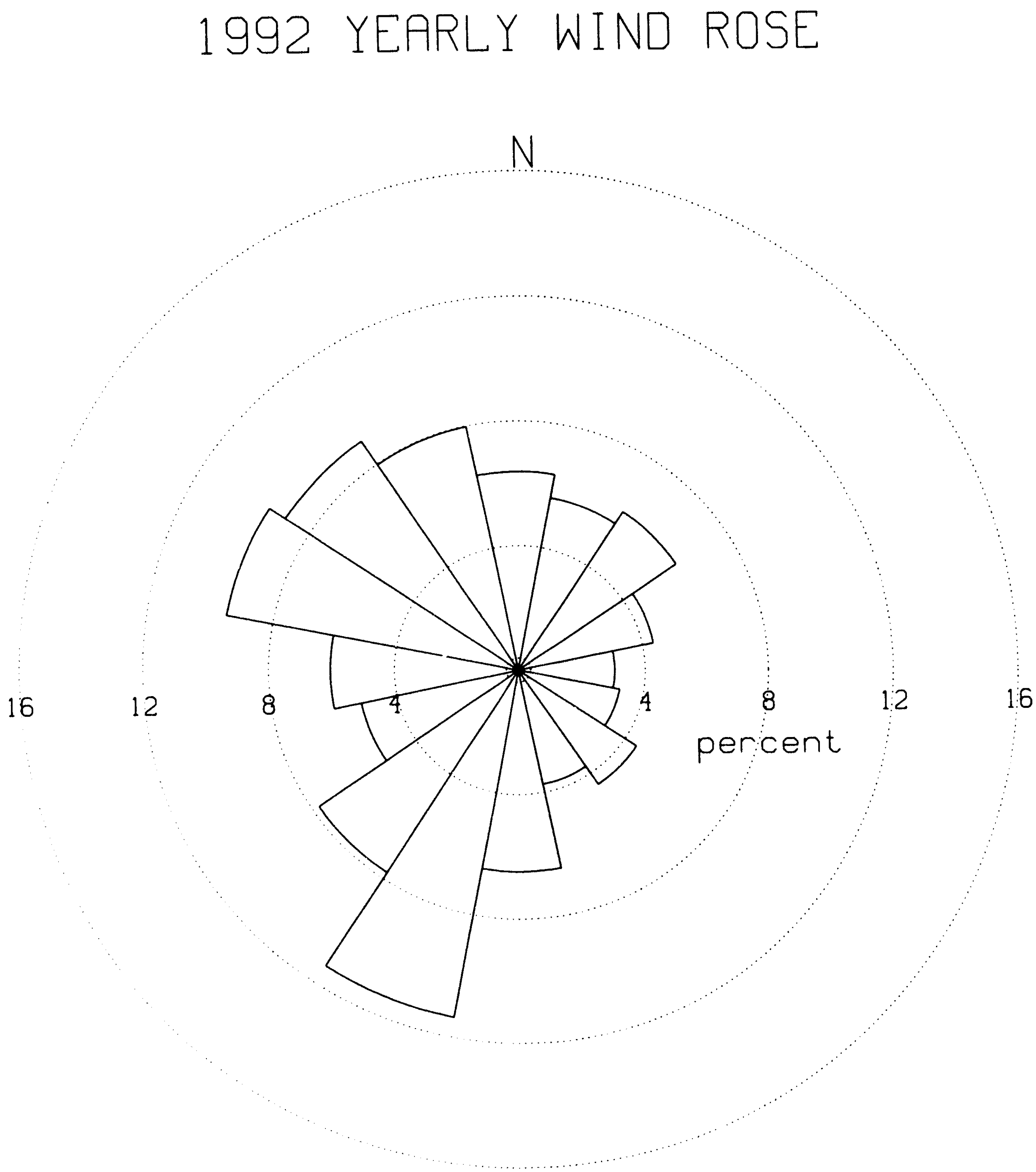


Figure 4: Annual Wind Rose for 1992.

Climatology of the BNL Site

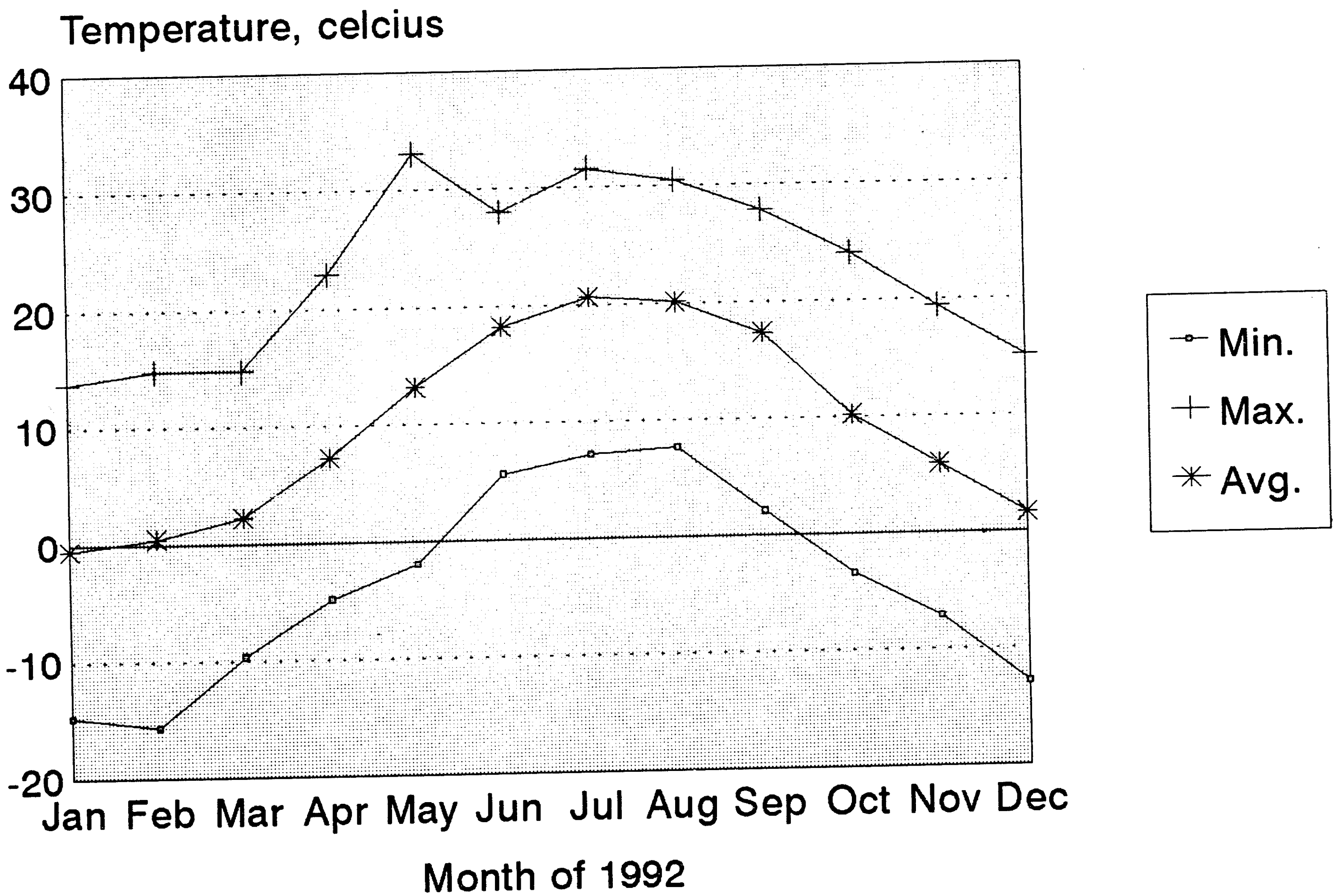


Figure 5: Climatology for the BNL Site - Temperature Data - 1992.

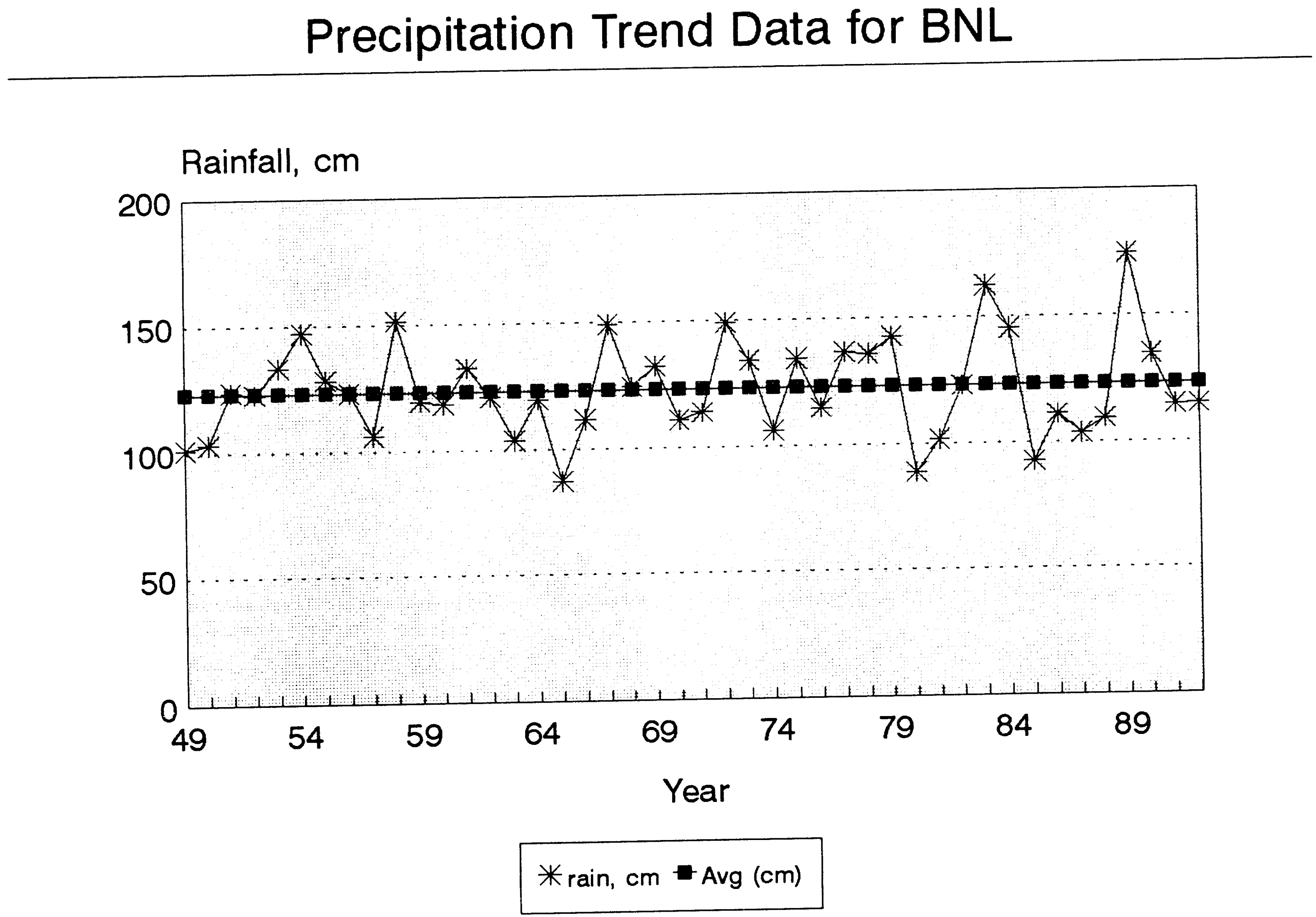


Figure 6: Precipitation Trend Data for BNL, 1949 to 1992.

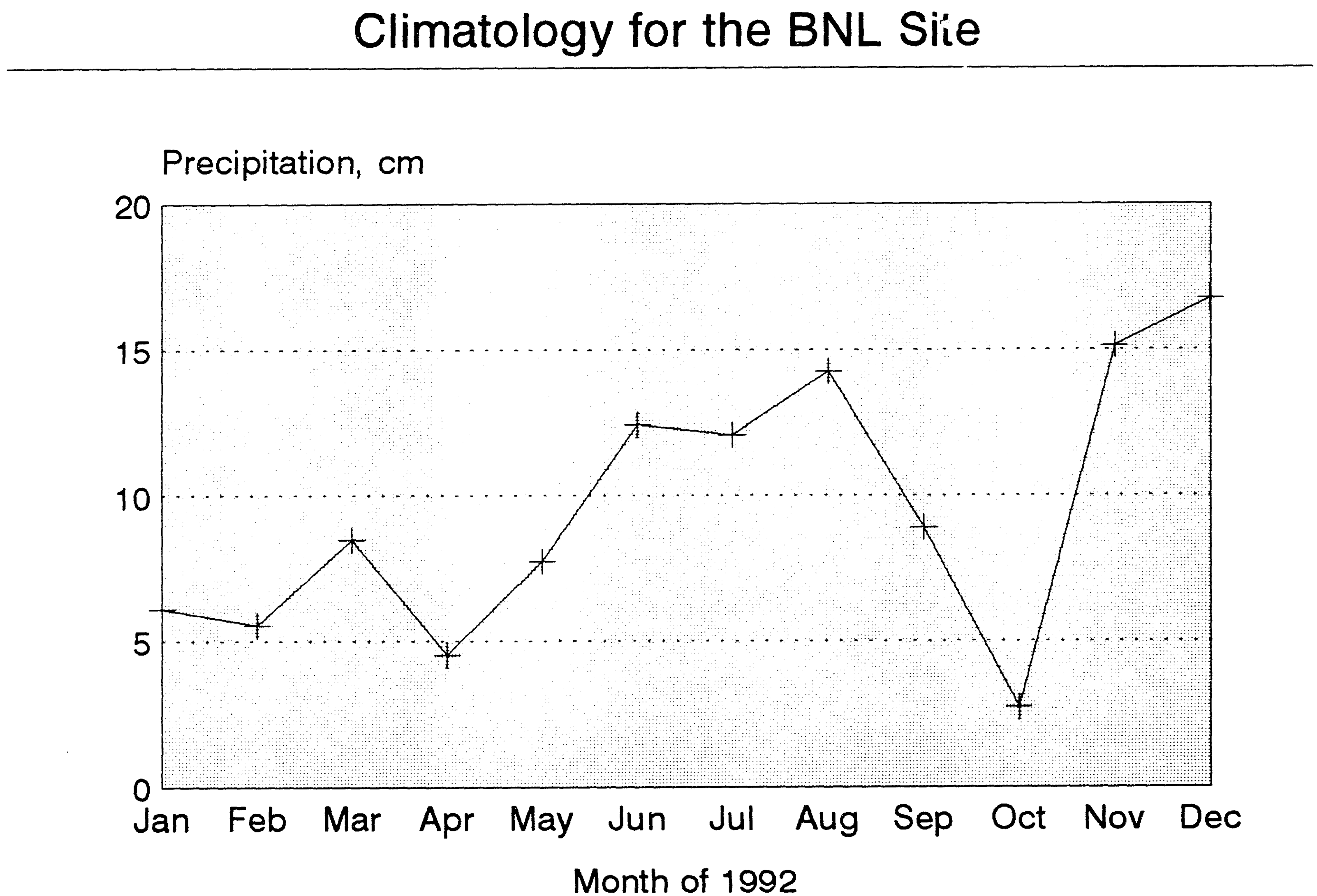


Figure 7: Climatology for the BNL Site: Precipitation for 1992.

The exact location of the triple-point intersection of these two divides is not known and may be under BNL. South of these divides the ground water moves southward to Great South Bay and to Moriches streams. In general, the ground water from the area between the two branches of the divide moves out eastward to the Peconic River. North of the divide ground water moves northward to Long Island Sound. Pressure of a higher water table to the west of the BNL area generally inhibits movement towards the west. Variability in the direction of flow on the BNL site is a function of the hydraulic potential and is further complicated by the presence of clay deposits that accumulate perched water at several places plus the pumping/recharge of ground water that are part of BNL daily operations. In general, ground water in the northeast and northwest sections of the site flows towards the Peconic River. On the western portion of the site, ground water flow tends to be towards the south while along the southern and southeastern sections of the site the ground water flow tends to be towards the south to southeast. Site-wide water table maps (Figure 8 and 9), based on piezometric data collected during June and November 1992 substantiates this observation. In all areas of the site, horizontal ground water velocity is estimated to range from 30 to 45 cm/d.[20-23] The site occupied by BNL has been identified by the Long Island Regional Planning Board[24] and Suffolk County as being over a deep flow recharge zone for Long Island. This implies that precipitation and surface water which recharges within this zone has the potential to replenish the lower aquifer systems (Magothy and/or Lloyd) which exist below the Upper Glacial Aquifer. The extent to which the BNL site contributes to deep flow recharge is currently under evaluation. However, it is estimated that up to two fifths of the recharge from rainfall moves into the deeper aquifers. In coastal areas, these lower aquifers discharge to the Atlantic Ocean or Long Island.[24]

The Laboratory is located in a section of the Oak/Chestnut forest region of the Coastal Plain. Because of the general topography and porous soil, there is little surface runoff or open water. Upland soils tend to be drained excessively, while depressions form small pocket wetlands. Hence, a mosaic of wet and dry areas on the site are correlated with variations in topography and depth to the water table. In the absence of fire or other disturbance, the vegetation normally follows the moisture gradient closely. In actuality, vegetation on site is in various stages of succession which reflects the history of disturbances to the area, the most important having been land clearing, fire, local flooding, and draining.

Mammals common to the site include species common to mixed hardwood forests and open grassland habitats. At least 180 species of birds have been observed at BNL, a result of its location within the Atlantic Flyway and the scrub/shrub habitats which offer food and resting opportunities to migratory songbirds. Open fields bordered by hardwood forests found at the recreation complex provide excellent hunting areas for hawks. Pocket wetlands with seasonal standing water provide breeding areas for amphibians. Permanently flooded retention basins and other watercourses support aquatic reptiles.

Except for occasional transient individuals, no Federal or New York State listed or proposed threatened or endangered species exist within the Laboratory area.[25,26] One New York State species of special concern, which has been confirmed as an inhabitant of the Peconic River on site, is the banded sunfish (Enneacanthus obesus). This species occurs in New York solely within the Peconic River system. That portion of the Peconic River which occurs on BNL

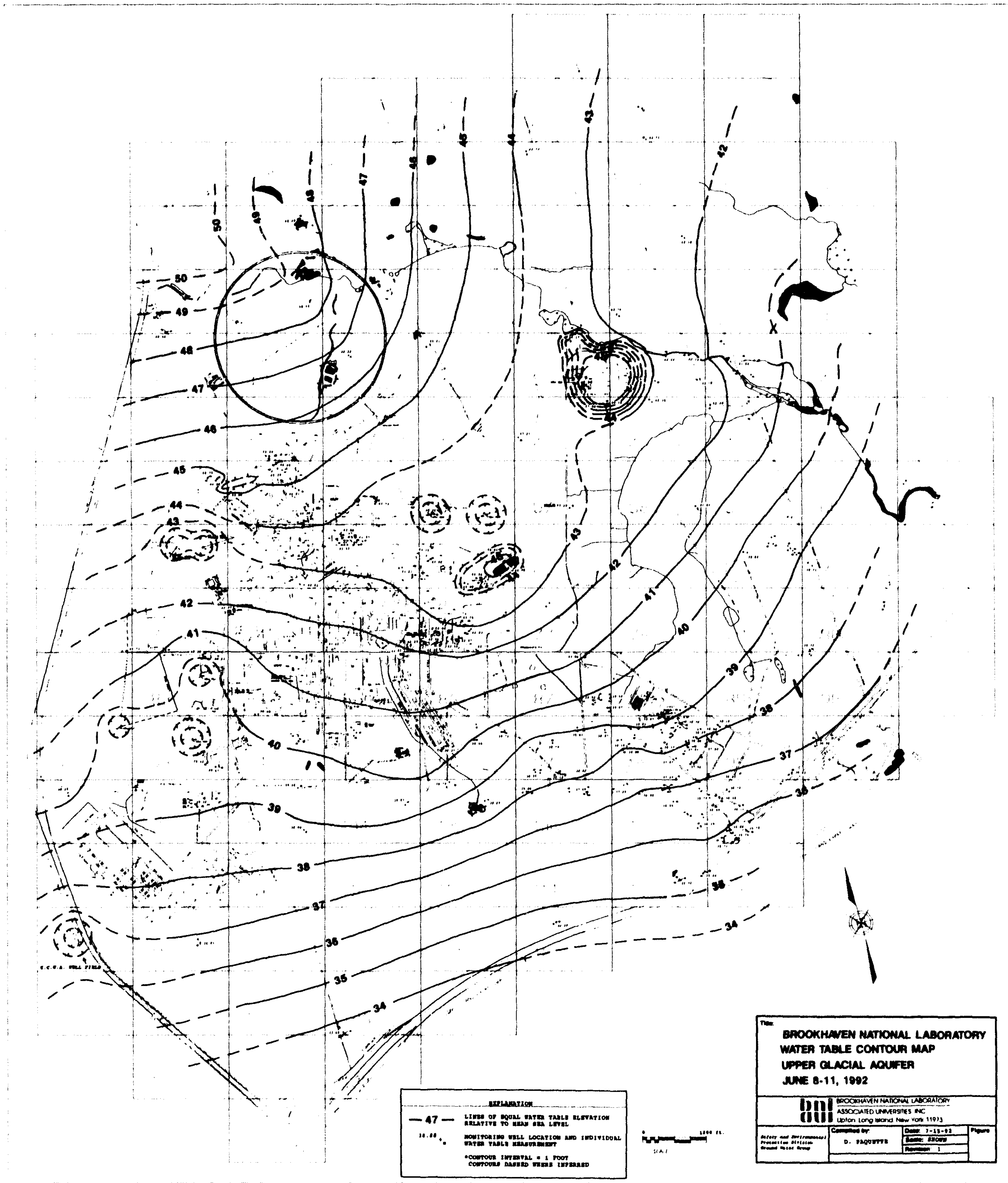


Figure 8: Site Water Table Map June 1992.

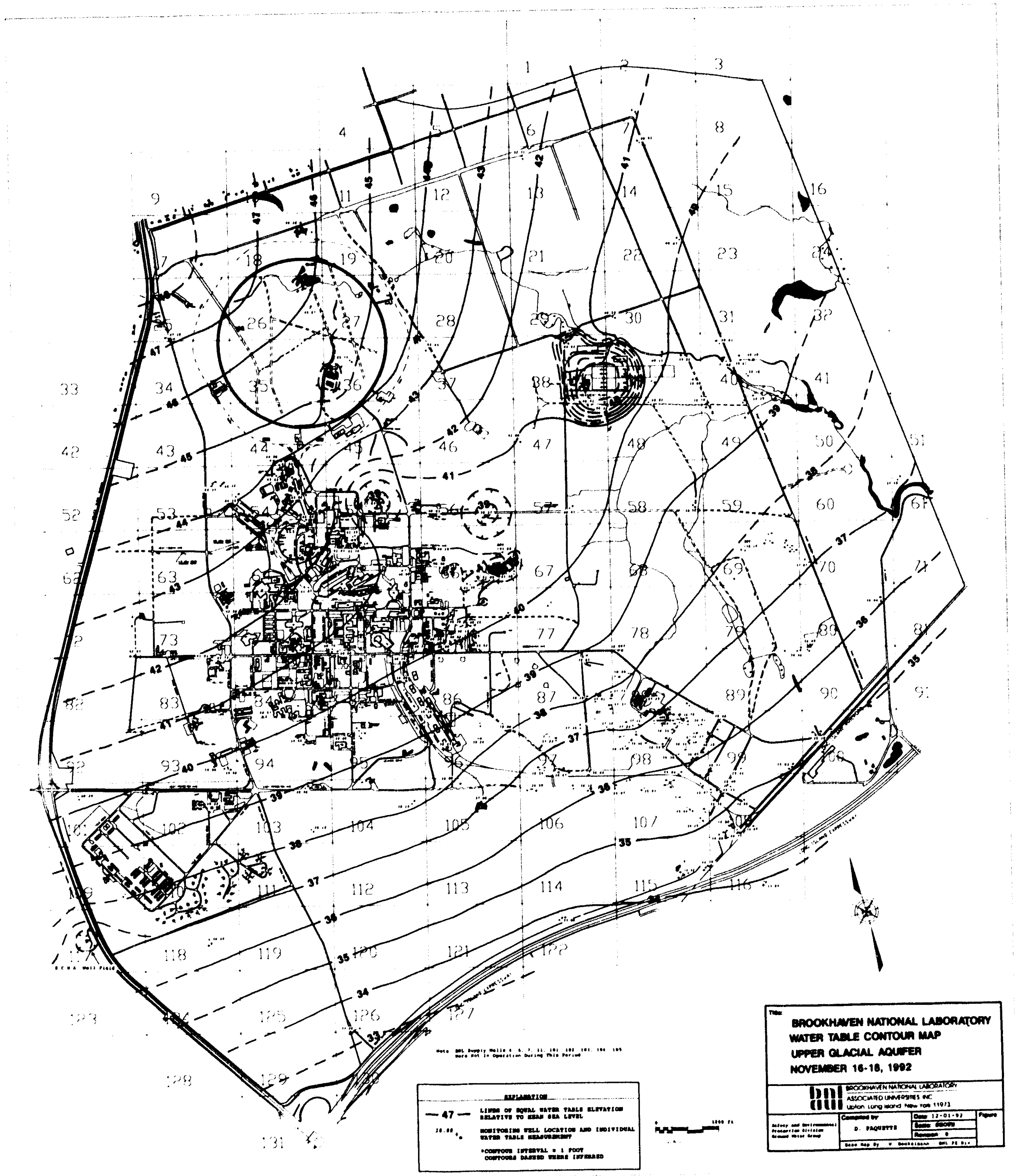


Figure 9: Site Water Table Map November 1992.

property has been designated as "scenic" in accordance with the New York State's Wild, Scenic, and Recreational Rivers Act (WSRRA). The wide variety of wildlife resources at BNL attest to Laboratory planning practices which have clustered development to minimize habitat fragmentation, particularly in environmentally sensitive areas such as the Peconic River corridor. Habitat fragmentation represents the greatest threat to wildlife habitats on Long Island today.

1.3 Existing Facilities

A wide variety of scientific programs are conducted at Brookhaven, including research and development in the following areas:

1. The fundamental structure and properties of matter;

2. The interactions of radiation, particles, and atoms with other atoms and molecules;

3. The physical, chemical, and biological effects of radiation;

4. The production of special radionuclides and their medical applications;

5. Energy and nuclear related technology; and

6. The assessment of energy sources, transmission and uses, including their environmental and health effects.

The major scientific facilities which are operated at the Laboratory to carry out the above programs are described below:

1. The HFBR is fueled with enriched uranium, moderated and cooled by heavy water. In the past, this facility operated at a routine power level ranging from 40 to 60 MW thermal. Since May 1991, it operated at a level of 30 MW thermal.

2. The Medical Research Reactor is an integral part of the Medical Research Center (MRC), is fueled with enriched uranium, moderated and cooled by light water, and is operated intermittently at power levels up to 3 MW thermal.

3. The Alternating Gradient Synchrotron is used for high energy physics research and accelerates protons to energies up to 30 GeV and heavy ion beams to 15 GeV/amu.

4. The 200 MeV Linear Accelerator (LINAC) serves as a proton injector for the AGS and also supplies a continuous beam of protons for radionuclide production by spallation reactions in the Brookhaven Linac Isotope Production Facility.

5. The Tandem Van de Graaff, Vertical Accelerator, Cyclotron, and research Van de Graaff are used in medium energy physics investigations, as well as for special nuclide production. The heavy ions from the Tandem Van de Graaffs can also be injected into the AGS for use in physics experiments.

6. The National Synchrotron Light Source utilizes a linear accelerator and booster synchrotron as an injection system for two electron storage rings which operate at energies of 750 MeV vacuum ultraviolet (VUV) and 2.5 GeV (x-ray). The synchrotron radiation produced by the stored electrons is used for VUV spectroscopy and for x-ray diffraction studies.

7. The Heavy Ion Transfer tunnel connects the coupled Tandem Van de Graaffs and the AGS. The interconnection of these two facilities permits the injection of intermediate mass ions into the AGS where the ions can be accelerated to an energy of 15 GeV/amu. These ions are then extracted and sent to the AGS experimental area for physics research.

8. The AGS Booster is a circular accelerator with a circumference of 200 meters that will receive either a proton beam from the Linac or heavy ions from the Tandem Van de Graaff. The Booster accelerates proton particles and heavy ions prior to injection into the AGS ring. This facility became operational in 1992.

9. The Radiation Therapy Facility operated jointly by the BNL Medical Department and State University of New York at Stony Brook, is a high energy dual x-ray mode linear accelerator for radiation therapy of cancer patients. This accelerator has been designed to deliver therapeutically useful beams of x-rays and electrons for conventional and advanced radiotherapy techniques.

Additional programs involving irradiations and/or the use of radionuclides for scientific investigations are carried out at other Laboratory facilities including those of the MRC, the Biology Department, the Chemistry Department, and the Department of Applied Sciences (DAS). Special purpose radionuclides are developed and processed for general use under the joint auspices of the DAS and the Medical Department.

2.0 COMPLIANCE SUMMARY

It is the policy of BNL to operate and maintain the site in compliance with applicable Federal, State, or local regulations and DOE Orders. This section provides a brief summary of the compliance status for existing facilities and operations during CY 1992 and the first quarter of 1993.

2.1 Environmental Permits

There are a variety of processes and facilities at BNL which operate under regulatory permits. These permits include one SPDES permit, a MFP license, a Resource Conservation Recovery Act (RCRA) permit, a certificate from NYSDEC registering tanks storing bulk quantities of hazardous substances, seven NESHAPS permits, 41 Certificates to Operate (CO) air emission sources from NYSDEC and 42 applications pending with NYSDEC either for renewals of existing COs, cancellations of existing COs, or for COs for air emission sources. The type and status of all environmental permits issued to the DOE through December 31, 1992 is presented in Table 1.

Table 1
BNL Site Environmental Report for Calendar Year 1992
BNL Environmental Permits

Bldg/Facility Designation	Process Description	Permitting Agency and Division	Permit Number	Expiration Date
134	blueprint machine	NYSDEC-Air Quality	472200 3491 13401	11-29-96
197	blueprint machine	NYSDEC-Air Quality	472200 3491 19701	Canceled 3-92
197	degreaser tank	NYSDEC-Air Quality	472200 3491 19702	3-22-96
197	acid metal cleaning	NYSDEC-Air Quality	472200 3491 19703	3-22-96
197	welding shop	NYSDEC-Air Quality	472200 3491 19704	4-1-95
197	fiche duplicator	NYSDEC-Air Quality	submitted 12-90, status pending	
197	cleaning room hoods	NYSDEC-Air Quality	472200 3491 19706	3-14-92*
197	cleaning room hoods	NYSDEC-Air Quality	472200 3491 19707	3-14-92*
197	epoxy coating/curing exhaust	NYSDEC-Air Quality	submitted 10-92, status pending	
206	cyclone G-10	NYSDEC-Air Quality	472200 3491 20601	4-1-95
207	belt sander	NYSDEC-Air Quality	472200 3491 20701	4-1-95
208	lead melting	NYSDEC-Air Quality	472200 3491 20801	11-29-96
208	vapor degreaser	NYSDEC-Air Quality	472200 3491 20802	11-29-96
208	sandblasting	NYSDEC-Air Quality	472200 3491 20803	11-29-96
208	sandblasting	NYSDEC-Air Quality	472200 3491 20804	11-29-96
244	cyclone collector	NYSDEC-Air Quality	472200 3491 24401	1-28-95
348	paint hood exhaust	NYSDEC-Air Quality	cancellation requested, pending[1]	
422	cyclone collector	NYSDEC-Air Quality	472200 3491 42202	11-29-96
422	cyclone collector	NYSDEC-Air Quality	472200 3491 42203	11-29-96
422	paint spray booth	NYSDEC-Air Quality	472200 3491 42204	Canceled 4-90
422	paint spray booth	NYSDEC-Air Quality	472200 3491 42205	Canceled 4-90
423	combustion unit	NYSDEC-Air Quality	472200 3491 42304	Canceled 11-89
423	stage II vapor recovery	NYSDEC-Air Quality	472200 D365 WG	9-27-95
423	welding hood	NYSDEC-Air Quality	submitted 10-92, status pending	
444	incinerator	NYSDEC-Air Quality	472200 3491 44401	11-29-96
452	combustion unit	NYSDEC-Air Quality	472200 3491 45204	Canceled 11-89
452	parts cleaner tank	NYSDEC-Air Quality	472200 3491 45201	Canceled 3-92
457	combustion unit	NYSDEC-Air Quality	472200 3491 45704	Canceled 11-89
457	sulfite dispensing	NYSDEC-Air Quality	472200 3491 45705	Cancellation[2]
458	paint spray booth	NYSDEC-Air Quality	472200 3491 45801	4-23-97[4]
462	machining, grinding exhaust	NYSDEC-Air Quality	472200 3491 46201	11-29-96
462	machining, grinding exhaust	NYSDEC-Air Quality	472200 3491 46202	11-29-96
473	vapor degreaser	NYSDEC-Air Quality	472200 3491 47301	3-22-96
479	combustion unit	NYSDEC-Air Quality	472200 3491 47904	Canceled 11-89
479	cyclone G-10	NYSDEC-Air Quality	472200 3491 47905	4-1-95
490	Inhalation Toxicology Facility	NYSDEC-Air Quality	472200 3491 49001	12-7-90*
490	Inhalation Toxicology Facility	NYSDEC-Air Quality	472200 3491 49002	12-7-90*
490	lead alloy melting	NYSDEC-Air Quality	472200 3491 49003	11/11/96
490	milling machine/block cutter	NYSDEC-Air Quality	472200 3491 49004	11/11/96
493	combustion unit	NYSDEC-Air Quality	472200 3491 49304	Canceled 11-89
493	incinerator	NYSDEC-Air Quality	472200 3491 493AO	Cancellation[3]
510	blueprint machine	NYSDEC-Air Quality	472200 3491 51001	11-29-91*
510	metal cutting exhaust	NYSDEC-Air Quality	submitted 12-90, status pending	
510	calorimeter enclosure	U.S.EPA - NESHAPS	BNL-689-01	None
526	polymer mix booth	NYSDEC-Air Quality	472200 3491 52601	4-1-95
526	polymer weighing	NYSDEC-Air Quality	472200 3491 52602	4-1-95
535B	plating tank	NYSDEC-Air Quality	472200 3491 53501	4-1-95
535B	etching machine	NYSDEC-Air Quality	472200 3491 53502	4-1-95
535B	PC board process	NYSDEC-Air Quality	472200 3491 53503	4-1-95
535B	welding hood	NYSDEC-Air Quality	submitted 12-90, status pending	
555	scrubber (1)	NYSDEC-Air Quality	472200 3491 55501	4-1-95
555	scrubber (2)	NYSDEC-Air Quality	472200 3491 55502	4-1-95
555	paint hood exhaust	NYSDEC-Air Quality	submitted 10-92, status pending	

Table 1 (Continued)

Bldg/Facility Designation	Process Description	Permitting Agency and Division	Permit Number	Expiration Date
610	combustion unit	NYSDEC-Air Quality	472200 3491 6101A	2-22-93
610	combustion unit	NYSDEC-Air Quality	472200 3491 61004	11-29-91*
610	combustion unit - ALF	NYSDEC-Air Quality	472200 3491 61005	11-29-91*
610	combustion unit	NYSDEC-Air Quality	472200 3491 61006	3-21-93
610	combustion unit	NYSDEC-Air Quality	submitted 8-91, status pending	
630	stage II vapor recovery	NYSDEC-Air Quality	472200 D366 WG	9-27-95
650	scrap lead recycling	NYSDEC-Air Quality	472200 3491 65001	11-29-96
650	shot blasting	NYSDEC-Air Quality	472200 3491 65002	11-29-96
703	machining exhaust	NYSDEC-Air Quality	submitted 10-92, status pending	
705	building ventilation	U.S. EPA - NESHAPS	BNL-288-01	None
725	blueprint machine	NYSDEC-Air Quality	472200 3491 72501	4-1-95
815	welding hood	NYSDEC-Air Quality	cancellation requested, pending[1]	
820	accelerator test facility	U.S.EPA - NESHAPS	BNL-589-01	None
901	tin lead solder	NYSDEC-Air Quality	472200 3491 90101	4-1-95
901	paint hood exhaust	NYSDEC-Air Quality	submitted 10-92, status pending	
902	spray booth exhaust	NYSDEC-Air Quality	submitted 12-90, status pending	
903	blueprint machine	NYSDEC-Air Quality	472200 3491 90301	11-29-96
903	cyclone G-10	NYSDEC-Air Quality	472200 3491 90302	4-1-95
903	brazing process exhaust	NYSDEC-Air Quality	submitted 12-90, status pending	
905	vapor degreaser	NYSDEC-Air Quality	472200 3491 90501	3-22-96
905	belt sander	NYSDEC-Air Quality	472200 3491 90502	6-18-95
911	blueprint machine	NYSDEC-Air Quality	472200 3491 91101	11-29-96
911	paint spray hood	NYSDEC-Air Quality	submitted 12-90, status pending	
919A	sandblasting	NYSDEC-Air Quality	472200 3491 91901	4-23-97
919A	sandblasting	NYSDEC-Air Quality	472200 3491 91902	4-23-97
919	solder exhaust	NYSDEC-Air Quality	submitted 10-92, status pending	
922	cyclone exhaust	NYSDEC-Air Quality	472200 3491 92201	4-1-95
924	spray booth exhaust	NYSDEC-Air Quality	submitted 12-90, status pending	
924	magnet coil production press	NYSDEC-Air Quality	submitted 10-92, status pending	
930	electroplating/acid etching	NYSDEC-Air Quality	submitted 10-92, status pending	
930	bead blaster	NYSDEC-Air Quality	submitted 10-92, status pending	
930	ultrasonic cleaner	NYSDEC-Air Quality	submitted 10-92, status pending	
930	paint hood exhaust	NYSDEC-Air Quality	submitted 10-92, status pending	
T30	combustion unit	NYSDEC-Air Quality	472200 3491 T3004	Canceled 11-89
	spray aeration project	NYSDEC-Air Quality	submitted 10-89, status pending	
AGS Booster	accelerator	U.S. EPA - NESHAPS	BNL-188-01	None
RHIC	accelerator	U.S. EPA - NESHAPS	BNL-389-01	None
	radiation therapy facility	U.S. EPA - NESHAPS	BNL-489-01	None
	radiation effects/neutral beam	U.S. EPA - NESHAPS	BNL-789-01	None
CSF(d)	major petroleum facility	NYSDEC-Water Quality	1-1700	3-31-93
STP(a) & RCB(b)	sewage plant & recharge basins	NYSDEC-Water Quality	NY-0005835	under review for renewal; I.O.S.
HWMF(c)	waste management	NYSDEC-Hazardous Waste	NYS ID No. 789 005 385	I.O.S.
BNL Site	chem tanks-HSBSRC	NYSDEC	1-000263	7-27-93

(a) Sewage Treatment Plant
(b) Recharge basins
(c) Hazardous Waste Management Facility
(d) Central Steam Facility
I.O.S. = Interim Operating Status.
HSBSRC = Hazardous Substance Bulk Storage Registration Certificate

*Note: Renewal application submitted more than 30 days prior to expiration date; process can continue to operate under provisions of the NYS Uniform Procedures Act.

[1] Cancellation requested 6-92, status pending.
[2] Cancellation requested 7-92, status pending.
[3] Process no longer in use, cancellation requested 11-13-90, status pending.
[4] Modification requested 7-92, status pending.

2.2 Ground Water Contamination in Excess of the NYS DWS

Ground water monitoring is performed at BNL to determine the impact of Laboratory operations on the uppermost aquifer underlying the site. Ground water samples are routinely analyzed for water quality parameters, metals, VOCs, and radionuclides. The following provides information on locations where ground water monitoring was performed in CY 1992. Where concentrations are reported in this section, they represent exceedences of the NYS DWS and are the maximum observed value for the calendar year.

Location	Status/Comments
Hazardous Waste Management Facility	Ground-water samples collected from surveillance wells located in and downgradient of the HWMF indicated that the following VOCs were observed at concentrations exceeding NYS DWS: TCA at Wells 88-04 (11 μg/L), 98-05 (9 μg/L), 98-16 (6 μg/L), 98-19 (5 μg/L), 99-04 (7 μg/L), 108-07 (22 μg/L), 108-08 (6 μg/L), 108-09 (15 μg/L), 108-12 (18 μg/L), 108-13 (21 μg/L), 108-14 (21 μg/L), 108-17 (57 μg/L), and 108-18 (220 μg/L); TCE at Wells 108-17 (16 μg/L) and 108-18 (16 μg/L); PCE at Wells 88-04 (38 μg/L), 98-19 (11 μg/L), 108-08 (6 μg/L), and 108-17 (8 μg/L); DCA at Wells 98-16 (5 μg/L) and 98-22 (10 μg/L); DCE at Wells 108-17 (6 μg/L) and 108-18 (24 μg/L); chloroform at Well 108-17 (110 μg/L); hexane at Well 108-07 (52 μg/L); and toluene at Well 108-08 (7 μg/L). The following metals were present in ground-water samples at concentrations above NYS DWS: Cadmium (Cd) at Well 98-04 (0.013 mg/L); Iron (Fe) at Wells 88-01 (4.4 mg/L), 88-02 (14.8 mg/L), 97-14 (0.35 mg/L), 98-01 (2.33 mg/L), 98-04 (2.91 mg/L), 98-08 (1.15 mg/L), 98-10 (2.8 mg/L),98-11 (3.81 mg/L), 98-22 (2.2 mg/L), 98-36 (2.23 mg/L), 99-01 (0.68 mg/L), 99-02 (0.47 mg/L) and 100-04 (1.038 mg/L); zinc (Zn) at Well 98-36 (14 mg/L); lead (Pb) at Wells 97-08 (0.103 mg/L), 98-07 (0.1023 mg/L) and 98-36 (0.274). Radionuclides that exceeded NYS DWS were observed in the following wells: gross beta in Well 88-04 (837 pCi/L); tritium in Well 99-02 (34500 pCi/L), and strontium-90 (Sr-90) in Wells 88-04 (290.26 pCi/L), 99-04 (9.94 pCi/L), and 98-30 (11.84 pCi/L). A pilot study to test the efficiency of the Spray Aeration System installed by H2M/Roux Associates in 1985, to better understand and define plume characteristics, and to study the changes in the direction of ground-water flow during system operation was conducted from November 1991 through February 1992. Analysis of pre- and post-spray aeration water samples indicated that the spray aeration system was effective in removing VOCs from the ground water. Post-spray samples did not indicate VOC concentrations above NYS DWS. In addition, air emission impacts were reviewed and found to be below

applicable State and Federal Standards. Further remedial investigation of the HWMF will be performed under the IAG as part of OU I Area of Concern ([AOC] 1, AOC 23).

Current Landfill

Ground-water samples collected from surveillance wells at the Current Landfill and downgradient areas indicated that the following VOCs were at concentrations that exceeded NYS DWS: benzene at Wells 87-05 (7 μg/L), 87-06 (6 μg/L), 87-07 (8 μg/L), 87-11 (5 μg/L), and 115-05 (7 μg/L); ethylbenzene at Wells 87-10 (5 μg/L) and 87-11 (8 μg/L); toluene at Wells 107-11 (5 μg/L) and 115-05 (8 μg/L); chloroethane at Wells 87-05 (6 μg/L), 87-07 (5 μg/L), 87-10 (5 μg/L), and 115-05 (16 μg/L); methylene chloride at Wells 107-08 (12 μg/L) and 115-05 (6 μg/L); TCA at Wells 107-09 (16 μg/L), 107-10 (7 μg/L), 107-11 (13 μg/L), 107-12 (15 μg/L), 107-13 (10 μg/L), 115-04 (13 μg/L), and 115-05 (7 μg/L); TCE at Well 107-09 (5 μg/L); DCE at Well 115-05 (12 μg/L); Cis-1,2-DCE at Well 87-10 (5 μg/L); DCA at Wells 87-10 (6 μg/L), 107-08 (9 μg/L), 107-13 (9 μg/L), 115-04 (39 μg/L), and 115-05 (220 μg/L); and PCE at Well 107-12 (5 μg/L). The following metals were present in ground-water samples at concentrations above NYS DWS: Fe at Wells: 87-05 (103.1 mg/L), 87-06 (52.4 mg/L), 87-07 (61.2 mg/L), 87-10 (201.0 mg/L), 87-11 (84.9 mg/L) and 87-12 (15.8 mg/L); Pb at Well 87-07 (0.10 mg/L). Radionuclides that exceeded NYS DWS: tritium in Well 87-06 (20500 pCi/L). Further remedial investigation of the Current Landfill area will be conducted under the IAG as part of OU I (AOC 3).

Former Landfill

Ground-water samples collected from surveillance wells at the Former Landfill and downgradient areas indicated that no parameters exceeded NYS DWS. Further remedial investigation of their area will be performed under the IAG as part of OU I (AOC 2).

Potable Wells

See Section 2.6: Safe Drinking Water Act.

North Boundary

Ground-water samples collected from the North Boundary surveillance Well 18-03 indicated that TCA and DCA were at concentrations above NYS DWS (8 μg/L and 6 μg/L, respectively). Metals that exceeded NYS DWS were: Fe in Wells 07-03 (3.74 mg/L), and 18-01 (2.31 mg/L). The North Boundary surveillance wells monitor upgradient (background) ground-water quality. The need to install additional background surveillance wells in this sector has been previously identified, and will be conducted under the IAG as part of a site-wide hydrogeologic characterization project.

West Sector

Ground-water samples collected from surveillance Wells 83-02 and 84-01, located in the west sector of the site near potable and process supply well fields, indicated that TCA concentrations were above NYS DWS (26 μg/L and 17 μg/L, respectively). Metals that exceeded NYS DWS were: Fe in Well 83-02 (0.56 mg/L). Ground-water contamination in these supply well areas will be investigated under the IAG as part of OU III (SubAOC 15A).

Southwest Boundary	Ground-water samples collected at Well 130-02 indicate that TCA and DCA is present at concentrations above NYS DWS (14 μg/L and 5 μg/L, respectively). Ground-water contamination at Well 130-02 will be investigated under the IAG as part of OU III (SubAOC 15B).
AGS Area	Ground-water samples collected in Wells 54-01 and 64-01, located in the AGS area, indicate that TCA is present at concentrations above NYS DWS (50 μg/L and 10 μg/L, respectively). Metals concentrations that exceeded NYS DWS were: Fe in Well 54-01 (1.14 mg/L); and Zn in Well 54-01 (18.7 mg/L). Ground-water contamination in this area will be investigated under the IAG as part of the OU III (AOC 14).
Building 830	Ground water samples collected from surveillance wells installed to monitor the Building 830 pipe leak area did not exceed NYS DWS for VOCs or metals or radioactivity. Further remedial investigation of this area will be conducted under the IAG as part of OU III (AOC 11).
Supply and Materiel Warehouse Area	Ground-water samples from surveillance wells at the S&M Warehouse area indicate that TCA is present at concentrations exceeding NYS DWS: Well 85-02 (53 μg/L) and Well 96-06 (9 μg/L). In December 1992, a soil gas survey was conducted in the vicinity of Building 208, which is located within the S&M Warehouse area. During this survey, TCA was detected at concentrations up to 92 ppm in the soil gas, and confirmed that the Bldg. 209 area is one of several potential source areas for the TCA detected in the ground water in this area. Further investigation of this area will be conducted under the IAG as part of OU III (AOC 26).
Central Steam Facility	Soil and ground water in the vicinity of the CSF are contaminated with VOCs which were released to the environment during a 1977 fuel oil/solvent spill. The following VOCs were observed in samples from ground-water surveillance wells that exceeded NYS DWS: TCA at Wells 76-04 (85 μg/L) and 76-21 (9 μg/L); TCE at Wells 76-04 (110 μg/L), 76-08 (52 μg/L), and 76-21 (12 μg/L); PCE at Wells 76-04 (100 μg/L), 76-05 (15 μg/L), 76-08 (50 μg/L), 76-19 (5 μg/L), and 76-21 (88 μg/L); xylene at Wells 76-04 (5,300 μg/L), 76-08 (95 μg/L), and 76-21 (600 μg/L); toluene at Wells 76-04 (9,100 μg/L) and 76-21 (10 μg/L); and ethylbenzene at Wells 76-04 (1,400

μg/L) and 76-21 (220 μg/L). Metals concentrations that exceeded NYS DWS were: Fe in Wells: 65-01(1.31 mg/L), 76-04 (8.46 mg/L), 76-06 (1.34 mg/L), and 76-21 (4.39 mg/L). Further remedial investigation of this area will be conducted under the IAG as part of OU IV. A RI/FS Work Plan has been finalized. Field investigations started in the fourth quarter of 1992.

Peconic River/ Sewage Treatment Plant Area

Ground-water samples collected from surveillance wells in the Peconic River/STP Areas did not exceed NYS DWS for VOCs. The following metals were present in ground-water samples at concentrations above NYS DWS: Cd in Wells 40.04 (0.01 mg/L) and 48-01 (0.0126 mg/L); Cu in Wells 39-03 (1.45 mg/L), 39-04 (7.14 mg/L), 40-01 (17.56 mg/L), 40-02 (7.37 mg/L), 40-04 (3.47 mg/L), 47-01 (4.49 mg/L) and 47-02 (5.00 mg/L); Fe in Wells 39-03 (1.80 mg/L), 39-05 (0.43 mg/L), 40-01 (14.7 mg/L), 40-02 (9.62 mg/L), 40-04 (2.97 mg/L), 40-05 (0.95 mg/L), 40-07 (0.42 mg/L), 47-01 (3.95 mg/L), 47-02 (6.8 mg/L), and 57-01 (4.98 mg/L); Zn in Well 57-01 (14.9 mg/L). Radionuclide concentrations that exceeded NYS DWS were: Gross Beta in Well 57-01 (50.2 pCi/L). Further remedial investigation of this area will be conducted under the IAG as part of OU V.

Meadow Marsh- Upland Recharge Area

Ground-water samples collected from surveillance wells downgradient of the Meadow Marsh-Upland Recharge Area did not exceed NYS DWS for VOCs, metals, or radioactivity. Further remedial investigation of this area will be conducted under the IAG as part of OU VI.

2.3 Clean Water Act

2.3.1 SPDES Permit

Sanitary and process waste waters discharged from the operations conducted at BNL are regulated by a SPDES permit which is issued by the NYSDEC. Specifically, effluents discharged to five recharge basins and the Peconic River are currently governed by monitoring requirements and effluent limitations contained in the SPDES Permit. Deviations from the permit limitations or monitoring requirements which occurred during 1992 are described in the subsequent sections of this chapter.

During 1992 the EPA finalized its rules regarding National Pollutant Discharge Elimination System (NPDES) Permits for Storm Water Discharges Associated with Industrial Activity. The Laboratory worked closely with the NYSDEC regarding this permit and after submitting documentation describing these BNL storm water discharges, incorporated storm water into the existing SPDES permit.

In November 1992, BNL received a new draft SPDES permit from the NYSDEC which contained additional monitoring requirements for the existing permitted outfalls as well as monitoring requirements for two new outfalls and for process specific waste waters. At the request of BNL, monitoring of storm water effluents was included with the new requirements. Comments which expressed BNL concerns regarding the draft permit were forwarded to the NYSDEC in January 1993. It is expected that the new SPDES permit will be issued before the end of the second quarter of 1993.

2.3.1.1 Recharge Basins

The existing BNL SPDES permit requires that BNL maintain records of flow and pH to the five permitted recharge basins. A grab sample collected from the AGS recharge basin (Station HO, Outfall 003) exhibited a pH value of 6.2 which is below the ground-water discharge limitations of 6.5 promulgated under 6NYCRR Part 703.6. All other pH values recorded for the remaining recharge basins were within NYS limitations. Due to the high ambient iron concentration within the ground water, which is utilized for once-through cooling, water containing elevated iron concentrations was discharged to two recharge basins in concentrations greater than the NYS ground-water discharge limitation.

Recharge Basin HP, which receives once-through cooling water from the MRR, was not in use during CY 1992 due to TCA contamination of the process wells which previously supplied this cooling water. During 1992 all cooling water used by the MRR was supplied by the chilled water plant. In addition, Recharge Basin HS was not sampled during 1992 due to dry conditions at this location.

The November 1992 draft SPDES permit contains numerous additional monitoring requirements for discharges to the recharge basins including measurement and monthly reporting of flow and pH and monitoring for numerous analytical parameters. Two Recharge Basins, Outfalls 007 (Station HX) and 008 (Station HW), have been included in the draft permit. Storm water also has been identified as a contributor to these recharge basins. Recharge Basin HW receives solely storm water runoff from paved and landscaped surfaces.

Recharge Basin HX receives effluent from the backwashing of WTP filter beds used to reduce ambient iron concentrations to within the NYS DWS. The WTP iron removal process uses hydrated lime (calcium hydroxide) to chemically precipitate the dissolved iron found in the ground water thus rendering the water fit for potable use. Preliminary studies of this effluent shows the filter backwash water to contain high concentrations of particulate iron. The draft SPDES permit requires that this effluent be monitored for soluble versus insoluble iron.

2.3.1.2 STP Effluent

In accordance with the conditions of the BNL SPDES permit, twenty (20) parameters are reported in the monthly Discharge Monitoring Report (DMR) which is submitted to both the NYSDEC and SCDHS. Samples are collected by BNL personnel in accordance with BNL SOPs and QA protocols. Twelve parameters (nitrogen, metals, organics, Sr-90, BOD5, total suspended solids, fecal coliform, and total coliform) are analyzed by contractor laboratories. Gross alpha, gross beta, and tritium are analyzed by the S&EP Radiological Laboratory which is certified by the NYSDOH for these analyses. The remaining parameters are recorded/analyzed by the STP operators. Review of data presented in Table 2, indicates that two exceedances of the SPDES permit discharge limits were observed

Table 2
BNL Site Environmental Report for Calendar Year 1992
SPDES Compliance for Sewage Treatment Plant Effluent (Outfall 001)

Parameter	Permitted Frequency of Sample/Yr	Actual Frequency of Sample/Yr	Maximum Effluent Value		SPDES Permit Limit		No. of Exceedances (per yr)
Temperature	250	250	77	°F	90	°F	0
Gross β	250	365	28.1	pCi/L	1000	pCi/L	0
BOD_5	12	12	<10	mg/L	20	mg/L	0
pH (Min)	365	365	5.9	SU	5.8	SU	0
pH (Max)	365	365	7.2	SU	9.0	SU	0
Suspended Solids	12	12	<5.0	mg/L	10.0	mg/L	0
Settleable Solids	250	250	0.0	ml/L	0.1	ml/L	0
Ammonia-Nitrogen	12	12	1.3	mg/L	2.0	mg/L	0
Cu (concentration)	12	12	0.091	mg/L	0.4	mg/L	0
Cu (loading)	12	12	0.41	#/day	3.0	#/day	0
Fe (concentration)	12	12	0.324	mg/L	0.6	mg/L	0
Pb (concentration)	12	12	<0.05	mg/L*	0.067	mg/L	0
Pb (loading)	12	12	<0.29	#/day	0.75	#/day	0
Ag (concentration)	12	12	0.03	mg/L	0.05	mg/L	0
Ag (loading)	12	12	0.19	#/day	0.75	#/day	0
Zn (concentration)	12	12	0.085	mg/L	0.3	mg/L	0
Zn (loading)	12	12	0.43	#/day	4.5	#/day	0
Gross α	250	365	2.92	pCi/L	10.0	pCi/L	0
Strontium-90	12	12	1.82	pCi/L	3.0	pCi/L	0
Flow	365	365	1.0	MGD	1.8	MGD	0
Chlorine (residual)	250	250	0.0	mg/L	0.05	mg/L	0
Fecal Coliform	12	17	9200	MPN/100ml	2000	MPN/100ml	1
Total Coliform	12	17	24000	MPN/100ml	10000	MPN/100ml	1
Tritium	250	365	28.9	nCi/L	NA		0
1,1,1-TCA	12	12	<5.0	µg/L	50	µg/L	0
Total	2787	3140					2

* The minimum detection limit (MDL) for lead varied from 0.002 mg/L to 0.05 mg/L. The maximum reported detected concentration of lead discharged during 1992 was 0.0054 mg/L.

NA: SPDES permit limit not specified.

at the STP effluent during 1992. Grab samples collected on April 2, 1992 showed fecal and total coliform to exceed their respective permit limits of 2,000 MPN/100 ml and 10,000 MPN/100 ml. All other reported analytical findings were below the regulatory levels established under SPDES permit. Table 3 contains the monthly summary of DMR data reported for CY 1992.

Fecal and total coliform are routinely observed in the discharge of the STP but at much lower concentrations than that evidenced by the April 2nd samples. In the ensuing months the Laboratory instituted an investigation of this occurrence which included retaining the analytical services of multiple contractor laboratories as well as the SCDHS. Review of the analytical data collected during this investigation indicated that one specific analytical laboratory produced results which were consistently higher than the other laboratories; in some cases several orders of magnitude higher. Review of Quality Control documents, and raw analytical data showed this laboratory to have an inferior performance record when compared to the other laboratories. However, the inherent nature of the fecal and total coliform analytical method precluded determining the absolute cause of the exceedances.

The draft SPDES permit received in November 1992, contained numerous modifications to the monitoring requirements for the STP discharge including; reduced effluent limitations, deletion of radiological monitoring, deletion of mass load limitations, increase in monitoring frequency and analytical parameters, and requirements for a Short Term High Intensity Monitoring (STHIM) program for certain organic and inorganic constituents.

2.3.2 SPDES Inspections and Audits

The operations of the STP are routinely monitored by the SCDHS. During 1992 the SCDHS conducted five inspections of the STP. Quarterly, a SCDHS Sanitarian conducted walk-through inspections of the STP operations building and ancillary support facilities and collected samples of STP influent and effluent for subsequent analysis by the SCDHS laboratory. The fifth inspection consisted of a walk-through inspection by SCDHS Public Health Engineers. All inspections found the STP operations to be satisfactory and all analytical data was found to be within the SPDES permit limitations.

2.3.3 NPDES Analytical Quality Assurance

The Laboratory participates in the NPDES Laboratory Performance Evaluation Program administered by the EPA. On January 30, 1992, proficiency check samples were received from the EPA and subsequently forwarded to the three laboratories responsible for the specific analyte. The respective parameters performed by each lab are listed below:

Laboratory name and address	Analytical Parameters
NYTEST Environmental Incorporated 60 Seaview Blvd. Port Washington, N.Y.	Copper, Lead, Iron, Zinc Ammonia-N, Nitrate-N and TKN
H2M Labs Inc. 575 Broadhollow Rd. Melville, N.Y.	BOD5, Total Suspended Solids
BNL STP Operations Lab Upton, N.Y.	pH, Total Residual Chlorine

TABLE 3
BNL Site Environmental Report for Calendar Year 1992
Summary of Monthly DMR Values for the STP Discharge

PARAMETER	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	UNITS
Max. Temp.	54	54	59	64	69.8	73.4	77	77	75.2	68	63	57	°F
Gross β	12.7	10.2	17.4	23.8	13.4	15.7	14.2	12.8	28.1	14.7	13.6	11.7	pCi/L
BOD5	<10	<10	<2.0	<2.0	<2.0	<2.0	4	<2.0	<2.0	<4.0	<2.0	<2.0	mg/L
pH (min.)	5.9	6.4	6.2	6.2	6.1	6.0	5.9	6.3	6.1	5.9	6.0	6.2	SU
pH (max.)	6.8	6.6	6.6	6.6	6.6	7.2	7.0	6.9	7.1	7.2	7.1	6.8	SU
Suspended Solids	<5.0	<5.0	<5.0	2.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	mg/L
Settleable Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ml/L
Ammonia	0.06	0.41	<0.05	<0.05	0.08	0.26	1.3	0.12	0.06	0.2	0.32	1.3	mg/L
Cu (max conc)	0.039	0.091	0.082	0.055	0.055	0.066	0.055	0.055	0.07	0.075	0.067	0.05	mg/L
Cu (load)	0.16	0.41	0.36	0.231	0.24	0.33	0.3	0.35	0.4	0.38	0.35	0.27	#/day
Fe (max conc)	0.193	0.274	0.202	0.134	0.218	0.177	0.324	0.122	0.29	0.116	0.234	0.3	mg/L
Pb (max conc)	<0.05	<0.05	<0.05	<0.038	<0.005	<0.005	0.0054	0.003	<0.05	<0.002	0.0027	0.005	mg/L
Pb (load)	<0.21	<0.22	<0.22	<0.16	<0.022	<0.025	0.03	0.019	<0.29	<0.095	0.014	0.027	#/day
Ag (max conc)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.003	0.0052	0.0071	mg/L
Ag (load)	<0.042	<0.045	<0.44	<0.042	<0.044	<0.051	<0.055	0.19	<0.057	<0.013	0.027	0.038	#/day
Zn (max conc)	0.045	0.072	0.077	0.056	0.076	0.085	0.051	0.045	0.043	0.046	0.05	0.051	mg/L
Zn (load)	0.19	0.32	0.34	0.235	0.33	0.43	0.28	0.29	0.25	0.23	0.26	0.27	#/day
Gross α	2.56	1.79	1.28	1.28	1.79	1.79	2.56	2.3	2.44	2.92	2.64	2.49	pCi/L
Sr 90	0.03	<0.382	<0.4	1.82	1.54	<1.7	<0.36	<0.01	1.96	1.07	0.02	<0.21	pCi/L
Flow	0.786	0.756	0.758	0.759	0.765	0.812	0.879	1.0	0.953	0.864	0.867	0.737	MGD
Cl(res)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	mg/L
Fecal Coliform	110	33	4	9200	1288	132.5	245	540	920	280	<2.0	130	MPN/100ml
Total Coliform	350	33	230	24000	252	793	1360	2400	2400	3400	23	170	MPN/100ml
Tritium (max.)	4.25	3.27	6.47	2.95	9.53	12.7	17	19.1	28.9	13.6	4.04	5.67	nCi/L
1,1,1 TCA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	µg/L

The analytical data for the proficiency check samples was forwarded to the EPA designated facility on March 25, 1992. With the exception of zinc, all analytical data was found to be within acceptable performance limits. Investigation of the zinc value showed that while the result was outside the acceptable restrictions imposed for this study, the result was within Contract Laboratory Program (CLP) protocol acceptable limits.

2.3.4 1993 SPDES Activities

During the first two months of 1993 no deviation from SPDES permit limitations occurred. The first SCDHS quarterly inspection of the STP, conducted in January, found all STP operations to be satisfactory. Analytical data for samples collected during this inspection are not available for inclusion with this report at this time. The Laboratory performed the STHIM program required by the draft SPDES permit during the month of February and will report the findings of this program to the NYSDEC in the second quarter of 1993.

Storm water discharges to Recharge Basins HN, HT and to specific wetlands were sampled and analyzed during the first quarter of 1993. This sampling program was actually initiated during the third quarter of 1992, but due to logistical obstacles could not be completed. This sampling program was instituted to address the EPA Storm Water Regulations which became finalized during the second quarter of 1992.

Samples for NPDES Performance evaluation were received from the EPA on March 2, 1993 and subsequently distributed to the STP Operations Laboratory for pH and residual chlorine analysis and to H2M Labs, Inc. for trace metals, nutrient, and biological oxygen demand analyses. The analytical data for these samples will be reported to the EPA designated facility during the second quarter of 1993.

2.3.5 Major Petroleum Facility

The BNL CSF supplies steam for heating and cooling to all major areas of the Laboratory through an underground distribution system. The MPF is the storage area for the fuels used at the CSF. Brookhaven National Laboratory operates its MPF under a license (No. 01-1700) which is issued by the NYSDEC and renewed annually.

The NYSDEC is required by Article 12 of the Navigation Law[27] to protect and preserve the lands and waters of New York State from all discharges of petroleum and specifically from major petroleum storage facilities. In order to fulfill this responsibility, all major petroleum storage facilities are required to be registered with the NYSDEC and must have a license to operate. The license is contingent on several conditions. In addition to general ground water monitoring conditions, additional conditions may be included from year to year.

All major petroleum storage facilities are required to install ground water monitoring wells. The license has general conditions which include regular testing of monitoring wells for floating and dissolved product. Typically the testing for floating product can be performed by the owner of the facility; however, testing for dissolved product is required to be performed by a NYSDEC certified laboratory.

Five ground water wells, one upgradient and four downgradient, are used for regulatory compliance monitoring of the BNL CSF. The well authorized for use by the NYSDEC as upgradient of the CSF is designated as Well ID 66-08 and is located approximately 1100 feet north of CSF Tank 611A. The four downgradient wells are designated as 76-16, 76-17, 76-18, and 76-19. Their approximate locations are shown in Figure 34. The well casings are constructed of polyvinyl chloride (PVC) and are four inches in diameter. These wells have PVC screens which are 20 feet in length and straddle the water table.

In accordance with conditions of the MPF license, regulatory compliance samples were collected from these wells twice during 1992 and submitted to a NYSDEC certified laboratory. The NYSDEC requested analyses for these wells are to include purgeable aromatics, purgeable halocarbons, and polynuclear aromatics listed in EPA Methods 601/602 and 610. The analytical results were transmitted to the NYSDEC. Another condition of the MPF license is that these wells be monitored monthly for floating product. This condition was fulfilled during CY 1992 and no floating product was found in any of these wells.

In addition to these compliance samples, these wells are also monitored several times a year as part of the BNL routine EM program. Analytical results from the routine monitoring program are discussed in Chapter 5 of this report.

2.3.5.1 Spill Prevention, Control and Countermeasures Plan (SPCC)

Brookhaven National Laboratory has had an SPCC Plan since the early 1980's. The early Plans contained a complete listing of all oil storage tanks with capacity and building numbers. In the mid 1980's direction from NYSDEC led to including only those storage tanks associated with the CSF and the Motor Pool Fuel Storage area (Building 326) on the SPCC storage tank listing. This Plan was revised in 1982, 1983, 1985, 1987, and 1990. All revisions have been submitted to the NYSDEC.

As a direct result of the Exxon Valdez, the American Trader and other waterway disasters, Congress enacted the Oil Pollution Act of 1990 (OPA-90). This Act contains significant modifications to many of the provisions of the Clean Water Act (CWA). One of these requirements is that facility owners/operators must prepare response plans outlining response capability to a "worst-case" discharge which is defined as the "largest foreseeable discharge in adverse weather conditions". These terms have been described in the legislative history to mean "a case that is worse than either the largest spill to date or the maximum probable spill for the facility type". Congress mandated that regulations implementing facility response plan requirements be issued not later than August 18, 1992. The statutory deadline for submission of the Facility Response Plans is February 18, 1993.

Although regulations implementing facility response plan requirements were not issued until February 17, 1993, BNL had contracted with an engineering consulting firm to prepare a facility response plan. This plan was submitted to EPA on February 18, 1993.

2.3.6 Oil/Chemical Spills

During 1992, members of the SEPD EPS responded to a total of 45 incidents where the potential existed for a release of oil or chemicals to the environment. While this represents an apparent increase in the number of incidents between 1991 and 1992, the change is attributable to both a heightened environmental awareness by Laboratory personnel as well as EP Section response to indoor releases of materials. Twelve of these incidents involved releases which were completely contained within the building and did not reach the environment. Eight of these releases required EPA, NYSDEC, and SCDHS notification. These spills were cleaned up and the associated contaminated absorbent and affected soil were sent off site for disposal in an approved manner. The remainder of these incidents involved very small quantities of material which were typically contained on asphalt, concrete, or impervious surfaces. Cleanup procedures were instituted and there were no environmental impacts as a result of these occurrences.

2.4 Clean Air Act (CAA)

2.4.1 Conventional Air Pollutants

During 1992, a variety of BNL air emission sources were evaluated with respect to NYS and Federal permitting requirements. The applicable regulations for these sources are the Codes, Rules, and Regulations of the State of New York, Title 6, Chapter III, Part 200, New York State Air Pollution Control Regulations and the Federal Clean Air Act. A summary of the permitted sources reviewed and their current status is provided below:

No. of Actions	Status/Comments
17	Certificates to Operate for fourteen existing emission sources (Emission ID Nos. 13401, 20801 to 20804, 42202, 42203, 44401, 46201, 46202, 65001, 65002, 90301, and 91101) were renewed by NYSDEC in January 1992. The COs for three additional sources (Emission ID Nos. 51001, 61004, and 61005) included in the same renewal request package were not reissued by NYSDEC by the end of CY 1992. These sources continue to operate under the provisions of the Uniform Procedures Act.[28]
2	A renewal request was submitted to NYSDEC in February 1992 for two COs (Emission ID Nos. 19706 and 19707) which expire on March 14, 1992. The NYSDEC had not reissued COs for these sources by the end of CY 1992. Both sources continue to operate under the provisions of the Uniform Procedures Act.[28]
2	In March 1992, NYSDEC canceled COs for a blueprint machine and a parts cleaning tank (Emission ID Nos. 19701 and 45201) as requested by the Laboratory.
8	During a June 1992 visit to BNL, a representative from NYSDEC inspected eight emission sources to confirm information provided on CO applications filed in December 1990. During the visit, applications for two of the sources were withdrawn

after it was learned that the sources were no longer in service. Despite repeated efforts by BNL to expedite their approval, NYSDEC had not issued the COs for the remaining six operating sources as of the end of CY 1992.

4 In July 1992, applications to modify COs for three existing sources (Emission ID Nos. 45801, 52601, and 90501) were submitted to NYSDEC. A request to cancel the CO for a sulfite dispensing machine was also submitted. Approval of these applications had not been received by the end of CY 1992.

1 In September 1992, BNL received a draft Permit to Construct from NYSDEC for a new combustion unit proposed for the CSF (Boiler No. 7). Comments were subsequently submitted to NYSDEC in October 1992 in response to several of the special operating conditions that had been proposed in the draft permit. There has been no written response to these comments from NYSDEC. Requests were submitted to NYSDEC to renew COs for the CSF Boiler No. 1A and Boiler No. 6 in February and March of 1993, respectively.

12 In October 1992, applications for COs for ten existing air emission sources were submitted to NYSDEC. The processes covered by the applications included one welding bench, two aerosol painting hoods, two soldering benches, one parts machining exhaust, a magnet coil production press, an electroplating and acid etching area, a metal parts deburring machine, and an ultrasonic parts cleaner. A Permit to Construct (PC) application for a magnet coil epoxy coating and curing operation and an application to modify a CO for a parts degreasing operation were also submitted. Approval of the applications was still pending as of the end of CY 1992.

In July 1992, BNL submitted a request for a variance from 6 NYCRR Part 201 permit filing requirements for short term releases of low concentration and low volume inert gas and hydrocarbon emissions from experimental processes. Although BNL has received a verbal approval of this request, a formal written response to the request is still pending.

As required pursuant to Title VI Section 608 of the CAA, the Laboratory purchased equipment to recover and recycle refrigerants ordinarily released to the atmosphere during the servicing and repair of refrigeration and air conditioning equipment. The equipment purchased in July 1992, included six portable refrigerant recovery systems for recovering refrigerants R-12, R-22, R-500, and R-502, one unit for recovering refrigerant R-11 from centrifugal chillers and two recovery/recycling units that are used to recover or recover and recycle R-12, R-22, R-500, and R-502 from ground level equipment. Plant Engineering (PE) personnel responsible for servicing and repairs to the air conditioning and refrigeration systems at the Laboratory received training from the equipment manufacturers prior to their utilization of the equipment.

Similarly, a refrigerant recovery unit was purchased by the operator of the commercial service station on site to recover refrigerant during repairs and servicing of motor vehicle air conditioning systems in accordance with Title VI Section 609 requirements. Meanwhile, arrangements were made by the Staff Services Division with a local service station which possesses an approved recovery unit to service air condition systems on Laboratory fleet vehicles until the Staff Services Division purchases its own recovery equipment. Technicians responsible for the operation of the recovery equipment at both sites have received appropriate training as required by the regulations.

In September, the PE Division began compiling an inventory of the refrigeration and air conditioning systems at the laboratory. The information compiled from the inventory will form the nucleus of a database which will be used to establish a priority ranking for the replacement or conversion of equipment over to systems that utilize low or non-ozone depleting refrigerants. In December, a work group consisting of representatives from PE and S&EP was formed to evaluate the various alternative refrigeration and air conditioning systems available and to develop an equipment replacement and conversion plan.

During the second half of 1992, a representative from the S&EP Division assisted in the preparation of a guidance document covering the registration and permitting of laboratory hoods as part of a work group formed by the NYSDEC. The work group, composed of seven representatives of the regulated community, was formed by the NYSDEC in June and was given the task of drafting a policy that would simplify the procedures for registering and permitting laboratory hoods several facilities expressed concerns about the difficulty they would have in gathering accurate qualitative and quantitative data on laboratory hood emissions for the more than 250 chemicals NYSDEC has identified as known and suspect carcinogens. In January 1993, the draft guidance document prepared by the work group was submitted to NYSDEC for their review.

Also in January 1993, a BNL work group began meeting to identify acceptable alternative replacements for methyl chloroform and trichlorotrifluoroethane, two chlorofluorocarbon (CFC) cleaning agents used by the Central Shops Division which are being phased out pursuant to provisions of Title VI of the CA Amendments of 1990. A second BNL work group began investigating low and non-ozone depleting refrigerants as replacements for Class I CFC refrigerants used in air conditioning and refrigeration systems at BNL in February 1993.

2.4.2 National Emissions Standard for Hazardous Air Pollutants (NESHAPs)

2.4.2.1 Radioactive Airborne Effluent Emissions Governed by NESHAPs

In 1992, BNL emissions complied with 40 CFR 61 regulations regarding radioactive airborne effluent releases. The EPA Region II was notified that seven operations had NESHAPs evaluations performed with the conclusion that a formal submission was not required. The site boundary dose resulting from BNL airborne emissions as calculated using CAP88 was 0.107 mrem. The radionuclide contributing the largest fraction of both the site boundary (87%) and population dose (99%) was argon-41. The total released source term of this nuclide was about 84% of that released in 1991. The 1991 effluent release data and dosimetric impact of these releases were transmitted to both DOE and EPA in compliance with the June 30, 1992 reporting requirements specified in 40 CFR 61, Subpart 94. Also, BNL received a facility compliance inspection in 1992 with no deficiencies reported. In March 1992, formal notification of Booster start up was submitted to EPA Region II. In September 1992, formal notification of Accelerator Test Facility (ATF) start up was submitted to EPA.

Experiments, construction of new facilities, and modifications to airborne effluent sources that have the potential to release radioactive materials require a NESHAPs evaluation. In the first quarter of 1993, new radioactive effluent sources were evaluated and all were found to contribute less than 0.1 mrem/yr to the site boundary radiation dose. Consequently, no formal NESHAPs applications were submitted to EPA Region II. Notification of the Building 750 Evaporator Facility start up was submitted in March of 1993.

2.4.2.2 Asbestos Emissions

In 1992, BNL emissions complied with 40 CFR 61 regulations regarding airborne fiber releases. The EPA Region II was notified on five occasions that operations required NESHAPs formal notification. Formal annual notification for nonscheduled small renovation operations for 1992 was made indicating an estimated amount of total friable asbestos material projected to be removed in small removal operations at 801 square feet of surface material, 3023 linear feet of pipe insulation and 252 cubic feet of miscellaneous material. This information was transmitted to both DOE and EPA in compliance with the reporting requirements specified in 40 CFR 61. Brookhaven National Laboratory has received several compliance inspections from DOE during 1992 that specifically reviewed asbestos NESHAPs requirements with no deficiencies reported. Renovation of existing facilities has a potential for airborne fiber release and requires a NESHAPs evaluation. In the first quarter of 1993, potential projects were evaluated and none of these fell into the reportable category; consequently, no formal NESHAPs notifications were submitted to EPA Region II.

2.5 Suffolk County Sanitary Codes

A number of storage facilities at BNL were brought into compliance with the requirements of SCDHS during 1992. The applicable regulations are the Suffolk County Sanitary Code, Articles 7 and 12. These storage facilities and their status are described below:

No.	Status/Comments
8	Existing outdoor aboveground fuel oil tanks at the CSF were cleaned and gas-freed in preparation to be retrofitted with the addition of overfill alarm systems. Installation of the high level float alarms was completed during the first quarter of 1992.
3	Three outdoor aboveground tanks used to store diesel fuel at the site maintenance facility were cleaned and gas-freed in preparation to be retrofitted with the addition of overfill alarm systems. Installation of the high level float alarms was completed during the second quarter of 1992.

1 A 1000 gallon outdoor underground tank (BNL ID# 633-1; SCDHS ID #142) used to store fuel oil at Building 633 was removed on June 22, 1992; the tank and excavation were inspected by a SCDHS representative. Since the tank was observed to be in excellent condition and there was no evidence of soil contamination, the inspector gave approval to fill in the excavation.

8 During the third quarter of 1992, eight underground tanks used to store No. 2 fuel oil for on-site heating were leak tested by a contractor using the Petro-Tite test. All tanks passed the test and will be retested in 1997 in accordance with Article 12 requirements.

7 Seven existing outdoor aboveground fuel oil storage tanks (at Buildings 89, 457, 610, 614, 618, and 619) were replaced by a secondarily contained aboveground tank unit during the fourth quarter of 1992. A welded steel roof prevents rain from entering the secondary containment reservoir.

1 A 3000 gallon underground tank (BNL ID #457-01; SCDHS ID #50) used to store No. 2 fuel for on-site heating at Building 457 was removed on September 9, 1992. Initially the tank was to be removed as part of a tank replacement project. However, contaminated soil was encountered during excavation and reported to the NYSDEC. It was determined that piping associated with the tank had leaked. A NYSDEC inspector witnessed the tank removal and various aspects of the remedial activities.

2 Secondary containment and overfill protection were provided to an existing outdoor aboveground water treatment chemical tank (SCDHS ID #152) at Building 707 to bring this facility into compliance with Article 12. A second outdoor aboveground water treatment chemical tank (SCDHS ID #153) at this facility was removed and replaced with a new tank (SCDHS ID #225). These modifications and upgrades were inspected by a representative from the DHS on November 19, 1992.

2 Two existing outdoor aboveground tanks at the WCF were to be removed and replaced with one tank as part of Phase III of BNL's tank upgrade program. An Architect-Engineering firm has prepared design documents for this project. A contract is anticipated to be awarded during CY 1993.

2.6 Safe Drinking Water Act

2.6.1 Applicability to BNL

The Laboratory maintains six wells and two water storage tanks for supplying potable water to the laboratory community. Regulations pertaining to the distribution and monitoring of public water supplies are promulgated under Part 5 of the New York State Sanitary Code. These regulations are applicable to any water supply which has at least five service connections or regularly serves at least 25 individuals. The Laboratory supplies water to a population of approximately 3,500 and must therefore comply with the provisions of these regulations.

2.6.2 Potable Water Monitoring Requirements

The potable water supply used at BNL was obtained from six wells during 1992. Routine monitoring of these wells and the potable water distribution system by BNL exceeded the minimum monitoring requirements prescribed by the SCDHS. Monitoring requirements for 1992 included quarterly analysis for POC, monthly bacteriological analyses, annual microextractables analysis, triennial organic pesticides analysis, and semi annual inorganic analyses (i.e., Full and Partial Chemical analyses). The content of the BNL monitoring program was reviewed and found acceptable by the SCDHS. Potable water samples were collected by BNL personnel and analyzed by a NYSDOH certified contractor laboratory using standard methods of analysis. All analytical data was submitted to the SCDHS as required by Chapter I, Part 5, of the NYS Sanitary Code. All reported bacteriological, inorganic, and POC analytical data collected during CY 1992 were within the NYS DWS. Bacteriological and inorganic parameters and POC analysis have been summarized in Tables 4 and 5, respectively. There were no organic pesticides nor microextractables detected in the BNL potable water system during 1992.

In November 1992, a malfunctioning pH dosing pump caused the over addition of caustic to the well water at Potable Well 11. The over addition caused the water entering the potable distribution system to reach a pH of 10. Immediate investigation of water samples collected from building water taps showed that the problem was isolated to the central area of the lab. The problem was rectified by draining the main service lines supplying water to the affected area and flushing building services. All potable water services were returned to normal pH levels within twelve hours of the initial occurrence.

Table 4
BNL Site Environmental Report for Calendar Year 1992
Potable Water Wells and Potable Distribution System,
Bacteriological, Full and Partial Chemical Analytical Data[1]

Compound	Well No. 4 (FD)	Well No. 6 (FF)	Well No. 7 (FG)	Well No. 11 (FP)	Well No. 12 (FQ)	Potable Distribution Sample	NYS Drinking Water Standard
Total Coliform	ND	ND	ND	ND	ND	ND	Negative
Chlorides	18	17	17	18	18	19	250 mg/L
Sulfates	10.5	10.3	10.8	13.3	11.8	11.6	250 mg/L
Nitrates	0.05	0.4	0.3	0.6	0.5	0.5	10 mg/L
Ammonia	0.05	0.05	0.02	<0.02	<0.02	<0.02	NS
Total Hardness	22	21	18	31	24	24	NS
Total Alkalinity	13	12.7	12	17	29	30	NS
Total Solids	60	63	66	69	77	78	NS
Specific Cond.	120	109	103	132	152	156	NS
Langliers Index	-3.47	-3.59	-3.74	-3.41	-1.5	-1.96	NS
pH	6.8	6.1	6.0	6.0	7.8	6.8	NS
Carbon Dioxide	19.9	38.2	21.3	28.1	7.3	7.1	NS
MBAS	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.5 mg/L
Arsenic	<10	<10	<10	<10	<10	<10	50 µg/L
Barium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.0 mg/L
Cadmium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	10 µg/L
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05 mg/L
Copper	0.04	0.03	<0.02	0.1	<0.1	0.12	1.0 mg/L
Fluoride	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	2.2 mg/L
Iron	2.5[2]	3.77[2]	1.6[2]	<0.02	<0.02	0.03	0.3 mg/L
Lead	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	50 µg/L
Manganese	0.14	0.07	0.07	<0.02	<0.02	<0.02	0.3 mg/L
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	2.0 µg/L
Selenium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	10 µg/L
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05 mg/L
Sodium	11.1	10.2	10.2	10.9	20.9	20.2	NS
Zinc	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	5.0 mg/L

1. This table contains the maximum concentration (minimum pH value) reported by the contractor laboratory.
2. Due to the high concentration of iron within the water produced by Wells 4, 6, and 7, this water is treated at the Water Treatment Plant for removal of iron.

ND: None detected
NS: DWS Not Specified
Well 10 (FO) was not analyzed for Inorganic parameters during CY 1992.

Table 5
BNL Site Environmental Report for Calendar Year 1992
Potable Water Wells,
Maximum Principal Organic Compound Data

Compound	WTP Effluent (F2)	Well No. 4 (FD)	Well No. 6 (FF)	Well No. 7 (FG)	Well No.10 (FO)	Well No. 11 (FP)	Well No. 12 (FQ)	NYS Drinking Water Standard
	<----------------------			µg/L			------------------------>	
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	5.
Chloromethane	ND	ND	ND	ND	ND	ND	ND	5.
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	2.
Bromomethane	ND	ND	ND	ND	ND	ND	ND	5.
Chloroethane	ND	ND	ND	ND	ND	ND	ND	5.
Fluorotrichloromethane	ND	ND	ND	ND	ND	ND	ND	5.
1,1-dichloroethene	ND	ND	ND	ND	ND	ND	ND	5.
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	5.
trans-1,2-dichloroethene	ND	ND	ND	ND	ND	ND	ND	5.
1,1-dichloroethane	0.8	ND	ND	ND	ND	0.7	ND	5.
cis-1,2-dichloroethene	ND	ND	ND	ND	ND	ND	ND	5.
2,2-dichloropropane	ND	ND	ND	ND	ND	ND	ND	5.
Bromochloromethane	ND	ND	ND	ND	ND	ND	ND	5.
1,1,1-trichloroethane	1.0	3.7	1.5	ND	ND	0.5	ND	5.
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	5.
1,1-dichloropropene	ND	ND	ND	ND	ND	ND	ND	5.
1,2-dichloroethane	ND	ND	ND	ND	ND	ND	ND	5.
1,1,2-trichloroethene	ND	ND	0.7	ND	ND	ND	ND	5.
1,2-dichloropropane	ND	ND	ND	ND	ND	ND	ND	5.
Dibromomethane	ND	ND	ND	ND	ND	ND	ND	5.
trans-1,3-dichloropropene	ND	ND	ND	ND	ND	ND	ND	5.
cis-1,3-dichloropropene	ND	ND	ND	ND	ND	ND	ND	5.
1,1,2-trichloroethane	ND	ND	ND	ND	ND	ND	ND	5.
Trihalomethanes	13.1	9.9	18.6	1.7	ND	ND	1.4	5.
1,1,2,2-tetrachloroethene	ND	ND	ND	ND	ND	ND	ND	5.
1,3-dichloropropane	ND	ND	ND	ND	ND	ND	ND	5.
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	5.
1,1,1,2-tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	5.
Bromobenzene	ND	ND	ND	ND	ND	ND	ND	5.
1,1,2,2-tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	5.

Table 5 (cont.)
BNL Site Environmental Report for Calendar Year 1992
Potable Water Wells,
Maximum Principal Organic Compound Data

Compound	WTP Effluent (F2)	Well No. 4 (FD)	Well No. 6 (FF)	Well No. 7 (FG)	Well No.10 (FO)	Well No. 11 (FP)	Well No. 12 (FQ)	NYS Drinking Water Standard
	<---	---	---	μg/L	---	---	--->	
1,2,3-trichloropropane	ND	ND	ND	ND	ND	ND	ND	5.
2-chlorotoluene	ND	ND	ND	ND	ND	ND	ND	5.
4-chlorotoluene	ND	ND	ND	ND	ND	ND	ND	5.
1,3-dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	5.
1,4-dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	5.
1,2-dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	5.
1,2,4-trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	5.
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	5.
1,2,3-trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	5.
Benzene	ND	ND	ND	ND	ND	ND	ND	5.
Toluene	ND	ND	ND	ND	ND	ND	ND	5.
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	5.
m-xylene	ND	ND	ND	ND	ND	ND	ND	5.
p-xylene	ND	ND	ND	ND	ND	ND	ND	5.
o-xylene	ND	ND	ND	ND	ND	ND	ND	5.
Styrene	ND	ND	ND	ND	ND	ND	ND	5.
Isopropylbenezene	ND	ND	ND	ND	ND	ND	ND	5.
n-propylbenzene	ND	ND	ND	ND	ND	ND	ND	5.
1,3,5-trimethylbenzene	ND	ND	ND	ND	ND	ND	ND	5.
tert-butylbenzene	ND	ND	ND	ND	ND	ND	ND	5.
1,2,4-trimethylbenzene	ND	ND	ND	ND	ND	ND	ND	5.
sec-butylbenzene	ND	ND	ND	ND	ND	ND	ND	5.
p-isopropyltoluene	ND	ND	ND	ND	ND	ND	ND	5.
n-butylbenzene	ND	ND	ND	ND	ND	ND	ND	5.

ND: Not detected.
Notes: For compliance determination with NYSDOH standards, potable wells were analyzed quarterly during the year by H_2M Labs, Inc., a NYS certified contract Laboratory.
The minimum detection limit for POC analysis is 0.5 μg/L.

Volatile organic compounds particularly TCA, have become problematic at BNL and have caused the shutdown of Potable Wells No. 4, 10, and 11 over the past three years. During 1991, Potable Well 4 was returned to service after submission of satisfactory data to the SCDHS showing that the WTP treatment process was adequate for the removal of this compound. As a condition for authorization to use Potable Well 4, BNL was required to collect treated water samples from the effluent of the WTP and analyze these samples for POCs. All analytical results for samples collected from the WTP effluent were found to meet the NYS DWS. During 1992, Potable Wells 10 and 11 were returned to service after having been retrofitted with carbon adsorption units. Construction of the Potable Well No. 11 treatment system was completed in April 1992 and the Potable Well No. 10 treatment system completed in October 1992. All treated water samples collected from these wells have shown these supplies to meet the NYS DWS.

The SCDHS conducted an inspection of the BNL potable water supply system in May 1992. This inspection consisted of walk-through inspections of the WTP, WTP support facilities and potable well support facilities. The SCDHS inspector noted only minor problems in the final report, and chemical analysis of water samples collected during this visit showed all analytical parameters to meet the NYS DWS.

An additional requirement of the 1992 monitoring program implemented by the SCDHS was the collection of first draw water samples for lead and copper analysis as required by the Federal Lead and Copper Rule. This program required the collection of tap water samples from bathroom or kitchen faucets which had been unused for a period of six to twelve hours. The objective of this program was to determine the aggressiveness of the potable supply to the plumbing fixtures. If the water was found to be aggressive, treatment alternatives, such as addition of corrosion inhibitors to the potable supply, were to be evaluated. The Laboratory collected water samples from forty sites during the period beginning July 1st and ending December 31st. The results of this program showed the ninetieth percentile samples to be below the regulatory action level promulgated by the EPA; therefore treatment was deemed not necessary. In accordance with the conditions of this program this testing will be repeated during the first six months of 1993.

2.6.3 <u>1993 Safe Drinking Water Act</u>

The Laboratory continued its routine surveillance of the potable water supply during the first quarter of 1993. Bacteriological, inorganic, and first quarter volatile organics analyses for 1993 showed the BNL potable water supply to meet all NYS DWS.

On March 9, 1993, the SCDHS published the 1993 minimum monitoring requirements for potable water supplies. These requirements include monitoring for asbestos, microbiological, inorganic chemicals, lead and copper, principal and synthetic organic compounds, pesticides, radiological and water quality parameters. Many of the specified analytes are new to the potable water system monitoring program; consequently a new and expanded potable water system sampling plan has been prepared by the Laboratory and submitted to the SCDHS for review and approval.

2.7 Toxic Substance Control Act (TSCA)

2.7.1 TSCA Program at BNL

The use and disposal of specific substances, such as PCBs, is regulated under TSCA. The requirements under this Act include labeling, inspections, record keeping, immediate notification and cleanup upon discovery of spills, and proper disposal. In May 1992, Departments/Divisions at BNL were requested by the SEPD to review, verify, and update previous inventories of PCB equipment in Buildings under their jurisdiction. The database, developed by the SEPD to enable tracking of all Department/Division PCB equipment, was updated as changes to individual inventories were reported. Written notifications were provided to the on-site Fire Group in order to identify areas where large quantities of small capacitors are used or in storage. The Laboratory Safety, Environment, and Administrative Policy and Procedures Manual (SEAPPM) for PCB management, developed during 1991, was issued June 1, 1992. This SEAPPM formalizes BNL policy and identifies responsibilities to ensure that the BNL PCB Program Requirements, issued by the SEPD in February 1990 to all Departments and Divisions, will be met. In addition, the Annual PCB Report for CY 1991 was prepared in accordance with the requirements of TSCA. This report is retained on file at the SEPD. A copy was also submitted to DOE-Brookhaven Area Office (BHO).

2.7.2 PCB Consent Order

In October 1984, the Laboratory received off-specification military fuels containing PCBs in excess of 50 ppm. The Laboratory blended this material with other fuel resulting in 286,000 gallons of material with a PCB concentration of approximately 80 ppm. On January 21, 1986, the EPA Region II formally approved BNL's plan to incinerate this material at a 10% firing rate (concentration of 8 ppm) in BNL's high-efficiency Boilers 4 and 5.[29] The material has remained in storage at BNL awaiting NYSDEC authorization to burn it.

Several activities occurred during 1992 related to the PCB contaminated fuel in storage at the CSF. In January 1992, EPA sent a letter to DOE regarding Federal Facilities Compliance Agreement concerning the burning of PCB contaminated jet fuel at the BNL CSF. In this letter, EPA denied the July 1991 DOE request to extend the PCB burn start and end dates. In addition, EPA set a deadline for DOE to resolve outstanding issues and complete negotiations with NYSDEC by March 13, 1992. A meeting was held in February 1992 with individuals from DOE, BNL, EPA, and NYSDEC to discuss and propose resolutions to any outstanding issues. A final NYSDEC Order on Consent was submitted to and signed by DOE on March 12, 1992. It was then returned to NYS and signed by the Commissioner of NYSDEC on May 15, 1992. This Order on Consent authorized and required DOE to ensure that AUI burn the PCB contaminated fuel in high efficiency Boiler 5 without obtaining permits from NYSDEC provided that the burn be performed in accordance with all conditions of the Order. In addition, a report providing information on the operation of the boiler during the PCB burn was required to be submitted to NYSDEC and EPA each month.

The Laboratory commenced burning of the PCB contaminated jet fuel on July 7, 1992. Approximately 164,365 gallons of this fuel were burned in Boiler 5 from the initial start up until the end of the CY 1992. The burn is anticipated to be completed during CY 1993.

2.7.3 PCB Contamination at Building 479 - January 28, 1992

On January 28, 1992 at approximately 1000 hours, a contractor discovered the odor of petroleum while excavating to provide footings as part of the Central Shops addition project adjacent to Building 479. The contractor advised his BNL contact of the problem and BNL personnel from PE and the OER responded to the scene. They observed one dark layer of soil, approximately 9 inches down from the surface that had an odor of petroleum. In an effort to determine the extent of the potential problem, the contractor was asked to excavate further and piled the excavated material on a plastic liner. Approximately 70 yards of soil were excavated until there was no longer any odor of petroleum within the excavation site. As a result, a pit of approximately 80' x 15' x 5' was dug adjacent to the building. At approximately 1130 hours, S&EP's Environmental Protection Section was contacted and responded to the site to sample the soil. Samples were collected by S&EP at approximately 1300 hours from three areas: the excavated soil pile and two locations on the floor of the excavation site. Upon return from the excavation site on January 28, 1992, the S&EP Division reported the finding as an oil spill to the NYSDEC: Spill #9111125, the EPA National Response Center: Reference 104816, and the SCDHS.

The soil samples that were delivered to the S&EP Analytical Laboratory were analyzed using a Gas Chromatography/Mass Spectrometer (GC/MS) and the results were initially available about 1730 hours on January 28th. One sample, collected from the base of the excavated area, indicated that oil was present at a concentration of 0.1%. The data from this sample also indicated that PCBs in the form of AROCHLOR-1254 may be present. The samples were then analyzed specifically for PCBs. Notification of the tentative results to PE personnel occurred during the evening of January 28th. Plant Engineering issued a verbal stop work to the contractor at 0705 hours on January 29th. Preliminary results, identified as "initial" in the data below, that confirmed early suspicions became available at 0910 hours. The results indicated that PCBs were detectable in all samples. The observed concentrations were:

Location	Initial PCB Conc. mg/kg	Final PCB Concentration mg/kg
Excavated Soil	4 - 6	4 - 6
Excavation Floor Near Bldg 479	2 - 4	2.4
Excavation Floor, South End Middle of Floor	700 - 1000	1300

With these data, the Laboratory management decided to form a Remedial Action Committee (RAC) tasked with addressing the further investigation and remediation of this problem. The RAC was composed of individuals from the DOE-BHO, OER, PE, and S&EP Divisions. The RAC was responsible for accomplishing the following activities:

* Identification of personnel, personal items, and construction equipment that were present at the construction site; determining if personnel contamination had occurred; and verifying that all equipment was free of PCB contamination prior to release;

* Securing the work site as per TSCA regulations and constructing temporary shelter over the construction site in order to minimize intrusion or rain/snow;
* Development of a sampling plan needed to determine the extent of contamination at the site plus the collection and analysis of these samples;
* Providing waste collection and disposal services for the contaminated soil in a manner compliant with TSCA and oil spill response requirements; and
* Maintaining communications with all regulators so that sample requirements were minimized and the site could be declared ready for construction to proceed at the earliest possible time.

Over the course of the 6 months and 21 days between discovery of the spill and when work was authorized to continue, 92 smear samples were collected to verify the absence of contamination on personal items and equipment. There were 298 soil samples collected and analyzed to determine if PCB, Total Petroleum Hydrocarbons (TPH), Toxic Characteristic Leaching Procedure (TCLP), or radioactive contamination existed in the areas of concern and to document the completion of the clean-up project. There was also in excess of 260 cubic yards of soil that was disposed of in the remediation process. Finally, the Laboratory agreed to include this area under the IAG as an AOC (#25) in subsequent investigations to determine whether ground water has been affected by the contamination that was observed at this construction site. As a result of these efforts, the site was declared remediated by all regulatory agencies and DOE authorized BNL to resume construction on August 18, 1992.

2.8 NYSDEC Bulk Chemical Storage Registration

Because improper storage and handling of hazardous substances are serious threats to New York's water supplies and to public safety, the New York State Legislature passed Article 40 of the Environmental Conservation Law (ECL), (the Hazardous Substances Bulk Storage Act of 1986). This law required the NYSDEC to develop and enforce State regulations governing the sale, storage, and handling of hazardous substances, as needed to prevent leaks and spills in New York State. A closely related law, ECL Article 37, requires the NYSDEC to issue a list of substances defined as hazardous.

The NYSDEC has implemented these hazardous substances bulk storage laws through five sets of Chemical Bulk Storage (CBS) regulations as follows:

- 6 NYCRR 595 - Releases of Hazardous Substances - Reporting, Response, and Corrective Action.
- 6 NYCRR 596 - Registration of Hazardous Substance Bulk Storage Tanks.
- 6 NYCRR 597 - List of Hazardous Substances.
- 6 NYCRR 598 - Standards for Storing and Handling Hazardous Substances.
- 6 NYCRR 599 - Standards for Constructing New Hazardous Substance Storage Facilities.

Owners of regulated tanks were responsible for registering these storage tanks with the NYSDEC by July 15, 1989. In accordance with Part 596,[30] BNL submitted application forms for the registration of Hazardous Substance Bulk Storage Tanks on July 13, 1989. Seventeen tanks, used primarily to store water treatment chemicals, were included in this registration package. The NYSDEC issued a Hazardous Substance Bulk Storage Registration (HSBSR) Certificate in August of 1989. The NYS regulations require this certificate to be renewed every two years. The Laboratory submitted a renewal request with updated information to the NYSDEC in June of 1991, as required under the law. The renewal request included one additional new storage tank which increased the total number of registered tanks to 18. Two of the tanks included on this registration were upgraded during 1992 to comply with SCDHS Article 12. The Laboratory anticipates submitting a renewal request with updated information to the NYSDEC by the end of the second quarter of CY 1993.

2.9 Resource Conservation and Recovery Act

2.9.1 Facility Upgrades

The upgrades required by Tiger Team and the EPA Multimedia Inspection have been completed in 1992. Additional fire protection capability has been accomplished by the installation of two 5000 gallon water tanks at the facility and Building 483 (the drum storage building) has been equipped with a dry chemical fire suppression system. In addition, three new "Haz-Stor" modular storage facilities have been installed at the HWMF for storage and segregation, fire protection, and secondary containment of flammable, reactive, and mixed wastes.

Work is continuing on the design and planning of a new HWMF. During 1992, the conceptual design was completed and the project funding was secured. The selection of Architectural and Engineering Services for Phase I Design is now under way.

2.9.2 Ninety Day Accumulation Areas

The requirement for Contingency Plans in 90-Day Accumulation Areas, identified by DOE Chicago Environmental Safety and Health (ES&H) Audit (Summer 1991), has been completed. Contingency Plans for the Areas were completed in the Summer of 1992.

Labeling deficiencies continued to be identified by the Hazardous Waste Management Section (HWMS) during routine inspections and Tier II audits. The "90-Day Accumulation Area Inspection Checklist" and training program developed by the HWMS has helped increase awareness of the requirements, but still more needs to be done to achieve 100% compliance. The HWMS has posted each Area with a sign which spells out the minimum requirements, and is planning on conducting on site, hands on training sessions during 1993.

2.9.3 RCRA Permit (6NYCRR Part 373 Permit)

The RCRA Permit (6NYCRR Part 373 Permit) is still in the application stage. The HWMS responded to the most recent Notice of Incomplete Application in August, 1991. The Regional Office of the NYSDEC has unofficially informed the HWMS that the Application is complete and should go to public notice in early 1993.

Work is also underway to develop a Permit Modification Plan which will meet the needs of the new HWMF being designed.

2.9.4 RCRA/TSCA Waste Moratorium

The moratorium on shipments of RCRA and TSCA wastes remains in place at BNL. The HWMS has submitted two "Case-by-Case" (Phase I) requests to ship wastes to the DOE to date. Both were approved, one during the Spring of 1992 and the second in early 1993, alleviating to some degree the backlog of hazardous waste stored due to the moratorium.

The HWMS submitted to DOE a "Reviewable Package" (Phase II) of policy and procedures for utilizing a combination of process knowledge and radiological surveying to declare wastes free of added radioactivity. Three rounds of comments and responses have been completed to date. Several new procedures were developed in response. Most of the major issues have been resolved, however, important issues of quality assurance and radiological survey procedures are still outstanding, and awaiting DOE response and guidance. Approval of the Process Knowledge Package is anticipated in Spring 1993.

The development of radioanalytical procedures (Phase III) to assay wastes suspected of containing added radioactivity is proceeding in a cooperative forum established by the DOE Chicago Field Office (CH), the Research and Development Working Groups (RADWG). The RADWG groups are made up of contractor personnel from the Chicago DOE Energy Research laboratories and have been joined by some of the San Francisco contractor laboratory personnel. Technical professionals are pooling resources and trying to develop a standard set of minimum requirements that all participants could use to meet the requirements of the Performance Objective for the Certification of Wastes Containing No Added Radioactivity.

2.10 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

On December 21, 1989, BNL was included as a Superfund Site on the National Priorities List (NPL). Subsequently, a draft IAG, also referred to as a Federal Facilities Agreement, was negotiated among DOE, EPA, and the NYSDEC. The IAG was written to insure compliance with CERCLA, the corrective action requirements of RCRA, NEPA, and corresponding NYS regulations. In particular, the IAG is intended to insure that environmental impacts associated with past and present activities at BNL are thoroughly and adequately investigated so that appropriate response actions can be formulated, assessed, and implemented. Following public review, the IAG became effective in May 1992.

There are currently twenty-six AOCs (some of which include sub-areas) at the BNL site to be addressed through the IAG. The AOCs consist of both active facilities such as the STP, HWMF, and potable wells and inactive facilities such as the former landfills, cesspools, and radioactive storage tanks. The AOCs have been grouped and prioritized into "OUs" and Removal Actions. This prioritized grouping is documented in the BNL Response Strategy Document (RSD).

In accordance with the IAG milestones, during 1992, the following field activities have been conducted and reports have been prepared and submitted to EPA and NYSDEC for their review:

- Site Baseline Report, January 1992.
- Response Strategy Document, final, January 1992.
- Soil Sampling and Analysis for the "D" low-level radioactive waste storage tank removal action, February 1992.
- Operable Unit I RI/FS Scope of Work, final, February 1992.
- Spray Aeration Trial Run, completed February 1992.
- Operable Unit V RI/FS Scope of Work, June 1992.
- Operable Unit IV Remedial Investigation field activities were initiated, July 1992.
- Modified Cesspool Sampling and Analysis Plan, October 1992.
- Spray Aeration Trail Run Report, final, October 1992.
- Building 208 Soil Vapor Survey, November 1992.
- Underground Storage Tank Phase I Sampling and Analysis Plan, December 1992.
- Operable Unit III RI/FS Scope of Work, December 1992.
- Technical Review Committee (DOE, BNL, EPA, NYSDEC, SCDHS, and Town of Brookhaven) quarterly meeting.
- Ground Water Advisory Committee established.
- A Site-wide Hydrogeological Characterization Project was initiated.
- A Historical Site Review was initiated to identify additional Areas of Concern.

2.10.1 1993 CERCLA Activities

In accordance with the IAG milestones, during the first quarter of 1993, the following field activities have been conducted and reports have been prepared and submitted to EPA and NYSDEC for their review:

- Spray Aeration Removal Action Sampling and Analysis Plan, March 1993 (Draft);
- Underground Storage Tank Phase I Sampling Activities, March 1993;
- Cesspool Removal Action Sampling Activities, January 1993.

2.11 Superfund Amendments and Reauthorization Act (SARA) of 1986

The SARA regulations require that BNL compile and submit Tier I or more detailed Tier II reports to the Site Emergency Response Commission (SERC), the Local Emergency Planning Committee (LEPC), and the responding fire organization. For BNL, the responding fire organization is the SEPD Fire and Rescue Group. Under federal SARA regulations, BNL is required to submit the Tier II report only if requested by the SERC, LEPC, or fire response group. In 1991, the SERC requested that BNL submit the Tier II report for 1990 and each year thereafter. The report lists the average and maximum daily amounts of each chemical on site which exceeds the threshold listed in the current EPA List of Lists. The Tier II report for CY 1992 was submitted in February 1993 to the Fire Response Group and to DOE-BHO office for transmittal to the SERC and LEPC.

2.12 National Environmental Policy Act

In 1992, DOE promulgated final rules for the implementation of NEPA under 10 CFR 1021. To reflect this new implementation rule, DOE Order 5440.1D was updated and replaced by DOE Order 5440.1E. To incorporate the finalized implementation regulations and DOE Orders into the NEPA process at the Laboratory an Environment, Safety, and Health Standard 6.1.1, entitled National Environmental Policy Act Documentation and Review Procedures, was issued in draft to the Laboratory community on November 23, 1992 and received ES&H Committee concurrence for issuance as a Standard in March 1993. Continuing BNL's pursuit of excellence in NEPA compliance, the Laboratory NEPA Coordinator attended a DOE Energy Research Environment, Safety, and Health Conference November 17-18, 1992 at which NEPA was a major topic. The Laboratory NEPA Coordinator also participated in quarterly meetings with other Energy Research facility NEPA coordinators starting in June 1992. The information transfer with other facility NEPA coordinators has been beneficial to all involved.

During CY 1992, environmental evaluations were completed for 238 proposed projects in accordance with DOE Orders 5440.1D and 5440.1E. Of these, 100 were considered minor actions requiring no additional documentation and 138 had Environmental Evaluation forms completed and submitted to DOE. Environmental assessments were revised for a proposed new Radiation Calibration Facility, a proposed Booster Application Facility, an underground vault addition to Chemistry to conduct radiation chemistry activities, the construction of a new HWMF, and the construction of a new building to house an experiment known as the XLS for the short term and a machine shop supporting the NSLS for the long term. Final approvals of the finding of no significant impact were issued to the construction of a RHIC and the XLS project on January 23, 1992 and July 2, 1992, respectively.

2.13 Federal Insecticide, Fungicide, and Rodenticide Act

Brookhaven National Laboratory has two programs where insecticides, herbicides, and pesticides are used. As per regulatory requirements, both users, the Biology Department and PE Division (Grounds Section) maintain a log of applications made and a log of the inventory at each facility. Key personnel are trained and certified by the NYSDEC for handling and application of these chemicals. Annual updating of training is required. The log books are available for inspection and verification by the regulatory agencies when required.

In 1992 the Laboratory was informed by the NYSDEC that due to the on-site application of pesticides, herbicides, and insecticides by Laboratory personnel, registration, as mandated by Article 33 of the New York State Environmental Conservation Law, as a Pesticide Business/Agency is required. Registration applications are being prepared and will be submitted to the NYSDEC by the end of the second quarter of 1993. Registration as a Pesticide Business/Agency requires that an annual report indicating the types and quantities of pesticides, insecticides, and herbicides applied during the previous year be submitted to the NYSDEC before January 15th of the subsequent year.

2.14 Endangered Species Act

Brookhaven National Laboratory received notification from the U. S. Fish and Wildlife Service (USFWS) and the NYSDEC on September 25, 1990 and September 24, 1990, respectively, that no Federal or New York State endangered or threatened species occur within the Laboratory's impact area. No species have been added to these respective lists and no new projects are imminently proposed which would require an update of this information.

2.15 National Historic Preservation Act

The Deputy Commissioner for Historic Preservation of the New York State Office of Parks, Recreation, and Historic Preservation issued a determination April 2, 1991 that only activities which would impact the Old Reactor Building (Building 701), the Old Cyclotron Enclosure (Building 902), and on-site World War I era trenches require additional consultation. All other activities would have no effect upon cultural resources in or eligible for inclusion in the National Register of Historic Places. No activities affecting these facilities were conducted during CY 1992.

2.16 Floodplain Management

No construction was conducted within the 100 year floodplain during CY 1992. Activities are proposed within the 100 year floodplain as part of the installation of new environmental monitoring sheds, installation of Parshall flumes within the Peconic River, and demolition of the existing environmental monitoring sheds. A freshwater wetlands permit was obtained for the construction of the new sheds effective January 20, 1993.

2.16.1 New York Wild, Scenic, and Recreational River Systems Act

That portion of the Peconic River that flows through BNL is classified as "Scenic" under New York's Wild, Scenic, and Recreational River Systems Act (WSRRSA). The Laboratory currently has two projects proposed, RHIC and the upgrade of environmental monitoring stations, subject to WSRRSA legislation which regulates activities up to 0.5 miles from the river bank. Paving of the ring road servicing the RHIC facilities was authorized under the New York State Freshwater Wetlands and WSRRSA by the NYSDEC on May 1, 1992. In addition on May 28, 1992, NYSDEC determined that the RHIC project met the requirements of "actual and substantial lawful commencement of the land use or development" under New York Code 666.9(b)(4) and was therefore exempt from requirements under the WSRRSA. Authorization for construction of the environmental monitoring stations was authorized on January 20, 1993. Application for completion of the RHIC tunnel system was submitted to the NYSDEC by DOE-BHO on February 17, 1993. Permit issuance is pending.

To address WSRRSA concerns for other current and future projects, NYSDEC prepared a draft Memorandum of Understanding (MOU) with DOE for actions within 0.5 miles of the Peconic River. This document was submitted to DOE-BHO and the Laboratory on April 15, 1992. Negotiations on this document continue. To strengthen BNL protection efforts, a draft Peconic River Management Plan was completed in December 1991. This document also remains to be finalized.

2.17 Protection of Wetlands

Other than the permitting actions described in Sections 2.16 and 2.16.1 above, no activities conducted during CY 1992 or the first quarter of 1993 impacted wetlands or their buffer zones. As part of the settlement of a Notice of Violation received by BNL from EPA for RCRA and TSCA violations. the Laboratory has proposed to conduct surveys of wetland habitats and develop protection, preservation, and possibly enhancement activities. The extent of activities to be conducted are still being negotiated.

2.18 Environmental Compliance Audits

2.18.1 Tiger Team Issues

In March and April of 1990, the DOE conducted a comprehensive ES&H and waste operations assessment of BNL. This effort, known as the Tiger Team Assessment (TTA), was conducted in response to Secretary of Energy Admiral James D. Watkins, Ret., 10-point initiative to strengthen ES&H programs and waste management operations in the DOE community. The purpose of the TTA was to develop concise information regarding the site's status on ES&H compliance issues, root causes for noncompliance, and the adequacy of response actions needed to address identified problems. In addition, the assessment included an evaluation of the adequacy and effectiveness of the DOE and site contractor, AUI, management, organization, and administration of the ES&H programs at BNL.[31] A complete documentation of the findings of this assessment has been published. The BNL Action Plan for the Tiger Team Assessment was completed and published in October 1990.[32]

In the area of compliance with environmental and waste management concerns, there were 37 findings dealing with the lack of conformance to Federal and State laws and regulations, County codes, DOE Orders, and 27 findings in which best management practices were not attained. By the end of 1992, 48 of the original 64 environmental related findings had been addressed. In the area of correcting environmental compliance issues, 32 of the 37 findings were addressed. Sixteen suggested best management practices had also been implemented. Three of the unresolved compliance issues are scheduled for closure in 1993. The remaining two require substantial resources and are being addressed on a schedule determined by a risk based prioritization system. A brief description of the status on each unresolved compliance issue is listed below:

Finding	Description of Progress
A/CF-1	Identification of air emission points was accomplished in 1992 by means of a questionnaire that was completed by each Department and Division. Submission of air permit applications for new sources identified by this survey is scheduled for the first quarter of 1993.
SW/CF-1	Identification of liquid effluent points was accomplished in 1992 by means of a questionnaire that was completed by each Department and Division. Following implementation of a sampling plan to characterize effluents identified by this survey, the BNL SPDES permit will be modified as required.
TS/CF-3	The BNL SEAPPM 6.3.0 was issued in June 1992. The ES&H standard is schedule for publication by the end of the second quarter in 1993.
TS/CF-4	This project requires upgrades to existing tanks. Funding for this task is expected in Fiscal Year 1994.
RAD/CF-1	The issues of thick targets, DOE guidance on no addition of radioactivity to hazardous waste, and identification of secure areas have yet to be resolved.

Addressing best management practice concerns has received a lower priority due to funding and resource constraints. Several best management practice improvements are associated with upgrades to the compliance strategy. Continued improvement in this area is dependent on available resources and subject to reprioritization based on on-going audits and appraisals by DOE and EPA.

2.18.2 EPA Audits

2.18.2.1 Multi-media Audit (1991)

A team consisting of approximately 15 EPA Region II inspectors with expertise in CAA, SDWA, NPDES, SPCC, RCRA, TSCA, Underground Storage Tanks (USTs), and NESHAPs regulatory programs performed an inspection at BNL during the week of March 4, 1991. The inspection consisted of interviews with BNL personnel, inspection of facilities, review of data reports and compliance documentation, and periodic sampling to confirm effluent releases. The majority of the issues identified by this inspection were discussed in the 1991 BNL Site Environmental Report[9]. Actions taken in 1992 focused on legal issues necessary to close the Notice of Violations (NOVs) received in 1991 and actions taken to respond to the January 1992 issuance of an NOV against AUI for alleged violations of the CWA and the Oil Pollution Prevention Regulations at the BNL CSF that were associated with this same multimedia inspection. The January 1992 NOV cited two violations: 1) BNL had failed to prepare an adequate SPCC Plan in accordance with 40 CFR 112.3 (a) and 112.7 and 2) BNL failed to fully implement an SPCC Plan prepared in accordance with engineering practices and meeting all requirements of 40 CFR 112.7, as required by Section 112.3 of the Regulations. The specific findings for this NOV were that BNL had failed to provide containment around its transformers and its two hundred and seventy-five gallon (275) tanks. Within thirty days of receipt of the NOV, AUI requested a hearing. Representatives from BNL and DOE attended a meeting to confer informally with EPA on February 25, 1992. As a result of discussions during this meeting, EPA requested additional information. A response was prepared and submitted to EPA on March 31, 1992. Brookhaven National Laboratory believes that with the submission of the revised SPCC plan on February 18, 1993, all technical actions required to satisfy this NOV have been completed.

2.18.2.2 NESHAPs Audit (1992)

On April 16, 1992, EPA inspectors conducted a 40-CFR-61 Subpart H, NESHAPs, compliance inspection. The inspection team interviewed BNL and DOE staff and conducted a tour of selected facilities. The major issues discussed during this inspection were timeliness of an advanced notice of start-up for the AGS Booster and how BNL planned to address sample verification for small sources. The first issue developed when BNL submitted a 60-day advanced notice of start-up and then, due to technical difficulties, had to wait almost 8 months to actually initiate operations. Brookhaven National Laboratory sent a notice of start-up within 15-days of the actual date but failed to reissue the 60-day advanced notice of start-up. The failure to renotify EPA 60 days in advance of start-up stemmed from an understanding of the regulations that the advanced notice of start-up need only be provided once. The second issue discussed was how BNL intended to comply with the 1990 CAA revisions which required verification of small source emissions. Brookhaven National Laboratory committed to submission of a proposed action plan by October 9, 1992. This plan was submitted on time.

On October 27, 1992, EPA and NYSDEC visited the site. The purpose of this visit was to introduce the NYSDEC inspectors to BNL since EPA was intending to transfer authority for NESHAPs, 40-CFR-61 Subpart H to the state in late 1992 or early 1993. At this meeting, the inspectors reviewed BNL's current compliance status at all facilities, our proposed action plans, and conducted a tour of the BNL site.

2.18.3 DOE Chicago ES&H Appraisals

2.18.3.1 DOE Chicago 1991 Appraisal

From July 8 through July 26, 1991, DOE Chicago conducted an ES&H Appraisal. The areas of the environmental protection program that were audited included the general administration of the program, compliance with the regulatory requirements of TSCA, RCRA, CERCLA, SDWA, NEPA, and compliance with applicable DOE orders. The audit team identified several areas of noncompliance with TSCA and RCRA regulations. Recommendations for improvements in the implementation of TSCA, RCRA, CERCLA, SDWA, and NEPA programs were also made. A total of 25 findings and 16 recommendations were made. At the conclusion of 1992, BNL had completed or closed 24 of these issues. The remaining item is issuance of an ES&H standard for handling PCBs. In 1992, a draft standard was written and internally reviewed. Department/Division comment and submission to the ES&H Committee will occur in 1993.

2.18.3.2 DOE Chicago 1993 Appraisal

While there were DOE Chicago ES&H appraisals performed at BNL during CY 1992, none dealt with environmental protection, restoration, or waste management issues. The next DOE Chicago appraisal took place from March 24 to April 1, 1993. During this appraisal, the areas audited included RCRA, CERCLA, SDWA, USTs, NESHAPs, CWA, CAA, and DOE Orders on environmental protection. Although the results of this appraisal have yet to be formalized, preliminary information indicates that there were six issues where the assessors would like to see additional improvements in the program. Three of these issues deal with waste management operations, and three are associated with environmental compliance. Listed below is a brief statement of the issue and BNL's current status.

Finding Number	DOE Chicago Comment	BNL Position
HW-1	Drum storage area should have all four sides enclosed.	Brookhaven National Laboratory's drum storage area is a three sided, roofed structure that has secondary containment in excess of the rated loading of the building. While it is possible for some precipitation to enter the contained area, there is little potential for precipitation to preempt secondary containment capacity.

HW-2	The backlog of radioactive waste should be shipped at an expedited schedule.	The shipping schedule is determined by compliance status and cost. Currently, radioactive waste shipments do not have the time constraints that apply to hazardous materials. Consequently, shipment of hazardous waste has taken priority.
HW-3	The Waste Analysis Plan relies too heavily on process knowledge.	The current Waste Analysis Plan utilizes generator process knowledge to classify the waste. This practice has been accepted by the New York State and EPA. The Waste Management Group has instituted verification of generator supplied information by sample analysis for certain waste characteristics. In addition, profile analyses performed by waste disposal contractors provide another check on process knowledge.
EC-1	The monitoring of argon-41 at the BMRR needs to be upgraded to meet current monitoring standards.	This capital upgrade received authorization in March 1993. The purchase order for the equipment has been finalized. Installation is expected in Fiscal Year 1994.
EC-2	The method used to dispose of purge water generated in the process of sampling ground water surveillance wells needs to receive formal concurrence with the IAG.	Currently, BNL discharges purge water to the ground about 6 meters down gradient of the well. This approach has received written concurrence from one party of the IAG and the sampling protocols which specify this method of disposal have been reviewed by all participants of the IAG.
EC-3	Spray paint booth record keeping may not be adequate.	Records are maintained by the S&EP Division on the types of paints used in paint spray applications subject to 6NYCRR Part 228 VOC limits. Operations did not have an equivalent inventory nor did they have readily available the quantity of material used.

Brookhaven National Laboratory has not yet received a formal report regarding this assessment and the listed issues may not be complete. A complete list of issues and concerns along with BNL's action plan to address the findings will be presented in the 1993 BNL SER.

2.18.4 Progress Assessment Team

2.18.4.1 Progress Assessment Team Activities in 1992

The Environment, Safety, and Health Progress Assessments are a part of the DOE's continuing effort to institutionalize line management accountability and the self-assessment process throughout DOE and its contractor organizations. The purpose of the BNL ES&H Progress Assessment was to provide the Secretary of Energy with an independent assessment of the adequacy and effectiveness of the DOE and contractor management structures, resources, and systems to address ES&H issues and requirements identified in the March 1990 Tiger Team Assessment. The Progress Assessment was not a comprehensive site-wide review of ES&H activities but rather a horizontal look at selected systems. The BNL Progress Assessment was designed to look at four functional areas: fire protection, industrial hygiene, worker safety, and ground-water monitoring. The assessment commenced with a site visit from December 8 through 11, 1992. During this time, the Progress Assessment Team collected or identified key documents and personnel for future reference. In addition, coordination of interviews and tours for the actual assessment was completed.

2.18.4.2 Progress Assessment Team Activities in the First Quarter of 1993

The BNL ES&H Progress Assessment was conducted from January 25 to February 5, 1993. Twelve individuals conducted the assessment in the four key areas of interest. The Progress Assessment Team identified a total of 25 issues during their review: 14 concerns and 11 weaknesses. A "concern" was defined as any situation or adverse condition that does not meet the requirements of an applicable law, agreement, DOE rule or Order, DOE procedure or constitutes a significant deficient practice not covered by procedure. A "weakness" was defined as any situation which indicates less than optimal performance and could be an indication of more serious problems. From the 25 observed issues, the Progress Assessment Team developed two key findings. The first finding, which they believed was generally applicable to both the DOE-BHO and BNL, was that although essential management systems for ES&H programs were in place, they were not sufficiently developed to provide the framework, oversight and information necessary to achieve ES&H excellence. Furthermore, managers and staff are not clearly held accountable to ensure that ES&H programs are appropriately developed and are implemented in a formal and rigorous manner. The second key concern was that DOE Headquarters Principal Support Officers do not coordinate their efforts in providing direction and guidance and in resolving common ES&H issues. A complete documentation of the findings of this assessment has been published.

In the area of environmental issues, the Progress Assessment Team identified two concerns and three weaknesses. A brief summary of each issue is listed below.

Finding Number	Description of Finding
E/C-1	The DOE-BHO does not have a formalized oversight program of BNL's environmental monitoring activities.
E/C-2	Although BNL has made significant progress since 1990, all elements of a ground water protection program have not yet been implemented.

E/W-1 Brookhaven National Laboratory does not have procedures that supplement formal guidance and instructions for key compliance and environmental reports.

E/W-2 The environmental monitoring program does not include regularly scheduled monitoring of on-site natural resources, such as flora and fauna, in order to determine the impact of DOE operations on these environmental media and the local environs. The current program which provides for this type of effort approximately every five years was deemed too infrequent.

E/W-3 The DOE Headquarters EM Group has not provided clear guidance, policy, procedures, and definition of funding responsibilities. Consequently, there is a lack of clarity regarding who is responsible to fund remedial action activities that require immediate attention.

Brookhaven National Laboratory has completed the factually accuracy review but has not completed a plan of action to address these findings as of this report.

2.19 Quality Assurance Program

The objectives of the EP Section Quality Assurance Program are to ensure that management provides planning, organization, direction, control, and support to achieve environmental program objectives; that the line managers achieve quality in their product or services; and that the Sections overall performance is reviewed and evaluated using a rigorous assessment process. This program has been developed to ensure full compliance with QA requirements established by DOE in Orders 5700.6,[14] Quality Assurance, and 5400.1, General Environmental Protection Program.[33]

The QA Program developed by BNL to achieve Laboratory objectives provides policies, responsibilities, and guidance procedures for the Divisions and Departments based on DOE Order 5700.6 and consistent with ASME NQA-1, Quality Assurance for Nuclear Facilities. Safety and Environmental Protection has adopted or adapted these program elements into the Division QA Program Plan and established responsibilities, methods, and controls for conducting its operations.[15] The EP Section has integrated these elements with the additional environmental QA requirements of DOE Order 5400.1 into the sampling, analysis, and data handling activities. The implementing procedures of the EP Section Standard Operating Procedure Manuals on Environmental Monitoring, Radiation Measurements, Analytical Chemistry, and Regulatory Programs, in conjunction with the S&EP Division QA Manual,[16] comprise the EP QA Program for the environmental surveillance and effluent monitoring programs.

Responsibility for quality at BNL starts at the top with the Laboratory Director and permeates down through the entire organization with individuals at each level assuming their appropriate share. The BNL QA organization is headed by the BNL QA Manager who coordinates and evaluates the quality activities for the entire laboratory, and provides professional assistance and guidance to the departments and divisions. The S&EP Division has appointed a QA Coordinator to assist, assess, advise, and improve the implementation of the Division-wide QA program. The Division has chartered an Improvement Committee, with membership from all S&EP sections and various position levels, responsible for encouraging, reviewing, and evaluating employee suggestions for improvements and making recommendations to the Division Head. The EP Section, because of its emphasis on quality issues, has established an EP QA Group directed by a full time QA Officer with environmental expertise and technical ASQC certification. This group is responsible for reviewing, advising, assessing, and improving EP activities.

One of the major activities in the EP QA Group is ensuring that sampling and analysis of environmental media are conducted in such a way as to provide representative defensible data. The QA program fulfills this by incorporating QA elements such as field sampling plan designs, documented procedures, chain of custody, calibration/standardization program, acceptance criteria, statistical data analysis, software QA, and data handling systems into the environmental surveillance and effluent monitoring programs.

Lastly, the EP QA Group is responsible for establishing a program of internal assessments and external audits to verify the effectiveness of EP sampling, analysis, and data base activities and their adherence to the QA program. Self assessments of the EP activities are performed annually by the EP group leaders to identify areas needing attention. The EP QA Officer performs internal audits, as in 1992 with a systems audit of the Environmental Monitoring Group. The analytical laboratories participate in interlaboratory performance evaluation programs organized by DOE, EPA, and NYSDOH. Contract laboratories used to augment the capabilities of the in-house laboratory are required to maintain a comprehensive QA program and are subject to audits by S&EP personnel to ensure its implementation. In addition to the internal reviews, the BNL QA Office, DOE-CH, and other regulatory agencies periodically audit the EP Section.

3.0 **ENVIRONMENTAL PROGRAM INFORMATION**

Brookhaven National laboratory is committed to environmental compliance and accountability. The Laboratory conducts an extensive program to monitor the environment in and around the BNL site. This program, required by DOE Orders 5400.1 and 5484.1, has five major objectives:

1. To demonstrate the effectiveness of pollution control programs,
2. To demonstrate compliance with applicable environmental laws and regulations,
3. To confirm adherence to the DOE and BNL Environmental Protection policies,
4. To estimate the impact of operations on the environment, and
5. To support environmental management decisions.

3.1 Program Organization

The Laboratory has three organizations involved in carrying out the tasks outlined above. These are:

a. The Office of Environmental Restoration was established in response to BNL being listed on the NPL on December 21, 1989 and reports directly to the Director's Office. The OER has prime responsibility for environmental restoration of areas contaminated during past spills and storage and disposal of hazardous and radioactive wastes.

b. The Hazardous Waste Management Section operates under the aegis of the SEPD and is responsible for the management of hazardous wastes produced by the Laboratory as a result of its operations.

c. Environmental Protection Section operates under the aegis of SEPD and is responsible for interacting with Laboratory research and support programs to ensure that operations are conducted in a manner that limits environmental impact and that facility emissions are consistent with regulatory guidelines. This Section also interacts directly with representatives from local, state, and federal regulatory agencies.

Summary description of the activities conducted by the above groups are given below.

3.1.1 Environmental Restoration

As indicated in Sections 2.10 and 3.1.a, the OER has full responsibility to conduct environmental restoration activities as per the IAG. A summary of the OER's activities are provided in Section 2.10, Compliance Summary.

3.1.2 Hazardous Waste Management Section

The HWMS operates a temporary storage facility for all BNL generated hazardous wastes, radioactive wastes and mixed wastes. All waste, except mixed waste, is transported off site for disposal. The HWM staff also manages the Waste Minimization Program and the Pollution Prevention Awareness Program. Specifically the HMW Staff:

a. Processes, stores, packages, solidifies, and prepares waste for shipment for disposal off site.

b. Tracks and documents the movement of hazardous, mixed, and radioactive wastes from waste accumulation areas to final disposal off site.

3.1.2.1 Waste Minimization and Pollution Prevention Programs

Brookhaven National Laboratory's Waste Minimization and Pollution Prevention Program comprises of the following three elements:

a. The BNL Waste Minimization Program plan has combined all the DOE requirements for Waste Management reporting, Waste Reduction Activity reporting, the Pollution Prevention Awareness Plan, and the Waste Minimization plan. This plan lays out a strategy for implementation of a formal waste minimization program at BNL and contains information on waste minimization accomplishments for non-hazardous solid waste, hazardous waste, radioactive waste, and mixed waste. A draft plan is expected to be submitted to DOE by September 1993. In addition, BNL is required to submit annually to NYSDEC, a Hazardous Waste Reduction Plan. This plan has been reviewed and approved by NYSDEC and will be updated annually by the HMWS.

b. Certification of Waste Minimization Activities: As required by regulation, BNL is required to certify on hazardous waste manifests, annual reports, and other documents that there is a program in place to minimize waste. To ensure that waste generators are aware of this responsibility, both the hazardous waste control form and the radioactive waste control form have the following certification statement the waste generator must sign:

"I certify that, to the best of my knowledge, the information provided above is true and complete, and that I have minimized the amount and toxicity of the waste to the extent practicable".

c. Training: The Hazardous Waste training program provides incentives and encourages awareness. The BNL ES&H Standards Manual Section 6.2.0, Hazardous Chemical Waste Minimization, and Section 3.5.0, Radioactive Waste Disposal, contain specific guidance for waste generators in the proper handling and disposition of wastes. The RCRA training program is administered by the HWMS's training group and attendance is mandatory by all waste generators on site.

Brookhaven National Laboratory's HWMS, with the assistance of the BNL Video Group, has prepared a VHS Video entitled "Waste Minimization at BNL", and serves as an excellent training/awareness tool which is presented to all new employees as part of the New Employees Safety Orientation. In addition, employees are encouraged to attend workshops, conferences, and professional development training sessions on waste minimization.

Incentives for waste reduction are provided through the Employee Suggestion Program (ESP), wherein employees are encouraged to submit their waste minimization ideas. If a suggestion is adopted, the employee is eligible to receive cash awards in proportion to the relative value of their idea. Several employees have received awards, especially in the area of substituting less toxic materials in the conduct of operations.

The Employee Performance Appraisal procedure now requires that an employee's awareness and adherence to BNL's safety and environmental policies and procedures be part of the appraisal system.

Departments and Divisions have their ES&H programs audited by the SEPD through a process known as Tier II appraisals. These programmatic reviews, conducted by a multi-disciplinary group of professionals from the SEPD, provides senior management with an independent assessment of the effectiveness of the Department/Divisions ES&H programs.

Awareness is accomplished through the BNL Video "GLANCE", which is used to communicate important safety and environmental issues to the general employee population. This Video Monitor is located in the Berkner Hall cafeteria. This has always drawn an audience from all walks of life at BNL. The BNL Bulletin, a widely read weekly publication by the Public Affairs Division, periodically runs articles on waste minimization and other pertinent environmental issues and concerns.

3.1.3 Environmental Protection Section

The Environmental Protection Section, is comprised of six groups: Environmental Compliance, Environmental Monitoring, Ground Water, Radioanalytical Laboratory, Nonradioactive Laboratory, and Quality Assurance. Although the monitoring activities of the EM Group are quite comprehensive to address the regulatory mandates, the role played by the remaining five is closely inter-linked to provide the laboratory with a framework that assures environmental compliance and accountability. The Compliance Group provides the Division and Laboratory with assistance and guidance in all regulatory compliance areas, and submits appropriate reports to the Regulatory Agencies. The Analytical Laboratories, both radioactive and nonradioactive, perform the required analysis of facility effluent and environmental samples as required for assessment of environmental impact or report submission. The Ground Water Group provides technical overview and assistance in conducting ground water monitoring and review of data for determining impact and revisions of the Environmental Monitoring Program. The Quality Assurance Group oversees the functions of the Section in terms of the directives on Quality Assurance, such as pertaining to environmental sampling, analytical processes and documentation, which includes review of data. The Section, in it entirety, also reviews projects for environmental impacts and provides audit support to the Laboratory's ES&H and environmental restoration programs. These safety and environmental reviews are performed on new construction projects as well as modifications to existing facilities. These reviews are performed from conceptual design through completion of construction and prior to final occupancy to assure that basic safety and environmental protection requirements are provided. As part of the review team, the SEPD EP staff members review these proposals and plans to assure that potential hazards are identified and potential environmental impacts are evaluated. In addition, these reviews are conducted to ensure that all necessary permits are obtained and that new construction or modifications comply with federal, state, and local regulations. Approximately 90 of these types of reviews were performed during CY 92.

Summary information on monitoring activities can be found in the Executive Summary. Complete details regarding individual monitoring activities, as mandated by DOE Orders and implemented by BNL, can be found in specific Sections 4.0 to 5.0. The activities that are required by environmental statutes are described in Section 2 (Compliance Summary).

3.2 Environmental Programmatic Changes in 1992

There were four significant modifications to the Site Environmental Monitoring Program in 1992. The most significant change to the program was the intensive soil sampling that was conducted at Bldg. 479 area following the discovery of oil stained soil while conducting excavation for the construction of new facilities. During the period from January to August 1992, more than 400 samples, comprising of smear and soil samples were collected. This program had a severe impact on the ground water monitoring program, in that the routine sampling schedule was disrupted. The impact was significant during the first quarter and the program returned to normal in the latter part of the second quarter. In December 1992, an additional field sampling person was hired to augment the capabilities of the environmental sampling team. This has allowed the program to begin achieving its goals.

In 1992, during late fall, a fauna sampling program was started and was aimed at collecting endemic species that represented areas where known contamination exists or are in proximity to water bodies receiving Laboratory effluents. Species from background areas were also collected.

The DOE Order 5400.1 has required that the Laboratory begin to do dose estimates to aquatic fauna. Towards this end, a program has been started where TLDs have been attached to mussels. As the dose is expected to be very small, the first stage of the exposure study will be to determine the feasibility of the TLDs and to optimize the best dosimetric tool that can be used for such assays. Currently, only sessile species have been selected. Fish will be targeted once the methodology is proven to be practical. Other techniques not requiring field studies, such as computer programs, are also being evaluated.

Effective January 10, 1992, the Laboratory started collecting water samples from the Peconic River (monthly) and air samples from one of BNL's air monitoring stations (weekly) on behalf of the NYSDOH. They are providing the necessary equipment and the sampling containers.

4.0 ENVIRONMENTAL PROGRAM DESCRIPTION

It is DOE policy to conduct its operations in an environmentally responsible manner and comply with applicable environmental standards. At BNL, a wide variety of environmental activities are performed to comply with laws and regulations, enhance environmental quality, and monitor the impact of effluent emission from site facility operations.

Section 2.0 summarized the status of BNL's compliance with applicable regulations, activities under way to achieve compliance, and programs to manage and improve environmental quality.

This section summarizes significant activities conducted in 1992 under Environmental Monitoring, which consists of:

1. Effluent monitoring, and
2. Environmental Surveillance.

Effluent monitoring is performed as appropriate by the facility operators and/or the SEPD EM Group environmental sampling team at the point of release to the environment. Environmental surveillance consists of sampling and analyzing environmental media on and off the BNL site to detect and quantify potential contaminants, and to assess their environmental and human health significance.

The sampling program includes collection of airborne effluents, ambient air, sewage and facility liquid effluent, ground water, surface water, soil, vegetation, fish, fauna, and sediment. The type of samples collected at a specific location depends on the site and the potential pollutants to be monitored. Added to this are the requirements mandated by specific permits.

A detailed description of the rationale and design criteria for the environmental surveillance and the effluent monitoring program is given in the BNL Environmental Monitoring Plan.[34] This plan also discusses the extent and frequency of monitoring and measurements, procedures for laboratory analyses, quality assurance requirements, and program implementation procedures.

Complete details regarding individual monitoring activities can be found in specific subsections grouped by environmental media.

4.1 Effluent Emissions and Environmental Surveillance

The primary purpose of the BNL effluent monitoring program is to determine whether:

1. Facility operations, waste treatment, and control systems functioned as designed to contain environmental pollutants; and

2. The applicable environmental standards and effluent control requirements were met.

The primary purpose of the BNL environmental surveillance program is to:

1. Quantify the presence of potential contaminants in the environment as a result of BNL operations; and

2. Assess environmental and human health impacts from BNL operations.

This annual report for CY 1992 follows the recommendations given in the DOE Order 5400.1, General Environmental Protection Program.[33]

4.1.1 Airborne Effluent Emissions - Radioactive

The locations of principle Laboratory facilities from which radioactive airborne effluents were released during 1992 are shown in Figure 10. Tritium was the only radionuclide detected routinely at the site boundary which was attributable to Laboratory operations, although Co-60 and Cs-137 were detected on a sporadic basis. There were no unusual effluent releases or processes that would explain the presence of these radionuclides during the sample interval. The presence of Cs-137 is most likely attributed to atmospheric fallout and the Co-60 is most likely on artifact as a result of background fluctuations in the detection equipment.

Oxygen-15, which has a two minute half-life, is produced at the BLIP facility by the interaction of protons and water or air in the beam tubes and is generated at an estimated rate of approximately 3 mCi per microampere-hour (0.11 GBq/uA-hr).[35] In June of 1992, a vacuum leak in the linear accelerator beam line caused this factor in increase to 51 mCi/uA-hr for approximately one week. During this time, about 5,321 uA-hrs were received by the BLIP facility causing an additional 271 Ci of O-15 to be released. Based on 147,575 milliampere-hours of normal operation and the increased emissions seen in June, a total of 758 Ci (28.1 TBq) of oxygen-15 was released via the Building 931 stack. Due to scheduled maintenance at the Linac and AGS, BLIP did not operate during the months of September through December 1992. Annual effluent emissions are listed in Table 6. Oxygen-15 is also generated as an air activation product at the AGS Booster Facility, which became operational in March of 1992. Due to the nature of production, and the diffuse release characteristics of the Booster, the total O-15 source term must also be calculated based on a knowledge of building air exchange rates and particle beam characteristics. The estimated O-15 source term attributed to Booster in 1992 was 39 Ci (1.37 TBq).

In addition to radionuclides released during the processing of targets from the BLIP facility, other radionuclides, in addition to O-15 are produced at the BLIP facility and are periodically emitted into the environment. Table 6 summarizes the gamma emitting radionuclides released from this facility. The predominant radionuclide released in 1992 was beryllium-7 (0.713 mCi [0.264 GBq]). The activity released was approximately ten times greater in 1992 than in 1991.

Argon-41, which has a 110-minute half-life, is produced at the MRR by neutron activation of stable atoms of argon-40 in the ventilating air of the reflector. It is released from the Building 491 stack at an estimated rate of 2.2 Ci $MW^{-1}h^{-1}$ (81.4 GBq $MW^{-1}h^{-1}$). The estimated release for the MRR stack during 1992 was 1,490 Ci (55.1 TBq) of argon-41. Monthly effluent emissions are listed in the Compendium.

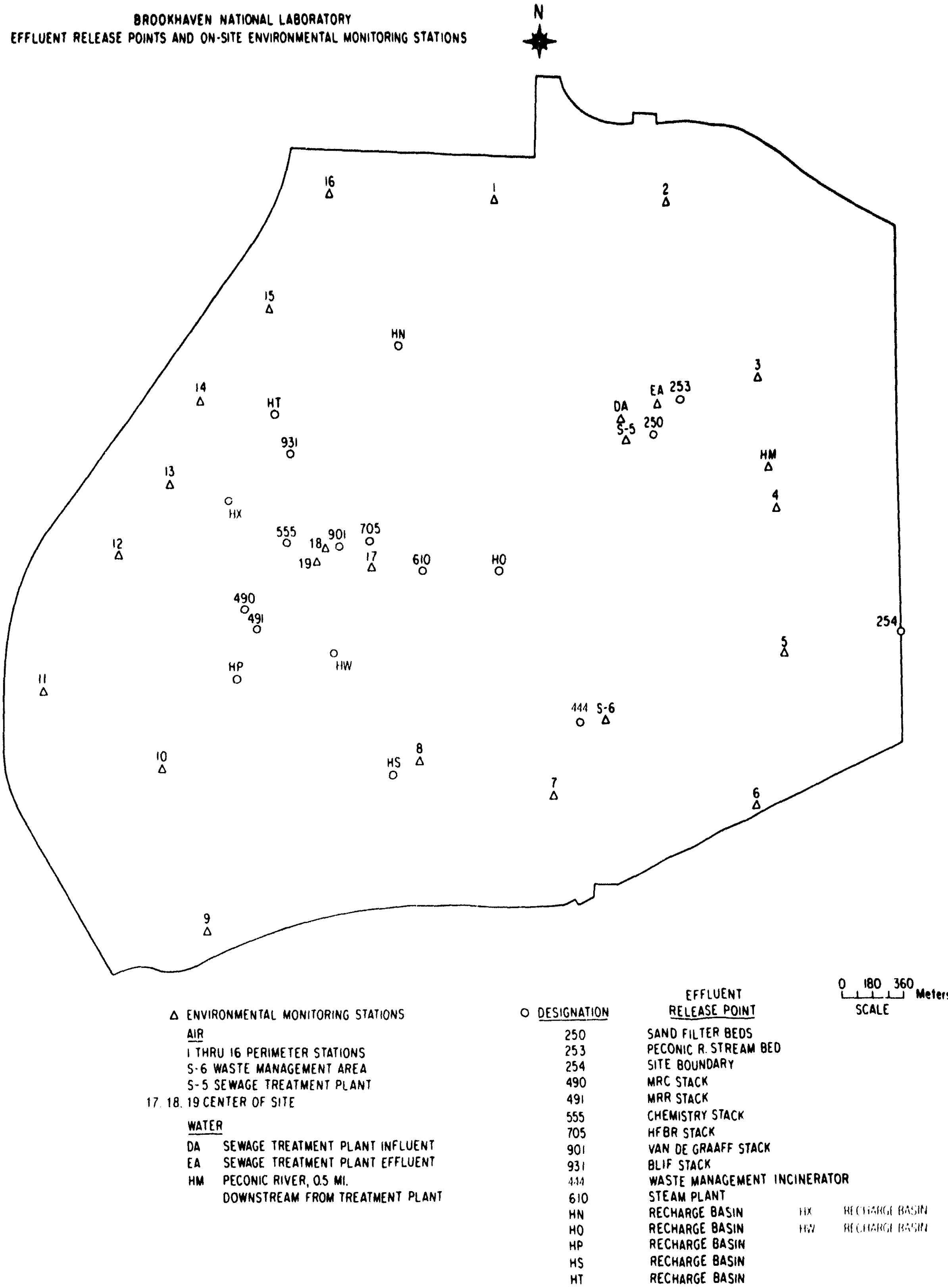


Figure 10: Brookhaven National Laboratory Effluent Release Points and On-site Environmental Monitoring Stations.

Table 6
BNL Site Environmental Report for Calendar Year 1992
Atmospheric Effluent Release Locations and Radionuclide Activity

Release Pt. Bldg. No.	Facility	Release Height (m)	Nuclide	uCi released CY 1992	Annual Avg Stack Conc. (uCi/cc)	DOE Order 5400.5 Limit (uCi/cc)
750	HFBR	100	Br-77	2.20E+03	1.06E-11	5.0E-08
			Br-82	5.12E+02	2.46E-12	9.0E-09
			Cs-137	1.75E+00	8.42E-15	4.0E-10
			H-3	7.00E+07	3.37E-07	1.0E-07
			I-126	3.35E-01	1.61E-15	3.0E-10
			Mn-54	1.02E-01	4.89E-16	2.0E-09
			Xe-133	2.84E+01	1.37E-13	5.0E-07*
			Xe-135	3.34E+02	1.60E-12	8.0E-08*
931	BLIP	18	Be-7	7.13E+03	8.01E-10	4.0E-08
			Co-56	7.62E+01	8.56E-12	5.0E-10
			Co-57	6.54E+01	7.34E-12	2.0E-09
			Co-58	1.38E+02	1.55E-11	2.0E-09
			Co-60	2.80E+01	3.15E-12	8.0E-11
			Cs-137	1.88E+00	2.11E-13	4.0E-10
			Ga-68	5.67E+00	6.37E-13	1.0E-07
			Ge-69	2.76E+01	3.10E-12	2.0E-08
			H-3	6.79E+04	7.63E-09	1.0E-07
			I-126	8.26E-01	9.27E-14	3.0E-10
			Mn-54	2.46E+02	2.77E-11	2.0E-09
			Na-22	5.18E+01	5.81E-12	1.0E-09
			O-15	7.58E+08	8.51E-05	2.0E-08*
			Xe-127	1.71E+01	1.92E-12	7.0E-08*
			Zn-65	2.25E+01	2.52E-12	6.0E-10
801	Acid Line	100	As-74	1.20E+00	3.79E-14	2.0E-09
			Br-77	2.14E+00	6.74E-14	5.0E-08
			Ce-143	1.02E+01	3.23E-13	4.0E-09
			Co-60	3.91E-06	1.23E-19	8.0E-11
			Cs-137	2.25E+00	7.10E-14	4.0E-10
			Ga-68	3.02E+02	9.52E-12	1.0E-07
			Ge-69	6.01E+01	1.90E-12	2.0E-08
			Xe-127	6.24E-01	1.97E-14	7.0E-08*
801	Non-Acid Line	100	Br-77	5.75E+03	1.73E-10	5.0E-08
			Br-82	9.16E+01	2.76E-12	9.0E-09
			Co-56	4.51E+00	1.36E-13	5.0E-10
			Co-57	3.93E+00	1.18E-13	2.0E-09
			Co-58	5.04E+01	1.52E-12	2.0E-09
			Co-60	5.84E+00	1.76E-13	8.0E-11
			Cs-137	4.13E+00	1.24E-13	4.0E-10
			Ga-68	2.80E+04	8.44E-10	1.0E-07
			Ge-69	2.06E+04	6.20E-10	2.0E-08
			I-124	3.82E+01	1.15E-12	6.0E-10
			I-126	3.74E+01	1.13E-12	3.0E-10
			Xe-127	4.73E+02	1.43E-11	7.0E-08*
491	BMRR	46	Ar-41	1.49E+09		1.0E-08*
555	Chemistry	16	H-3	1.07E+03	3.83E-11	1.0E-07
444	Incinerator	8.7	See Table X			

Note: All 5400.1 Derived Concentration Guides are for inhaled air except indicated by "*".

The total tritiated water vapor released from the Laboratory research facilities during 1992 was 70.1 Ci (2.6 TBq). This represents a factor of 1.7 decrease from 1991. High Flux Beam Reactor operations accounted for 99.8% of the total released by the site. Table 6 and the Compendium present summaries of annual tritium release data.

The Building 705 100-meter stack receives airborne effluents from three separate exhaust systems: The HFBR (Building 750) and the Hot Laboratory (Building 801) acid and non-acid lines. Gamma emitting nuclides released from the 100-meter stack are shown in Table 6. Tritium is the major radionuclide released from the HFBR. The Building 801 Hot Laboratory Complex air effluent release from the acid and non-acid off-gas systems are reported in Table 6. These releases are the result of processing BLIP targets for the recovery of the radioisotopes used by medical health practitioners. In 1992, releases from the Building 801 Hot Laboratory acid line increased from 1991 values by a factor of five, while the non-acid line emissions decreased by a factor of 1.1. Releases from this facility were not detected by air sampling at the site boundary.

The Laboratory incinerates certain low-level radioactive wastes at the HWMF incinerator, Building 444 (Figure 10). The total quantities of the individual radionuclides in the incinerated materials during 1992 are shown in Table 7. Carbon-14 was the predominant radionuclide released from the incinerator of an annual rate of 0.280 mCi (10.4 MBq). Table 7 also indicates the analogue radionuclide used for the CAP88 Model when the radionuclide released was not present in the computer library. Site meteorological characteristics and administrative limits on the amount of material incinerated ensure that airborne concentrations at the site boundary are small fractions of the applicable standards.

4.1.2 Airborne Effluent Emissions - Nonradioactive

Nonradioactive airborne emissions result from a variety of processes at BNL. The majority of these processes are defined by NYS air laws as minor sources and include processes such as blueprint machines, welding/soldering activities, degreasers, sandblasters, machining exhausts, painting operations and small package combustion units. There are four large boilers at BNL, located at the CSF, which generate the largest amount of nonradioactive airborne emissions.

The CSF is located along the eastern perimeter of the developed portion of the BNL site. The CSF supplies steam for heating and cooling to all major facilities through the underground steam distribution and condensate grid. Since 1976, the CSF has utilized alternate liquid fuel (ALF) in the three high efficiency boiler units for the purpose of energy recovery. In 1992, the fraction of light feed stock (LFS) relative to total fuel consumption was less than one percent. These LFS fuels typically have a weighted average sulfur content in No. 6 oil.[36] The NYSDEC also requires that the combustion efficiency of the boilers be 99.0% at a minimum.[36] Stack testing performed in 1983 in accordance with NYSDEC requirements demonstrated the mean fuel combustion efficiency over the entire range of boiler loading capacities to be greater than 99.9% for the individual boiler units firing ALF,[37,38] thus providing greater combustion efficiency than required by state criteria. Standard Operating Procedures require all LFS samples to be analyzed for PCBs prior to their use to ensure that the facility operations are conducted in accordance with EPA and NYSDEC regulations.

Table 7
BNL Site Environmental Report for Calendar Year 1992
Estimated Radioactivity in Incinerated Materials

Nuclide	Analogue	μCi Released
Au-199	Ag-111	2.01
C-14		2.80
Co-57		5.01
Cr-51		156
Cu-67	Cu-64	2.00
Fe-55		0.10
H-3		255
I-125		53.1
Sn-113m	Sn-113	5.60
Sn-117m	Sn-125	67.5
Sr-85	Sr-89	20.0
Y-88	Y-91	26.0

4.1.3 Liquid Effluents

The basic policy of liquid effluent management at the Laboratory is to minimize the volume of liquids requiring processing prior to on-site release or solidification for off-site burial at a licensed facility.[39] Accordingly, liquid effluents are segregated by the generator at the point of origin on the basis of their anticipated concentrations of radioactivity or other potentially harmful agents.

4.1.4 Liquid Waste Management

Liquid chemical wastes are collected by the Hazardous Waste Management Group (HWMG), and subsequently packaged in accordance with Department of Transportation (DOT), EPA, and NYSDEC regulations and DOE Orders for licensed off-site disposal.

The HWMG also collects small quantities of low-level liquid radioactive wastes from waste accumulation areas throughout the site. Depending on the radionuclide and its concentration, these wastes are either directly solidified at the HWMF or processed at the WCF. Buildings where large volumes (up to several hundred liters) of low-level liquid radioactive waste are generated have dual waste handling systems. These systems are identified as "active" (D) and "inactive" (F). The D-waste liquid stream is always collected for disposal through the WCF. The F-waste liquid stream is sampled, analyzed, and compared to DOE, BNL, and SPDES release criteria. If concentration meets release criteria, the liquid waste may be released to the sanitary waste stream. Otherwise, the liquid waste is transferred to the WCF for processing. In 1992, authorized releases of F-waste to the sanitary system totaled 5.63 million liters with a total gross beta activity of 0.24 mCi (8.9 MBq) and a total tritium activity of 34 mCi (1.26 GBq). The volume of material released in 1992 represents a nine fold increase over 1991. The gross beta activity released increased by a factor of 1.4, while the tritium activity released increased by a factor of 2.3. These releases are significantly lower than pre-1989 values.

At the WCF, liquid waste is distilled to remove particulate, suspended, and dissolved solids. The solidified residues from the evaporator are transferred to the HWMF for subsequent shipment and disposal at an authorized off-site disposal facility. The distillate, which contains tritium, is collected and transported to the STP. It is released into a lined hold-up pond where it mixes with precipitation and effluent diverted from the STP (Figure 11). This water is then pumped back to the STP at a controlled rate where it is added to the dosing tanks of the sand filter beds. This process permits a controlled release of liquid effluents and aids the Laboratory in achieving its administrative discharge concentration limit of 20,000 pCi/L (740 Bq/L) and the goal of 10,000 pCi/L (370 Bq/L). By comparison, the DCG[1] for tritium is 2,000,000 pCi/L (0.074 MBq/L). In 1992, approximately 1.1 Ci (40.7 GBq) of tritium was placed into the lined holding pond.

4.1.4.1 Sanitary System Effluents

Primary treatment of the sanitary waste stream to remove suspended solids is provided by a 950,000 liter clarifier. The liquid effluent flows from the clarifier onto sand filter beds, from which about 85% of the water is recovered by an underlying tile field. This recovered water is then released into a small stream that contributes to the headwaters of the Peconic River. This release is a permitted discharge. The Peconic River is an intermittent stream within the BNL site. From the mid 1980's until April of 1989, virtually all water released to this channel recharged to ground water prior to reaching the site boundary. Beginning in April 1989 and continuing throughout 1990, heavy rains produced sufficient upstream contribution to result in the Peconic tributary on the BNL site to once again leave the site. During 1991 and 1992, however, the majority of the flow reverted back to the recharge regime with off-site flow being recorded during March through July 1991 and again from February through March 1992.

The effluent not collected by the tile fields, approximately 10 - 15%, is assumed to percolate to the ground water under the beds and/or evaporate. A schematic of the STP and its related sampling arrangements is shown in Figure 11. Real time monitoring of the clarifier influent for radioactivity, pH and conductivity, takes place at two locations: about 1.8 km upstream of the STP and as the influent is about to enter the clarifier. The upstream station provides about one hour of advanced warning that liquid effluents which may exceed BNL effluent release criteria or SPDES limits have entered the system. At the clarifier, an oil monitor examines STP influent for the presence of oil. Effluent leaving the clarifier is monitored a third time for radioactivity. Effluent that does not meet BNL and/or SPDES effluent release criteria are diverted to one of two lined holding ponds, with a 26.5 million liter capacity, until the effluent meets the release criteria. The effluent diverted to the holding pond is evaluated for treatment and released when the addition of this material will not result in exceeding BNL SPDES or administrative release criteria.[40] In addition to real time monitoring, the clarifier effluent (Location DA) and the outfall to the Peconic River (Location EA) are monitored for radiological and nonradiological parameters through a combination of volume proportional and grab samples.

4.1.4.2 Radiological Analyses

The proportional samples collected at Location DA, the effluent from the STP clarifier, and Location EA, the STP discharge point into the Peconic River, are analyzed daily for gross alpha, beta, and tritium activities. An aliquot is composited for monthly strontium-90 and gamma spectroscopy analyses. The results of these measurements are reported in Tables 8 and 9. Seven year trend plots of gross beta and tritium concentrations that were released to the Peconic River are presented in Figures 12 and 13. A total tritium activity trend plot from 1971 to the present is presented in Figure 14.

The gross alpha data at the STP are consistent with prior year's data. All results are essentially less than the system detection limit and have a mean value which approaches zero. This means that alpha concentration measurements for these locations are at background levels. The tritium concentrations increased in 1992 by a factor of about 1.5 over 1991 levels. This occurred in

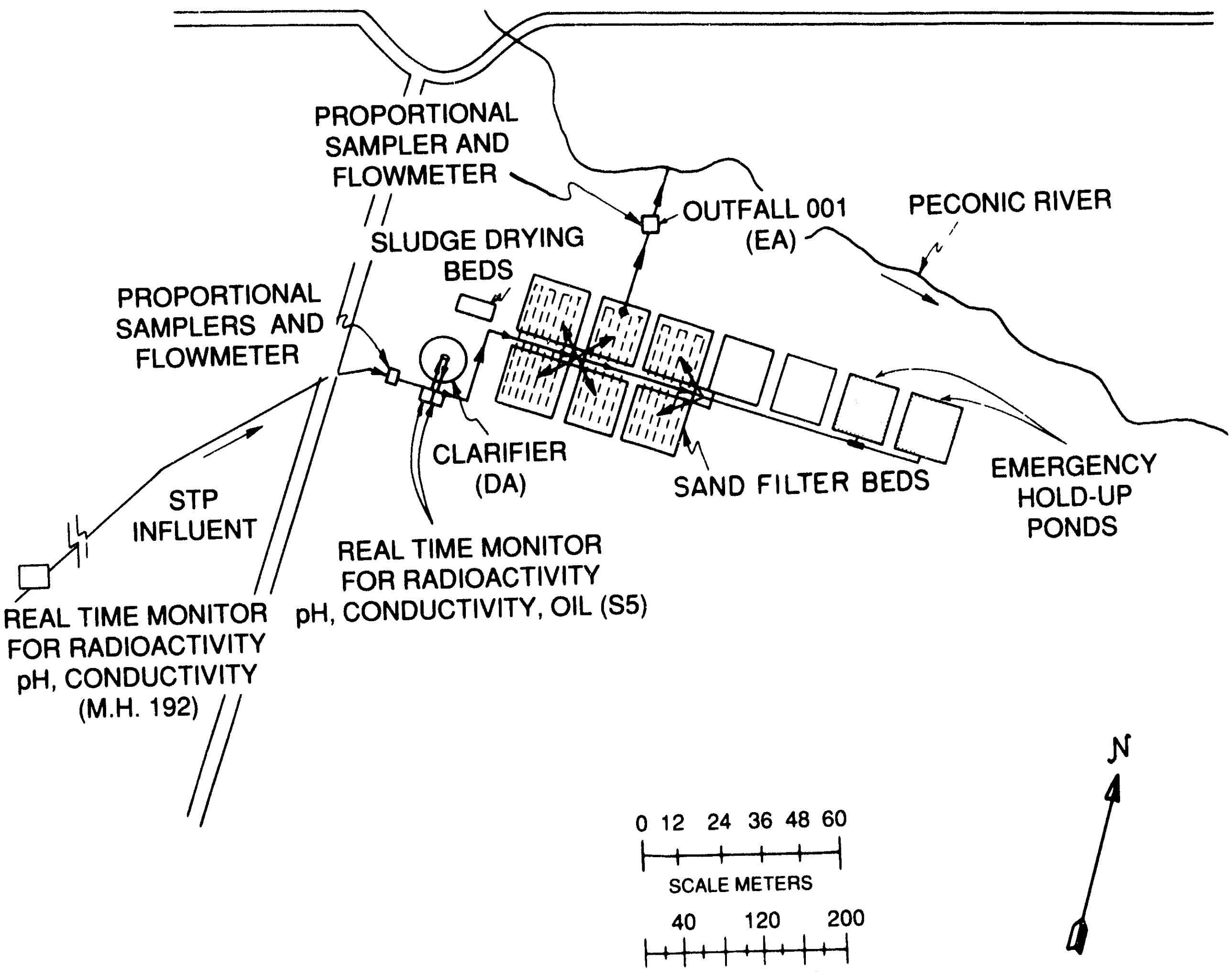


Figure 11: Sewage Treatment Plant - Sampling Stations.

large part due to HFBR operations in the summer of 1992. Controlled releases of WCF distillate from the STP emergency holding ponds continued in 1992. The 1992 tritium concentrations discharged to the Peconic River were below regulatory standards and were within BNL administrative controls (10,000 pCi/L).[40] The total tritium activity released into the sanitary system was 3.9 Ci (144 GBq) as compared to 2.6 Ci (96 GBq) in 1991. The tritium activity discharged from Location EA was 3.0 Ci (111 GBq) as compared to 2.1 Ci (76 GBq) in 1991. The concentrations of Sr-90 and gamma emitting radionuclides entering the STP returned to pre-1988 levels. At Location DA, all radionuclide concentrations were at or below pre-1988 levels. At Location EA, except for Cs-137, the remaining concentrations are essentially constant with prior year's data.[9] Elevated Cs-137 concentrations persist at Location EA due to residual leaching of this radionuclide from the sand filter beds. This activity is present due to an unplanned release on June 14 - 15, 1988. A discussion of the incident can be found in the 1988 BNL SER.[9] In 1992, Cs-137 concentrations were still a factor of two greater than pre-1988 values.

In 1992, gross beta concentrations at Location EA were approximately 1.4 times the influent concentrations. Cesium-137 concentrations in water collected from Location EA were 22 times the concentration found in the clarifier. This ratio is 1.8 times lower than in 1991. Strontium-90 concentrations at Location EA averaged out to be near MDL concentrations (Sr-90 MDL = 0.1 pCi/L). None of the monthly values that were positive resulted in any violation of SPDES permit. If the BNL administrative policy dose criteria of 4 mrem/yr were used for comparison, daily ingestion of water, discharged by BNL to the Peconic River, would result in an annual dose of 0.3 mrem (0.003 mSv) or 7.5% of BNL's current discharge policy.

4.1.4.3 Sanitary System Nonradiological Analyses

The effluent from the Laboratory STP discharges into the Peconic River at Location EA (Outfall 001) and is subject to the conditions of the SPDES Permit No. NY-0005835, authorized by the NYSDEC. Monthly DMRs are submitted to the NYSDEC and SCDHS which provide detailed analytical results and performance information regarding the operational activities at the STP. Table 2 contains the maximum concentration of contaminants observed within the STP discharge during 1992. The data collected during 1992 indicates a compliance rate of greater than 99.9% for all parameters monitored. A complete monthly summary of DMR data is presented in the Table 3.

Two permit limitation exceedances were observed during CY 1992. The contaminants responsible for these exceedances were fecal and total coliform bacteria. In order to investigate these incidents several independent laboratories were retained so that the analytical data from several sources could be evaluated. Examination of the data indicated that the reported findings were inconsistent and that one specific laboratory reported data that was consistently higher than the others. Review of quality control documentation failed to identify a specific cause to the difference in data. The investigation into the cause of these violations was, therefore, inconclusive; however, the analytical method used for measuring the concentration of coliform is the suspected cause of inconsistent data.

Table 8
BNL Site Environmental Report for Calendar Year 1992
Sewage Treatment Plant Influent and Effluent Gross Alpha, Gross Beta, and Tritium Concentrations

Month	Flow Liters	Gross Alpha Avg.	Gross Alpha Max.	Gross Beta Avg.	Gross Beta Max.	Tritium Avg.	Tritium Max.
		<-----------	-----------	-----pCi/L	-----------	-----------	----------->
Sample Location Station DA - Clarifier Effluent							
January	8.59E+07	0.26	1.54	5.06	9.82	1644.47	6146.96
February	6.64E+07	0.22	1.79	5.27	10.20	697.00	4719.53
March	7.72E+07	0.71	2.05	6.29	12.28	1222.39	5594.64
April	8.33E+07	0.50	2.30	21.00	148.00	741.55	2650.71
May	5.21E+07	0.40	2.56	5.41	11.14	3696.80	10962.11
June	9.21E+07	0.85	2.56	6.45	14.92	6194.43	17675.25
July	1.03E+08	0.65	4.61	6.16	12.28	7562.97	18208.77
August	1.17E+08	0.41	2.24	5.98	44.76	5203.57	12495.71
September	1.09E+08	0.60	2.59	6.22	15.68	10116.74	30697.92
October	9.88E+07	1.08	4.48	4.76	9.25	1252.02	6481.01
November	8.94E+07	1.01	2.14	4.41	8.12	1151.06	4061.57
December	6.93E+07	0.49	2.41	4.83	14.17	400.99	1343.02
Annual Avg.		0.60		6.82		3323.67	
Total Rel (L or mCi)	1.04E+09	0.72		6.37		3881.98	
Sample Location Station EA - Chlorine House Effluent							
January	6.24E+07	0.67	3.33	8.14	12.65	2089.54	4246.74
February	5.76E+07	0.53	1.79	7.71	11.90	733.01	3271.98
March	7.02E+07	0.56	3.58	8.67	17.38	1686.24	6469.20
April	5.94E+07	0.42	1.28	11.69	23.80	1133.56	2952.80
May	5.19E+07	0.44	1.79	[illegible].78	13.41	4259.92	9525.44
June	6.61E+07	0.66	0.77	9.96	12.84	5753.28	3601.93
July	7.02E+07	0.72	2.56	9.89	14.17	7264.91	16992.35
August	8.97E+07	0.12	1.57	7.98	7.37	4832.12	2790.11
September	7.53E+07	1.33	9.06	14.02	28.14	8961.77	28857.38
October	6.88E+07	1.01	2.92	10.34	14.73	.2017.29	13624.82
November	8.59E+07	0.90	0.90	9.81	9.81	1237.98	1237.98
December	6.06E+07	0.54	2.49	7.60	11.14	1861.11	5673.37
Annual Avg.		0.66		9.55		3485.89	
Total Rel (L or mCi)	8.18E+08	0.65		7.82		2968.70	
SPDES Limit		3.0 (Ra-226)		1000		Not Listed	
NYS Drinking Water Standard		155		50		20000	
Typical Minimum Detection Limit (MDL)		2.3		6		1000	

Table 9
BNL Site Environmental Report for Calendar Year 1992
Sewage Treatment Plant Influent and Effluent
Gamma Spectroscopy and Sr-90 Results

	Flow (Liters)	Co-57 (pCi/L)	Co-60 (pCi/L)	I-131 (pCi/L)	Cs-137 (pCi/L)	Sr-90 (pCi/L)
Sample Station DA - Clarifier Influent						
January	8.59E+07	----	----	----	0.06	-0.01
February	6.64E+07	----	----	----	0.11	-0.09
March	7.72E+07	----	----	----	----	-0.27
April	8.33E+07	----	----	738.00	----	1.16
May	5.21E+07	----	0.03	26.10	0.07	6.56
June	9.21E+07	----	0.10	0.54	----	-0.83
July	1.03E+08	----	----	----	0.12	-0.24
August	1.17E+08	0.01	----	----	0.06	0.04
September	1.09E+08	----	----	----	0.06	-0.43
October	9.88E+07	----	----	----	0.08	-0.56
Novemeber	8.94E+07	----	----	----	0.07	-0.08
December	6.93E+07	----	----	----	0.08	0.53
Annual Avg.		0.001	0.01	60.29	0.06	0.23
Total Release (L or mCi)	1.04E+09	0.001	0.01	62.89	0.06	0.24
Sample Station EA - Discharge to Peconic River						
January	6.24E+07	----	----	----	1.27	0.03
February	5.76E+07	----	----	----	0.85	-0.20
March	7.02E+07	----	----	----	1.04	-0.34
April	5.94E+07	----	0.15	19.00	4.71	1.81
May	5.19E+07	----	----	----	----	1.54
June	6.61E+07	----	0.52	----	13.60	-1.70
July	7.02E+07	----	0.12	----	3.11	-0.36
August	8.97E+07	----	0.09	----	2.70	-0.01
September	7.53E+07	----	----	----	1.74	1.96
October	6.88E+07	----	----	----	0.84	1.07
Novemeber	8.59E+07	----	0.03	----	0.86	0.02
December	6.06E+07	----	0.05	----	0.83	-0.21
Annual Avg.		0.00	0.08	1.33	2.66	0.28
Total Release (L or mCi)	8.18E+08	0.00	0.07	1.09	2.17	0.23
DOE Order 5400.5 Derived Concentration Guides (pCi/L)		200000	5000	3000	3000	1000
Concentration Required to Produce SDWA Annual Dose (pCi/L)		8000	200	120	120	40
SPDES Limit						10
NYS DWS						8
Typical MDL		0.14	0.23	0.21	0.2	0.1

Note: No EA sample composite collected in May for gamma spectroscopy.

Gross Beta Concentration Data
Sewage Plant and Peconic River

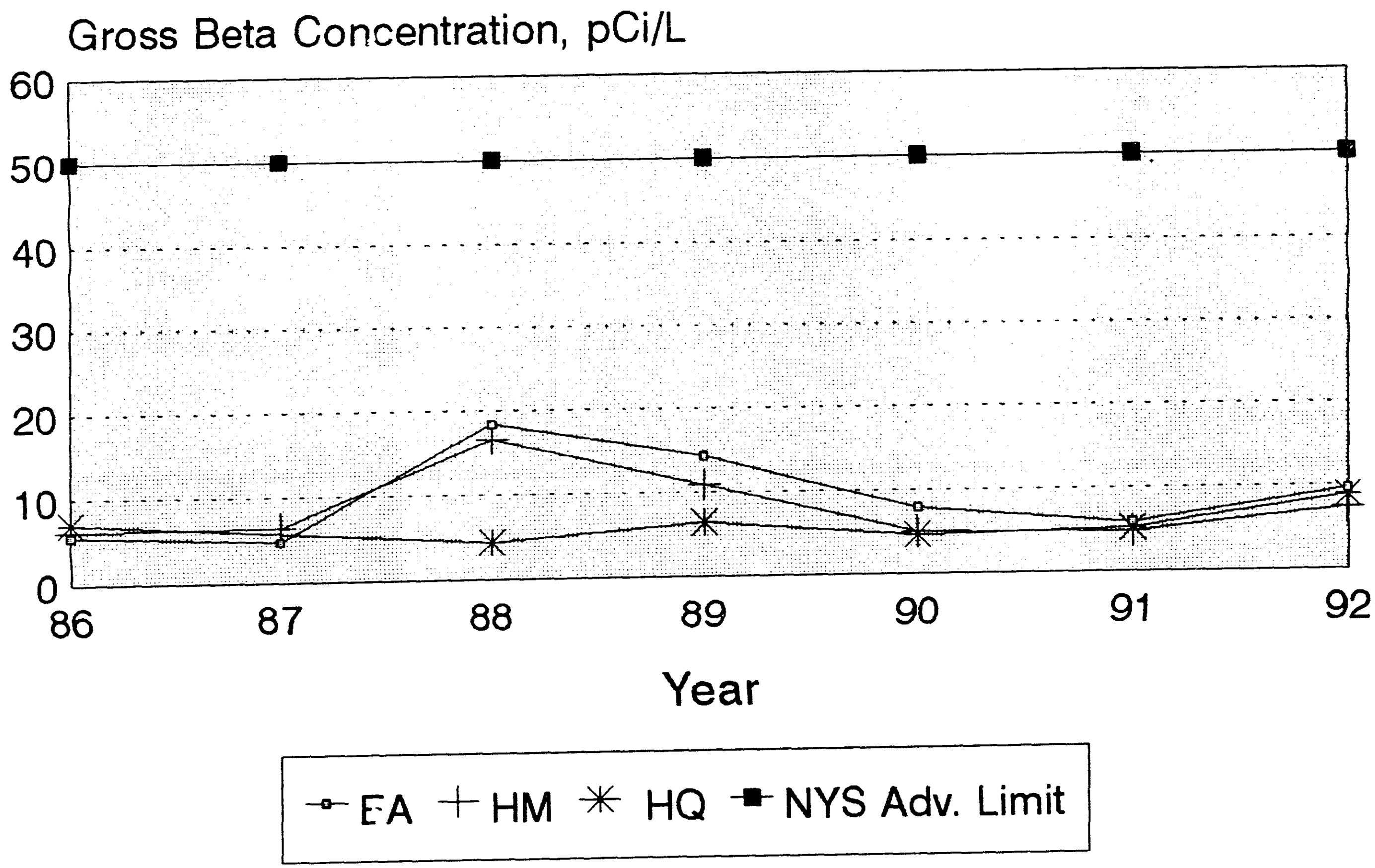


Figure 12: Gross Beta Concentration Data: Sewage Treatment Plant and Peconic River 1986 - 1992.

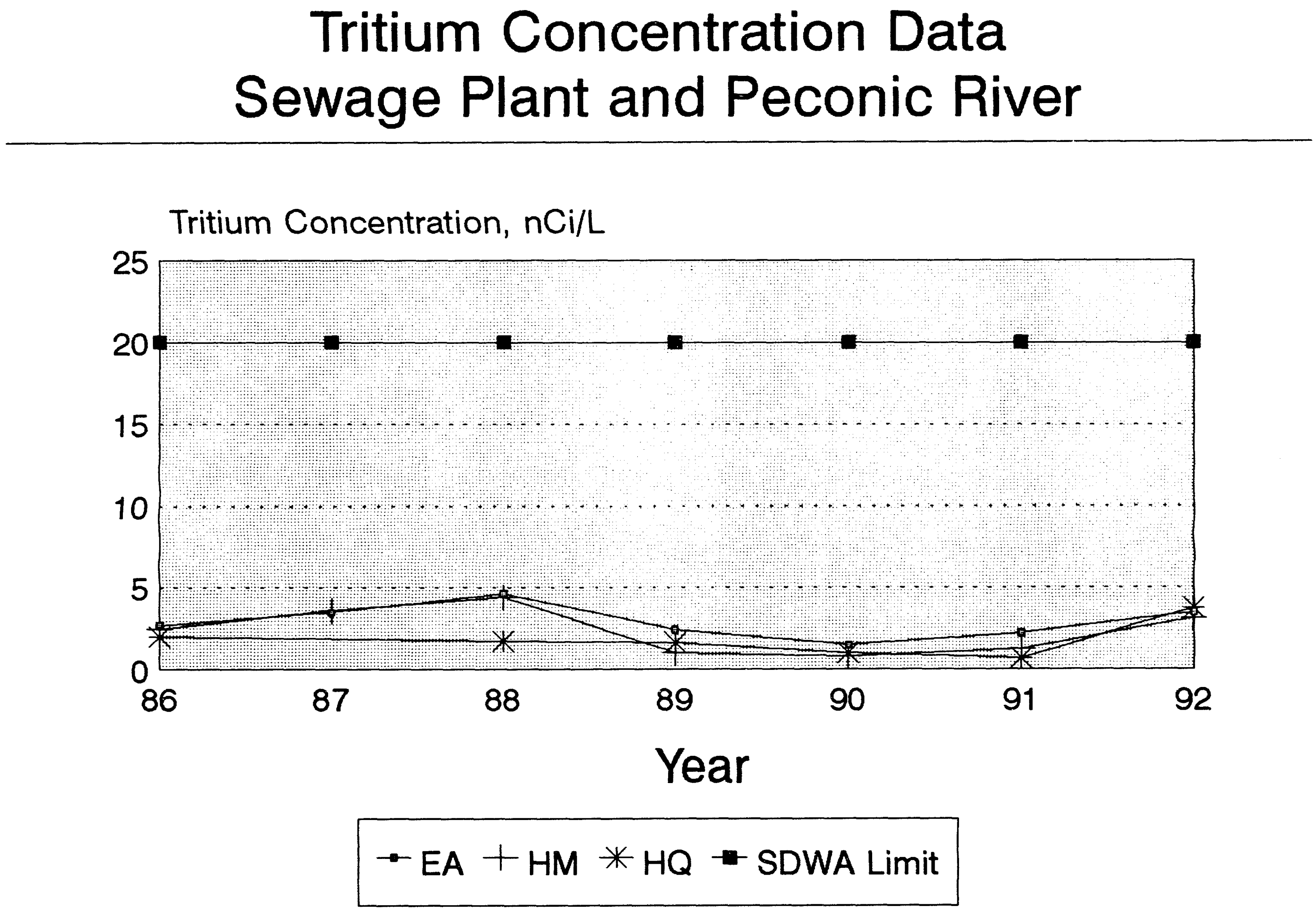


Figure 13: Tritium Concentration Data: Sewage Plant and Peconic River - 1986 - 1992.

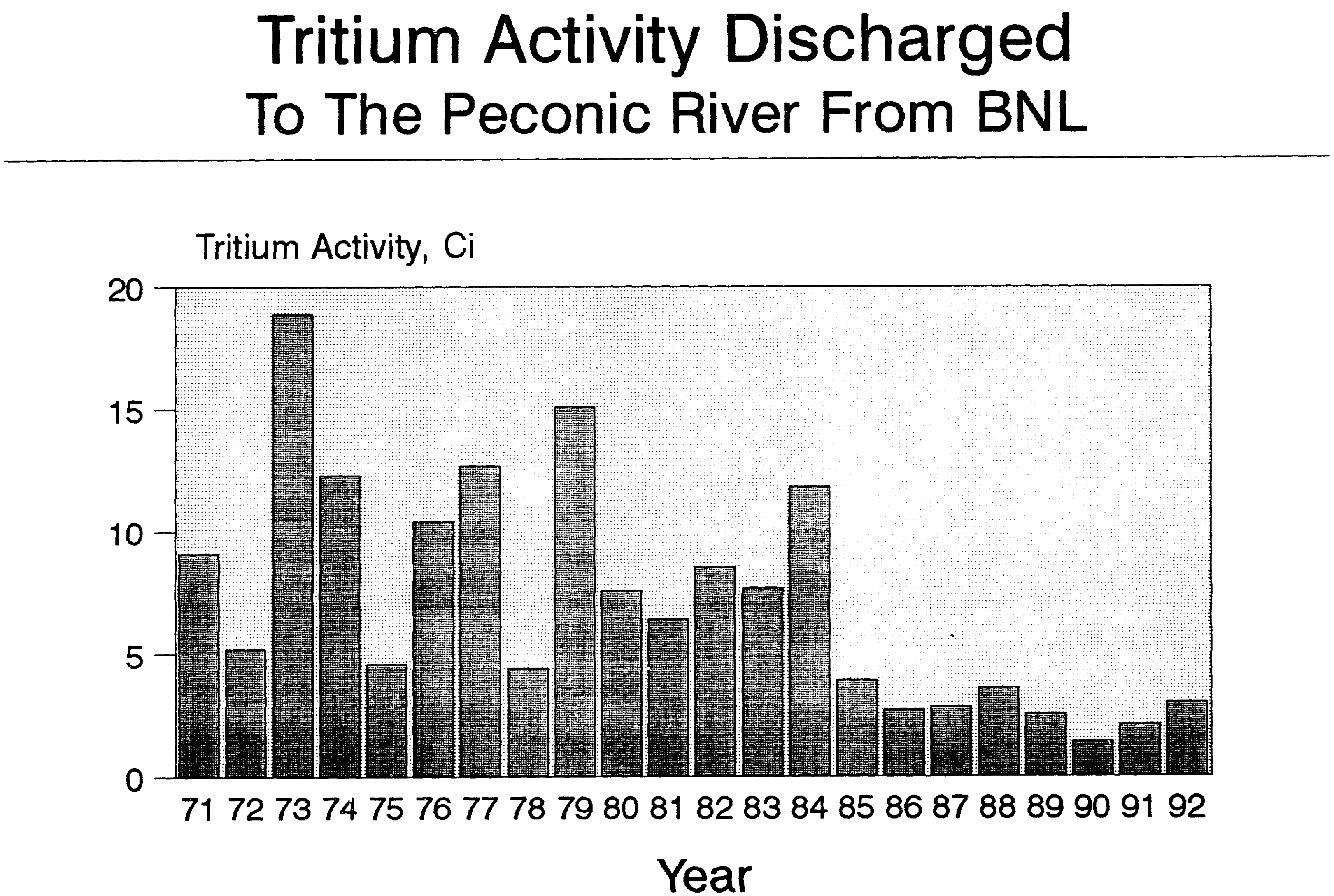


Figure 14: Tritium Activity Discharged to the Peconic River from BNL - 1971 - 1992.

In addition to the collection and analysis of the STP effluent for compliance purposes, the EM Group monitored the STP influent and effluent routinely during 1992. Daily influent and effluent samples were collected, composited by the SEP analytical laboratory and analyzed monthly for metals. In addition, the effluent is monitored daily for pH, conductivity, temperature, dissolved oxygen and chlorine residual and weekly for water quality parameters. Daily influent and effluent logs are also maintained by the STP operators for the parameters of flow, pH, temperature, settleable solids, and chlorine residual.

The analytical results for the samples collected from the STP by the EM Group have been summarized on Table 10. Comparison of the effluent data to the SPDES effluent limitations show all parameters to be within the regulatory limit.

The expiration date for the BNL SPDES permit was May 1, 1988. Efforts to renew the SPDES permit continued during CY 1992 with additional support documentation regarding waste water flow rates delivered to the NYSDEC in June 1992. A draft renewal permit was subsequently issued by the NYSDEC in November 1992. The proposed draft permit contains numerous permit modifications including: an increase in parameters requiring monitoring at the STP, an increase in monitoring frequency at the STP, addition of monitoring and reporting requirements for the recharge basins, addition of two recharge basins, process specific monitoring requirements, preparation of best management practices for site runoff, preparation of an engineering report regarding the upgrade of the STP process and additional short term monitoring requirements. The draft permit is expected to be finalized some time during the second quarter of 1993.

Figures 15 through 23 present five year trend plots for the maximum monthly concentrations and the average loading of copper, iron, lead, silver, and zinc in the effluent of the STP. Plotted along with the observed concentrations are the current SPDES permit limits and the 1992 proposed limits for the SPDES permit renewal. While all metals concentrations are well within the existing permit conditions, the proposed revised SPDES permit would establish lower acceptable release concentrations. The proposed discharge limits on allowed releases of copper, lead and zinc could necessitate stricter source control in order to assure compliance.

Process Specific Waste Water Assessments

In order to prevent violation of SPDEs permit limitations and the release of waste waters which exceed ground water effluent standards, the Laboratory requires that process waste waters suspected of containing contaminants at concentrations which may exceed one or both of these standards be held, characterized, and authorized by the SEPD prior to disposal.

During the SPDES permit renewal negotiations, the Laboratory identified specific sources of process waste water, characterized the effluents and sought to incorporate these discharges under the BNL SPDES permit. These processes consist of photographic developing operations at Buildings 118 and 197, electroplating and chemical etching within Building 535, and chemical cleaning at Building 197. Characterization of these effluents consisted of analyzing daily composite samples collected over three consecutive days for pollutants specific to the operation. In all instances it was determined that these operations should have a minimal impact on STP operations and that sewer disposal of these waste presented a minimal environmental impact. The SPDES permit renewal will require routine monitoring of these waste water effluents.

Table 10
BNL Site Environmental Report for Calendar Year 1992
Sewage Treatment Plant[a]
Average Water Quality and Metals Data

	Sewage Treatment Plant Influent (DA)				Sewage Treatment Plant Effluent (EA)			
	N	Min.	Max.	Avg.	N	Min.	Max.	Avg.
pH (SU)[b]	NA	3.0	6.4	NA	NA	5.9	6.4	NA
Conductivity (umhos/cm)				(c)	230	124	353	203
Temperature.[b] (°C)	NA	10	22	NA	260	6.3	24.9	16
<u>Results in mg/L[d]</u>								
Dissolved Oxygen	NA	NA	NA	NA	257	3.3	15.7	8.0
Chlorides	NA	NA	NA	NA	51	28.0	139	68.0
Nitrate as (N)	NA	NA	NA	NA	55	2.4	14.8	4.5
Sulfates	NA	NA	NA	NA	53	14.3	26.1	16.1
Chlorine Residual	NA	NA	NA	NA	263	0.00	0.05	0.02
Ag	12	<0.025	<0.025	<0.025	12	<0.025	<0.025	<0.025
Cd	12	<0.0005	<0.0005	<0.0005	12	<0.0005	0.0019	<0.0005
Cr	12	<0.005	<0.005	<0.005	12	<0.005	<0.005	<0.005
Cu	12	0.05	0.16	0.071	12	<0.05	0.11	0.066
Fe	12	0.28	0.83	0.47	12	0.13	0.57	0.23
Mn	12	<0.05	<0.05	<0.05	12	<0.05	<0.05	<0.05
Na	12	22.4	30.5	25.8	12	23.3	29.0	25.7
Pb	12	<0.002	0.0088	0.0047	12	<0.002	0.0053	0.0031
Zn	12	0.05	0.09	0.07	12	0.056	0.22	0.18

NA: Not Analyzed.
(a) Locations shown in Figure 11.
(b) The pH and temperature values reported are those recorded on the strip chart recorder operated by the sewage treatment plant operator.
(c) Metered.
(d) Mathematically, the indicated average metal value reported is calculated by summing all values above the laboratory detection limit (MDL) then dividing this sum by the total number of sample pool entries (i.e., all non-detectable values are evaluated as zero). If the average is less than the average is reported as less than the MDL.

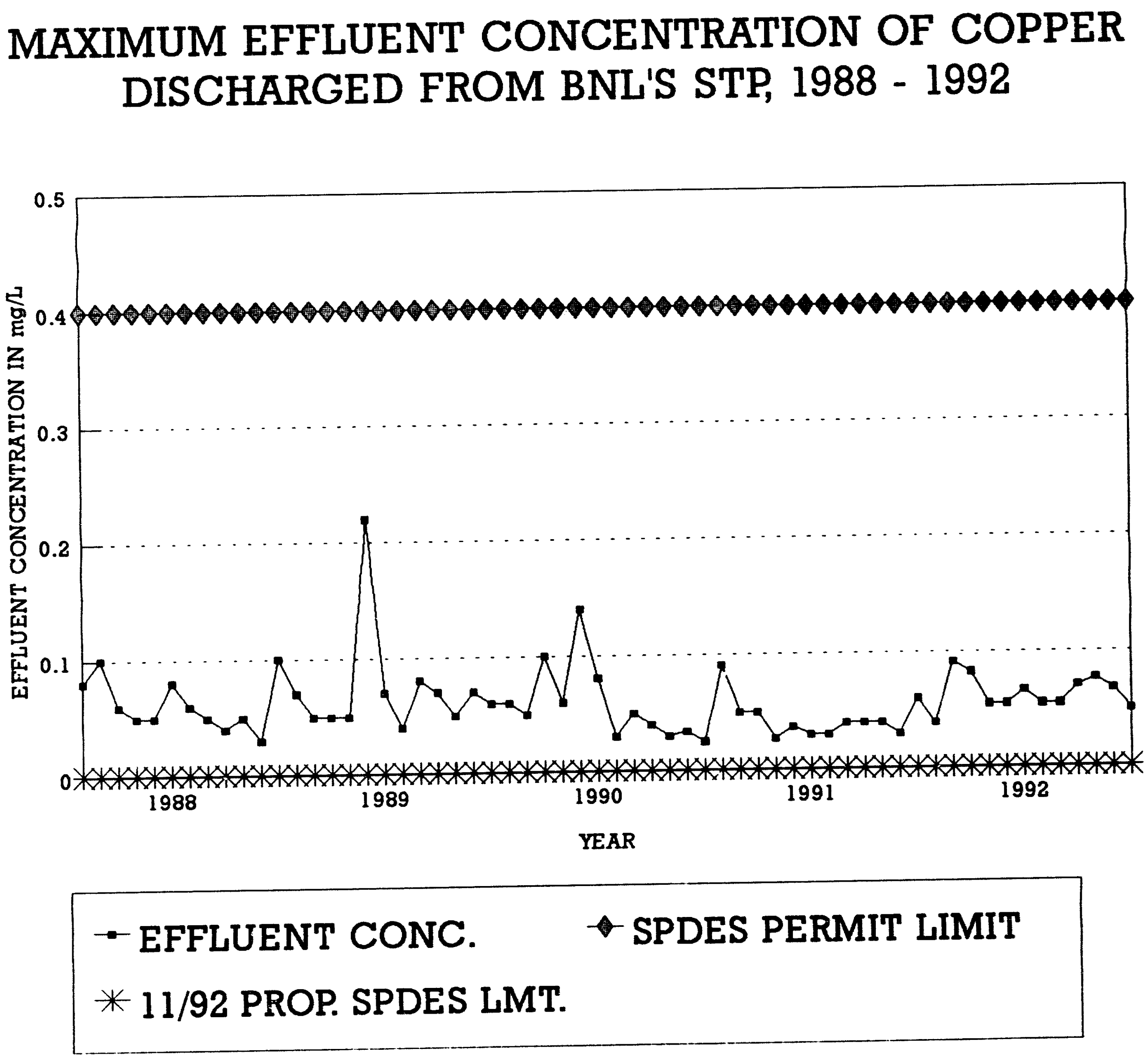


Figure 15: Maximum Effluent Concentration of Copper Discharged from BNL's STP: 1988 - 1992.

2 of 3

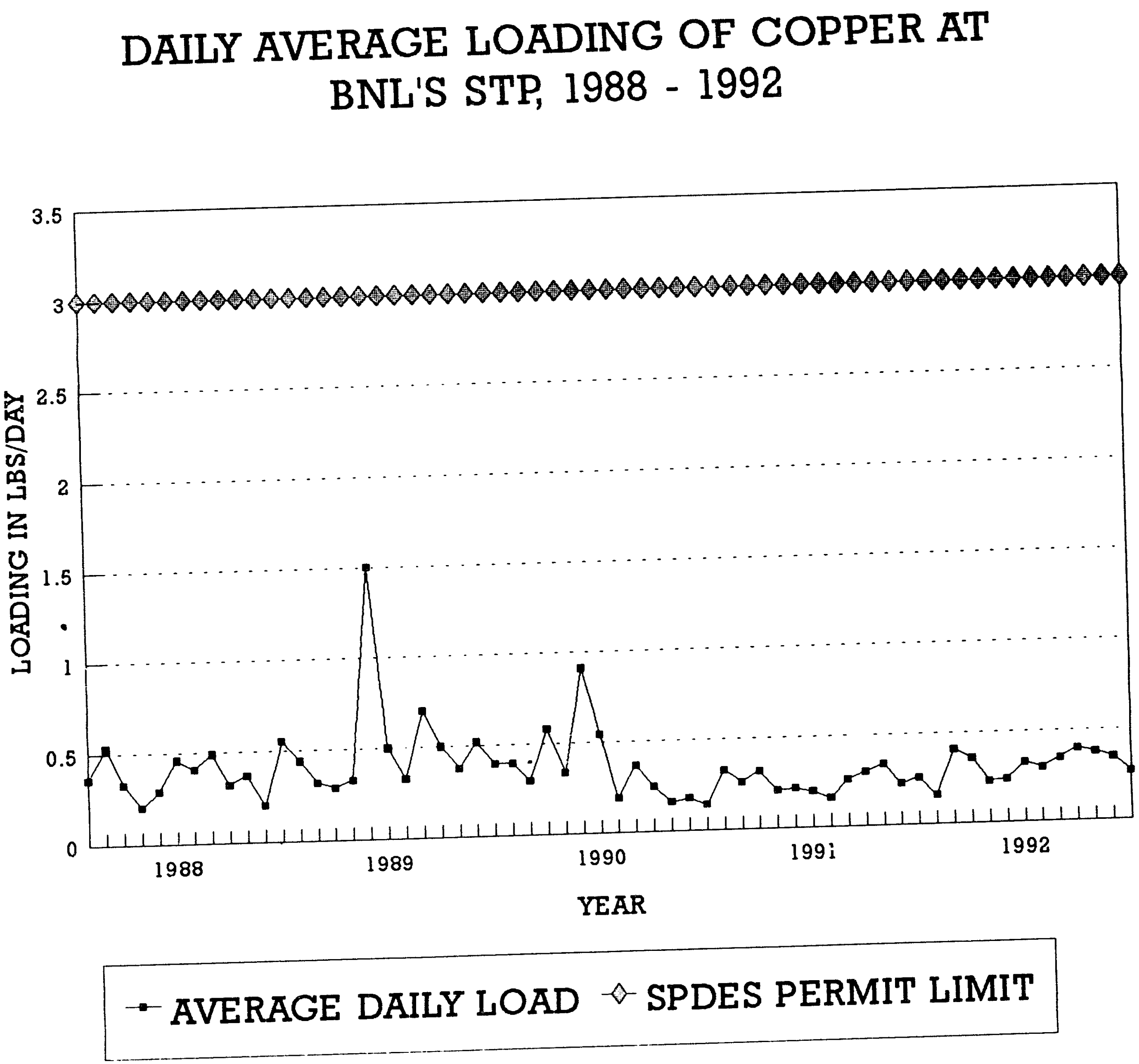


Figure 16: Daily Average Loading of Copper at BNL's STP: 1988 - 1992.

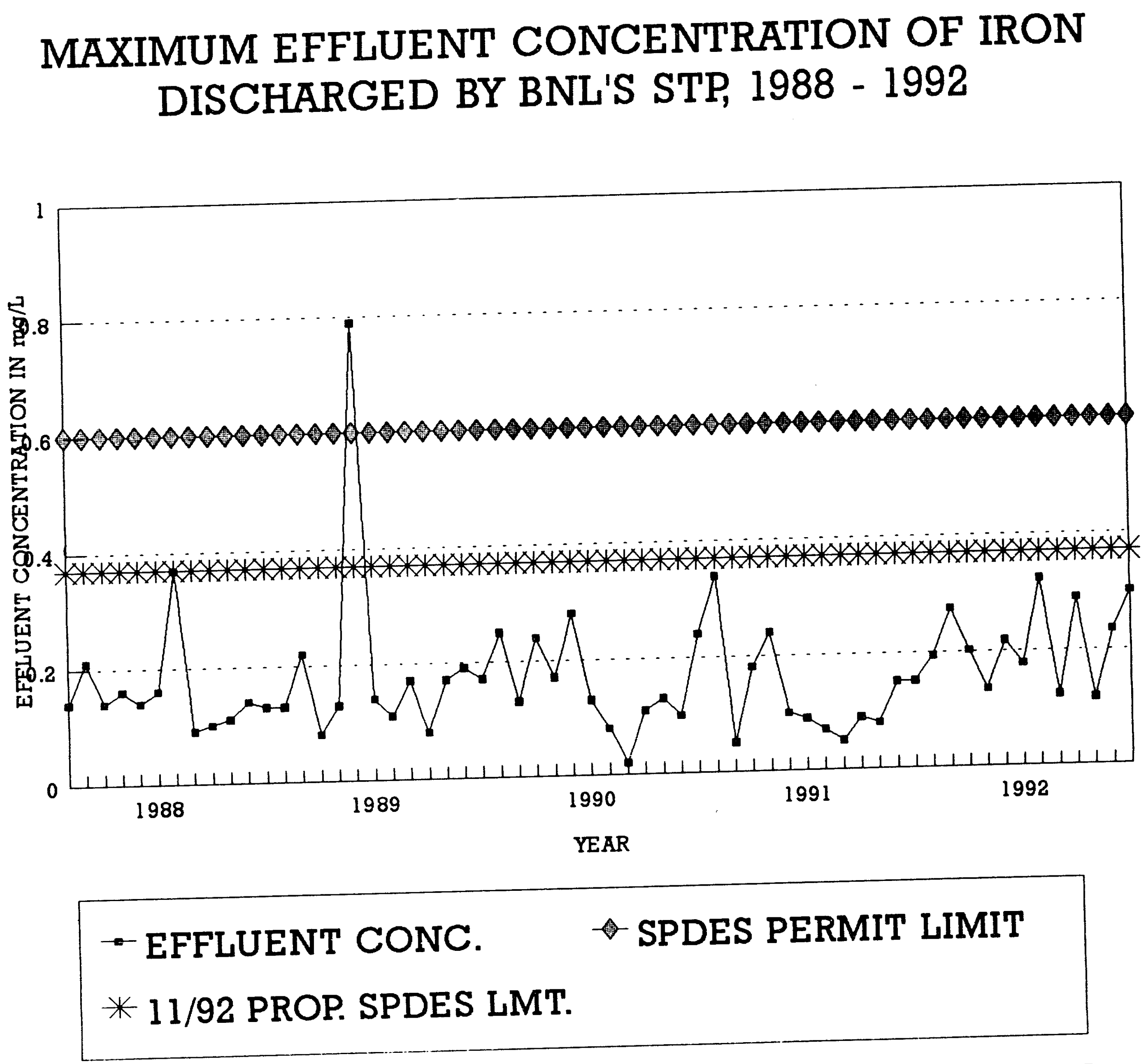


Figure 17: Maximum Effluent Concentration of Iron Discharged by BNL's STP: 1988 - 1992.

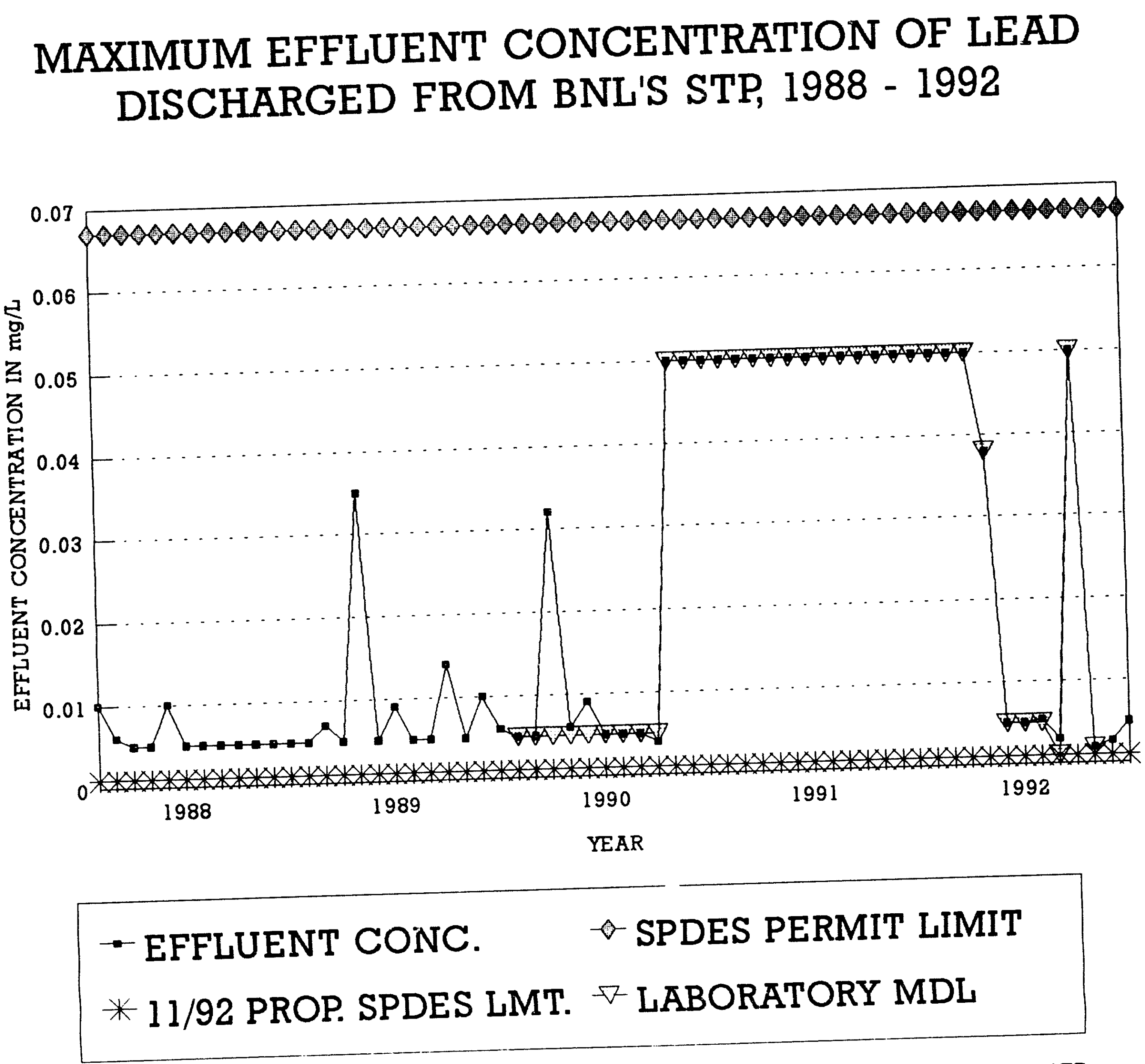


Figure 18: Maximum Effluent Concentration of Lead Discharged by BNL's STP: 1988 - 1992.

DAILY AVERAGE LOADING OF LEAD AT BNL'S STP, 1988 - 1992

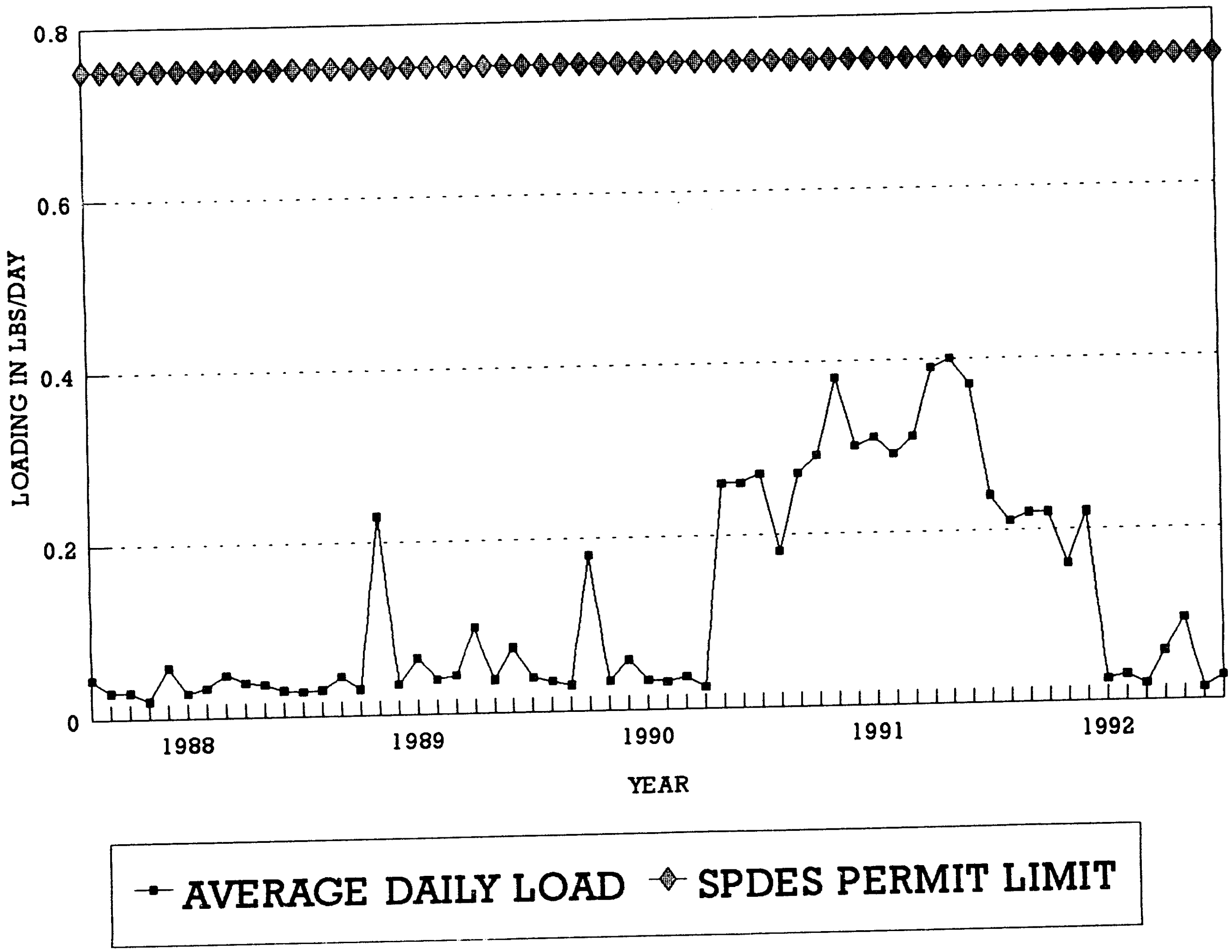


Figure 19: Daily Average Loading of Lead at BNL's STP: 1988 - 1992.

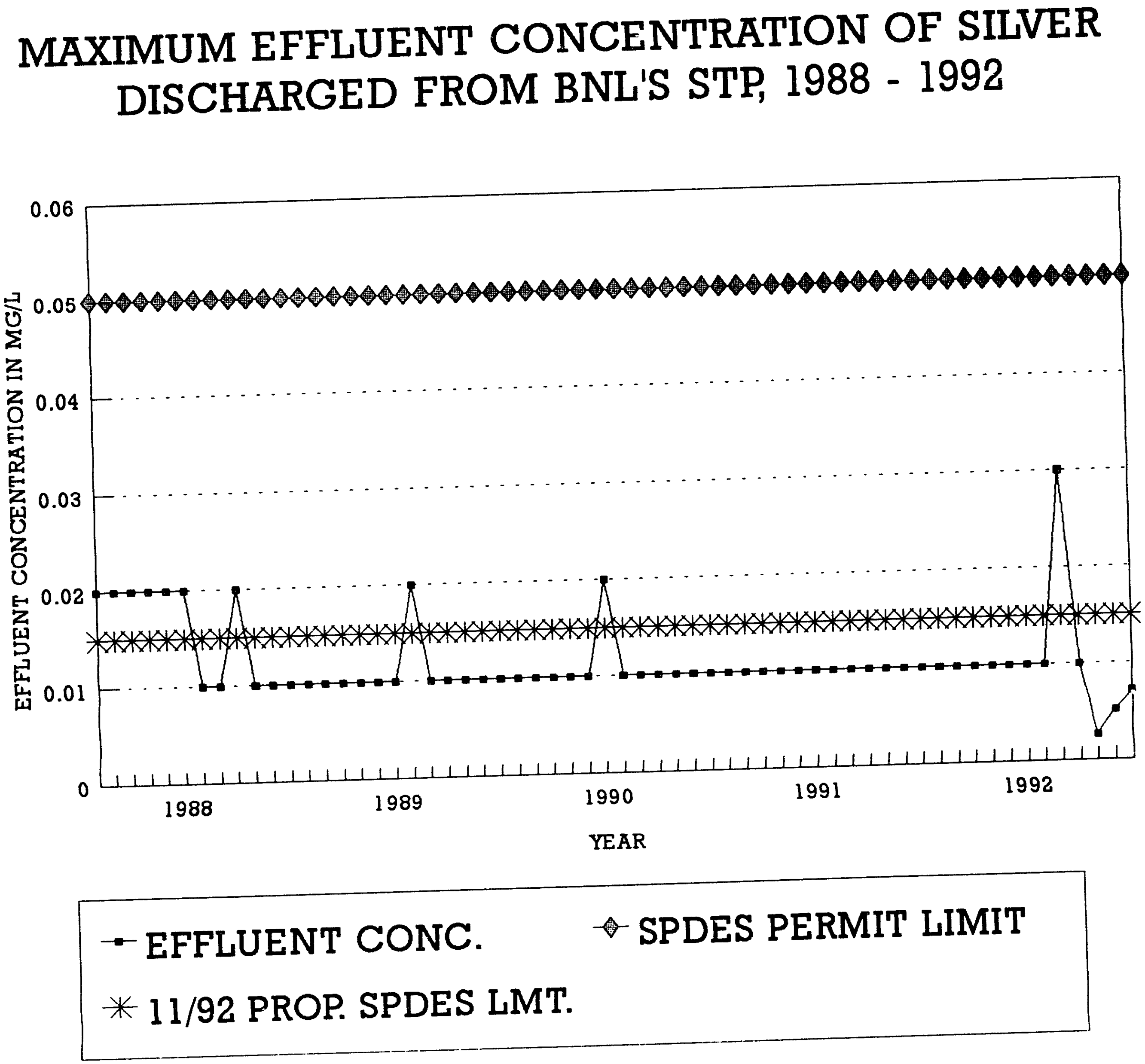


Figure 20: Maximum Effluent Concentration of Silver Discharged from BNL's STP: 1988 - 1992.

DAILY AVERAGE LOADING OF SILVER AT BNL'S STP, 1988 - 1992

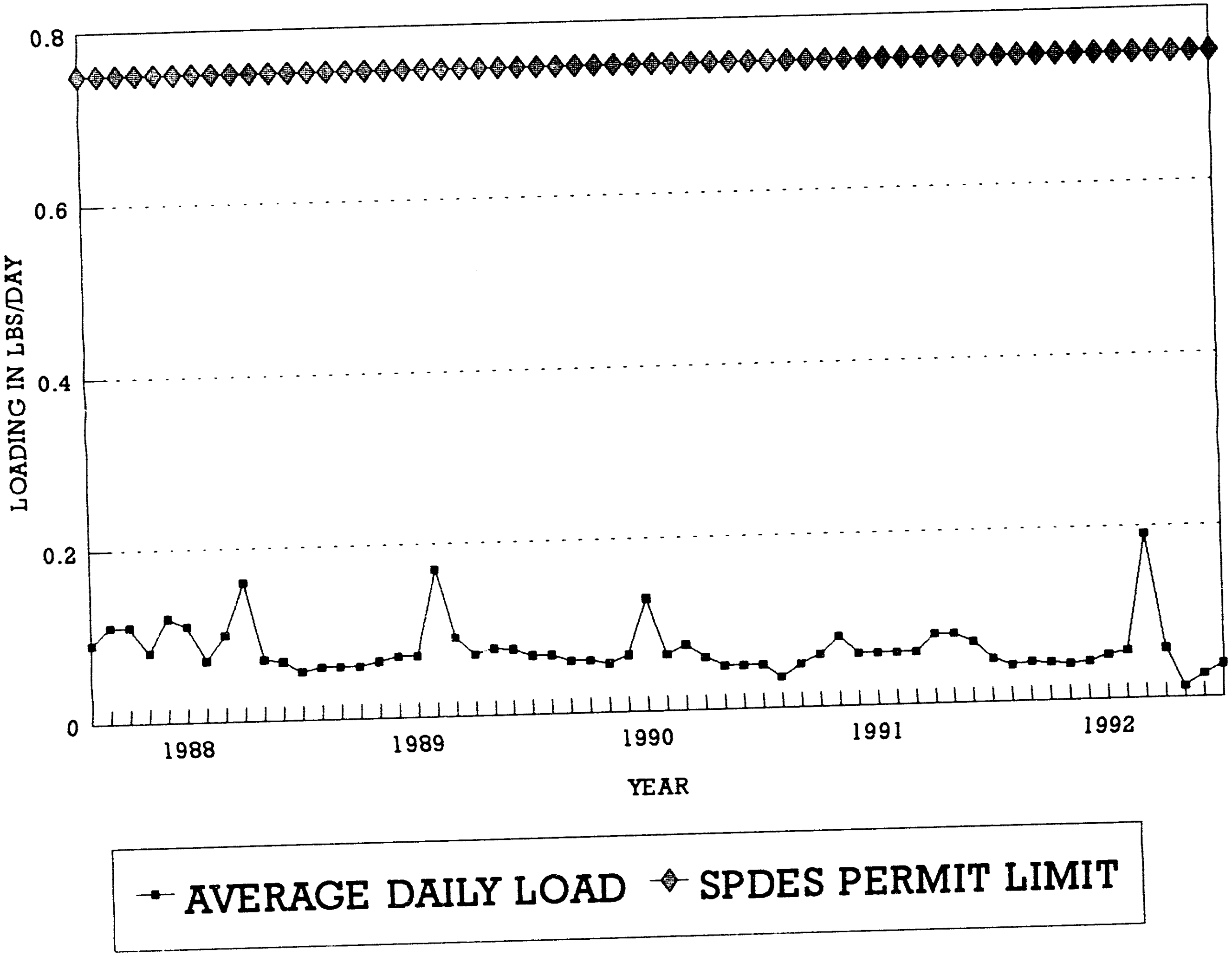


Figure 21: Daily Average Loading of Silver at BNL's STP: 1988 - 1992.

MAXIMUM EFFLUENT CONCENTRATION OF ZINC DISCHARGED FROM BNL'S STP, 1988 - 1992

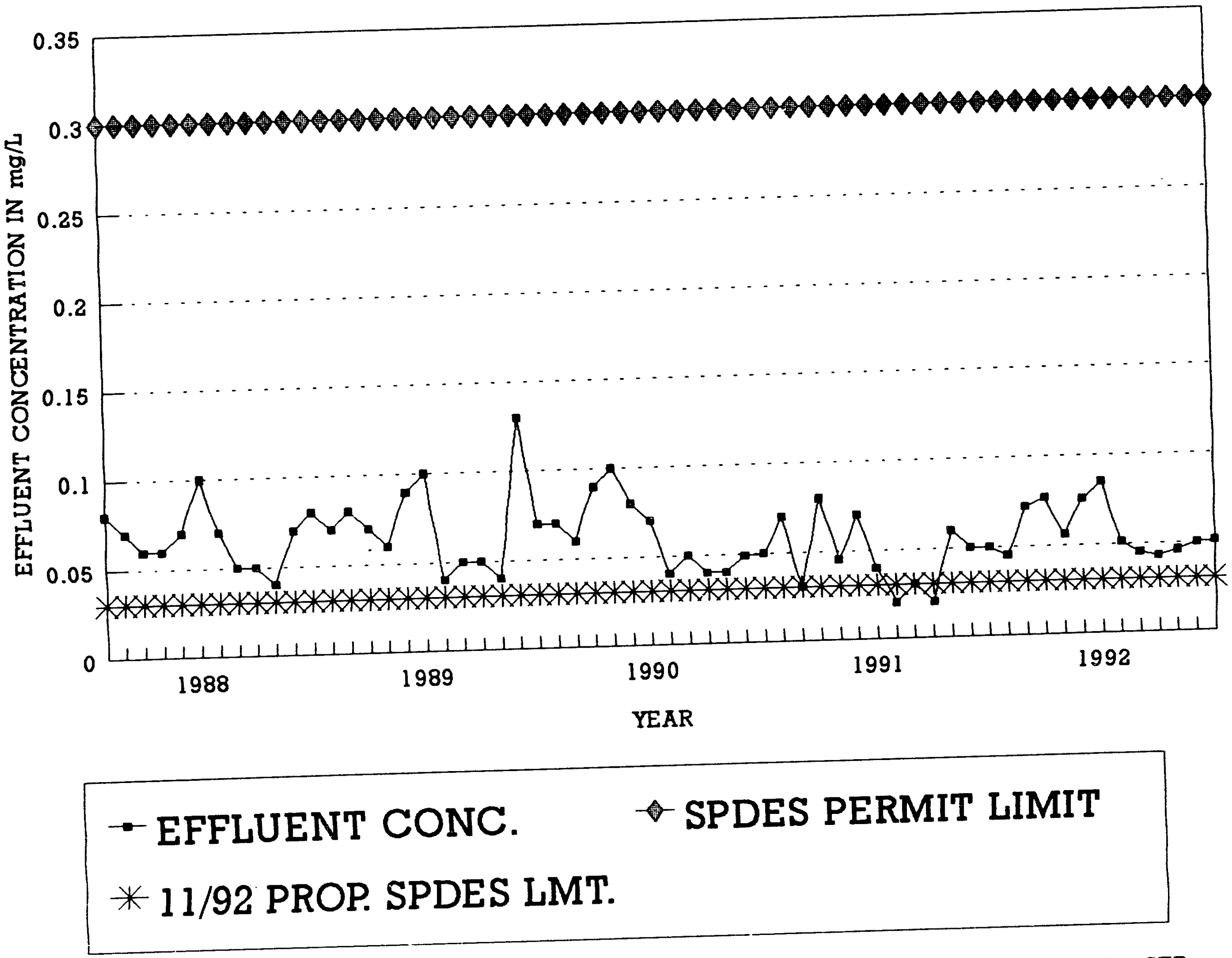


Figure 22: Maximum Effluent Concentration of Zinc Discharged from BNL's STP: 1988 - 1992.

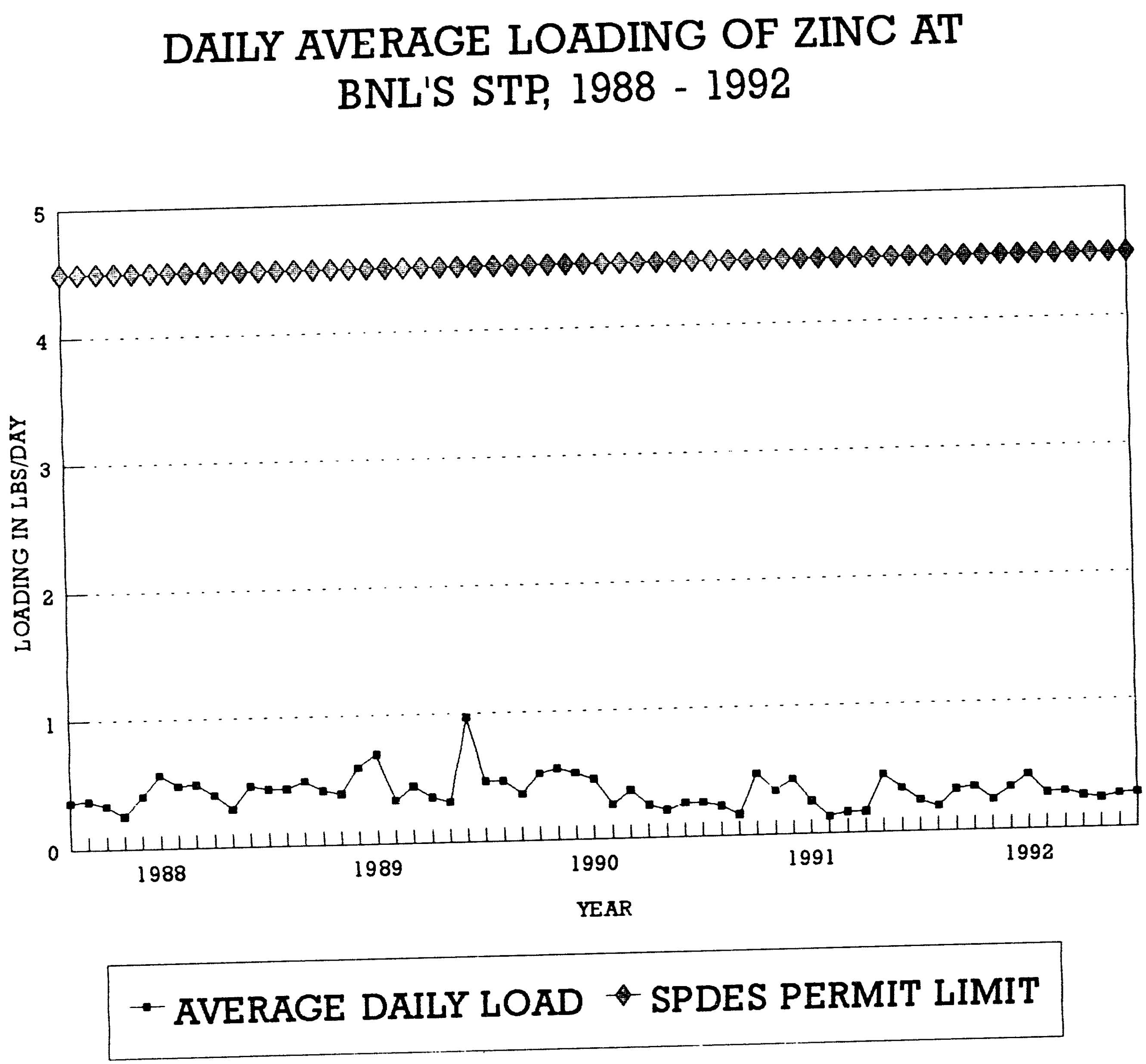


Figure 23: Daily Average Loading of Zinc at BNL's STP: 1988 - 1992.

Process waste waters which have not been evaluated for incorporation into the SPDES permit or are not expected to be of consistent quality are held for characterization and evaluation by S&EP prior to sewer disposal. Typical waste waters which are routinely evaluated are ion exchange column regeneration wastes, cooling tower waste water, primary cooling water systems, and other industrial waste waters. In order to determine the means for disposal of these wastes, samples are collected and analyzed for contaminants specific to the process. The analyses are then reviewed and the concentrations and mass loads compared to the SPDES effluent limitation. If the concentration and/or mass load are within the effluent standard, sewer disposal authorization is granted; if not, alternate means of disposal are evaluated. In all instances, any waste which contains hazardous levels of contaminants is remanded to the HWM group for disposal guidance.

4.1.4.4 Recharge Basins

Figure 24 depicts the locations of BNL recharge basins within the physical complex. An overall schematic of water use at the Laboratory is shown in Figure 25. After use in "once through" heat exchangers and process cooling, approximately 6.09 MLD of water was returned to the aquifer through on-site recharge basins; 1.94 MLD to Basin HN (Outfall 002) located about 610 m northeast of the AGS; 3.97 MLD to Basin HO (Outfall 003) about 670 m east of the HFBR; 0.07 MLD to Basins HS (Outfall 005) and HT (Outfall 006) and 0.07 MLD to recharge basin HX. There was no recharge to Basin HP (Outfall 004) in 1992 because the MRR operated using cooling water from the Chilled Water Facility.

A polyelectrolyte and dispersant was added to the AGS cooling and process water supply to keep the ambient iron in solution. Of the total AGS pumpage, approximately 0.38 MLD was discharged to the HN Basin, and 3.26 MLD to the HO Basin. The HFBR secondary cooling system water recirculates through mechanical cooling towers and was treated with inorganic polyphosphate and mercaptobenzothiozone to control corrosion and deposition of solids. The blowdown from this system (0.71 MLD) was also discharged to the HO Basin. During 1992 water samples were collected from Recharge Basins HN, HO, HT, HW, and HX. No samples were collected at Recharge Basins HS and HP due to a lack of flow at these locations. With the exception of HX, these locations are scheduled to be sampled quarterly, but due to unscheduled sampling requests, they were sampled three times during 1992. Samples collected at all recharge basins were analyzed for radiological and nonradiological parameters.

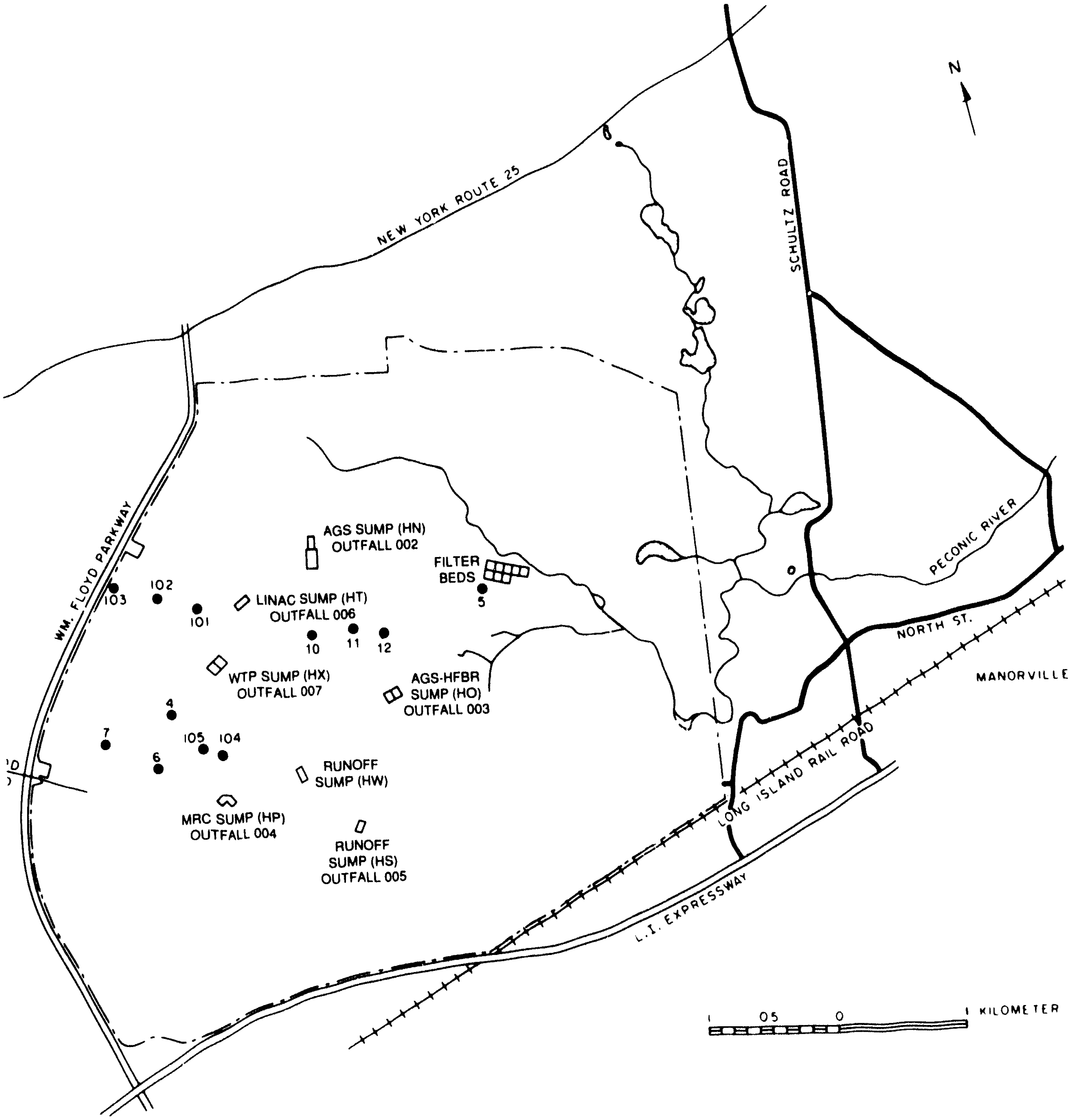


Figure 24: On-site: Potable and Supply Wells and Recharge Sumps.

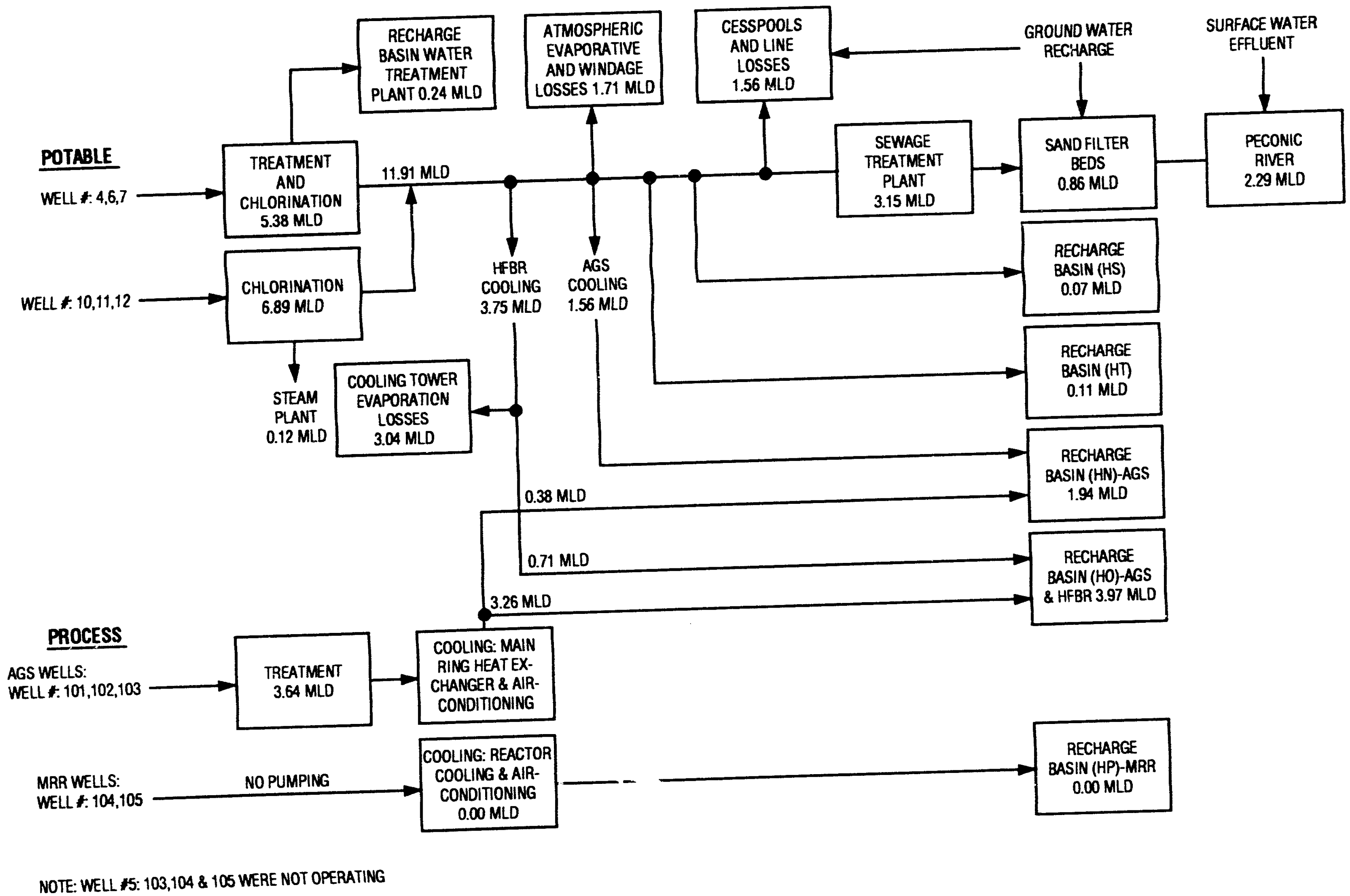


Figure 25: Brookhaven National Laboratory Schematic of Water Use and Flow for 1992.

4.1.4.5 Recharge Basins - Radiological Analyses

Radiological results for recharge basin samples are reported in Table 11. The data indicates that trace quantities of activity were discharged to Recharge Basin HN. All concentrations detected were small fractions of effluent release limits. The activity detected at Recharge Basin HN resulted from the discharge of primary magnet rinse water into the recharge basin. The observed concentrations of Be-7 and Mn-54 result from high energy particle interactions in the cooling water at both the AGS and LINAC facilities. The presence of the remaining radionuclides is most likely due to activation of facility components and subsequent corrosion. No samples contained strontium-90 above ambient levels and for virtually all samples the tritium concentration was at or less than the system MDL. If a person ingested water from Sump HN as the sole source of drinking water for one year, this would result in a committed effective dose equivalent of less than 0.019 mrem (0.0002 mSv).

4.1.4.6 Recharge Basins - Nonradiological Analyses

To determine the overall impact of these discharges on the environment, the analytical data is compared to ground-water discharge standards promulgated under 6NYCRR Part 703.6. Review of the analytical data for samples collected from the recharge basins showed all parameters, except for pH and iron at recharge basin HO, to be below their respective ground-water discharge standard. Effluents to recharge basin HO contain elevated levels of iron and depressed pH due to the discharge of ground water which is used in once through cooling water systems. The presence of precipitation may also contribute to the depressed pH of this discharge.

Samples collected from these recharge basins were analyzed for water quality parameters, metals and volatile organic compounds. This data has been summarized in Tables 12, 13, and 14, respectively. With regard to VOC analyses, chloroform and bromodichloromethane were detected in the discharge to HO and HT; all other organic compounds analyzed by the SEP analytical laboratory were not detected.

Location HX is the WTP recharge basin which is used for the discharge of effluent generated during the backwashing of the WTP filter beds. Well water collected from Potable Wells 4, 6 and 7 contains ambient levels of iron which exceed the NYS DWS; consequently this water must be treated for the removal of iron prior to distribution for potable use. The WTP provides this treatment using lime, (calcium hydroxide) which precipitates the iron from solution. The filter beds are used to separate the iron floc which is formed during the treatment process. This discharge is, consequently high in particulate iron. Filtration of this effluent, however, shows the filtrate to meet the NYS ground water effluent standard.

Table 11
BNL Site Environmental Report for Calendar Year 1992
Radioactive Material Detected in On-site Recharge Basin Water

Location	Lab ID	Sample Date	Be-7	Na-22	Mn-54	K-40	Tritium	Gross Alpha	Gross Beta
			<-------------------------			pCi/L			------------------------->
HN	HN920110	10-Jan-92	ND	0.164	ND	ND	892.000	1.680	1.320
HN	HN920513	13-May-92	ND	ND	ND	0	15.300	0.659	1.550
HN	HN920721	21-Jul-92	20.900	ND	0.228	ND	163.000	0.925	16.800
HN	HN920721F	21-Jul-92	25.900	ND	0.410	ND	56.300	0.356	8.910
Avg. pCi/L			23.400	0.164	0.319	0	281.650	0.905	7.145
HO	HO920110	10-Jan-92	ND	ND	ND	ND	908.000	1.770	0.982
HO	HO920513	13-May-92	ND	ND	ND	ND	124.000	-0.220	1.100
HO	HO920722	22-Jul-92	ND	ND	ND	ND	38.500	0.219	1.060
Avg. pCi/L			0	0	0	0	356.833	0.590	1.047
HT	HT920110	10-Jan-92	ND	ND	ND	ND	715.000	0.860	0.868
HT	ZF9205102	13-May-92	ND	ND	ND	ND	0.023	-0.160	-0.230
HT	HT920513	13-May-92	ND	ND	ND	2.650	-56.200	-0.210	1.890
HT	HT920513F	13-May-92	ND	ND	ND	ND	-96.500	-0.200	0.944
HT	HT920721	21-Jul-92	ND	ND	ND	4.100	-173.000	0.000	1.060
Avg. pCi/L			0	0	0	3.375	77.865	0.058	0.906
Typical MDL			1.6	0.2	0.2	3.9	300	0.46	1.2
DOE Order 5400.5 Derived Concentration Guide			1000000	10000	50000	70000	2000000		
Concentration required to produce SDWA Annual Dose			40000	400	2000	280	80000		

Note: Basins HS and HP were dry throughout 1992.
ND: Not detected.

Table 12
BNL Site Environmental Report for Calendar Year 1992
Water Quality Data in On-Site Recharge Basins

		FIELD MEASUREMENTS							ANIONS								
Location[a]	No. of Samples	pH (SU)	Temperature °C			Conductivity (umhos/cm)			Chlorides mg/L			Sulfates mg/L			Nitrate-Nitrogen[b] mg/L		
			Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
HN (RHIC Recharge)	3	6.8 - 8.1	18	8	27	118	104	142	18	13.5	21.3	12.8	11.7	13.7	<1.0	<1.0	<1.0
HO (HFBR - AGS)	3	6.2 - 7.8	16	15	17	141	93	200	20.5	19.7	21.3	14.9	13.3	16.4	<1.0	<1.0	<1.0
HT (LINAC)	6	6.8 - 7.5	19	17	24	136	122	155	17.8	16	21.2	11.7	10.1	15.1	<1.0	<1.0	<1.0
HW (Warehouse runoff)	1	7.1	--	23	23	---	37	37	----	<4	<4	----	4.5	4.5	---	<1.0	<1.0
NYSDEC Effluent Limitation		6.5 - 8.5			(c)			(c)			500.0			500.0			20.0
Typical MDL		--			--			10			4.0			4.0			1.0

MDL: Minimum detection limit.
(a) Locations of recharge basins are shown in Figure 25.
(b) Holding time expired.
(c) No standard specified.

Table 13
BNL Site Environmental Report for Calendar Year 1992
Average Metals Data in On-Site Recharge Basins

Location [a]	No. of Samples		Ag	Cd	Cr	Cu	Fe	Hg	Mn	Na	Pb	Zn
			Parameter									
			<------------------				mg/L					------------------>
HN (RHIC)	3	Min.	<0.025	<0.0005	<0.005	<0.05	0.1	<0.0002	<0.05	9.1	<0.002	<0.02
		Max.	<0.025	<0.0005	<0.005	<0.05	0.19	<0.0002	<0.05	17.9	0.005	0.04
		Avg.	<0.025	<0.0005	<0.005	<0.05	0.15	<0.0002	<0.05	14.9	0.003	<0.02
HO (AGS/HFBR)	3	Min.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	14.4	<0.002	<0.02
		Max.	<0.025	<0.0005	<0.005	<0.05	1.69	<0.0002	0.2	17.6	<0.002	0.02
		Avg.	<0.025	<0.0005	<0.005	<0.05	0.81	<0.0002	0.12	15.8	<0.002	<0.02
HT[b] (LINAC)	6	Min.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	10.1	<0.002	<0.02
		Max.	<0.025	<0.0005	<0.005	<0.05	0.17	<0.0002	<0.05	21.6	<0.002	<0.02
		Avg.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	13.6	<0.002	<0.02
HW (Weaver Rd.)	1		<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	<1.0	0.002	<0.02
HX (Filtered)			<0.025	<0.0005	<0.005	<0.05	<0.075	NA	<0.05	11.0	<0.002	<0.02
HX (Unfiltered) (Water treatment Plant)			0.07	<0.0005	<0.005	<0.05	9.3	NA	0.26	11.8	0.022	<0.02
Min. Detection Limit			0.025	0.0005	0.005	0.05	0.075	0.0002	0.05	1.0	0.002	0.02
6NYCRR Part 703.6 Effluent Limitation			0.100	0.020	0.100	1.0	0.600	0.004	0.6	(c)	0.050	5.0

NA: Not analyzed.
(a) Locations of recharge basins are shown in Figure 25.
(b) This recharge basin has two effluents which are denoted HT and HT2 in data contained in Volume 2.
(c) Effluent standard not specified

Table 14
BNL Site Environmental Report for Calendar Year 1992
Chlorocarbon Data in On-site Recharge Basins

Location[a]	No. of Samples		Chloroform[b] µg/L	Bromodichloromethane µg/L
HO (AGS/HFBR)	4	Avg.	< 2.0	< 2.0
		Min.	< 2.0	< 2.0
		Max.	3.0	< 2.0
HT (LINAC)	8	Avg:	< 2.0	< 2.0
		Min:	< 2.0	< 2.0
		Max:	5.0	3.0
NYS Effluent Limitations			7.0	5.0
Typical MDL			2.0	2.0

ND: Not detected
MDL: Minimum detection limit.

(a) Locations of recharge basins are shown in Figure 25.
(b) NYSDOH drinking water standard is 100 µg/L.

4.1.5 Environmental Measurements and Analyses

4.1.5.1 External Radiation Monitoring

Dose-equivalent rates from gamma radiation at the site boundary, including natural background, weapons test fallout, and that attributable to Laboratory activities were determined through the use of CaF_2:Dy TLDs.[41,42] The locations of the on-site and off-site TLDs are shown in Figures 26 and 27, respectively. The TLDs were positioned using a standard 16 sector wind-rose with Sector No. 1 centering on true north. The dose-equivalent rates observed are given in Table 15. The annual average dose-equivalent rate as indicated by all TLDs was 69.1 mrem/yr (0.69 mSv/yr). The dose-equivalent rate at the site boundary was 71.4 mrem/yr (0.71 mSv/yr), while the off-site average rate was 67.4 mrem/yr (0.67 mSv/yr). Differences between the on-site and off-site TLD dose-equivalent rate are the result of the terrestrial component of the external dose measurement and not related to BNL operations.[9]

The 1992 on- and off-site TLD results show an average radiation exposure increase of approximately 11% over 1991 values. This is due to the introduction of new TLD chips, the alteration of the chip heating parameters, and the use of a new, low temperature annealing oven. It is not due to an increase in facility radioactive emissions, which actually dropped overall in comparison to 1991.

The maximum dose at the site boundary due to argon-41 and oxygen-15 airborne emissions was calculated using CAP88[43] as 0.095 mrem (0.001 mSv). This value is not measurable using today's best available technology.

4.1.5.2 Atmospheric Radioactivity

The Laboratory's environmental air monitoring program is designed to identify and quantify airborne radioactivity attributable to natural sources, to activities unrelated to the Laboratory (e.g., above ground nuclear weapon tests), and to Laboratory activities. The predominant radionuclides measured in air at the site boundary were tritium, fission products related to weapons test, fallout, and Be-7 produced in the atmosphere as a result of cosmic particle inter-action in the atmosphere.

4.1.5.3 Tritium Analyses

Sampling for tritium vapor was performed at twenty-two different on-site stations (as shown in Figure 26). Location 6T had a duplicate sample train all year (identified as 6T1 and 6T2 in Table 16) and air samples were routinely collected in the counting room (Location 17CR) and analytical lab (Location 17L). The method of sampling was the collection of water vapor by drawing a stream of air through silica gel cartridges. The data collected from these stations are presented in Table 16. The maximum annual average tritium concentration at the site boundary was observed at Station 16T (NNW Location) and was 3.6 pCi/m^3 (0.13 Bq/m^3). This air concentration would result in whole body dose from the inhalation and submersion pathways of 0.0028 mrem (0.000028 mSv). By comparison, the National Council on Radiation Protection (NCRP) publication 91 recommends that 1 mrem (0.01 mSv) is a dose which is below regulatory concern.[44]

Table 15
BNL Site Environmental Report for Calendar Year 1992
External Dose Equivalent Rates for All TLD Locations

Location	No. of Samples	Exposure Period (days)	Annual Dose (mrem)
10T1.8	4	349	70.27
11T2.1 (P4)	2	169	73.34
12T1.4	4	349	79.44
13T1.3	4	349	73.31
13T1.4	4	349	71.37
14T1.3	4	349	74.16
15T1.7	4	349	71.29
16T2.1 (P2)	4	349	67.66
1T2.2	3	262	65.50
2T2.6	2	168	57.19
3T2.8	4	350	66.64
4T2.6	4	350	62.61
5T2.5	4	350	77.97
6T2.8 (P7)	4	350	71.17
7T1.6	4	350	80.69
7T2.5	4	350	74.37
8T1.3	4	350	71.74
8T2.3	4	350	62.96
Bldg. 197	3	?56	88.49
Bldg. 907	4	349	67.02
10T12.0	4	370	69.88
10T9.3	4	364	78.33
11T17.8	2	189	57.50
11T3.7	4	365	61.50
12T12.5	4	359	73.35
12T5.0	4	360	71.34
12T7.2	4	358	68.25
13T2.6	4	364	65.28
13T8.2	4	358	63.42
14T3.1	4	364	67.93
14T5.6	4	358	77.51
15T3.0	3	259	66.67
16T3.4	4	364	66.57
1T3.0	4	371	62.76
1T8.8	4	352	61.13
2T10.5	4	342	77.80
2T2.4 (S13)	4	350	73.95
2T3.2	4	356	69.36
3T8.8	4	362	64.12
4T7.5	4	362	64.91
5T17.1	4	354	64.24
5T4.2	4	354	58.04
5T6.5	4	356	62.60
6T5.6	3	265	66.72
7T9.7	4	356	61.04
8T8.0	4	362	69.54
9T8.3	4	376	76.82
Gun Barrel	4	349	23.98
Gun Barrel	4	369	27.18

Annual Average, All Locations 69.10 +/- 6.61 mrem
Annual Average, On-site Locations 71.36 +/- 6.90 mrem
Annual Average, Off-site Locations 67.43 +/- 5.84 mrem
Annual Average, Gun Barrel TLDS 25.58 +/- 1.60 mrem

Table 16
BNL Site Environmental Report for Calendar Year 1992
Ambient Air Tritium Concentrations at Perimeter and Control Locations

Location	No. of Samples	Min. pCi/m3	Max. pCi/m3	Flow Weighted Average pCi/m3	Average pCi/m3
On-Site Samples					
2T	27	-6.57	32.96	2.54	2.37
3T	42	-8.08	66.48	3.17	2.57
4T	41	-1.42	16.72	1.24	1.36
5T	37	-6.55	15.18	1.58	0.87
6T1	49	-7.23	10.47	0.72	0.86
6T2	47	-3.38	12.41	1.22	1.32
7T	30	-1.31	12.64	2.23	1.93
8T	45	-8.65	14.60	0.82	0.82
9T	49	-4.94	81.31	2.29	2.66
10T	43	-9.10	11.49	-0.21	-0.29
13T	44	-7.29	38.40	1.27	0.73
14T	45	-10.00	8.85	0.17	0.24
15T	38	-3.06	107.97	3.53	2.45
20T	38	-5.02	13.49	2.69	0.74
Process Controls					
17CR	116	-10.00	137.51	4.32	3.02
17L	42	8.08	36.87	8.08	9.73
Background Locations					
11T	47	-10.24	4.98	-0.13	-0.14
16T	47	-9.59	137.51	4.69	3.60

Note: DOE Order 5400.5 Derived Concentration Guide in semi-infinite clouds for H-3 is 1.E+05 pCi/m3.

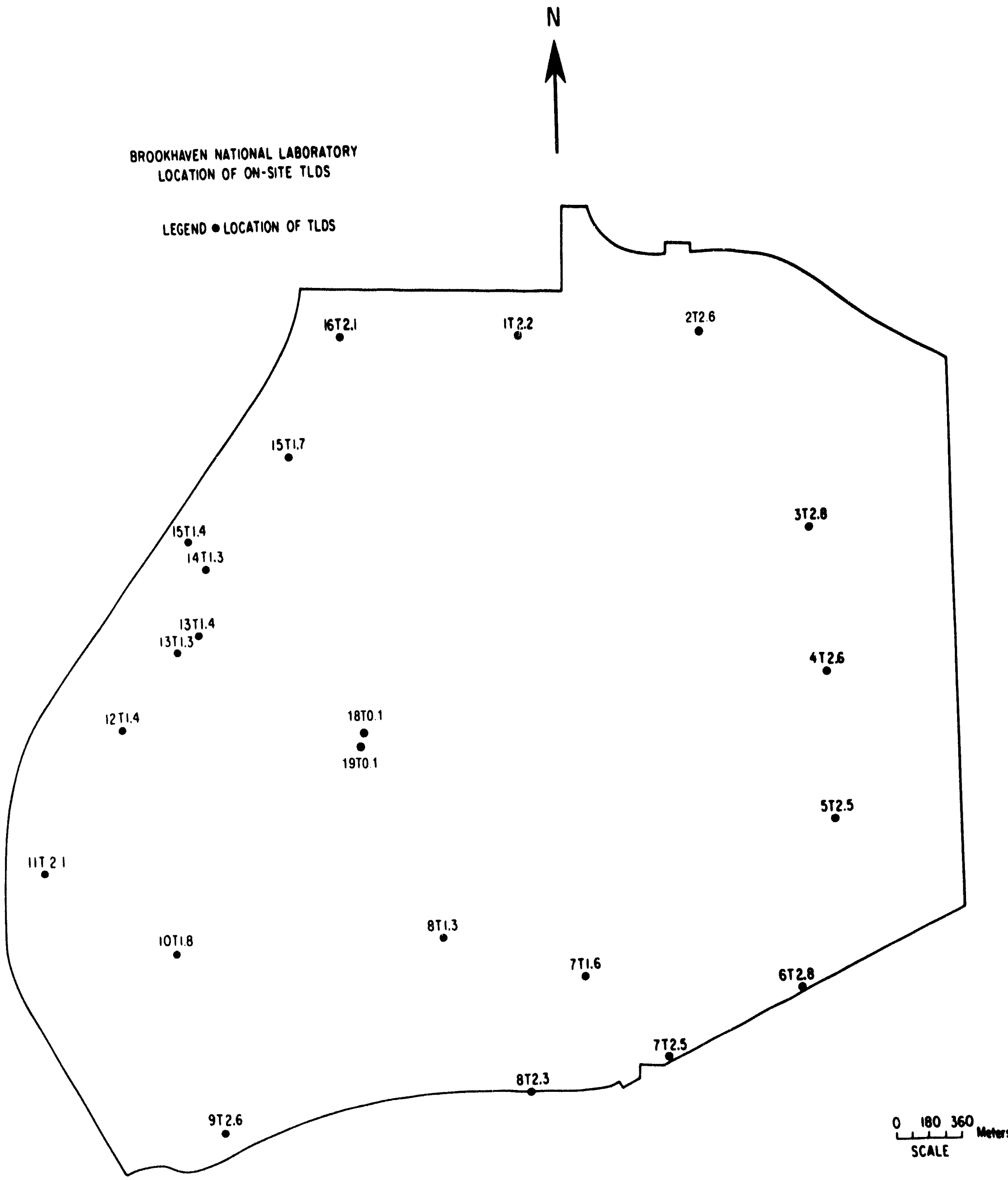


Figure 26: Brookhaven National Laboratory Location of On-site TLDs.

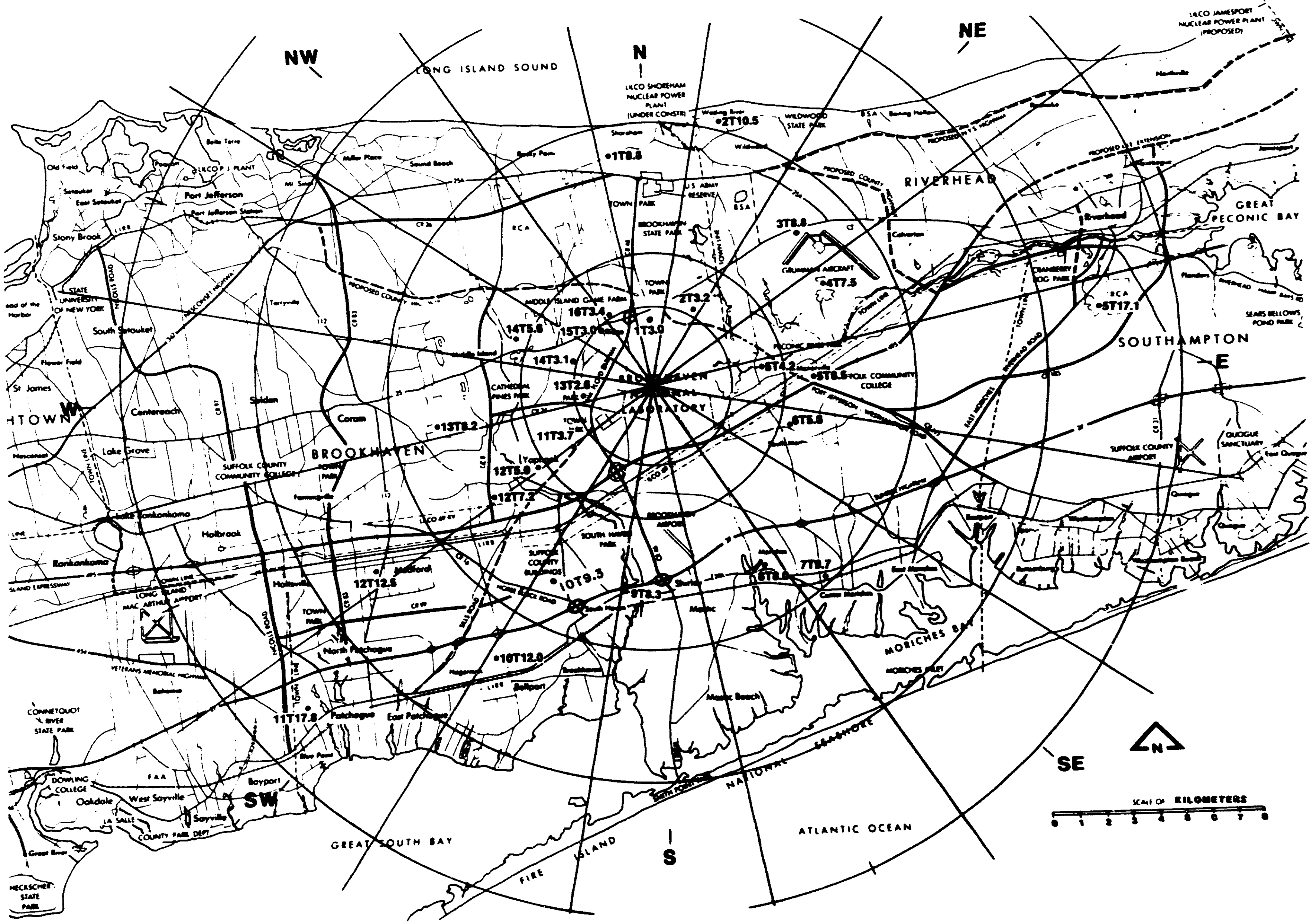


Figure 27: Brookhaven National Laboratory Location of Off-site TLDs.

The airborne tritium concentrations measured outside Building 535 (Location 20T) reflect ambient air concentrations in the central part of the Laboratory site. The annual average air concentration at this location was 0.7 pCi/m^3 (0.026 Bq/m^3) and would represent a dose of 0.0006 mrem (0.000006 mSv) to the typical BNL employee.

For the foreseeable future, site perimeter monitoring will continue to be used as a method to monitor for potential large releases and provide an upper boundary for both model verification and dose estimates. Compliance verification will be performed using CAP88 and measured source terms plus BNL meteorology.

4.1.5.4 Radioactive Particulates

During 1992, positive displacement air pumps were operated at five on-site monitoring stations (16T2.1, 11T2.1, 6T2.8, 4T2.4, and S6). The sampling media consisted of a 5-cm diameter air particulate filter followed by a 51.5 cm^3 canister of triethylene diamine-impregnated charcoal for the collection of radiohalogens. In general, air particulate samples were collected on a weekly basis and counted for gross alpha and beta activity using an anticoincidence proportional counter. Sample Location S6 gross alpha and gross beta data have higher average values than other sample sites because this location was sampled daily for the first quarter of 1992. The sampling period was then changed to weekly after review of data, and operations at the HWMF indicated that there was no technical justification for conducting a daily sampling regime. The gross beta concentrations are comparable to EPA values for Yaphank, New York.[5-8]

In addition, analyses for gamma-emitting nuclides were performed on a weekly composite of the filter papers and on charcoal filter bed samples that had a sample period of one month. The analytical results for air particulate filters are shown in Table 17. Gamma-emitting radionuclides detected on charcoal filters are reported in Table 18.

The presence of Chernobyl fallout, weapons test fallout from previous years, and cosmogenically produced radionuclides were detected by gamma spectroscopy at or near the systems minimum detectable activity levels.

4.1.5.5 Radioactivity in Precipitation

Pot-type rain collectors are situated at Locations 4T2.4 and 11T2.1 (Figure 10). Dry deposition and precipitation samples are scheduled for collection on a weekly basis. Portions of each collection are to be processed for gross alpha, beta, and tritium analysis. A fraction of both the precipitation (wet) and dry deposition (dry) samples are composited for quarterly gamma analysis. Strontium-90 analyses are performed quarterly on precipitation samples. The data for 1992 are reported in Table 19 and reflect typical washout values associated with atmospheric scrubbing[10] and the presence of radioactive particulate resulting from cosmogenic production, nuclear weapons fallout and Chernobyl. These data are similar to those detected by EPA[5-8] at their Yaphank, New York Monitoring Station. The data are not as complete as expected due to sample collection instrument failures which resulted in the inability to reliably collect both dry deposition and precipitation samples.

4.1.5.6(a) Radioactivity in Soil, Grass, and Vegetation

The results of soil and grass sampling conducted at three off-site locations in the vicinity of the site are shown in Table 20. The results are consistent with data collected in previous years.[9] No nuclides attributable to Laboratory operations were detected. The observed concentrations represent the contribution of primordial and cosmogenic sources, and weapons test fallout.

Analysis of vegetation in the vicinity of Bldg. 830, where evidence of radionuclide contamination was demonstrated, showed the presence of Co-60 and Cs-137, both of which were present in the liquid discharged as a leak from the facility. Data are shown in Table 20.

Soil samples collected from on-site locations were analyzed for radioactivity. For all areas, except adjacent to the NEXRAD balloon launch site, the results obtained from analysis approximated values typically seen in soil samples collected through out Suffolk County for radioactivity assay. Data are shown in Table 21.

During field surveys in preparation for construction of the NEXRAD balloon launch site, an area outside the construction zone was identified as having elevated Cs-137 concentration in soil (Table 21). Depth profile information was collected, as well as external exposure rate data, to determine the extent of the affected area. Based on these data, soil was removed until Cs-137 concentrations reached local background levels (≈ 2 pCi/g [0.07 Bq/g]). The excavated area was then filled with clean soil.

Table 17
BNL Site Environmntal Report for Calendar Year 1992
Gross Alpha, Gross Beta, Gamma-Emitting Radionuclide Concen
for Ambient Air Monitoring Stations

Location	Total Flow (m^3)		Gross Alpha	Gross Beta	Be-7	Co-60	Cs-137
			<--------	--------	pCi/m^3	--------	-------->
16T2.1	5163	Min.	-0.0021	-0.0523	0.1190	ND	0.0326
		Max.	0.0032	0.0913	0.2910	ND	0.0448
		Avg.	0.0007	0.0198	0.0373	ND	0.0018
		N	45	45	45	45	45
11T2.1	5193	Min.	-0.0030	-0.0052	0.0897	ND	0.0409
		Max.	0.0043	0.0651	0.5100	ND	0.0409
		Avg.	0.0007	0.0173	0.0669	ND	0.0008
		N	46	46	47	47	47
6T2.8	8985	Min.	-0.0070	-0.0230	0.1210	0.0145	0.0265
		Max.	0.0052	0.1140	0.5830	0.0597	0.0575
		Avg.	0.0006	0.0167	0.0376	0.0023	0.0023
		N	84	84	85	85	85
4T2.4	4405	Min.	-0.0026	-0.0569	0.1300	ND	----
		Max.	0.0045	0.0811	0.2750	ND	----
		Avg.	0.0006	0.0172	0.0331	ND	----
		N	47	47	47	47	47
S6	3861	Min.	-0.0221	-0.5200	0.1030	ND	0.0156
		Max.	0.0202	0.2240	0.6820	ND	0.0156
		Avg.	0.0004	0.0166	0.0328	ND	0.0005
		N	104	104	46	46	46
Typical MDL			0.002	0.006	0.0224	0.0036	0.0031

N: Number of samples collected.

Table 18
BNL Site Environmental Report for Calendar Year 1992
Air Station Charcoal Filter Gamma Analysis Results

Location	Total Flow (m^3)		K-40 (pCi/m^3)	Cs-137 (pCi/m^3)
16T2.1	5427	Min.	0.1870	---
		Max.	0.5400	---
		Avg.	0.3411	---
		N	11	11
11T2.1	5193	Min.	0.2140	0.0038
		Max.	0.5420	0.0065
		Avg.	0.4003	0.0019
		N	12	12
6T2.8	5106	Min.	0.2380	0.0129
		Max.	0.7100	0.0136
		Avg.	0.3241	0.0025
		N	12	12
4T2.4	4408	Min.	0.0953	---
		Max.	0.5650	---
		Avg.	0.1162	---
		N	12	12
S6	3584	Min.	0.0440	---
		Max.	0.6200	---
		Avg.	0.5026	---
		N	12	12
DOE Order 5400.5 DAC			900	400

N: Number of samples collected.

Table 19
BNL Site Environmental Report for Calendar Year 1992
Radionuclide Concentrations in Precipitation (Wet and Dry) at
Stations 4T and 11T

Location			Gross Alpha nCi/m^2	Gross Beta nCi/m^2	Tritium nCi/m^2	Be-7 nCi/m^2	Cs-137 nCi/m^2	Sr-90 nCi/m^2
4T2.4	Dry	Min.	-0.0235	-0.692	-1.3720	ND	0.0768	ND
		Max.	-0.0079	0.0634	27.9878	ND	0.0768	ND
		Avg.	-0.0157	-0.0029	13.3079	ND	0.0768	ND
		N	2	2	2	1	1	0
	Wet	Min.	0.0061	0.1213	0.5241	5.1067	ND	0.0135
		Max.	0.1291	0.8723	358.8415	6.7774	ND	0.0135
		Avg.	0.0401	0.4176	111.5966	6.2101	ND	0.0135
		N	5	5	5	3	3	1
11T2.1	Dry	Min.	-0.0311	0.0230	6.9512	ND	ND	ND
		Max.	0.0546	0.0576	7.2561	ND	ND	ND
		Avg.	0.0117	0.0403	7.1037	ND	ND	ND
		N	2	2	2	1	1	0
	Wet	Min.	0.0046	0.1767	-34.3750	7.8571	0.0517	-0.0328
		Max.	0.1352	3.0288	67.4543	7.8571	0.0517	0.0126
		Avg.	0.0552	0.9091	7.0164	7.8571	0.0517	-0.0101
		N	6	6	6	2	2	2

ND: Not detected.
N: Number of samples collected.

Table 20
BNL Site Environmental Report for Calendar Year 1992
Radionuclide Concentrations in
Vegetation and Soil in and around BNL

Location	Matrix	Sample Date	Be-7	Cs-137	K-40	Ra-226	Th-232	Co-60
			<------------	------------	pCi/g	------------	------------	------------>
Yaphank Honor Farm	Soil	06/17/92	ND	0.11	4.61	0.41	0.55	ND
NYS Game Farm (Ridge)	Soil	06/17/92	ND	0.66	2.05	0.15	0.23	ND
Young's Orchard (Northville)	Soil	06/17/92	ND	0.55	4.01	0.60	0.98	ND
Yaphank Honor Farm	Grass	06/17/92	ND	ND	4.31	ND	ND	ND
NYS Game Farm (Ridge)	Grass	06/17/92	ND	ND	270	ND	ND	ND
Young's Orchard (Northville)	Grass	06/17/92	0.69	ND	3.30	ND	ND	ND
Young's Orchard (Northville)	Strawberrys	06/17/92	ND	ND	2.22	ND	ND	ND
BNL #830 Area	Tree Leaves	07/15/92	ND	1300	7.45	ND	18.60	0.23
Typical MDL			0.07	0.01	0.18	0.03	0.23	ND

ND: Not detected. Radionuclide Concentration less than the system MDL.
MDL: Minimum detection limit.

Table 21
BNL Site Environmental Report for Calendar Year 1992
Soil Samples: Radioactivity

Sample Location	Number of Samples	Gross Alpha Avg.	Gross Alpha Max.	Gross Beta Avg.	Gross Beta Max.	K-40 Avg.	K-40 Max.	Mn-54 Avg.	Mn-54 Max.	Co-60 Avg.	Co-60 Max.	Cs-137 Avg.	Cs-137 Max.	Ra-226 Avg.	Ra-226 Max.	Th-232 Avg.	Th-232 Max.	Sr-90 Avg.	Sr-90 Max.
		<------	------	------	------	------	------	------	------	µg/g	------	------	------	------	------	------	------	------	------>
Cesspool #96	3	NA	NA	NA	NA	4.49	4.91	ND	ND	ND	ND	0.33	0.44	0.39	0.44	0.56	0.68	NA	NA
RWCF (5-02, 5-03)	2	-0.63	-0.63	6.14	6.57	6.49	6.76	0.45	0.60	ND	ND	0.12	0.13	0.57	0.58	0.76	0.78	NA	NA
#725	1	NA	NA	NA	NA	4.60	4.60	ND	ND	ND	ND	0.20	0.20	0.44	0.44	0.50	0.5	NA	NA
NEXRAD Site																			
0' - 3'	1	NA	NA	NA	NA	NA	NA	ND	ND	ND	ND	4.30	4.30	NA	NA	NA	NA	0.06	0.06
3' - 8'	1	NA	NA	NA	NA	NA	NA	ND	ND	0.29	0.29	1270	1270	NA	NA	NA	NA	0.02	0.02
8' - 12'	1	NA	NA	NA	NA	NA	NA	ND	ND	ND	ND	3.52	3.52	NA	NA	NA	NA	0.07	0.07
12' - 19'	1	NA	NA	NA	NA	NA	NA	ND	ND	ND	ND	0.56	0.56	NA	NA	NA	NA	0.03	0.03
929	2	NA	NA	NA	NA	2.22	2.47	ND	ND	ND	ND	0.019	0.023	0.22	0.26	ND	ND	NA	NA
Typical Suffolk County Soil Concentrations			NA		NA		4.40		NA		0.44		0.50		0.68		NA		NA

NA: Not analyzed.
ND: Not detected.

Table 21 (Continued)
BNL Site Environmental Report for Calendar Year 1992
Soil Samples: Metals

Well No.	No. of Samples	Ag		Cd		Cr		Cu		Fe		Hg		Mn		Na		Pb		Zn	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		mg/L																			
Bldg. 120	2	NA	NA	<1.0	<1.0	5.3	5.1	15.0	11.6	4300	3500	0.22	0.10	NA	NA	NA	NA	18.0	17.5	NA	NA
Bldg. 479	1	<0.05	<0.5	<0.1	<0.01	<0.5	<0.5	NA	NA	NA	NA	<0.02	<0.02	NA	NA	NA	NA	<0.5	<0.5		
Bldg. 526	1	<2.5	<2.5	0.33	0.33	7.8	7.8	19.0	19.0	6300	6300	0.02	0.02	92	92	<100	<100	5.0	5.0	32	32
Bldg. 929	4	<0.25	<0.25	NA	NA	NA	NA	2.8	2.6	2624	2168	NA	NA	124	65	<0.1	<0.1	NA	NA	12.1	7.4
STP Line	4	<5.0	<3.0	<1.0	<1.0	<5.0	<5.0	<5.0	<2.0	2000	690	<0.2	<0.1	39	31	14.0	13.0	<5.0	<5.0	5.6	<1.5

NA: Not applicable.
ND: Not detected.

4.1.5.6(b) Nonradioactive Contaminants in Soil

Soil samples collected from on-site locations were analyzed for nonradiological contaminants. Except for the PCB contamination investigation at a PCB spill site (Section 2.7.3), the parameters listed for and concentrations observed were typical of values noted in background soil samples on site (DOE survey). Data are shown in Tables 21 and 22.

4.1.5.6(c) Terrestrial Ecology

In 1992, a special program was initiated to collect terrestrial fauna samples on site and off site for radiological assay. Efforts were made to collect endemic species, and locations selected were in the STP, HWM Area, and along on-site water bodies (Figure 28). Table 23 lists the species caught and the radionuclides observed in specific tissue samples: flesh and liver. The predominant radionuclides detected were Cs-137 and K-40, with all other gamma-emitting radionuclides being at or below the system MDL. Species caught in the vicinity of the AGS, HWM Area, and Recharge Basins showed concentrations of Cs-137 that ranged from 280 to 8170 pCi/Kg wet (10.4 to 302 Bq/Kg wet), where as similar species caught away from such areas showed reductions in Cs-137 activity, with values ranging from 71 to 134 pCi/Kg wet (2.6 to 5.0 Bq/Kg wet). This data also identified the Cs-137 distribution pattern in fauna, with Cs-137 concentrations being 2 to 6 times greater in flesh than liver tissues. This is consistent with published data.[45]

As these species do not form a part of human food consumption, dose assessments were not performed. Samples collected from off-site areas could not be processed in time to be included in this report.

4.1.5.7 Peconic River Aquatic Surveillance

Radionuclide measurements were performed on surface water samples collected from the Peconic River at six locations; HM, the location of the former site boundary approximately 790 meters downstream of the discharge point; HQ, located approximately 2.1 km downstream from the discharge point; HA and HB, located approximately 5 km downstream from the discharge point; HC, located approximately 7 km downstream of the discharge point; HR, located 21 km downstream from the discharge point. A control location (Location HH) located on the Carmans River in North Shirley, which is not influenced by BNL liquid effluent, was also sampled. The Peconic River sampling stations are identified in Figure 29. Routine grab sampling at both the former site boundary (Location HM) and the current site boundary (Location HQ) was conducted three times per week. The locations are equipped with V-notched weirs to permit flow proportional sampling and volume measurements. Due to heavy vegetation growth down stream of these weirs, which causes no vertical drop across the weir, volume measurements could not be performed with the existing equipment. Figure 30 provides a twenty-two year review of liquid discharge volumes to the Peconic River and flow estimates for the Peconic River on-site. The data indicate that there was no measurable flow at the site boundary since 1983. Non-quantifiable flow, due to vegetation growth in the river bed downstream of the weir has existed at Location HM since 1984. Between 1985 and 1992, water levels at Location HQ have been below the conduit which transports water from the BNL site to the weir at Location HQ. As stated earlier, vegetation growth below the weir is now too dense to permit flow

Table 22
BNL Site Environmental Report for Calendar Year 1992
Soil Samples: Polychlorinated Biphyenyls (PCBs), Total Petroleum Hydrocarbons (TPH), and Oil

Sample Location	Parameter	Number of Samples	Concentration (ppm)		
			Max.	Min.	Avg.
479	PCB	17	---	---	<0.01
		16	---	---	<1.00
		84	160.00	0.10	15.26
	TPH	11	---	---	<10
		92	70000	1	3650
	Oil	8	---	---	<100

Table 22 (Continued)
BNL Site Environmental Report for Calendar Year 1992
Soil Samples, Chlorocarbon Data

Well No.	No. of Samples	TCA		TCE		PCE		DCA		DCE		Chloroform	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		<------------ μg/L ------------>											
Bldg. 120 Cesspool	2	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Bldg. 457	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bldg. 479 PCB Spill Area	7	<72	<5	<72	<0.05	<72	<0.07	<72	<5	<72	<0.07	<72	<0.06
Bldg. 610 CSF	2	65	120	<5.5	<5.0	<5.5	<5.0	<5.5	<5.0	<5.5	<5.0	<5.5	<5.0
NEXRAD Site	5	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
STP Line	2	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	ND

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.

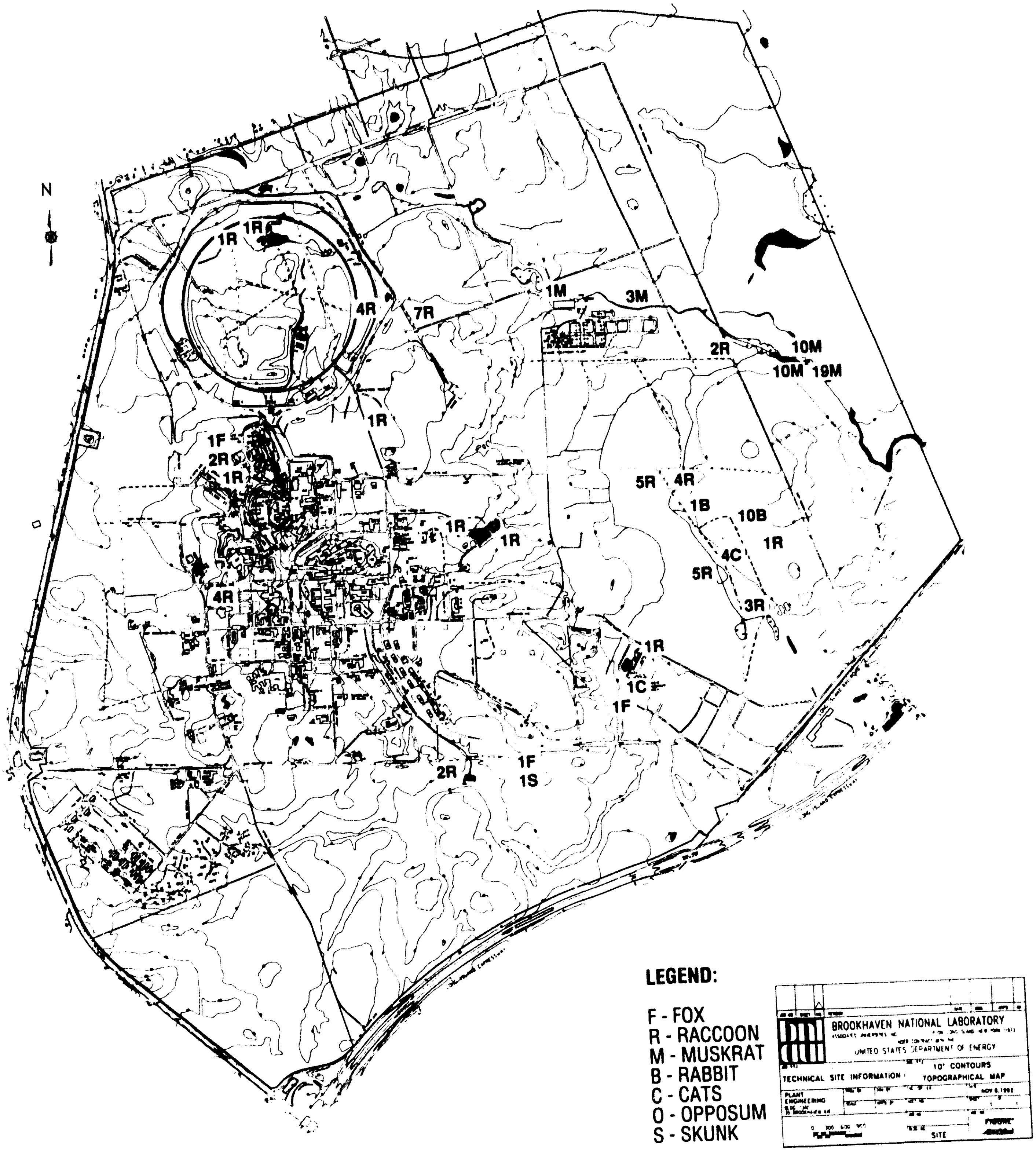
Table 22 (Continued)
BNL Site Environmental Report for Calendar Year 1992
Soil Samples, BETX Data

Well No.	No. of Samples	Benzene		Bromo-chloromethane		Dibromol Chloromethane		Toluene		Xylene		Ethyl-Benzene		Methylene Chloride	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		µg/L													
Bldg. 120 Cesspool	2	<50	<50	ND	ND	ND	ND	<50	<50	<50	<50	<50	<50	ND	ND
Bldg. 457	2	<1	<1	ND	ND	ND	ND	<1	<1	6.4	9.7	5.6	7.8	ND	ND
Bldg. 479 PCB Spill Area	7	<72	<0.05	<1.4	<5	<1.4	<5	<72	<5	<72	<5	<72	<5	2.5	3.0
Bldg. 610 CSF	2	<5.5	<5.0	<5.5	<5.0	<5.5	<5.0	<5.5	<5.0	<5.5	<5.0	<5.5	<5.0	4.5	9.0
NEXRAD Site	5	<100	<100	----	----	ND	ND	<100	<100	<100	<100	<100	<100	210	300
STP Line	2	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	ND

ND: Not detected.

Table 23
BNL Site Environmental Report for Calendar Year 1992
Radionuclide Concentrations in Terrestrial Fauna

Sample Location	Sample Date	Species	Tissue Analyzed	Cs-137 Conc.	K-40 Conc.
				<-----pCi/Kg	wet------->
AGS	10/01/92	Deer	Flesh	6150	7720
			Liver	1120	1880
Grid #79	12/27/92	Cat	Flesh	430	3220
			Liver	170	1750
Grid #106	12/10/92	Fox	Flesh	8170	3380
			Liver	2980	1470
Grid #98	12/23/92	Cat	Flesh	513	2460
			Liver	339	1360
Grid #18	12/29/92	Cat	Flesh	21	2590
			Liver	ND	1660
Grid #57	12/19/92	Racoon	Flesh	345	2760
			Liver	224	1800
Grid #54	12/26/92	Racoon	Flesh	134	2070
			Liver	71	1770
Grid #79	12/20/92	Racoon	Flesh	480	1910
			Liver	280	1420
Grid #66	12/30/92	Oppossum	Flesh	809	1740
			Liver	729	2580



FAUNA SAMPLING ON SITE-1992

Figure 28: Fauna Sampling On Site - 1992.

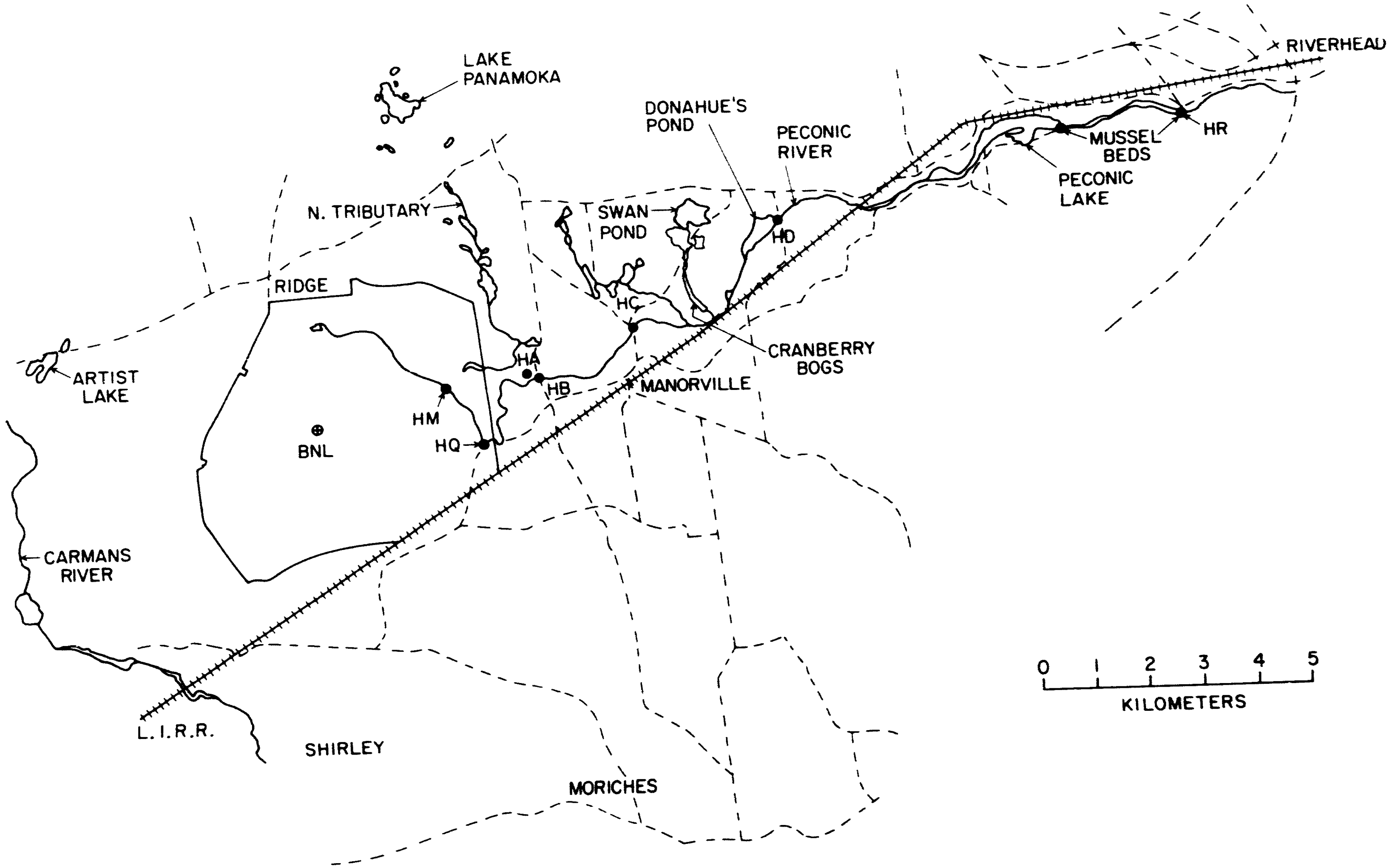


Figure 29: Peconic River Sampling Stations.

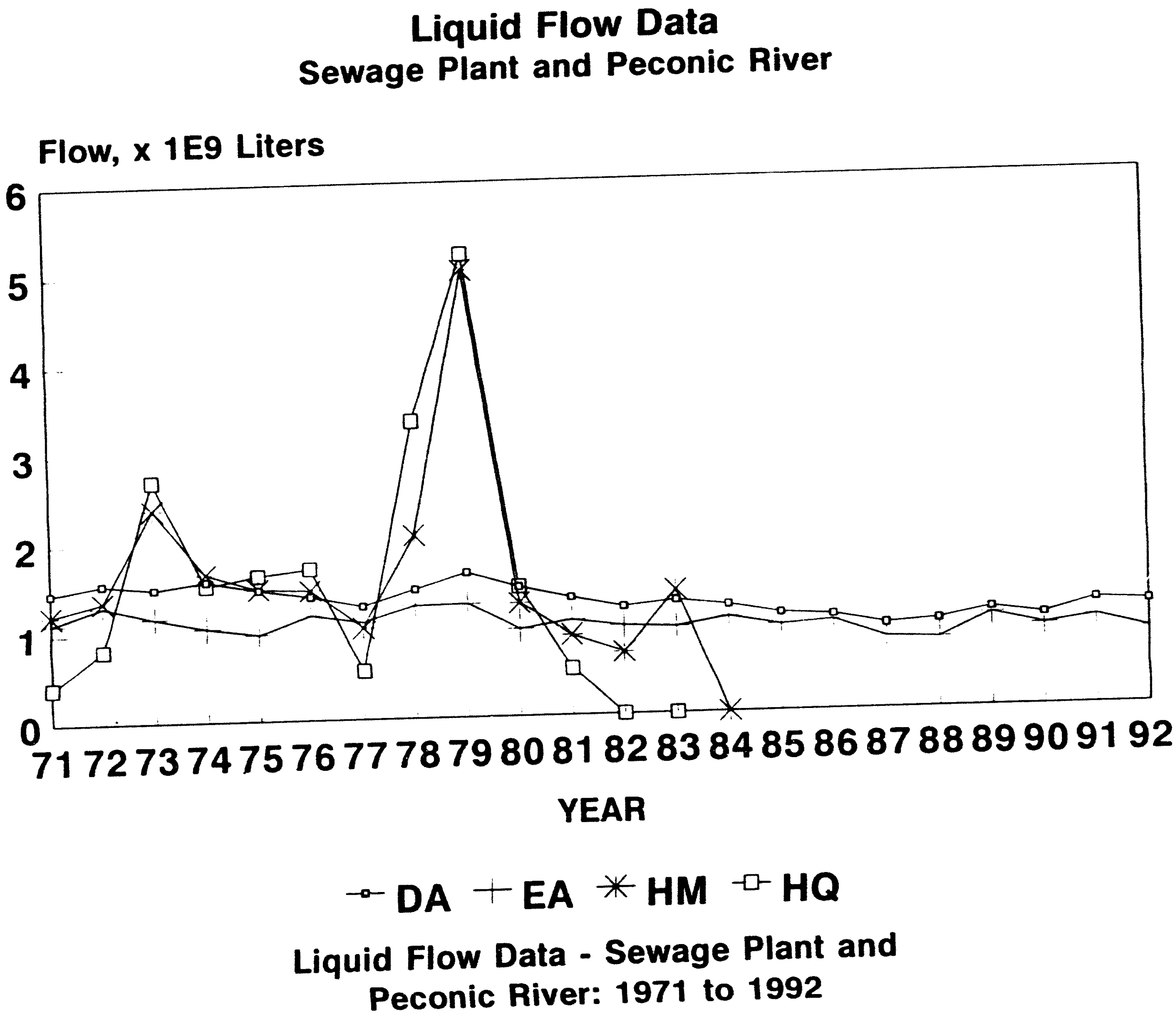


Figure 30: Liquid Flow Data - Sewage Plant and Peconic River: 1971 - 1992.

measurement using the currently installed equipment. Samples from Locations HA, HB, HC, HR, and HH were collected during the second, third, and fourth quarters of 1992. No samples were collected in the first quarter due to a reprioritization of field sampling team activities associated with the PCB investigation at Building 479.

The radiological data generated from the analysis of Peconic River surface water sampling are summarized in Table 24. The data indicate that gross beta, Cs-137, and Co-60 are present above ambient levels at Locations HM and HQ, with the tritium level exceeding BNL's administrative limit in September at Station HM.

4.1.5.8 Peconic River Aquatic Surveillance - Nonradiological Analyses

The Peconic River was sampled at six locations during 1992; two on-site (Sampling Locations HM and HQ) and four off site (Sampling Locations HA, HB, HC, and HR). In addition, the Carmans River was also sampled (Location HH) as an off-site control location. These locations were sampled and analyzed for water quality parameters (i.e., pH, temperature, conductivity, and dissolved oxygen), anions (i.e., chlorides, sulfates, and nitrates), metals, and VOCs routinely during 1992. Location HQ was not analyzed for metals nor water quality parameters during 1992 due to no flow at this location.

A summary of water quality and metals analytical data for samples collected from the surface waters is contained in Tables 25 and 26, respectively. Review of this data indicates all water quality parameters to be consistent with the off-site control location and with historical data. Analytical data for metals showed all parameters to be consistent with historical data and the background Carmans River Station. All concentrations with the exception of iron are well below the NYS DWS and the existing SPDES effluent limitations. Iron is prevalent above the NYS DWS at all locations most probably due to the high concentration of iron prevalent in ground water and native sediments.

With regard to VOC analyses, during 1992 all surface waters were analyzed for VOC contamination by the SEP analytical laboratory. Volatile organic compounds were not detected in any surface water samples collected during 1992.

4.1.5.9 Aquatic Biological Surveillance

The Laboratory, in collaboration with the NYSDEC Fisheries Division, has an ongoing program for the collection of fish from the Peconic River and surrounding fresh water bodies (Figure 29). In 1992, fish samples from the Peconic River were collected at Donahue's Pond, and Forge Pond. Control samples were collected from Carmans River, Swan Pond, and Searington and Hall Ponds in Hempstead, Long Island, NY. Specific information regarding the sampling point, distance from the BNL effluent release point, species of fish collected and analytical results are presented in Table 27. In CY 1992, only gamma spectroscopy analysis was performed on these samples. The Peconic River fish contained Cs-137 concentrations which ranged from near background levels at Donahue's Pond (74 - 157 pCi/kg-wet [2.8 - 6.0 Bq/kg-wet]) to 630 pCi/kg-wet (23 Bq/kg-wet) at Forge Pond. In order to obtain an estimate of the Sr-90 concentrations in fish for 1992, a Cs-137 to Sr-90 ratio was developed from the data reported in previous years. This relationship was then used to estimate the Sr-90 concentration for use in dosimetric assessment.

Table 24
BNL Site Environmental Report for Calendar Year 1992
Annual Gross Alpha, Gross Beta, Tritium, Sr-90, and Gamma Activity
Concentrations in Peconic River and Carmans River

Site Code	Sampling	Location	Descriptive Statistics	Gross Alpha	Gross Beta	Tritium	Cs-137	K-40	Sr-90
				<------		pCi/L			------>
HM	Peconic River	On-site	N	150	150	150	11	11	4
			Avg.	0.68	7.28	3129	1.39	2.93	-0.25
			Max.	3.38	28.00	24230	2.21	9.34	0.15
HQ	Peconic River Boundary	Site	N	113	113	113	1	1	NS
			Avg.	0.67	8.84	3759	ND	ND	NS
			Max.	4.68	19.10	19	0.28	4.70	0.33
HA	Peconic River	Off-site	N	3	3	3	2	2	3
			Avg.	0.19	1.21	-22	0.25	2.4	0.13
			Max.	0.44	1.62	19	0.28	4.70	0.33
HB	Peconic River	Off-site	N	3	3	3	2	2	3
			Avg.	0.18	1.14	-143	0.09	ND	0.24
			Max.	0.47	1.74	-34	0.19	ND	0.53
HC	Peconic River	Off-site	N	3	3	3	2	2	3
			Avg.	0.20	1.98	-20	ND	ND	0.21
			Max.	0.44	2.38	15	ND	ND	0.16
HR	Peconic River Riverhead	Off-site	N	2			2	2	3
			Avg.	0.00	2.02	-68	0.19	1.74	0.10
			Max.	0.29	2.04	-37	0.39	3.49	0.25
HH	Carmans River (Background)	Off-site	N	2	2	2	3	3	3
			Avg.	0.52	1.08	646	ND	4.2	-0.03
			Max.	0.82	1.81	1320	ND	12.50	0.17
Typical MDL				0.46	1.2	300	0.20	3.90	0.10
Typical MDL for HM and HQ only				2.30	6.0	1000	---	---	---
DOE Order 5400.5 Derived Concentration Guide				(a)	(a)	80000	3000	7000	1000
Concentration Required to Produce SDWA Annual Dose				(a)	(a)	20000	120	280	40

ND: Not detected.
MDL: Minimum detection limit.
NS: Not sampled.
N: Number of samples.

Table 25
BNL Site Environmental Report for Calender Year 1992
Water Quality Parameters for Surface Water Samples
Collected Along the Peconic and Carmans River

River	Sample Location		pH	Conductivity	Temperature	Dissolved Oxygen	Chlorides	Sulfates	Nitrates
			(SU)	µmhos/cm	°C	mg/L	mg/L	mg/L	mg/L
Peconic	HM	N	146	146	146	146	51	51	51
		Min.	5.2	102	0.7	3.9	21.3	13.9	1.9
		Max.	8.0	309	24.9	16.6	50.7	28.7	14.9
		Avg.	NA	189	14.2	9.3	31.9	15.9	4.3
	HQ	N	4	3	4	4	0	0	0
		Min.	6.5	164	15.3	4.6			
		Max.	9.8	191	26.0	9.3			
		Avg.	NA	175	18.3	6.2			
	HA	N	3	3	3	2	3	3	3
		Min.	6.0	43	1.2	7.2	5.9	<4.0	<1.0
		Max.	6.3	117	23.7	8.7	7.8	16.7	1.0
		Avg.	NA	70	15.2	8.0	7.0	7.9	<1.0
	HB	N	4	4	4	3	3	3	3
		Min.	6.2	50	1.4	6.2	6.4	<4.0	<1.0
		Max.	6.4	52	22.4	9.3	7.6	17.0	1.1
		Avg.	NA	51	9.9	8.3	7.1	7.8	<1.0
	HC	N	3	3	3	2	3	3	3
		Min.	6.2	53	3.5	9.0	7.7	4.0	<1.0
		Max.	8.1	60	26.4	15.0	9.2	8.6	<1.0
		Avg.	NA	57	17.0	12.0	8.4	6.5	<1.0
	HR	N	3	3	3	1	3	3	3
		Min.	6.7	85	1.2	—	12.0	9.9	<1.0
		Max.	7.1	147	26.0	—	14.5	12.4	<1.0
		Avg.	NA	109	15.4	8.6	13.0	10.8	<1.0
Carmans	HH	N	3	3	3	1	3	3	3
		Min.	6.6	81	3.4	—	7.5	9.8	<1.0
		Max.	7.0	149	23.7	—	22.1	16.9	1.2
		Avg.	NA	119	14.3	8.8	16.9	12.2	<1.0
NYS Drinking Water Standards			6.5 - 8.5	(a)	(a)	(a) (Daily Avg.)	250.	250.	10.

(a) No standard specified.
Note: The Peconic River and Carmans River sample locations are shown in Figure 29.

Table 26
BNL Site Environmental Report for Calendar Year 1992
Metals Concentration Data for Water Samples
Collected Along the Peconic and Carmans River

River	Sample Location		Ag	Cd	Cr	Cu	Fe	Hg	Mn	Na	Pb	Zn
			<-------	-------	-------	-------	-------	mg/L	-------	-------	-------	------->
Peconic	HM	N	12	12	12	12	12	12	12	12	12	12
		Min.	<0.025	<0.0005	<0.005	<0.05	0.22	<0.0002	<0.05	19.1	<0.002	0.03
		Max.	<0.025	0.0008	0.0064	0.06	0.77	<0.0002	0.07	28.2	0.012	0.05
		Avg.	<0.025	<0.0005	<0.005	<0.05	0.37	<0.0002	<0.05	23.3	0.002	0.04
	HA	N	3	3	3	3	3	3	3	3	3	3
		Min.	<0.025	<0.0005	<0.005	<0.05	0.27	<0.002	<0.05	4.1	<0.002	<0.02
		Max.	<0.025	<0.0005	<0.005	<0.05	1.75	<0.002	0.06	5.7	0.003	0.03
		Avg.	<0.025	<0.0005	<0.005	<0.05	0.86	<0.002	<0.05	4.7	0.002	0.02
	HB	N	3	3	3	3	3	2	3	3	3	3
		Min.	<0.025	<0.0005	<0.005	<0.05	0.66	<0.0002	<0.05	4.6	<0.002	<0.02
		Max.	<0.025	<0.0005	<0.005	<0.05	4.16	<0.0002	0.08	5.5	0.005	<0.02
		Avg.	<0.025	<0.0005	<0.005	<0.05	2.23	<0.0002	0.05	4.9	0.003	<0.02
	HC	N	3	3	3	3	3	3	3	3	3	3
		Min.	<0.025	<0.0005	<0.005	<0.05	0.31	<0.0002	<0.05	5.4	<0.002	<0.02
		Max.	<0.025	<0.0005	0.007	<0.05	1.59	<0.0002	0.08	5.8	0.003	<0.02
		Avg.	<0.025	<0.0005	<0.005	<0.05	0.91	<0.0002	0.05	5.6	<0.002	<0.02
	HR	N	3	3	3	3	3	3	3	3	3	3
		Min.	<0.025	<0.0005	<0.005	<0.05	0.41	<0.0002	0.08	8.1	<0.002	<0.02
		Max.	<0.025	<0.0005	<0.005	<0.05	1.04	<0.0002	0.14	8.8	<0.002	<0.02
		Avg.	<0.025	<0.0005	<0.005	<0.05	0.67	<0.0002	0.10	8.4	<0.002	<0.02
Carmans	HH	N	3	3	3	3	3	3	3	3	3	3
		Min.	<0.025	<0.0005	<0.005	<0.05	0.17	<0.0002	<0.05	13.8	<0.002	<0.02
		Max.	<0.025	<0.0005	<0.005	<0.05	3.87	<0.0002	0.17	14.4	<0.003	<0.02
		Avg.	<0.025	<0.0005	<0.005	<0.05	1.61	<0.0002	0.10	14.1	<0.002	<0.02
NYS Drinking Water Standards			0.05	0.01	0.05	1.3	0.3	0.002	0.3	(a)	0.015	5.0

(a) No standard specified.

Note: The Peconic River and Carmans River sample locations are shown in Figure 29.

Table 27
BNL Site Environmental Report for Calendar Year 1992
Radionuclide Concentrations in Fish and Mussels

Sample[d] Location	Sample Date	ID #	Remarks	Distance from BNL Discharge, (Km)	Species	Cs-137 Conc.	Net Cs-137 Conc.	K-40 Conc.	Sr-90[c] Conc.	Net Sr-90 Conc.
						<------ pCi/Kg Wet				------>
Swan Pond	07/27/92	SPF-1	Control	--	Yellow Perch[a]	162	NA	1801	180	NA
Peconic River	08/07/92	SPF-2	Control	--	Yellow Perch[a]	174	NA	1590	193	NA
Upstream	08/07/92	SPF-3	Control	--	Yellow Perch[a]	180	NA	1523	200	NA
Calverton	08/07/92	SPF-4	Control	--	Large Mouth Bass[a]	97	NA	1716	137	NA
	08/07/92	SPF-5	Control	--	Golden Shiner	61	NA	2062	68	NA
	08/07/92	SPF-6	Control	--	Brown Bullhead	70	NA	1529	140	NA
	08/06/92	SPF-7	Control	--	Blue Gills	55	NA	1634	80	NA
	08/06/92	SPF-8	Control	--	Blue Gills	55	NA	1546	80	NA
	08/06/92	SPF-9	Control	--	Blue Gills	72	NA	1740	104	NA
	08/06/92	SPF-10	Control	--	Blue Gills	71	NA	1998	103	NA
	07/27/92	SPF-11	Control	--	Blue Gills	53	NA	1592	77	NA
	07/27/92	SPF-12	Control	--	Blue Gills	46	NA	1622	67	NA
	07/27/92	SPF-13	Control	--	Blue Gills	36	NA	1197	52	NA
Carmans River	08/05/92	CR(2)-1	Control	--	Brown Bullhead	31	NA	1953	62	NA
	08/05/92	CR(2)-2	Control	--	Brown Bullhead	19	NA	1781	38	NA
	08/05/92	CR(2)-3	Control	--	Blue Gill	20	NA	1930	29	NA
	08/05/92	CR(2)-4	Control	--	Pumpkin Seed	36	NA	2131	51	NA
Searington Pond N. Hempstead	08/20/92	SEP-1	Control	--	Goldfish	ND	NA	1780	NA	NA
Hall Pond W. Hempstead	08/19/92	HP-1	Control	--	Goldfish	36	NA	1670	NA	NA
Donahue's Pond	07/30/92	DPF-1	Peconic	10.0	Pumpkinseed	176	128	2073	195	122
	07/30/92	DPF-2	Peconic	10.0	Chain Pickerel	227	179	1690	252	179
	07/30/92	DPF-3	Peconic	10.0	Brown Bullhead	122	74	1550	135	62
	07/30/92	DPF-4	Peconic	10.0	Pumpkinseed	205	157	2080	228	155
	08/03/92	DPF-5	Peconic	10.0	Brown Bullhead	187	139	2050	208	135
	08/03/92	DPF-6	Peconic	10.0	Brown Bullhead	145	97	1450	161	88
	08/03/92	DPF-7	Peconic	10.0	Brown Bullhead	205	157	1640	228	155
	08/03/92	DPF-8	Peconic	10.0	Yellow Perch	145	97	1270	194	121
	07/30/92	DPF-9	Peconic	10.0	Golden Shiner	136	88	1830	110	37
Forge Pond	07/29/92	FPF-1	Peconic	20.0	Pumpkinseed	207	159	2184	259	186
	07/30/92	FPF-2	Peconic	20.0	Freshwater Mussels[b]	42	-6	156	53	-20
	07/30/92	FPF-3	Peconic	20.0	Blue Gills	167	119	2013	217	144
	07/30/92	FPF-4	Peconic	20.0	Black Crappie	191	143	1489	239	166
	07/30/92	FPF-5	Peconic	20.0	Black Crappie	298	250	2760	373	300
	07/30/92	FPF-6	Peconic	20.0	Brown Bullhead	65	17	1550	82	9
	07/30/92	FPF-7	Peconic	20.0	Golden Shiner	71	23	1927	89	16
	07/30/92	FPF-8	Peconic	20.0	Blue Gill	148	100	1959	215	142
	07/30/92	FPF-9	Peconic	20.0	Blue Gill	132	84	1560	198	125
	07/30/92	FPF-10	Peconic	20.0	Chain Pickerel	262	214	1565	327	254
	08/05/92	FPF-11	Peconic	20.0	Chain Pickerel	630	582	3350	788	715
	08/04/92	FPF-12	Peconic	20.0	Gold Shiner	89	41	1930	111	38
	08/04/92	FPF-13	Peconic	20.0	Gold Shiner	65	17	1340	81	8
	08/04/92	FPF-14	Peconic	20.0	Gold Shiner	129	81	2860	161	88
	08/04/92	FPF-15	Peconic	20.0	Yellow Perch	168	120	1520	210	137

ND: Not detected.
NA: Not applicable.
(a) Migratory fish - Peconic River to Swan Pond.
(b) Filter feeders - No biomagnification seen for ^{137}Cs.
(c) Based on ratio of ^{137}Cs; Sr-90 for fishes.
(d) See Figure 29 for location of sampling stations.
Note: Background concentration values based on radionuclide activity in endemic and nonmigratory fish.

The Forge Pond and Donahue's Pond analytical data for Cs-137 indicates that this radionuclide is present in net concentration levels which range from 1.0 to 8.6 times control data. The presence of these levels may be indicative of a BNL contribution to the Cs-137 inventory. The maximum individual and collective dose from the aquatic biological pathway were calculated based on the measured 1992 Cs-137 concentrations and Sr-90 concentrations estimated by dividing the 1992 Cs-137 concentrations by the Cs-137 to Sr-90 ratio. Since fishing for human consumption occurs downgradient of the Laboratory's boundary, only samples collected off site were used for this assessment. Based on the methods and results just described, the maximum individual committed effective dose-equivalent was estimated to be 0.87 mrem (0.0087 mSv) and the collective committed effective dose-equivalent was estimated to be 0.54 person-rem (0.0054 person-Sv). The exposed population was estimated to be 625 and comprised of individuals who frequently fish in the Forge Pond Area.

4.5.1.0 Biomonitoring of the STP Liquid Effluent

Analysis of the STP effluent, which discharges into the Peconic River, for water quality and radioactivity is an integral part the laboratory's EM program. Biomonitoring, which monitors the impact of BNL effluent on aquatic biota, was added to the base monitoring effort in 1987.

The type of species used in the 1992 monitoring effort ranged from sensitive species (brown or rainbow trout) to hardy species (bluegills, large mouth bass, golden shiner, etc.). The latter (hardy) species are also endemic to Long Island freshwater bodies and are considered as local game fish. The experimental set up consisted of a once-through flow system of the effluent through an aquarium which contained the fish. Dissolved oxygen and temperature was monitored daily. Integrated water samples were collected in conjunction with fish sampling. Data collected in 1992 paralleled observations made in 1987 - 1991 in that there is short term rapid intake of the principal radionuclide Cs-137 that reaches equilibrium when the concentration in fish flesh is about 40 times the concentration found in the water. No differences were found between the trout species and the endemic species except that variations in dissolved oxygen and temperature impacted markedly on uptake characteristics of the trout species (decreased uptake during summer months). Effluent characteristics seemed to promote good growth rate, thus testifying to the viability of the effluent stream. In addition, TLDs have been implanted on mussels to determine the feasibility of estimating doses to aquatic fauna. Because of the low levels of radionuclides in the water, exposure times of a year may be required. Data from this experiment will be reported in the CY 93 Site Environmental Report.

5.0 **GROUND WATER PROTECTION**

The effort to protect ground water quality at BNL is being implemented through programs designed to minimize future releases of environmental pollutants, and through site remediation activities being carried out under the IAG between the USDOE, USEPA, and NYSDEC. The IAG provides a framework for remediation of contaminated soils and ground water at BNL over a 30-year period.

The strategy for protecting ground water at the BNL Site is comprised of the following elements:

1. Engineering design reviews and environmental assessments for new and existing facilities to ensure that potential environmental impacts are fully evaluated and reduced to acceptable levels;

2. Upgrading existing facilities to reduce the risk of accidental release of contaminants to the environment (i.e., upgrading underground storage tanks, replacement of deteriorated sewer lines, construction of new waste management facilities utilizing best available technologies, etc.);

3. Prompt response and remediation of spills to prevent migration of contaminants to surface waters and ground water;

4. Conducting a ground water and surface water monitoring program to provide for the early detection of contaminant releases;

5. Development of waste minimization practices to reduce the volume and toxicity of all wastes, and to utilize best management practices for the management and proper disposal of generated wastes;

6. Development of a Pollution Prevention Awareness Program to ensure that employees are cognizant of their responsibilities for the proper storage, use and disposal of chemicals in the work place;

7. Conducting environmental restoration activities in areas where soils and ground water have been contaminated by chemical and radionuclides by past use, storage and disposal activities.

5.1 Ground Water Surveillance

Ground water quality at BNL is routinely monitored through a network of 153 surveillance wells. The surveillance wells generally monitor specific site facilities where degradation of the ground water is known or suspected, to fulfill permit requirements, and at BNL site boundary areas, to assess the quality of ground water entering or leaving the site. Specific facilities include: the STP/Peconic River Area, Meadow Marsh-Upland Recharge Area, HWMF area, Current Landfill, Former Landfill, Ash Repository, CSF/MPF, AGS, WCF, and a number of smaller facilities. Wells located in specific areas of concern are shown in Figures 31 through 36. Table 28, provides a cross reference index which

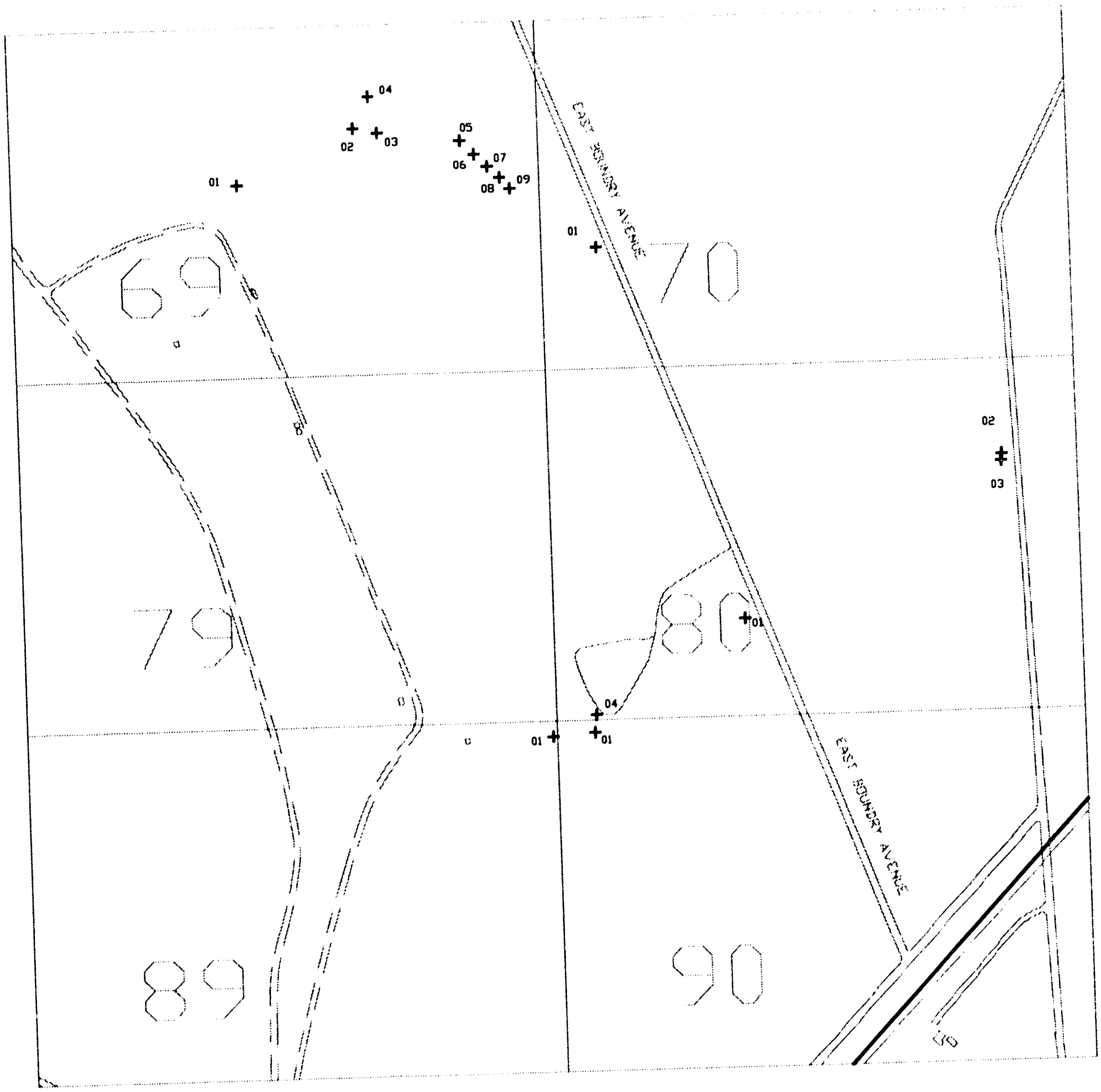


Figure 31: Ground Water Monitoring Wells: Meadow Marsh Area.

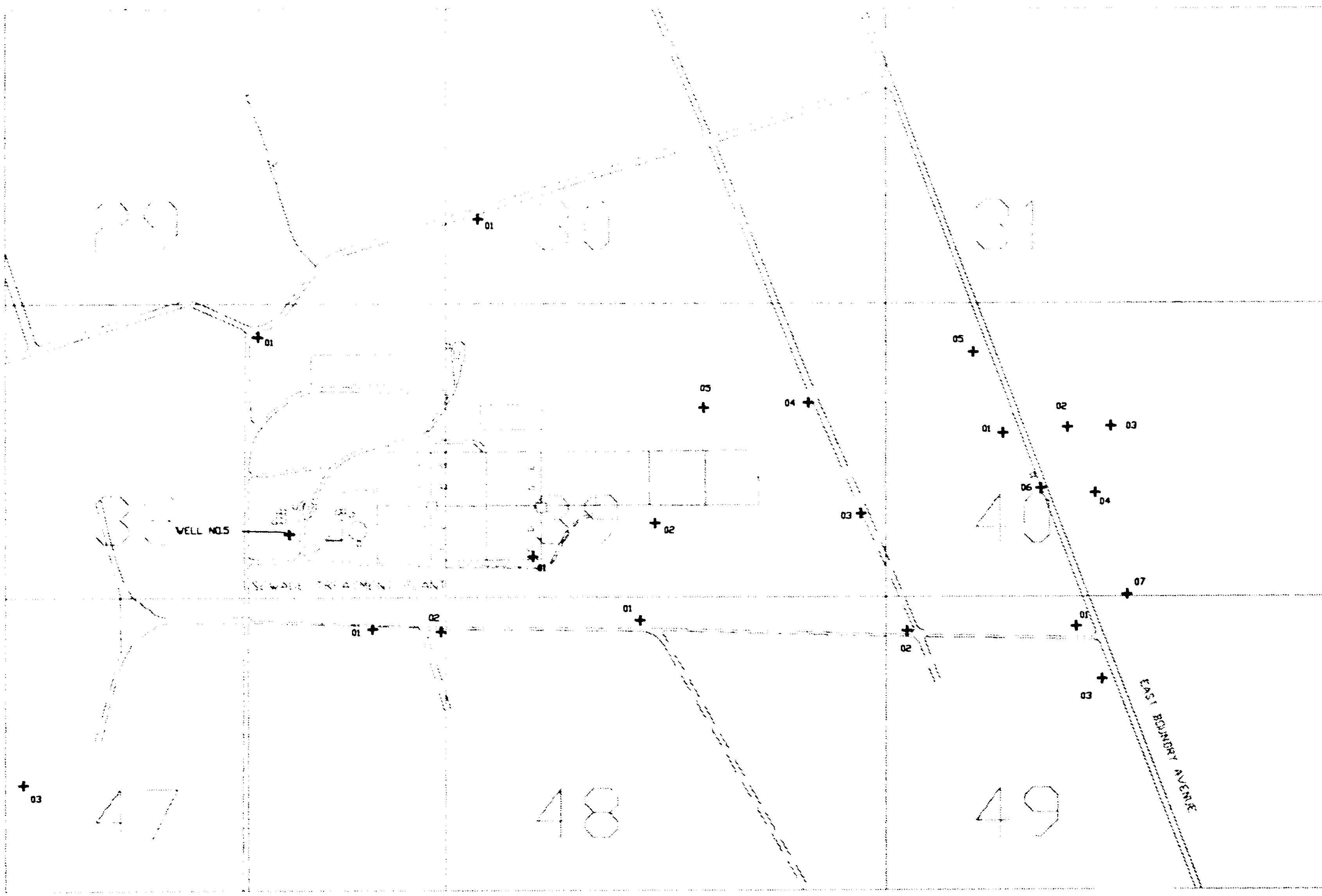


Figure 32: Ground Water Monitoring Wells: Peconic River Area.

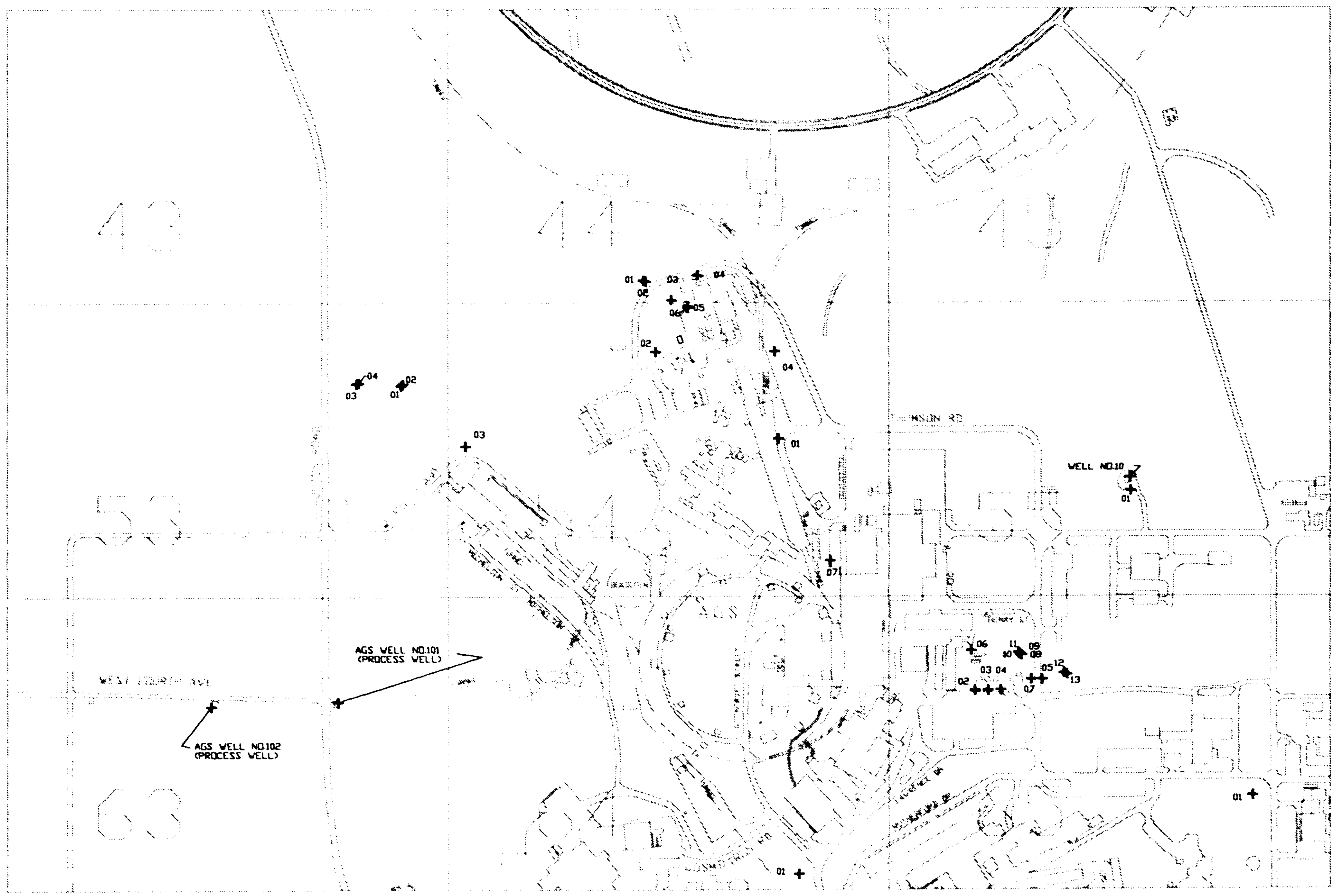


Figure 33: Ground Water Monitoring Wells: AGS and Building 811 Areas.

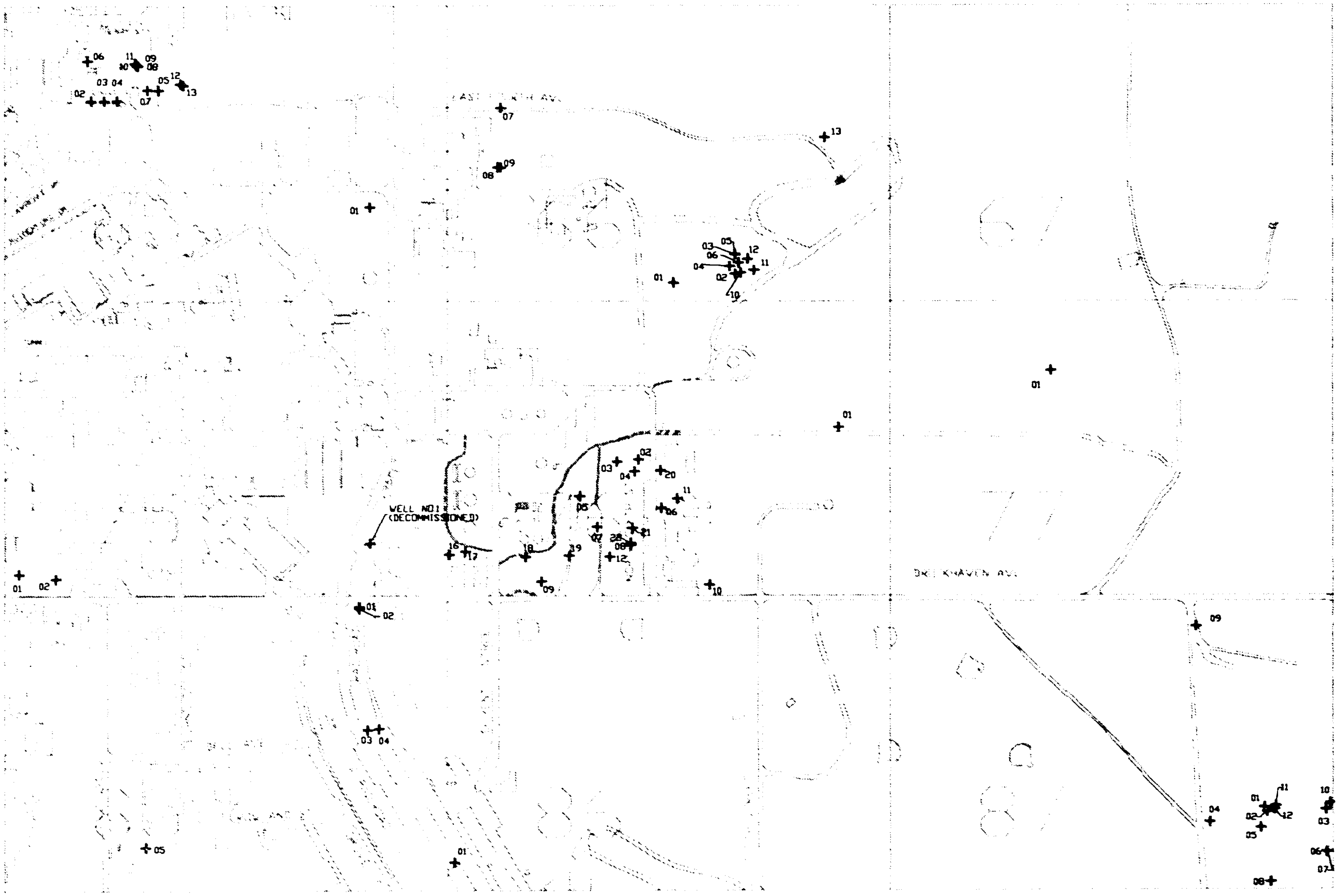


Figure 34: Ground Water Monitoring Wells: Central Steam Facility Area.

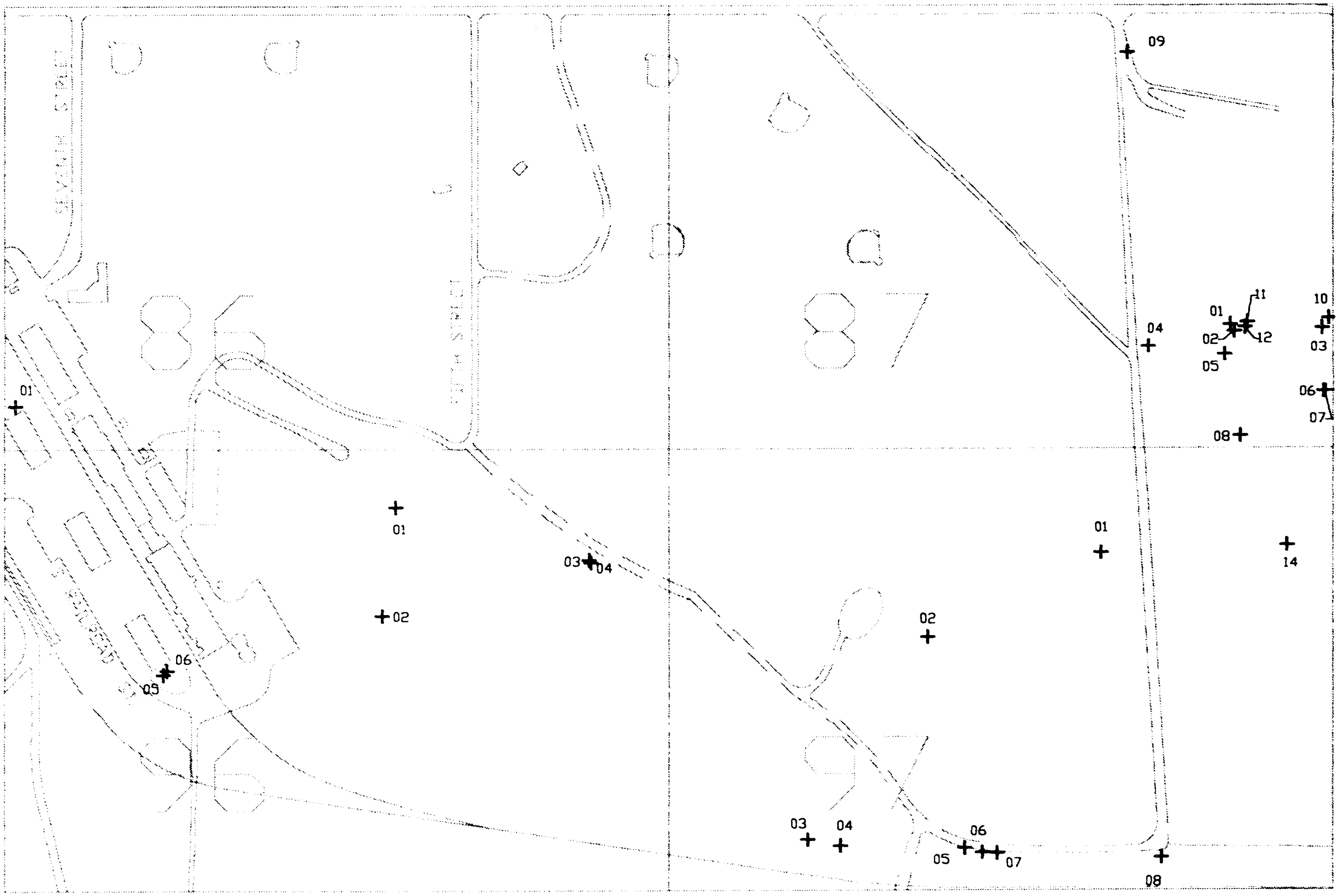


Figure 35: Ground Water Monitoring Wells: Current Landfill, Former Landfill, and Ash Fill Areas.

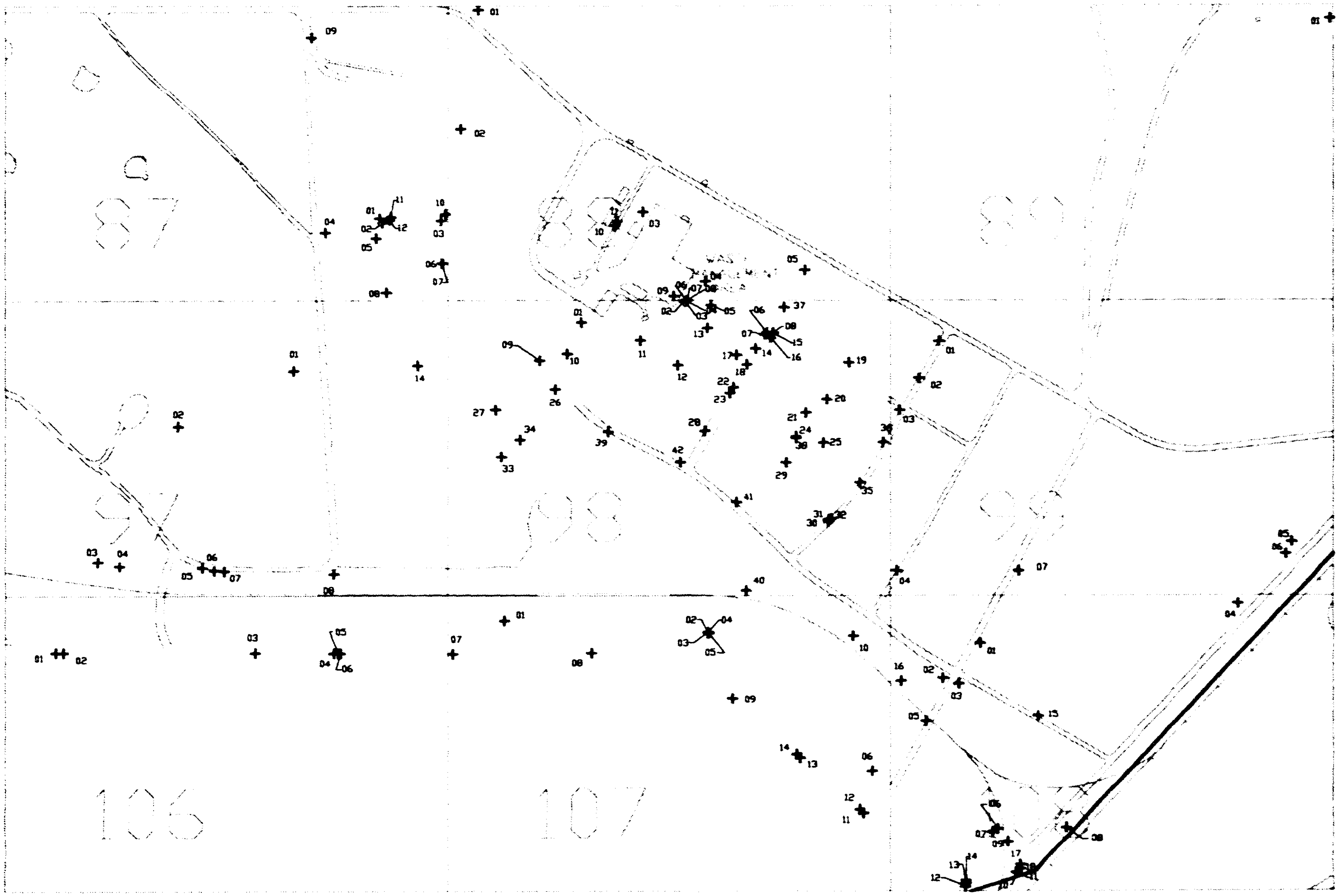


Figure 36: Ground Water Monitoring Wells: Hazardous Waste Management and Current Landfill Areas.

Table 28
BNL Site Environmental Report for Calendar Year 1992
Monitoring Well Identification Cross Reference

Area Loc.	New Well ID	Old Well ID	Reg. Comp. *if Yes	Scheduled Sampling Frequency per Year
CSF Area MPF Lic.	66-08		*	12
	76-16		*	12
	76-17		*	12
	76-18		*	12
	76-19		*	12
1977 Spill	65-01			2
	76-02	D13		2
	76-04	IT1		2
	76-05	IT5		2
	76-06	IT2		2
	76-07	D14		2
	76-08	IT4		2
	76-09	D15		2
	76-10	IT3		2
	76-20			2
	76-21			2
Building 830	66-07			2
	66-08		*	2
	66-09			2
WCF	65-02	D9		3
	65-03	D10		3
	65-04	D11		3
	65-05	D12		3
	65-06	D8		3
AGS	44-01	558		3
	44-02	559		3
	54-01	SJ		3
	54-02	SG		3
	54-05	556		3
	54-06	557		3
	54-07			3
	64-01			3
RHIC	37-01			3

Area Loc.	New Well ID	Old Well ID	Reg. Comp. *if Yes	Sampling Frequency per Year
Army LF (X-26)	53-01	IT2D		1
	53-02	IT2S		1
	53-03	IT1S		1
	53-04	IT1D		1
LINAC	54-03	2G		3
P&GA	75-01			3
	75-02			3
Current LF	87-04	WG		4
	87-05	1K	*	4
	87-06	W9	*	4
	87-07	2C	*	4
	87-09	562		4
	87-10	563	*	4
	87-11	564	*	4
	87-12	565		4
	88-01	W6	*	4
	88-02	WT	*	4
	97-14			4
	98-09	2H		4
	98-10	2J		4
	98-33			4
	98-34			4
	107-07			4
	107-08			4
	107-09			4
	115-01			4
	115-02			4
	115-03			4
	115-04			4
	115-05			4
Old LF & Chem Dumps	96-02	D5		3
	96-03	D16		3
	96-04	D4		3
	97-01	D2		3
	97-02	D3		3
	97-03	D6		3
	97-05	D1		3
	97-08	1J		3
	97-14			3
	105-01	D7		3
	106-04	D18		3

Area Loc.	New Well ID	Old Well ID	Reg. Comp. *if Yes	Sampling Frequency per Year
Ash Repository	104-01	D20		3
HWMA	88-03	MW1		3
	88-04	MW2		3
	98-01	2K		3
	98-04	WC		3
	98-05	PW5		As Req.
	98-07	MW3		3
	98-11	WI		3
	98-16	PW1		As Req.
	98-19	MW6		3
	98-21	MW5		3
	98-22	MW4		3
	98-25	PW2		As Req.
	98-30	MW7A		3
	98-32	MW7B		3
	99-01	W3		3
	99-02	W7		3
	99-04			3
	99-05			3
	99-06			3
	107-10			3
	107-11			3
	107-12			3
	107-13			3
	107-14			3
	108-01	MW13		3
	108-02	PW3		As Req.
	108-03	MW8		3
	108-05	MW12		3
	108-07	D17		3
	108-08	MW11		3
	108-09	PW4		As Req.
	108-12	MW10		3
	108-13			3
	108-14			3
	108-17			3
	108-18			3
North Boundary	13-01	12-01		3
	18-01			3
	18-02			3
	18-03			3
	25-01	560		3
	25-02	561		3
West Sector	72-01			3
	83-01			3
	83-02			3
	84-01			3
	101-01			3
	102-01			3
South Boundary	118-01			3
	118-02			3
	122-01			3
	122-02			3
	126-01	130-01		3
	130-02			3
Building 479	95-04		*	12
Supply and Materiel	85-01	75-03		3
	85-02	75-04		3
	85-03			3
	85-04			As Req.
	86-01			3
	96-05			As Req.
	96-06			3
PR/STP and NE Site	22-01			3
	30-01	XF		3
	38-01			3
	39-03	XJ		3
	39-04	XK		3
	39-05			3
	40-01	XL		3
	40-02	XX		3
	40-03	X3		3
	40-04	XY		3
	40-05	XO		3
	40-07	X2		3
	47-01	XB		3
	47-02	XC		3
	47-03			3
	48-01	XD		3
	49-02	XI		3
	61-01	X1		3
Meadow Marsh	58-01			3
	70-01			3
	80-02			3
	80-03			3
	80-04	90-01		3
	89-01			3
	100-03			3
	100-04			3

assigns grid coordinates for each well to the historic location identifier. Unlike previous years this report uses only the new identifiers. The conversion to the grid numbering system was implemented in order to establish a uniform identification system for the surveillance wells.

5.1.1 Potable Water and Process Supply Wells

During 1992, approximately 16.0 MGD were pumped from the BNL potable and supply network. This network consists of six potable supply wells (Wells 4, 6, 7, 10, 11, and 12) and five secondary cooling water supply wells (Wells 101, 102, 103, 104, and 105). The six potable supply wells and three secondary cooling water wells are screened within the Upper Glacial aquifer. Well No. 104, however, is screened in both the Upper Glacial aquifer and the Magothy aquifer. Wells 4, 6, 7, 10, 11, and 12 were used to supply drinking water, and Wells 101, 102, and 103 were used to supply secondary cooling water to the AGS. Wells 104 and 105 were not operational during 1992 due to TCA concentrations above NYS DWS. Following the shut down of these wells in 1990, water from the Chilled Water Facility has been utilized for secondary cooling requirements of the BMRR.

The data presented in subsequent text and tables are compared to DCGs to determine compliance with operational limits and, because the Upper Glacial aquifer underlying Nassau and Suffolk Counties has been designated as a "Sole Source" aquifer, the data are also compared to the EPA and NYS DWS.

Grab samples were obtained from the potable wells on a quarterly basis and analyzed for radioactivity, water quality indices, metals, chlorocarbon compounds, trihalomethane compounds, and benzene, ethylbenzene, toluene, and xylene (BETX). Potable Well Nos. 10 and 11, which were out of service during 1991 due to the presence of TCA that exceeded the NYS DWS of 5 μg/L, were fitted with activated carbon filtration units and returned to service during CY 1992.

Process Supply Well Nos. 101, 102, and 103 were used periodically during 1992 to provide cooling water to the AGS facility. These wells were not sampled in 1992 by SEPD. Water chemistry analyses (i.e., pH and conductivity) were performed by the AGS facility operators as needed to meet their operational requirements. As discussed above, Process Supply Wells 104 and 105 which were used to provide secondary cooling water to the MRR remained out of service due to the presence of TCA in concentrations above NYS DWS. Due to the potential for cross contamination of the underlying Magothy aquifer, the future use of Well 104 is currently under review by BNL.

5.1.1.1 Radiological Analyses

The average radionuclide concentrations are reported in Table 29. The presence of Co-60 in Potable Well No. 10 which was seen in only one sample, could be related to its proximity to the AGS Area. The concentrations of radionuclides observed in potable water, including this observation, were all small fractions of the applicable water standards or guides and therefore do not pose a safety or health risk to individuals who drink or use the water on site. The dose resulting from consuming 100% of the daily water intake from the highest concentration water sources would result in a committed effective dose equivalent of 0.01 mrem (0.0001 mSv). Quality Control samples consisting of distilled and tap water from Building 535 are analyzed daily for gross alpha, gross beta, and tritium. These results are also presented in Table 29 and can be used for comparison with other ground water sample results.

Table 29
BNL Site Environmental Report for Calendar Year 1992
On-site Potable and Porcess Water
Annual Radionuclide Concentrations (pCi/L)

Well Code	Location	No. of Samples		Gross Alpha	Gross Beta	Tritium	Sr-90	Co-60	K-40
F1	WTP-In	3	Max.	0.26	1.20	224	0.00	ND	14.80
			Avg.	0.08	0.69	77	-0.07	ND	6.00
F2	WTP-Out	4	Max	0.82	1.50	41	0.08	1.01	ND
			Avg	0.36	1.10	-16	-0.16	0.25	ND
FD	#4	3	Max	0.26	0.94	-17	4.57	ND	ND
			Avg	0.07	0.51	-45	2.08	ND	ND
FE	#5	4	Max	0.56	5.10	55	0.14	ND	4.45
			Avg	0.14	1.93	-41	-0.15	ND	1.11
FF	#6	4	Max	0.31	0.68	78	-0.09	ND	2.23
			Avg	0.14	0.47	-7	-0.21	ND	0.56
FG	#7	3	Max	0.31	0.60	120	0.27	ND	ND
			Avg	0.12	0.58	-21	0.11	ND	ND
FI	#102	4	Max	0.41	1.70	750	0.83	ND	4.95
	AGS		Avg	0.09	1.17	212	0.10	ND	1.24
9	Biology	4	Max	1.30	2.20	130	0.23	ND	4.49
			Avg	0.30	0.99	43	-0.20	ND	1.12
FO	#10	4	Max	0.67	5.10	170	-0.01	0.53	ND
			Avg	0.66	3.55	105	-0.14	0.13	ND
FP	#11	3	Max	1.20	1.30	160	-0.19	ND	ND
			Avg	0.33	0.93	119	-0.22	ND	ND
FQ	#12	3	Max	0.37	2.60	120	0.15	ND	ND
			Avg	0.06	1.21	22	0.06	ND	ND
FN	Bldg. 535	247	Max	2.82	15.68	19590	NA	NA	NA
	Potable Water		Avg	0.49	4.53	93	NA	NA	NA
ZB	Bldg. 535	247	Max	2.56	20.21	992	NA	NA	NA
	Distilled		Avg	0.16	1.93	-50	NA	NA	NA
NYS Drinking Water Standard				15	50	20000	8	(a)	(a)
DOE 5400.5 Drinking Water Guide				(a)	(a)	80000	40	200	280
Typical MDL				0.53	1.20	300	0.10	0.23	3.90

WTP-In: Water Treatment Plant Influent
WTP-Out: Water Treatment Plant Effluent
ND: Not detected
MDL: MDL
(a) No standard specified
NA: Not analyzed
Note: DOE Order 5400.5 drinking water guide concentrations obtained by dividing DCGs by 25.

5.1.1.2 Non-radiological Analyses

Six wells were used to supply potable water at BNL during CY 1992. The NYSDOH governs the quality of potable water supplies and requires that the water purveyor routinely monitor the supply for organic, bacteriological, and inorganic constituents. The NYSDOH requirements (under authority of the Safe Drinking Water Act) are implemented by the SCDHS. Monitoring requirements for 1992 included quarterly analysis for POCs, monthly bacteriological analyses, annual microextractables analysis, triennial organic pesticides analysis, and semi annual inorganic analyses (i.e., full and partial chemical analyses). Potable water samples were collected by BNL personnel and analyzed by a NYSDOH certified contractor laboratory using standard methods of analysis. All analytical data was submitted to the SCDHS as required by Chapter I, Part 5 of the NYS Sanitary Code. The bacteriological and inorganic analytical data and POC analytical data collected during CY 1992 has been summarized on Tables 4 and 5, respectively. Review of this data showed the BNL potable supply to meet the NYS DWS. There were no organic pesticides nor microextractables detected in the BNL potable water system during 1992.

In addition to the NYSDOH compliance monitoring requirements, the S&EP Division maintains a comprehensive sampling and analysis program for the BNL potable water supply. During 1992, S&EP monitored the potable wells for metals, water quality parameters, and VOCs. Statistical analysis of the data collected during 1992 for the potable wells is contained in Tables 30, 31, and 32.

Review of the water quality data for the Laboratory potable supply wells shows the indices of water quality such as nitrates, sulfates, and chlorides to be well within the limits established in the NYS DWS.[11,12] The pH values in these wells ranged from 5.5 - 6.7 and are typical of Long Island.[46,47] The pH of water distributed by the BNL water treatment plant (WTP-EFF) ranged from 6.5 to 8.2 while the pH of raw ground water from Potable Well Nos. 10, 11, and 12, which is introduced directly into the distribution system, was 6.0 to 6.7 prior to treatment. Well Nos. 10, 11, and 12 are equipped with metering pumps which control the addition of sodium hydroxide in order to maintain the pH of the pump effluent at approximately 7.3.

The majority of metals including silver, cadmium, chromium, copper, and mercury were not detected in the Laboratory supply system. Manganese, lead, and zinc were detected at levels below their respective NYS DWS. Iron was not detected in water samples collected at the well head of Potable Well Nos. 10, 11, and 12 and was not detected in water from the BNL WTP. Iron was detected at ambient levels in Potable Well Nos. 4, 6, and 7. The water from these latter wells is treated at the WTP which has an iron removal efficiency in excess of 90% and permits distribution of water (WTP-EFF) at concentrations below the 0.3 mg/L NYS DWS. Sodium was detected in all wells at ambient concentrations.

During the second or third month of each quarter, BNL schedules the collection of potable water samples which are analyzed on site by S&EP for ten organic compounds. The ten organic compounds consist of volatile halogenated aliphatic hydrocarbons and aromatic hydrocarbons. These samples serve both as a quality control on the contractor laboratory and as an additional source of organic data used in trend analysis of water quality. Water samples are collected from the well head and before treatment. Review of the organics data

Table 30
BNL Site Environmental Report for Calendar Year 1992
Potable Water and Process Supply Wells
Water Quality Data

Well ID		pH (SU)	Conductivity (µmhos/cm)	Chlorides (mg/L)	Sulfates (mg/L)	Nitrate-Nitrogen (mg/L)
WTP-IN	N	3	3	3	3	3
(F1)	Min.	5.52	87	18.2	10	<1
	Max.	5.75	122	19.7	11	<1
	Avg.	NA	104	18.8	10.5	<1
WTP-EFF	N	3	3	3	3	3
(F2)	Min.	6.48	104	17.7	9.7	<1
	Max.	8.2	161	20.0	10.9	<1
	Avg.	NA	132	18.8	10.2	<1
4 (FD)	N	3	3	3	3	3
	Min.	5.66	74	15.1	9.6	<1
	Max.	6.05	126	17.9	10.8	<1
	Avg.	NA	102	16.2	10.3	<1
6 (FF)	N	3	3	3	3	3
	Min.	5.61	102	13.4	9.7	<1
	Max.	6.13	116	15.8	11.4	<1
	Avg.	NA	108	14.4	10.7	<1
7 (FG)	N	3	3	3	3	3
	Min.	5.86	70	13.6	8.9	<1
	Max.	6.23	116	16.5	10.7	<1
	Avg.	NA	98	15.2	9.7	<1
10 (FO)	N	1	1	1	1	1
	Value	6.34	107	11.9	11.9	<1
11 (FP)	N	3	3	3	3	3
	Min.	5.96	92	13.4	11.9	<1
	Max.	6.01	118	14.6	12.5	<1
	Avg.	NA	106	14.2	12.2	<1
12 (FQ)	N	4	4	4	4	4
	Min.	6.40	104	14.0	10.9	<1
	Max.	6.68	130	16.9	12.0	<1
	Avg.	NA	118	15.4	11.4	<1
5 (FE)	N	4	4	4	4	4
	Min.	5.93	48	4.8	7.8	<1
	Max.	6.57	63	6.1	8.5	<1
	Avg.	NA	51	5.7	8.1	<1
NYSDWS		(a)	(a)	250	250	10
Typical MDL		---	10	4	4	1

MDL: Minimum detection limit.
(a) No standard specified.

Table 31
BNL Site Environmental Report for Calendar Year 1992
Potable Water and Process Supply Wells
Annual Metals Concentration

Well ID		Ag	Cd	Cr	Cu	Fe	Hg	Mn	Na	Pb	Zn
		<----	----	----	----	mg/L	----	----	----	----	---->
WTP-IN	N	3	3	3	3	3	3	3	3	3	3
(F1)	Min.	<0.025	<0.0005	<0.005	<0.05	0.85	<0.0002	<0.05	9.8	<0.002	<0.02
	Max.	0.05	<0.0005	<0.005	<0.05	2.15	<0.0002	0.12	10.4	<0.002	<0.02
	Avg.	<0.025	<0.0005	<0.005	<0.05	1.57	<0.0002	0.06	10.1	<0.002	<0.02
WTP-EFF	N	3	3	3	3	3	3	3	3	3	3
(F2)	Min.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	9.5	<0.002	<0.02
	Max.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	10.4	0.0026	<0.02
	Avg.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	9.8	<0.002	<0.02
4 (FD)	N	3	3	3	3	3	3	3	3	3	3
	Min.	<0.025	<0.0005	<0.005	<0.05	0.3	<0.0002	0.08	9.7	<0.002	<0.02
	Max.	<0.025	<0.0005	<0.005	<0.05	2.63	<0.0002	0.14	10.5	0.0027	<0.02
	Avg.	<0.025	<0.0005	<0.005	<0.05	1.82	<0.0002	0.12	10.2	<0.002	<0.02
6 (FF)	N	3	3	3	3	3	3	3	3	3	3
	Min.	<0.025	<0.0005	<0.005	<0.05	3.22	<0.0002	0.06	8.7	<0.002	<0.02
	Max.	<0.025	<0.0005	<0.005	<0.05	5.79	<0.0002	0.08	10.6	0.0025	0.03
	Avg.	<0.025	<0.0005	<0.005	<0.05	4.24	<0.0002	0.07	9.8	<0.002	<0.02
7 (FG)	N	3	3	3	3	3	3	3	3	3	3
	Min.	<0.025	<0.0005	<0.005	<0.05	0.23	<0.0002	0.07	9.0	<0.002	<0.02
	Max.	<0.025	<0.0005	<0.005	<0.05	1.84	<0.0002	0.07	10.1	0.0025	0.05
	Avg.	<0.025	<0.0005	<0.005	<0.05	1.20	<0.0002	0.07	9.4	<0.002	<0.02
10 (FO)	N	1	1	1	1	1	1	1	1	1	1
	Value	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	9.8	<0.002	<0.02
11 (FP)	N	3	3	3	3	3	3	3	3	3	3
	Min.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	9.8	<0.002	<0.02
	Max.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	10.5	0.004	0.02
	Avg.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	10.0	0.0024	<0.02
12 (FQ)	N	4	4	4	4	4	4	4	4	4	4
	Min.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	11.0	<0.002	<0.02
	Max.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	13.1	0.003	<0.02
	Avg.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	11.9	<0.002	<0.02
5 (FE)	N	4	4	4	4	4	4	4	4	4	4
	Min.	<0.025	<0.0005	<0.005	<0.05	0.20	<0.0002	<0.05	3.4	0.0021	0.03
	Max.	<0.025	<0.0005	<0.005	0.16	0.62	<0.0002	<0.05	3.8	0.0071	0.06
	Avg.	<0.025	<0.0005	<0.005	0.07	0.39	<0.0002	<0.05	3.6	0.0040	0.05
NYSDWS		0.05	0.01	0.05	1.3**	0.3	0.002	0.3	(a)	0.015**	5.0
Typical MDL		0.025	0.0005	0.005	0.05	0.075	0.0002	0.05	1.0	0.002	0.02

MDL: Minimum detection limit.
(a) No standard specified.
** The action levels promulgated under the Federal Lead and Copper rule are 1.3 mg/l for copper and 0.015 mg/L for lead.

Table 32
BNL Site Environmental Report for Calendar Year 1992
Potable Water and Supply Wells
Chlorocarbon Data

Well ID	No. of Samples		1,1,1 Trichloroethane	Chloroform
			<--------------- µg/L	-------------->
WTP-IN (F1)	3	Avg:	<2.0	<2.0
		Min:	<2.0	<2.0
		Max:	3.0	5.0
WTP-EFF (F2)	5	Avg:	<2.0	9.3
		Min:	<2.0	7.0
		Max:	<2.0	14.0
4 (FD)	7	Avg:	<2.0	4.0
		Min:	<2.0	4.0
		Max:	3.0	4.0
6 (FF)	3	Avg:	<2.0	<2.0
		Min:	<2.0	<2.0
		Max:	<2.0	<2.0
7 (FG)	3	Avg:	<2.0	<2.0
		Min:	<2.0	<2.0
		Max:	<2.0	<2.0
10 (F)	1		<2.0	<2.0
11 (F)	3	Avg.	5.0	<2.0
		Min.	4.0	<2.0
		Max.	6.0	<2.0
12 (FQ)	4	Avg:	<2.0	<2.0
		Min:	<2.0	<2.0
		Max:	<2.0	3.0
5 (FE)	2	Avg:	<2.0	<2.0
		Min:	<2.0	<2.0
		Max:	<2.0	<2.0
NYS Drinking Water Standards			5.0	100.0
Typical MDL			2.0	2.0

WTP-IN: Water Treatment Plant Influent.
WTP-EFF: Water Treatment Plant Effluent.
MDL: Minimum detection limit.

shows that only chloroform and TCA were detected in the potable wells. The concentration of TCA evidenced within Well 11 appears to exceed the NYS DWS; however, this well was fitted with a carbon adsorption treatment system during CY 1992 which effectively reduces the concentration of TCA to below the NYS DWS. All remaining eight organic compounds were not detected in water samples collected during CY 1992.

5.1.2 Ground Water Monitoring

Ground water monitoring is being performed at BNL as an integral part of the BNL Environmental Monitoring Program. This program includes monitoring at active waste processing and temporary storage facilities to comply with RCRA, waste treatment facilities, operational monitoring around accelerators, and in areas of known or suspected soil and ground water contamination.

Most ground water monitoring wells on the site are 2" to 4" in diameter and constructed of PVC material and were installed using RCRA and CERCLA protocols. In several areas of the site (e.g., the STP, HWMF, and Current Landfill), a number of old, small diameter (1.25") wells constructed of carbon steel casings and brass screens are utilized. These wells will be upgraded to PVC during the planned remedial investigations, and these older wells will either be abandoned or used for water level measurements.

Ground water samples were collected following documented sampling procedures based on EPA guidelines.[48] Analytical techniques used are described in this report (see Appendix C), and in the BNL Site Environmental Monitoring Plan.[34] The species analyzed are listed in Table 33.

Samples were analyzed by the BNL-S&EP Analytical Laboratory and subcontracted laboratories. The data presented in subsequent text and tables are compared to DCGs to determine compliance with operational limits, and because the Upper Glacial aquifer underlying Nassau and Suffolk Counties has been designated as a "Sole Source" aquifer,[2] these data are also compared to the NYS DWS.

5.1.2.1 Radiological Analyses

In 1992, the cooperative program between BNL and the SCDHS continued for the collection and analysis of samples from wells serving private homes. As part of this program, samples were collected quarterly from 16 private drinking water wells in Suffolk County. Twelve of these sampling stations were from homes near the Laboratory, with the remainder from locations randomly selected by SCDHS. A total of 18 different locations were sampled in 1992. Samples were analyzed for gross alpha, gross beta, and tritium on a quarterly basis, while analyses for Sr-90 and gamma spectroscopy were performed annually. Results from this program are presented in Table 34 which indicate that tritium was detected in samples collected from four locations adjacent to the Laboratory. (One location was a sampling point along the Peconic River and three locations were private potable wells.) The private wells in the sampling program are screened at depths ranging from 50 to 200 feet and had annual average tritium concentrations that ranged from below detection limits to 818 pCi/L (30 Bq/L). Although above background, these data were consistent with data collected since 1979, and were less than 24% of concentration limits and 6% of the dose limit specified by the NYS DWS for

Table 33
BNL Site Environmental Report for Calendar Year 1992
Radionuclides and Chemicals Analyzed in Enviornmental Samples

Radiological Parameters	Chemical Parameters
^{3}H	pH (field and laboratory)
Sr-90	Conductivity (field)
γ-spectrometry: Natural Activation Fission	Na, Cr, Fe, Cu, Zn, Cd, and Pb
Gross Alpha	Hg
Gross Beta	Chlorides, Sulfates, Nitrate-Nitrogen Volatile Organic Constituents Semi-volatile Organic Constituents

Table 34
BNL Site Environmental Report for Calendar Year 1992
Radionuclide Concentrations in Off-Site Potable Water

Sample Location	Number of Samples	Gross Alpha		Gross Beta		Tritium		Sr-90	Co-60	K-40	Cs-137
		Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Avg.	Avg.	Avg.
		<---					pCi/L				--->
1	4	0.15	0.39	1.60	1.81	-92	68	-0.14	0.13	3.00	0.78
2	4	0.05	0.15	0.98	1.51	-154	-110	-0.30	ND	ND	ND
3 (PR)	4	0.11	0.55	3.36	4.87	4757	12400	0.19	ND	2.67	1.18
4	4	0.16	0.41	0.95	1.62	637	1020	-0.25	0.12	3.11	0.10
5*	4	0.57	1.07	2.05	2.80	818	1180	-0.56	ND	ND	ND
6 (PR)	4	0.08	0.26	1.47	4.76	-59	11	-0.44	ND	ND	ND
7	4	0.31	0.50	2.58	3.51	-61	-16	-0.29	ND	15.4	0.90
8 (PR)	4	0.27	0.63	1.23	1.70	-77	78	-0.26	ND	ND	0.17
9	4	0.18	0.66	1.22	4.31	-88	83	-0.06	ND	ND	ND
10	4	0.15	0.44	0.99	2.53	-59	68	-0.29	ND	ND	ND
11	4	0.04	0.27	0.66	1.25	-68	1	-0.58	ND	ND	ND
12	4	0.15	0.26	1.09	1.59	-92	-5	-0.14	ND	ND	0.66
13	4	0.42	0.73	0.90	1.74	-50	13	-0.14	ND	ND	ND
14	3	0.60	1.01	1.21	1.93	-34	6	-0.09	ND	ND	ND
15	3	0.04	0.23	1.13	1.36	-118	1	0.01	ND	ND	ND
16 (PR)	2	0.00	0.00	2.53	2.95	-38	-6	NA	ND	2.48	ND
17	2	0.07	1.19	-0.08	0.08	-181	-150	NA	ND	ND	ND
18	2	0.51	0.51	0.64	0.64	230	489	NA	ND	ND	ND
NYS Drinking Water Standard		15.		50.		20000		8	(a)	(a)	(a)
Typical MDL		0.53		1.2		300		0.1	0.23	3.9	0.2

PR: Peconic River sampling point.
NA: Not analyzed.
ND: Not detected.
MDL: Minimum detection limit.
(a) Standard not specified.
* Th^{238} at a concentration of 0.19 pCi/L was observed <u>only</u> in Well #5.

community water supplies. Gamma spectroscopy results from these private wells in 1992 indicated the presence of trace quantities of world-wide fallout radionuclides Sr-90 and Cs-137, and of naturally occurring K-40. In most of the samples, the observed concentrations were below the detection limit but above the two sigma counting error. They are reported as trace for trending purposes. The Peconic River sampling location was observed to contain Cs-137. The reported concentration, 1.18 pCi/L (0.04 Bq/L), agrees well with the 1992 annual average Cs-137 concentration in the Peconic River on site of 1.39 pCi/L (0.05 Bq/L). Strontium-90 results are effectively at or below the analytical detection limits.

The data for the samples collected from control wells, wells in the North Boundary and West Sectors, South Boundary, central part of the BNL site, RHIC, the Current and Former Landfills, Former Army Landfill, Ash Repository, MPF, CSF, Peconic River on site/off site, Meadow Marsh-Upland Recharge, and the HWM areas are shown in Tables 35, 36, 37, and 38.

The yearly average concentrations of radionuclides in samples from the wells adjacent to the sand filter beds at the STP, downstream of the Peconic River, and adjacent to the Meadow Marsh-Upland Recharge Area are summarized in Table 35. The location of these wells are presented in Figures 31 and 32. Elevated gross beta, tritium, and Sr-90 concentrations have been found in on-site wells adjacent to the sand filter beds and the Peconic River. The observed levels are probably attributable to losses from the tile collection field underlying the sand filter beds and periodic recharge to ground water from the Peconic River in this area. In 1992, on-site gross beta ground water concentrations in this area ranged from 0.01% to 22.5% of the NYS DWS. Tritium concentrations ranged from nondetectable to 22.5% of the NYS DWS. Gamma emitting radionuclides, except for K-40 and Cs-137, were not detected in any of the Peconic River on site/off site and the Meadow Marsh-Upland Recharge Area monitoring wells.

At the North Boundary, Former Army Landfill, AGS, WCF, PG&A, NSLS, RHIC, Building 830, South Boundary, and West Sector site wells, (Figure 33 and Tables 36 and 37) most results were either below the system detection limits or typical of ground water not impacted by laboratory operations. The highest gross beta level observed was in the vicinity of WCF area at Location 65-02. Down gradient of the AGS and at Building 811, Na-22 was routinely detected at concentrations up to 1.5% of NYS DWS. Strontium-90 was also detected in these and other AGS area wells in concentrations representing less than 15% of the NYS DWS.

In the vicinity of Building 830 (Table 36), radiological results for ground water monitoring samples indicated the presence of Co-60 in two of these wells. The Co-60 concentrations are most likely related to operational activities at Building 830 associated with the "D-waste" line leak. The observed concentrations are less than 7% of the NYS DWS. Well 65-03 in the same area showed Sr-90 concentration levels slightly above ambient conditions but well below (7%) the NYS DWS. Ground water samples analyzed from monitoring wells near the P&GA building indicated no significant concentrations of radionuclides.

Table 35
BNL Site Environmental Report for Calendar Year 1992
Peconic River On-site/Off-site, Meadow Marsh/Upland Recharge Area
Ground Water Surveillance Wells, Radioactivity Data

Area	Sample ID	Number of Samples	Gross Alpha Max.	Gross Alpha Avg.	Gross Beta Max.	Gross Beta Avg.	Tritium Max.	Tritium Avg.	Cs-137 Max.	Cs-137 Avg.	K-40 Max.	K-40 Avg.	Sr-90 Max.	Sr-90 Avg.
			<---- pCi/L ---->											
Peconic River On-site	22-01	2	0.19	0.06	2.23	1.51	123	99	ND	ND	12.00	6.00	0.17	0.13
	30-01	2	0.40	0.34	0.34	0.28	648	-13	ND	ND	4.35	2.18	0.01	-0.14
	38-01	2	0.90	0.41	1.28	1.24	-80	-110	ND	ND	ND	ND	0.08	-0.08
	39-03	2	0.27	0.16	1.85	1.66	721	334	ND	ND	ND	ND	0.28	0.03
	39-04	1	0.00	0.00	5.44	5.44	4500	4500	ND	ND	ND	ND	1.20	1.20
	39-05	2	0.34	0.32	8.12	5.10	484	423	0.16	0.08	4.49	2.24	0.75	0.56
	40-01	2	0.92	0.14	13.80	11.26	2880	2440	ND	ND	ND	ND	-0.07	-0.09
	40-02	2	0.79	0.61	5.82	5.57	812	310	ND	ND	ND	ND	1.20	0.90
	40-03	2	0.27	0.10	1.13	0.90	523	99	ND	ND	ND	ND	0.34	0.06
	40-04	2	3.94	2.00	3.79	3.28	892	628	ND	ND	ND	ND	-0.12	-0.18
	40-05	2	0.13	0.04	2.91	2.70	-66	-115	ND	ND	3.93	3.24	1.01	0.65
	40-07	2	0.19	0.16	5.48	3.06	600	311	0.75	0.74	ND	ND	0.02	-0.12
	47-01	2	1.04	0.82	2.15	1.94	668	52	ND	ND	ND	ND	0.04	0.10
	47-02	2	1.71	1.17	4.84	3.64	588	-136	ND	ND	ND	ND	NA	NA
	47-03	2	0.74	0.37	0.15	0.13	-16	-43	ND	ND	ND	ND	-0.26	-0.32
	48-01	1	-0.06	-0.06	1.44	1.44	-30	-30	ND	ND	ND	ND	-0.43	-0.43
	49-02	2	0.71	0.48	5.51	4.19	531	306	ND	ND	33.60	33.60	0.61	0.36
	58-01	2	3.10	1.52	2.04	1.48	86	-25	ND	ND	ND	ND	0.01	-0.03
Peconic River Off-site	80-02	2	0.19	0.09	1.28	0.79	92	57	ND	ND	ND	ND	0.76	C.35
	80-03	2	0.10	0.05	0.64	0.53	92	59	ND	ND	ND	ND	0.12	-0.11
Meadow Marsh/ Upland Recharge	70-01	1	0.12	0.12	1.62	1.62	91	91	ND	ND	ND	ND	0.03	0.03
	89-01	1	0.28	0.28	3.63	3.63	-70	-70	ND	ND	13.90	13.90	0.13	0.13
	100-03	1	0.64	0.64	2.61	2.61	92	92	ND	ND	ND	ND	-0.16	-0.16
	100-04	1	0.00	0.00	0.26	0.26	-608	-608	ND	ND	ND	ND	0.03	0.03
NYS Drinking Water Standard			15		50		20000		(a)		(a)		8	
DOE Order 5400.5 Derived Concentration Guide For Drinking Water			(a)		(a)		80000		120		280		40	
Typical MDL			0.53		1.20		300		0.20		3.90		0.10	

NA: Not analyzed.
ND: Not detected.
MDL: Minimum detection limit.
(a) No standard specified.

Note: Well 80-04 (Meadow Marsh area) not sampled. Well 00-X4 (Peconic River Off-site) not sampled.
The following wells (Peconic River On-site area) showed an one time concentration of: Well 39-03 Na^{22} at 0.15 pCi/L; Well 40-07 (Peconic River On-site area); Co-60 at 0.61 pCi/L.

Table 36
BNL Site Environmental Report for Calendar Year 1992
Ground Water Surveillance Wells, Radioactivity Data
Miscellaneous Areas of the BNL Site

Area	Well ID.	Number of Samples	Gross Alpha Avg.	Gross Alpha Max.	Gross Beta Avg.	Gross Beta Max.	Tritium Avg.	Tritium Max.	Na-22 Avg.	Na-22 Max.	Co-60 Avg.	Co-60 Max.	Mn-54 Avg.	Mn-54 Max.	Cs-137 Avg.	Cs-137 Max.	K-40 Avg.	K-40 Max.	Sr-90 Avg.	Sr-90 Max
			<----------								pCi/L									---------->
Army Landfill (x-26)	53-01	1	0.09	0.09	0.98	0.98	-160	-160	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.13	-0.13
	53-02	1	0.79	0.79	0.87	0.87	111	111	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.11	-0.11
	53-03	2	0.12	0.16	0.26	0.53	-25	-50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05	0.09
	53-04	1	0.13	0.13	1.51	1.51	-121	-121	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.17	-0.17
AGS	44-01	2	0.27	0.32	2.63	2.83	126	910	ND	ND	0.64	1.29	ND	ND	ND	ND	ND	ND	-0.07	-0.07
	44-02	2	-0.09	0.09	0.48	0.72	-248	135	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.90	1.20
	54-01	1	5.07	5.07	5.55	5.55	262	262	3.05	3.05	ND	ND	ND	ND	ND	ND	3.26	3.26	NA	NA
	54-05	2	0.60	0.72	2.36	2.45	-187	38	ND	ND	0.65	1.29	ND	ND	ND	ND	ND	ND	-0.04	0.16
	54-06	2	0.48	1.11	3.25	3.59	-66	11	0.16	0.33	ND	ND	ND	ND	ND	ND	2.23	4.45	0.04	0.07
	64-01	2	1.05	1.84	3.18	3.78	-70	581	1.59	2.17	ND	ND	ND	ND	ND	ND	1.20	2.40	0.71	0.89
WCF	65-01	2	0.58	1.74	1.74	1.96	-238	180	ND	ND	ND	ND	0.39	0.77	ND	ND	ND	ND	-0.13	-0.11
	65-02	2	-0.23	0.43	5.82	6.42	180	232	ND	ND	ND	ND	ND	ND	1.39	2.77	ND	ND	0.64	1.11
	65-03	2	-0.55	-0.46	4.19	4.68	303	11	0.78	0.98	ND	ND	ND	ND	ND	ND	4.82	6.54	1.09	1.34
	65-04	2	0.09	0.83	4.08	4.53	-139	106	0.34	0.68	ND	ND	ND	ND	ND	ND	ND	ND	0.38	0.53
PG&A	75-01	2	1.08	1.48	1.72	1.89	487	591	ND	ND	ND	ND	0.09	0.19	ND	ND	ND	ND	-0.11	0.11
	75-02	2	0.78	1.25	2.62	2.64	532	567	0.13	0.25	ND	ND	ND	ND	ND	ND	2.53	5.15	0.10	0.13
NSLS	85-01	2	0.64	1.41	1.28	1.89	58	59	ND	ND	0.20	0.41	ND	ND	ND	ND	1.31	2.62	-0.03	-0.03
	85-02	2	0.05	0.31	0.54	0.64	59	81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.20	-0.15
Bldg. 830	66-07	1	0.45	0.45	1.55	1.55	51	51	ND	ND	0.36	0.36	ND	ND	ND	ND	ND	ND	0.02	0.02
	66-08	2	-0.11	-0.08	1.30	1.59	134	228	0.35	0.70	7.61	14.80	0.22	0.44	0.39	0.77	ND	ND	-0.32	-0.08
	66-09	1	0.37	0.37	0.91	0.91	-133	-133	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-1.82	-1.82
RHIC	37-01	2	-0.26	-0.21	1.98	2.00	-34	87	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.12	0.16
LINAC	54-03	2	-0.46	0.21	1.65	2.72	-61	48	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.04	0.22
NYS Drinking Water Standards			15		50			20000		(a)		(a)		(a)		(a)		(a)		8
DOE Order 5400.5 Derived Concentrations Guide for Drinking Water			(b)		(b)			80000		400		200				120		280		40
Typical MDL			0.53		1.2			300		0.2		0.23				0.2		3.9		0.1

ND: Not detected.
MDL: Minimum detection limit.
(a) Standard not specified.

Note: Wells 54-02 (AGS area), 65-06 and 65-06 (WCF area) not sampled. The following wells showed a one time concentrations of: Well 66-08 (Bldg. 830 area): Zn-65 at 2.94 pCi/L, Well 75-02 (PG&A area): Ra-226 at 0.03 pCi/L.

Table 37
BNL Site Environmental Report for Calendar Year 1992
North Boundary, West Sector, South Boundary, and Supply & Materiel Areas
Ground Water Surveillance Wells, Radioactivity Data

Area	Sample(a) ID	Number of Samples	Gross Alpha		Gross Beta		Tritium		Co-60		Cs-137		K-40		Sr-90	
			Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
			<---------- pCi/L ---------->													
North Boundary	12-01	3	-0.32	-0.00	1.06	0.77	282	91	ND	ND	ND	ND	ND	ND	-0.12	-0.20
	18-01	3	0.48	0.16	1.89	1.59	313	60	ND	ND	ND	ND	ND	ND	0.30	0.22
	18-02	3	0.34	0.11	0.76	0.43	253	84	ND	ND	ND	ND	ND	ND	0.89	0.14
	18-03	3	0.54	-0.21	2.11	1.28	299	116	ND	ND	ND	ND	ND	ND	2.77	0.83
	25-01	3	0.18	0.13	1.06	1.04	221	29	0.79	0.48	0.96	0.32	ND	ND	0.29	0.01
	25-02	3	0.21	0.11	3.02	2.23	310	132	ND	ND	ND	ND	ND	ND	0.19	0.13
West Sector	72-01	2	0.13	0.07	0.98	0.42	16	11	0.86	0.29	ND	ND	ND	ND	0.12	0.11
	83-01	2	0.50	0.14	0.49	0.38	104	38	ND	ND	1.01	0.34	ND	ND	0.25	0.06
	83-02	2	1.78	1.44	0.83	0.64	109	48	ND	ND	ND	ND	ND	ND	-0.11	-0.16
	84-01	2	-1.16	-1.28	3.02	2.14	129	68	ND	ND	ND	ND	6.71	5.06	0.02	0.01
	101-01	2	-0.24	-0.28	0.60	0.55	77	-110	ND	ND	ND	ND	2.20	1.10	0.37	0.24
South Boundary	118-01	2	0.26	0.09	1.62	0.70	92	17	ND	ND	ND	ND	2.22	2.21	1.14	0.25
	118-02	2	0.41	0.20	1.21	1.19	49	19	2.80	1.40	ND	ND	19.0	9.50	-0.16	-1.84
	122-01	2	-0.05	-0.09	1.17	1.02	-5	-14	ND	ND	ND	ND	ND	ND	0.14	0.09
	122-02	2	0.16	0.15	2.04	1.96	455	393	ND	ND	0.27	0.14	ND	ND	-0.06	-0.08
	126-01	2	0.36	0.15	3.97	2.49	38	-34	ND	ND	0.13	0.07	ND	ND	0.08	0.03
	130-02	2	1.49	0.98	1.25	1.12	150	120	ND	ND	ND	ND	ND	ND	0.13	0.12
Supply & Materiel	85-03	1	-0.81	-0.81	1.10	1.10	-117	-117	ND	ND	ND	ND	ND	ND	-0.03	-0.03
	86-01	1	-0.12	-0.12	0.83	0.83	-143	-143	ND	ND	ND	ND	ND	ND	-0.25	-0.25
	96-06	1	-0.33	0.33	1.10	1.10	6	6	ND	ND	ND	ND	ND	ND	-0.43	-0.43
NYS Drinking Water Standard			15		50		20000		(b)		(b)		(b)		8	
DOE Order 5400.5 Derived Concentration Guide For Drinking Water			(b)		(b)		80000		200		120		280		40	
Typical MDL			0.53		1.20		300		0.23		0.20		3.90		0.10	

ND: Not detected.
MDL: Minimum detection limit.
(a) South Boundary wells monitoring Hazardous Waste Management Facility and Current Landfill are not included.
(b) Standard not specified.

Note: Well 105-02 (S&M area) was not sampled.

Table 38
BNL Site Environmental Report for Calendar Year 1992
Ground Water Surveillance Wells, Radioactivity Data
Current Landfill, Old Landfill, and Ash Repository Areas

Area	Well ID.	Number of Samples	Gross Alpha Avg.	Gross Alpha Max.	Gross Beta Avg.	Gross Beta Max.	Tritium Avg.	Tritium Max.	Na-22 Avg.	Na-22 Max.	Co-60 Avg.	Co-60 Max.	K-40 Avg.	K-40 Max.	Cs-137 Avg.	Cs-137 Max.	Sr-90 Avg.	Sr-90 Max.
			<----								pCi/L							---->
Current Landfill	87-05(a)	4	0.91	5.16	16.1	19.6	10260	17200	ND	ND	ND	ND	14.42	19.10	ND	ND	1.87	2.74
	87-06	4	4.99	11.00	22.62	24.70	19325	20500	0.38	0.48	0.04	0.16	17.45	20.30	ND	ND	3.90	4.61
	87-07	4	0.04	3.07	20.67	29.8	15375	16800	0.25	0.33	ND	ND	15.73	17.30	ND	ND	0.17	1.75
	87-09	5	0.20	0.95	0.60	1.59	-117	-43	ND	ND	ND	ND	ND	ND	0.05	0.24	1.10	-0.13
	87-10	4	0.13	0.31	8.10	14.10	-544	537	0.58	0.63	ND	ND	10.48	11.9	0.04	0.13	1.42	4.25
	87-11	4	1.06	2.46	10.01	17.80	3662	4880	ND	ND	ND	ND	9.10	19.8	0.06	0.25	-3.56	1.37
	87-12	5	0.32	0.68	1.32	1.62	-81	201	ND	ND	ND	ND	1.18	5.88	ND	ND	0.17	0.75
	88-01	4	1.09	2.79	1.25	1.81	1022	4240	ND	ND	ND	ND	ND	ND	ND	ND	0.08	0.23
	88-02	4	1.02	2.11	1.50	2.11	-47	346	ND	ND	ND	ND	0.60	2.40	ND	ND	0.25	1.09
	97-14	3	0.44	0.73	1.76	2.57	2660	4790	ND	ND	ND	ND	4.83	14.5	ND	ND	0.32	0.45
	98-01	4	0.09	0.26	6.06	6.91	492	1610	ND	ND	ND	ND	3.93	4.15	ND	ND	1.73	2.10
	98-09	3	0.22	0.36	6.28	6.69	198	249	ND	ND	ND	ND	ND	ND	ND	ND	0.38	0.74
	98-10	4	0.05	0.31	8.12	12.20	4618	5590	0.06	0.26	ND	ND	0.52	2.10	ND	ND	2.28	2.73
	98-33	4	0.39	0.68	2.59	2.98	609	1010	ND	ND	0.04	0.15	4.64	6.54	ND	ND	0.12	0.47
	98-34	4	1.50	4.88	11.10	12.70	4406	7130	0.08	0.33	ND	ND	5.97	10.90	ND	ND	1.64	2.98
	107-07	4	0.56	1.29	1.50	2.23	302	431	ND	ND	ND	ND	ND	ND	ND	ND	-0.16	-0.36
	107-08	3	0.90	2.04	1.85	2.27	821	1050	ND	ND	ND	ND	6.60	19.70	ND	ND	-0.13	-0.04
	107-09	3	0.22	0.39	0.87	1.44	1563	1820	ND	ND	ND	ND	ND	ND	ND	ND	-0.02	0.63
	115-01	4	0.53	1.43	1.04	2.46	-190	31	ND	ND	0.24	0.95	0.82	3.28	ND	ND	-0.14	-0.05
	115-02	4	0.31	0.46	0.83	1.21	-119	-12	ND	ND	0.15	0.60	ND	ND	ND	ND	0.13	0.63
	115-03	4	0.23	0.36	0.60	1.28	-99	107	ND	ND	ND	ND	ND	ND	0.19	0.77	-0.22	-0.09
	115-04	3	0.09	0.45	0.94	2.30	946	991	ND	ND	ND	ND	3.50	10.50	ND	ND	-0.04	-0.05
	115-05	3	0.07	0.21	0.30	0.64	2463	2760	ND	ND	0.26	0.77	ND	ND	0.21	0.62	-0.12	-0.10
Old Landfill	96-02	3	-0.13	-0.08	1.54	2.80	-75	-1	ND	ND	0.18	0.54	1.32	3.95	ND	ND	-0.04	0.10
	96-03	3	-0.34	-0.36	1.22	1.59	-26	33	ND	ND	ND	ND	ND	ND	0.29	0.88	-0.22	0.07
	96-04	3	-0.08	0.07	1.21	1.51	-83	-5	ND	ND	ND	ND	ND	ND	ND	ND	-0.12	-0.27
	97-01	3	0.17	0.72	0.77	1.02	-41	89	ND	ND	ND	ND	2.07	3.56	ND	ND	-0.07	0.15
	97-02	2	-0.09	-0.06	0.70	1.47	-44	33	ND	ND	ND	ND	ND	ND	ND	ND	-0.15	-0.14
	97-03	3	0.82	1.89	17.70	19.90	-74	27	ND	ND	ND	ND	ND	ND	ND	ND	2.36	3.81
	97-05	3	0.19	0.37	12.41	32.90	-30	45	ND	ND	ND	ND	0.81	2.42	0.05	0.14	0.76	2.24
	97-08	3	0.11	0.27	-0.01	0.08	-110	16	ND	ND	ND	ND	ND	ND	ND	ND	-0.13	-0.27
	105-01	3	0.29	0.19	0.75	1.06	-86	65	ND	ND	0.07	0.21	ND	ND	ND	ND	-0.23	0.21
	106-04	2	0.21	0.29	-0.07	0.32	-83	-52	ND	ND	ND	ND	1.92	3.83	ND	ND	-0.23	-0.15
Ash Repository	104-01	3	0.07	0.33	1.84	2.04	-36	212	ND	ND	ND	ND	ND	ND	ND	ND	1.01	2.79
NYS Drinking Water Standard				15		50		20000		(b)		(b)		(b)		(b)		8
DOE Order 5400.5 Drinking Water Guide				(b)		(b)		80000		400		200		280		120		40

ND: Not detected.
MDL: Minimum detection limit.
(a) Well 87-05 showed Be-7 at a concentration of 11.4 pCi/L.
(b) Standard not specified.

Note: Wells 87-04 and 106-02 were not sampled.

Radionuclide results for samples collected at the Current and Old Landfill areas and at the Ash Repository area are presented in Table 38. At the Current Landfill, nine downgradient wells consistently show elevated gross beta concentrations; 15 wells exhibit above background concentrations of tritium; eight wells (essentially those with elevated gross beta concentrations) have elevated Sr-90 levels; Na-22 was detected in five wells; and Cs-137 was detected in five wells. The highest annual average gross beta, tritium, Sr-90, Na-22, Co-60, and Cs-137 concentrations were 60%, 103%, 57%, 0.15%, 0.47% and 0.6%, respectively of the NYS DWS. In general, radionuclide concentrations in the downgradient Current Landfill wells are consistent with inorganic contaminants, specifically iron, observed at the same locations. The presence of radionuclides in ground water samples, collected from the Current Landfill area, is the result of BNL's past practice of placing low specific activity material in that location. This practice was terminated in 1978.

At the Old Landfill, the maximum gross beta concentrations of 32.9 pCi/L was observed in Well 97-05. Tritium and gamma activity concentrations were at or below the MDL of the system and well below the NYS DWS. Strontium-90 was detected at Well 97-03 at a concentration of 3.81 pCi/L. This has been observed consistently over the past few years. The presence of radionuclides in ground water samples from the Old Landfill and Chemical Hole Area is the result of BNL's past practice of placing low specific activity material in that location.

Table 39 shows that radionuclide concentrations in the MPF and CSF Areas (Figure 34). Data indicates that the radionuclides were all at or below the MDL of the system, except for the presence of Co-60 in wells at the CSF. Well 66-08 which is used as an upgradient well for the CSF (but down gradient of Building 830) showed Co-60 which is attributable to the spill at Building 830.

The ground water monitoring program conducted at the HWMF (Figure 36) consists of a shallow well network located near the facility and a set of deeper wells that extends out from the facility in the direction of ground water flow. The radiological results for the samples collected from this program are presented in Table 40. Elevated annual average gross beta concentration was observed in Well 88-04. The observed concentration was 1674% of the gross beta NYS DWS. Twenty-five well locations exhibit tritium concentrations in excess of ambient levels. The maximum annual average concentration observed in this area was 172% of the NYS DWS. Sodium-22 and Co-60 were detected periodically in samples from this area at concentrations substantially less than 1% of the NYS DWS. Strontium-90 was detected in excess of the NYS DWS at the three wells identified with elevated gross beta concentration. At Well 88-04, the Sr-90 concentration was 290.26 pCi/L (10.92 Bq/L); at Well 98-04, the Sr-90 concentration was 9.94 pCi/L (0.37 Bq/L); and at Well 98-30, the Sr-90 concentration was 11.84 pCi/L (0.43 Bq/L). The NYS and EPA Sr-90 NYS DWS is 8 pCi/L (0.3 Bq/L). The locations where these concentrations were observed were well within the site boundary. Ground water concentrations at all site boundary stations were well within regulatory guidelines.

Pumping Wells 98-05, 98-16, 98-25, 108-02, 108-09 used for the Spray Aeration Project at the HWMF, were active till February 1992, at which time, the project was shut down after the test run made from November 1991 to February 1992 was terminated. Radioactive data indicated that all activities were at or below MDL.

Table 39
BNL Site Environmental Report for Calendar Year 1992
Ground Water Surveillance Wells, Radioactive Data
Major Petroleum Facility and Central Steam Facility

Area	Well ID	No. of Samples	Gross Alpha		Gross Beta		Tritium		Co-60		Cs-137		K-40		Sr-90	
			Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg
Major Petroleum Facility	66-08(a)	2	-0.08	-0.11	1.59	1.35	228	135	14.8	7.62	0.77	0.39	ND	ND	-0.08	-0.68
	76-16	2	0.16	0.08	2.19	2.19	227	132	ND	ND	ND	ND	2.73	1.37	0.07	-0.06
	76-17	2	0.34	0.22	8.84	5.71	251	73	3.04	1.61	ND	ND	16.30	8.25	0.28	0.07
	76-18	2	-0.14	-0.18	2.00	1.93	-21	-59	ND	ND	ND	ND	ND	ND	0.22	-0.05
	76-19	2	0.59	0.34	4.76	4.53	84	-26	ND	ND	ND	ND	ND	ND	0.08	-0.03
	95-04	2	0.45	0.22	2.23	1.11	80	40	ND	ND	ND	ND	ND	ND	-0.14	-0.23
Central Steam Facility	65-01(a)	2	1.74	0.29	1.96	1.74	180	-238	ND	ND	ND	ND	ND	ND	0.11	-0.02
	76-02	2	0.33	0.16	2.46	2.00	171	67	0.80	0.40	0.80	0.40	2.61	1.32	0.74	0.33
	76-04	2	1.25	0.62	3.06	1.99	188	-15	ND	ND	ND	ND	6.03	3.02	0.36	0.17
	76-05	2	0.05	-0.42	1.81	1.78	82	-230	0.13	0.06	ND	ND	3.54	1.77	-0.02	-0.18
	76-06	3	0.10	-0.32	3.89	2.29	80	1	0.69	0.23	ND	ND	3.32	1.11	0.38	0.26
	76-07	3	-0.08	-0.13	1.32	0.71	66	-435	0.56	0.19	0.19	0.0	ND	ND	1.07	0.48
	76-08	2	-0.26	-0.46	9.67	4.03	119	67	0.10	0.05	ND	ND	4.30	2.20	1.20	0.60
	76-09	2	0.09	-0.05	0.98	0.72	66	-237	0.14	0.07	ND	ND	3.55	1.78	-0.06	-0.06
	76-10	2	-0.09	-0.12	2.15	2.02	247	133	ND	ND	ND	ND	3.55	1.78	0.09	0.00
	76-20	2	0.05	-0.50	3.81	2.97	310	236	ND	ND	ND	ND	ND	ND	-0.06	-0.15
	76-21	2	0.22	0.18	3.06	2.93	245	23	ND	ND	0.16	0.08	ND	ND	0.34	0.32
	76-22	2	0.33	0.22	1.17	0.96	627	394	2.39	1.20	ND	ND	ND	ND	0.16	-0.05
NYS Drinking Water Standard			15		50		20000		(b)		(b)		(b)		8	
DOE Order 5400.5: Derived Concentration Guide for Drinking Water			(b)		(b)		80000		200		120		280		40	
Typical MDL			0.53		1.2		300		0.23		0.2		3.9		0.1	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) Standard not specified.
Note: Well 66-08 showed a one time concentration of Na-22 at 0.70 pCi/L and Zn-65 at 2.95 pCi/L. Wells 76-18 and #65-01 showed a one time concentrations of Mn-54 at 0.57 and 0.77 pCi/L, respectively.

Table 40
BNL Site Environmental Report for Calendar Year 1992
Ground Water Surveillance Wells, Radioactive Data
Hazardous Waste Management Area

Area	Well ID	No. of Samples	Gross Alpha		Gross Beta		Tritium		Be-7		Na-22		Co-60		K-40		Mn-54		Cs-137		Sr-90	
			Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg
HWM	88-03	2	0.26	0.16	6.80	5.40	1840	1545	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.13	-0.20
Area	88-04	3	1.10	0.72	837.00	713.00	1880	1495	ND	ND	1.02	0.50	0.81	0.77	9.38	6.96	ND	ND	ND	ND	290.26	160.07
	98-04	3	0.70	0.39	42.00	33.00	3480	2860	ND	ND	0.18	0.06	ND	ND	2.9	0.9	ND	ND	0.79	0.34	9.94	4.69
	98-07	3	-0.45	-0.62	1.93	1.40	96	73	9.98	3.33	ND	ND	ND	ND	11.20	3.70	ND	ND	ND	ND	0.18	-0.03
	98-11	1	0.05	0.05	4.72	4.72	1510	1510	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	98-19	3	0.19	0.14	1.93	1.61	374	277	ND	ND	ND	ND	0.64	0.21	11.8	3.93	ND	ND	0.57	0.19	0.24	0.07
	98-21	3	0.78	0.36	5.78	5.67	1450	1165	ND	ND	0.19	0.07	ND	ND	2.54	0.85	ND	ND	ND	ND	0.65	0.36
	98-22	3	0.39	0.13	4.72	4.67	1150	1075	ND	ND	0.46	0.11	ND	ND	14.20	4.73	ND	ND	ND	ND	0.93	0.46
	98-30	3	0.65	0.43	39.80	34.65	10400	4114	ND	ND	ND	ND	ND	ND	2.32	0.77	0.33	0.11	ND	ND	11.84	7.75
	98-32	3	0.94	0.74	4.16	3.10	1320	1116	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.75	0.19	-0.01	-0.07
	98-36	1	-0.05	-0.05	2.91	2.91	2080	2080	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
	99-01	1	0.52	0.52	0.38	0.38	-69	-69	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.28	-0.28
	99-02	3	0.13	0.03	2.68	2.23	34500	12450	8.16	2.72	ND	ND	ND	ND	ND	ND	0.41	0.14	ND	ND	-0.11	-0.20
	99-04	3	0.54	0.43	3.21	1.75	1640	1490	ND	ND	ND	ND	ND	ND	2.41	0.80	ND	ND	ND	ND	0.04	0.04
	99-05	3	-0.26	-0.27	1.06	0.79	-56	-189	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.23	0.05
	99-06	3	0.16	0.12	1.13	0.70	-224	-245	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.15	0.05
	107-09	4	1.29	0.33	2.23	1.50	431	302	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.63	0.00
	107-10	3	0.48	0.45	3.85	2.89	1690	1527	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.36	0.12	0.23	-0.01
	107-11	2	0.15	0.08	0.76	0.70	2650	1970	ND	ND	ND	ND	0.58	0.29	ND	ND	ND	ND	ND	ND	0.06	0.00
	107-12	2	0.07	-0.04	8.65	5.78	2130	1540	ND	ND	ND	ND	ND	ND	3.08	1.54	ND	ND	0.31	0.26	0.05	-0.03
	107-13	2	0.37	0.15	6.19	3.25	1730	1497	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.[illegible]3	0.00
	107-14	2	0.37	0.25	1.02	0.70	1350	1154	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.36	0.12	-0.08	-0.26
	108-01	3	0.51	0.14	5.93	3.40	1630	1300	ND	ND	ND	ND	ND	ND	5.25	1.75	1.03	0.34	ND	ND	0.10	0.05
	108-03	3	1.04	0.45	2.91	2.58	1730	1397	ND	ND	ND	ND	ND	ND	3.33	2.12	ND	ND	ND	ND	0.53	0.16
	108-05	3	0.44	0.43	6.27	3.01	1760	1340	ND	ND	ND	ND	ND	ND	3.69	1.23	0.16	0.05	ND	ND	0.61	0.13
	108-07	4	0.57	0.13	2.04	1.75	4830	2235	ND	ND	ND	ND	ND	ND	4.44	2.00	ND	ND	ND	ND	0.02	-0.13
	108-08	2	0.21	-0.02	6.87	5.28	1020	854	ND	ND	ND	ND	ND	ND	6.08	3.04	ND	ND	ND	ND	0.16	0.00
	108-12	3	0.51	0.28	5.78	3.98	4800	4187	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.02	-0.07
	108-13	3	0.56	0.45	4.42	3.10	4340	3320	ND	ND	ND	ND	ND	ND	5.58	1.86	ND	ND	ND	ND	-0.12	-0.15
	108-14	3	0.15	0.06	1.85	1.13	835	569	12.50	4.17	ND	ND	1.46	0.50	ND	ND	ND	ND	ND	ND	-0.03	-0.15
	108-17	2	0.07	-0.09	1.21	0.50	1270	777	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.03	-0.11
	108-18	2	0.09	-0.04	1.78	1.14	482	-34	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.08	-0.11
NYS Drinking Water Standard			15		50		20000		(a)		(a)		(a)		(a)		(a)		(a)		8	
DOE Order 5400.5 Derived Concentration Guide for Drinking Water			(a)		(a)		80000		4000		400		200		280		2000		120		40	
Typical MDL			0.53		1.2		300		1.60		0.20		0.23		0.20		0.18		3.90		0.10	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
Note: Well 88-05 not sampled.

5.1.2.2 Nonradiological Analyses

Sewage Treatment Plant/Peconic River Area: The surveillance well network at the STP and Peconic River areas consist of 17 shallow Upper Glacial aquifer wells. Because of known radiological and chemical contamination of the soils and ground water, the BNL STP, and the nearby Peconic River areas (both on site and off site), are to be the subject of a RI/FS (OU V) conducted under the IAG between DOE, EPA, and NYSDEC. During 1992, ground water samples from the 17 surveillance wells were analyzed for water quality, VOCs, and metals (Tables 41 -44). Water quality data from most wells located both upgradient and downgradient of the STP indicate that the pH was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 5.99. Other water quality parameters were below the applicable NYS DWS. Results of metals analyses of ground water samples indicate that iron was detected in nine wells above NYS DWS, with maximum observed iron concentrations ranging from 0.42 - 14.7 mg/L. Copper was detected above NYS DWS in seven wells, with maximum observed concentrations ranging from 1.46 - 17.56 mg/L. Lead was detected in three wells above NYS DWS, with maximum observed concentrations ranging from 0.019 - 0.034 μg/L. Cadmium and zinc were also detected in Well 40-04, at concentrations of 0.01 and 10.80 mg/L, respectively. Because most of these wells are constructed of carbon steel casings and brass screens, these elevated metals concentrations may be related, in part, to the deterioration of the wells themselves. Detectable concentrations of copper, cadmium, and zinc were not observed in the downgradient Wells 38-01 and 39-05, which are constructed of PVC. Volatile Organic Compounds were not detected in any samples.

Meadow Marsh-Upland Recharge Area: The surveillance well network at the Meadow Marsh-Upland Recharge area consists of eight shallow Upper Glacial aquifer wells and one upper Magothy aquifer well. The Meadow Marsh-Upland Recharge area was used by BNL in the mid 1970's as an experimental sewage treatment area. As a result of this experiment, the soils and ground water in this area are suspected of being contaminated with a variety of radionuclides, metals, and VOCs. The Meadow Marsh-Upland Recharge area is to be the subject of a RI/FS (OU VI) conducted under the IAG. During 1992, ground water samples from the eight surveillance wells were analyzed for water quality, VOCs, and metals (Tables 41 - 44). Water quality data from wells located both upgradient and downgradient of the Meadow Marsh area indicate that the pH was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 5.80. The NYS DWS for nitrate-nitrogen was exceeded in downgradient Well 89-01 at a concentration of 10.5 mg/L. A second downgradient well, 90-01, exhibited elevated but below NYS DWS nitrate-nitrogen levels. Other water quality parameters were below the applicable NYS DWS. Results of metals analyses of ground water samples indicate that iron was detected above NYS DWS in Well 100-03 and 100-04 at maximum concentrations of 0.49 and 1.03 mg/L, respectively. Volatile Organic Compounds were not detected in any samples.

Current Landfill Area: The surveillance well network at the Current Landfill consists of shallow Upper Glacial aquifer wells near the Landfill and a series of progressively deeper Upper Glacial wells downgradient of the Landfill. The BNL Current Landfill ceased operations in 1990 in accordance with the Long Island Landfill Law. The Current Landfill has been identified as a source of ground water contamination, and permanent closure (i.e., capping) of this facility will follow the completion of the planned RI/FS (OU I) to be conducted under the IAG.

Table 41
BNL Site Environmental Report for Calendar Year 1992
Peconic River/Sewage Treatment Plant and Meadow Marsh Area
Ground Water Surveillance Wells, Water Quality Data

Well No.	No. of Samples(c)	pH (SU)	Conductivity Max. (µmhos/cm)	Conductivity Avg. (µmhos/cm)	Chlorides Max. (mg/L)	Chlorides Avg. (mg/L)	Sulfates Max. (mg/L)	Sulfates Avg. (mg/L)	Nitrate-Nitrogen(b) Max. (mg/L)	Nitrate-Nitrogen(b) Avg. (mg/L)
Peconic River/STP										
47-03(a)	2	5.67	42.	41.	6.0	5.6	8.5	8.4	ND	ND
22-01	2	5.24	34.	29.	6.6	5.6	6.9	6.8	ND	ND
30-01	2	6.70	68.	62.	6.7	6.6	ND	ND	ND	ND
38-01	2	4.93	52.	52.	5.5	5.3	9.1	8.9	1.1	ND
39-03	2	6.09	59.	49.	5.4	5.2	5.5	ND	ND	ND
39-04	1	6.51	154.	---	28.5	---	5.6	---	ND	---
39-05	2	5.74	57.	57.	5.7	5.2	8.8	8.4	1.8	1.8
40-01	2	6.60	176.	167.	31.6	31.6	13.8	6.9	ND	ND
40-02	2	6.36	145.	128.	9.3	9.2	6.0	5.6	ND	ND
40-03	2	5.07	111.	86.	5.4	5.0	41.9	32.2	ND	ND
40-04	2	6.54	107.	101.	9.6	9.2	7.8	7.2	ND	ND
40-05	2	5.56	53.	52.	7.4	6.6	5.8	ND	ND	ND
40-07	2	6.72	67.	59.	4.9	4.7	8.7	8.4	ND	ND
47-01	2	5.82	81.	73.	4.8	4.7	6.5	5.6	ND	ND
47-02	2	6.24	50.	45.	4.8	ND	6.8	6.6	ND	ND
48-01	1	6.19	73.	---	5.8	---	4.0	---	ND	---
49-02	2	5.98	27.	20.	6.9	6.7	6.7	6.4	ND	ND
Meadow Marsh										
58-01(a)	2	5.42	59.	53.	8.8	8.2	8.9	8.8	ND	ND
70-01	1	5.69	19.	---	ND	---	8.5	---	ND	---
80-02	3	5.93	55.	46.	10.6	8.7	6.9	6.3	ND	ND
80-03	3	5.81	65.	54.	7.3	7.0	12.6	12.0	ND	ND
89-01	1	5.95	160.	---	7.3	---	14.5	---	10.5	---
90-01	1	5.59	118.	---	5.9	---	12.5	---	6.4	---
100-03	1	5.86	49.	---	8.5	---	7.1	---	ND	---
100-04	1	6.15	74.	---	6.5	---	10.6	---	ND	---
NYS Drinking Water Standards		6.5 - 8.5	(c)		250.0		250.0		10.0	
Typical MDL		--	10.		4.0		4.0		1.0	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) Holding time expired for all samples.
(c) No standard specified.

Table 42
BNL Site Environmental Report for Calendar Year 1992
Peconic River/Sewage Treatment Plant Area and Meadow Marsh Area
Ground Water Surveillance, Metals Data

Well No.	No. of Samples	Ag		Cd		Cr		Cu		Fe		Hg		Na		Pb		Zn	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		<------ mg/L ------>																	
Peconic River/STP																			
47-03(a)	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	3.8	3.7	<0.002	<0.002	<0.02	<0.02
39-03	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	1.46	0.73	1.80	1.66	<0.0002	<0.0002	3.8	3.3	<0.002	<0.002	0.12	0.096
39-04	1	<0.025	----	<0.0005	----	<0.005	----	7.14	----	0.11	----	<0.0002	----	22.9	---	<0.002	----	0.078	----
39-05	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.43	0.27	<0.0002	<0.0002	3.9	3.6	<0.002	<0.002	<0.02	<0.02
40-01	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	17.56	8.78	14.7	7.4	<0.0002	<0.0002	22.1	20.6	<0.002	<0.002	1.35	0.98
40-02	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	7.37	3.68	9.62	4.89	<0.0002	<0.0002	7.48	6.09	0.009	0.005	0.77	0.68
40-04	2	<0.025	<0.025	0.0101	0.0050	<0.005	<0.005	3.47	1.73	2.97	1.95	<0.0002	<0.0002	7.4	6.8	0.032	0.019	10.80	9.25
40-05	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	0.195	0.09	0.95	0.65	<0.0002	<0.0002	3.9	3.8	<0.002	<0.002	0.89	0.86
40-07	2	<0.025	<0.025	0.0029	0.0014	<0.005	<0.005	<0.05	<0.05	0.42	0.21	<0.0002	<0.0002	4.4	4.1	0.034	0.018	3.80	2.27
47-01	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	4.49	2.24	3.95	2.01	<0.0002	<0.0002	4.0	3.9	<0.002	<0.002	3.8	2.6
47-02	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	5.00	2.50	6.8	3.61	<0.0002	<0.0002	3.2	3.2	0.0192	0.0126	1.20	1.03
48-01	1	<0.025	----	0.0126	----	<0.005	----	<0.05	----	0.18	----	<0.0002	----	3.5	---	0.0040	----	1.5	----
All Others (n=5)	10	<0.025	<0.025	0.0078	0.0009	<0.005	<0.005	0.095	<0.05	0.29	<0.075	<0.0002	<0.0002	6.1	3.6	0.007	<0.002	3.60	0.75
Meadow Marsh																			
58-01(a)	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	6.5	5.8	<0.002	<0.002	0.032	<0.02
100-03	1	<0.025	----	<0.0005	----	<0.005	----	<0.05	----	0.49	----	<0.0002	----	4.5	---	<0.002	----	<0.02	----
100-04	1	<0.025	----	0.0015	----	0.0185	----	<0.05	----	1.028	----	<0.0002	----	6.97	---	0.017	----	0.56	----
All Others (n=5)	9	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	7.40	4.84	0.002	<0.002	0.06	<0.02
NYS Drinking Water Standard		0.05		0.01		0.05		1.0		0.3		0.002		(b)		0.050		5.0	
Typical MDL		0.025		0.0005		0.005		0.05		0.075		0.0002		1.0		0.002		0.02	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) No standard specified.

Table 43
BNL Site Environmental Report for Calendar Year 1992
Peconic River/Sewage Treatment Plant Area and Meadow Marsh Area
Ground Water Surveillance Wells, Chlorocarbon Data

Well No.	No. of Samples	TCA		TCE		PCE		DCA		DCE		Chloroform	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		<-- μg/L -->											
Peconic River/STP													
47-03(a)	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
All Others (n=16)	30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Meadow Marsh													
58-01(a)	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
All Others (n=7)	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.		5.		100.	
Typical MDL		2.		2.		2.		2.		2.		2.	

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit.
NA: Not analyzed.
(a) Upgradient well.

Table 44
BNL Site Environmental Report for Calendar Year 1992
Peconic River/Sewage Treatment Plant Area and Meadow Marsh Area
Ground Water Surveillance Wells, BETX Data

Well No.	No. of Samples	Benzene Max.	Benzene Avg.	Ethylbenzene Max.	Ethylbenzene Avg.	Toluene Max.	Toluene Avg.	Xylene Max.	Xylene Avg.
		<----------			μg/L				---------->
Peconic River/STP									
47-03(a)	2	ND	ND	ND	ND	ND	ND	ND	ND
All Others (n=16)	30	ND	ND	ND	ND	ND	ND	ND	ND
Meadow Marsh									
58-01(a)	2	ND	ND	ND	ND	ND	ND	ND	ND
All Others (n=7)	11	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.	5.
Typical MDL		2.		2.		2.		2.	2.

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.

In the areas near and downgradient of the Current Landfill, 22 ground water surveillance wells were sampled for water quality, VOCs, and metals during 1992 (Tables 45 - 48). Water quality data from wells located at the Current Landfill indicate that the pH was typically slightly below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 6.30. Although water quality parameters were within NYS DWS, downgradient wells did detect elevated (i.e., above background) conductivity levels. Average conductivity for the upgradient Well 87-09 was 86 μmhos/cm whereas the average conductivities for wells directly downgradient of the Current Landfill ranged from 169 - 1216 μmhos/cm. Metals analyses indicate that ten surveillance wells in close proximity of the Current Landfill had average iron concentrations that exceeded the NYS DWS of 0.3 mg/L. Upgradient Well 87-09 had an average iron concentration below the typical minimum detection limit and Well 88-01 (a carbon steel well) had an average concentration of 2.65 mg/L. Average concentrations in the downgradient wells ranged from 0.41 - 175.5 mg/L. Although there is no NYS DWS specified for sodium, sodium concentrations were elevated in downgradient wells. Upgradient Well 87-09 had an average sodium concentration of 8.3 mg/L, whereas sodium concentrations in the wells located directly downgradient of the Current Landfill ranged from 5.7 - 87.7 mg/L. Ground water analyses for VOCs indicate that eight downgradient wells had concentrations of organic contaminants above NYS DWS during 1992. Organic contaminants were not detected in upgradient Wells 87-09 and 88-01. Of the downgradient wells where NYS DWS were exceeded: TCA was detected at maximum concentrations of 13 μg/L at Well 107-09, 13 μg/L in Well 115-04, and 6 μg/L in Well 115-05; DCA was detected at maximum concentrations of 6 μg/L in Well 87-10, 9 μg/L in Well 107-08, 39 μg/L in Well 115-04, and 200 μg/L in Well 115-05; DCE was detected in Wells 115-04 and 115-05 at maximum concentrations of 5 μg/L and 12 μg/L, respectively; benzene was detected in Wells 87-05, 87-06, 87-07, 87-11, and 115-05 at maximum concentrations of 7 μg/L, 6 μg/L, 8 μg/L, 5 μg/L, and 7 μg/L, respectively; ethylbenzene was detected at Wells 87-10 and 87-11 at maximum concentrations of 10 μg/L and 8 μg/L, respectively; and toluene was detected in Well 115-05 at a maximum concentration of 7 μg/L; chloroethane was detected in Wells 87-05, 87-10, and 87-11 at maximum concentrations of 6 μg/L, 5 μg/L, and 6μg/L, respectively; and cis 1,2-dichloroethene was detected in Well 87-10 at a maximum concentration of 5 μg/L. In 1992, BNL entered into a cooperative agreement to determine the vertical and horizontal extent of VOC contamination along the BNL southeast boundary in areas downgradient of the Current Landfill and HWMF. Seven temporary wells were installed at the site boundary, downgradient of the Current Landfill. Nine VOCs were detected at concentrations exceeding NYS DWS. Chloroethane was detected in five temporary wells at a maximum concentration of 110 μg/L; DCA was detected in six wells at a maximum concentration of > 870 μg/L; DCE was detected in six wells at a maximum concentration of 37 μg/L; TCA in six wells at a maximum concentration of 150 μg/L; TCE in five wells at a maximum 10 μg/L; cis 1,2-dichloroethene in five wells at a maximum concentration of 20 μg/L; methylene chloride in two wells at a maximum concentration of 7 μg/L 1,2-dichloropropane in one well at 7 μg/L; and vinylchloride in one well at 11 μg/L. During this investigation, three temporary wells were also installed off site, south of the Long Island Expressway. Analysis of ground-water samples from these wells indicate that VOCs emanating from the Current Landfill appear to have migrated beyond the BNL southern boundary. In one temporary well (Well 0), DCA and TCA were detected at maximum concentrations of 18 μg/L and 10 μg/L, respectively.

Table 45
BNL Site Environmental Report for Calendar Year 1992
Current Landfill, Former Landfill, and Ash Repository
Ground Water Surveillance Wells, Water Quality Data

Well No.	No. of Samples(c)	pH (SU)	Conductivity (µmhos/cm)		Chlorides (mg/L)		Sulfates (mg/L)		Nitrate-Nitrogen(b) (mg/L)	
			Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
Current Landfill										
87-03(a)	5	5.81	113.	86.	22.2	12.1	15.1	13.7	1.0	ND
88-01(a)	4	7.18	456.	409.	31.4	23.9	22.4	18.2	ND	ND
87-05	4	6.56	868.	789.	73.0	59.9	11.7	6.2	ND	ND
87-06	4	6.60	999.	880.	46.5	43.4	6.6	4.8	ND	ND
87-07	4	6.65	1052.	890.	51.7	47.2	8.8	8.2	ND	ND
87-10	4	6.45	1507.	1216.	237.0	97.1	25.7	13.5	ND	ND
87-11	4	6.54	850.	778.	51.4	39.0	4.4	4.2	ND	ND
87-12	5	6.61	230.	169.	16.0	15.6	12.3	10.1	ND	ND
88-02	4	5.67	291.	254.	35.4	31.8	52.3	51.1	ND	ND
97-14	3	6.25	360.	236.	32.9	24.8	17.9	15.9	ND	ND
98-09	3	5.77	94.	82.	12.6	11.9	9.4	8.9	ND	ND
98-10	4	5.65	68.	58.	9.5	9.0	ND	ND	ND	ND
98-33	4	6.49	245.	183.	20.4	18.1	11.7	9.9	ND	ND
98-34	4	6.45	449.	382.	24.0	21.9	12.2	11.4	ND	ND
107-07	4	6.48	216.	183.	27.8	24.5	25.0	23.9	ND	ND
107-08	3	6.34	296.	224.	27.7	17.6	14.2	9.1	ND	ND
107-09	4 (1)	6.46	110.	88.	11.5	----	11.7	----	ND	---
115-01	4 (1)	6.28	74.	65.	6.9	----	9.1	----	ND	---
115-02	3 (1)	6.20	70.	59.	5.9	----	8.3	----	ND	---
115-03	4 (1)	6.22	70.	63.	5.3	----	7.9	----	ND	---
115-04	3 (0)	6.03	120.	102.	NA	----	NA	----	NA	---
115-05	3 (0)	6.11	160.	127.	NA	----	NA	----	NA	---
Former Landfill										
96-02(a)	3	5.29	104.	100.	16.9	11.9	14.1	9.3	ND	ND
96-03	3	5.47	120.	101.	11.6	10.3	21.7	21.3	1.3	1.3
96-04	3	5.30	94.	86.	11.6	7.3	21.7	15.9	1.3	ND
97-01	3	5.63	55.	51.	7.7	6.7	18.5	12.5	ND	ND
97-02	2	5.46	57.	49.	5.8	5.0	8.3	7.8	ND	ND
97-03	3	6.54	234.	207.	10.9	8.2	43.9	26.4	1.1	ND
97-05	3	5.62	129.	102.	5.5	4.8	10.5	9.3	2.7	2.1
97-08	3	6.01	53.	46.	4.6	4.4	8.9	8.5	ND	ND
97-14	3	6.25	360.	236.	32.9	24.8	17.9	15.9	ND	ND
105-01	3	6.33	89.	79.	7.4	6.9	14.9	12.9	ND	ND
106-04	2	5.68	55.	53.	6.8	6.4	9.7	9.6	ND	ND
Ash Repository										
104-01	3	6.16	154.	152.	17.5	13.3	11.6	11.4	ND	ND
NYS Drinking Water Standards		6.5 - 8.5	(d)		250.0		250.0		10.0	
Typical MDL		--	10.		4.0		4.0		1.0	

NA: Not analyzed.
ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) Holding time expired for all samples.
(c) Number in parenthesis represents number of samples analyzed for Chlorides, Sulfates, and Nitrates-nitrogen.
(d) Standard not specified.

Table 46
BNL Site Environmental Report for Calendar Year 1992
Current Landfill and Former Landfill Areas
Ground Water Surveillance Wells, Metals Data

Well No.	No. of Samples	Ag Max.	Ag Avg.	Cd Max.	Cd Avg.	Cr Max.	Cr Avg.	Cu Max.	Cu Avg.	Fe Max.	Fe Avg.	Hg Max.	Hg Avg.	Na Max.	Na Avg.	Pb Max.	Pb Avg.	Zn Max.	Zn Avg.
		<----								mg/L									---->
Current Landfill																			
87-09(a)	5	<0.025	<0.025	0.0024	<0.0005	<0.005	<0.005	<0.05	<0.05	0.160	<0.075	<0.0002	<0.0002	11.9	8.3	0.002	<0.002	0.02	<0.02
88-01(a)(c)	4	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	4.440	2.654	<0.0002	<0.0002	19.5	14.9	0.046	0.012	4.60	1.89
87-05(c)	5	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	103.10	78.46	<0.0002	<0.0002	55.6	45.8	0.004	<0.002	9.10	3.02
87-06(c)	5	<0.025	<0.025	<0.0005	<0.0005	0.005	<0.005	<0.05	<0.05	52.40	43.64	<0.0002	<0.0002	34.0	31.0	0.C08	<0.002	1.28	0.58
87-07	6	<0.025	<0.025	0.0045	0.0012	<0.005	<0.005	<0.05	<0.05	61.20	48.42	<0.0002	<0.0002	37.0	35.3	0.101	0.034	0.31	0.09
87-10	4	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	201.00	175.5	<0.0002	<0.0002	127.0	87.7	<0.002	<0.002	<0.02	<0.02
87-11	4	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	84.90	76.075	<0.0002	<0.0002	28.4	25.2	<0.002	<0.002	<0.02	<0.02
87-12	5	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	15.80	13.97	<0.0002	<0.0002	16.0	14.7	<0.002	<0.002	<0.02	<0.02
88-02(c)	4	<0.025	<0.025	0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	14.80	10.15	<0.0002	<0.0002	25.5	23.6	0.007	0.002	1.36	0.67
97-14	3	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.35	0.22	<0.0002	<0.0002	32.2	23.9	0.002	<0.002	<0.02	<0.02
98-09	3	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	1.15	0.41	<0.0002	<0.0002	7.8	7.3	0.002	<0.002	0.08	0.05
98-10	4	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	2.80	1.074	<0.0002	<0.0002	6.9	5.7	0.009	0.003	0.04	<0.02
All Others (n=10)	37	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	32.9	11.9	0.003	<0.002	0.06	<0.02
Former Landfill																			
96-02(a)	3	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	17.7	17.0	0.004	0.003	<0.02	<0.02
97-08	3	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.216	0.155	<0.0002	<0.0002	3.9	3.7	0.103	0.034	0.02	<0.02
All Others (n=9)	22	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.075	<0.075	<0.0002	<0.0002	9.3	5.3	0.012	<0.002	0.02	<0.02
Ash Repository																			
104-01	3	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.075	<0.075	<0.0002	<0.0002	11.1	10.3	0.002	<0.002	<0.02	<0.02
NYS Drinking Water Standard		0.05		0.01		0.05		1.3		0.3		0.002		(b)		0.015		5.0	
Typical MDL		0.025		0.0005		0 005		0.5		0.075		0.0002		1.0		0.0002		0.02	

MDL: Minimum detection limit.
(a) Upgradient well.
(b) No standard specified.
(c) Steel well casing and brass screen.

Table 47
BNL Site Environmental Report for Calendar Year 1992
Current Landfill and Former Landfill Areas
Ground Water Surveillance Wells, Chlorocarbon Data

Well No.	No. of Samples	TCA Max.	TCA Avg.	TCE Max.	TCE Avg.	PCE Max.	PCE Avg.	DCA Max.	DCA Avg.	DCE Max.	DCE Avg.	Chloroform Max.	Chloroform Avg.
		<------------					µg/L						------------>
Current Landfill													
87-09(a)	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
88-01(a)	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
87-10	4	ND	ND	ND	ND	ND	ND	6.0	4.2	ND	ND	ND	ND
107-08	3	ND	ND	ND	ND	ND	ND	9.0	6.7	ND	ND	ND	ND
107-09	3	13.0	9.7	4.0	3.0	3.0	1.7	ND	ND	ND	ND	4.0	2.0
115-04	2	13.0	7.7	1.0	ND	ND	ND	39.	13.	5.	1.7	ND	ND
115-05	2	6.0	4.5	3.0	1.5	ND	ND	200.0	165.0	12.0	9.5	ND	ND
All Others (n=15)	57	ND	ND	ND	ND	ND	ND	3.0	ND	ND	ND	7.0	ND
Former Landfill													
96-02(a)	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
96-03	3	6.0	4.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
97-02	2	3.0	ND	ND	ND	6.0	4.5	ND	ND	ND	ND	7.0	3.5
Other Wells (n=8)	22	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.0	ND
Ash Repository													
104-01	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.0	ND
NYS Drinking Water Standard		5.		5.		5.		5.		5.		100.	
Typical MDL		2.		2.		2.		2.		2.		2.	

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.

Table 48
BNL Site Environmental Report for Calendar Year 1992
Current Landfill and Former Landfill Areas
Ground Water Surveillance Wells, BETX Data

Well No.	No. of Samples	Benzene Max.	Benzene Avg.	Ethylbenzene Max.	Ethylbenzene Avg.	Toluene Max.	Toluene Avg.	Xylene Max.	Xylene Avg.
		<------	------	------	µg/L	------	------	------	------>
Current Landfill									
87-09(a)	5	ND	ND	ND	ND	ND	ND	ND	ND
88-01(a)	4	ND	ND	ND	ND	ND	ND	ND	ND
87-05	5	7.0	5.2	ND	ND	ND	ND	ND	ND
87-06	4	6.0	4.0	ND	ND	ND	ND	ND	ND
87-07	5	8.0	6.8	ND	ND	ND	ND	ND	ND
87-10	4	3.0	2.2	10.0	5.8	ND	ND	4.0	ND
87-11	4	5.0	3.2	8.0	2.0	ND	ND	ND	ND
115-05	2	7.0	5.0	ND	ND	7.0	3.5	ND	ND
All Others (n=14)	47	4.0	ND	ND	ND	ND	ND	ND	ND
Former Landfill									
96-02(a)	3	ND	ND	ND	ND	ND	ND	ND	ND
All Others (n=10)	22	4.0	ND	ND	ND	ND	ND	ND	ND
Ash Repository									
104-01	3	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.	5.
Typical MDL		2.		2.		2.		2.	2.

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.

Former Landfill: The surveillance well network monitoring the Former Landfill area consist of a total of eleven shallow Upper Glacial aquifer wells. The Former Landfill area has been identified as an area contributing to soil and ground water contamination, and permanent closure (i.e., capping) of this facility will follow the completion of the planned RI/FS (OU I) to be conducted under the IAG. During 1992, ground water samples were collected from the eleven Former Landfill surveillance wells and were analyzed for water quality, VOCs, and metals (Tables 45 - 48). Water quality data from wells upgradient and downgradient of the Former Landfill indicate that the pH was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 5.78. Metals analyses indicate that only Well 97-08 exceeded NYS DWS with a maximum observed lead concentration of 0.103 mg/L. Analyses of ground water samples for VOCs indicate that two wells had concentrations of organic contaminants above NYS DWS. Well 96-03 had a maximum TCA concentration of 6.0 μg/L, and Well 97-02 had a maximum PCE concentration of 6 μg/L. Based upon well location and ground water flow patterns (Figures 9 and 10), the TCA detected in Well 96-03 may have originated from the CSF area (OU IV), which is located upgradient of the Former Landfill area. No VOCs were detected in the upgradient Well 96-02.Ash Repository Area: The Ash Repository area is monitored by a single downgradient shallow Upper Glacial aquifer well. The Ash Repository area has been identified as an area potentially contributing to soil and ground water contamination, and will be subject to an RI/FS (OU I) under the IAG. During 1992, ground water samples were collected from the Ash Repository well and analyzed for water quality, VOCs, and metals (Tables 45 - 48). Water quality data from Well 104-01 indicate that the pH was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 6.16. The remaining water quality parameters, metals, and VOC concentrations were below the applicable NYS DWS.

Hazardous Waste Management Facility Area: At the HWMF, the ground water surveillance well network consists of shallow Upper Glacial aquifer wells located near the facility and progressively deeper Upper Glacial wells extending out from the facility in the direction of ground water flow. Soil and ground water contamination has been found within the HWMF and ground water contamination has been verified to extend from this facility downgradient to the property boundary. In 1986, BNL initiated a Spray Aeration Project to remediate the ground water contamination,[49] and this facility will be the subject of a RI/FS (OU I) conducted under the IAG. At the HWMF and Spray Aeration Project Area, 27 surveillance wells and five recovery wells were monitored for water quality, metals, and VOCs, and five ground-water extraction wells were monitored for metals and VOCs (Tables 49 - 52). Water quality data indicate that the pH was typically slightly below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 6.24. All other water quality parameters were below the applicable NYS DWS. Metals analyses of ground water from Wells 98-01, 98-04, 98-11, 98-36, 99-01, and 99-02 indicate that Fe was detected at concentrations above NYS DWS, at 2.22 mg/L, 2.91 mg/L, 3.81 mg/L, 2.23 mg/L, 0.68 mg/L, and 0.47 mg/L, respectively. Also, Pb was detected above NYS DWS in Well 88-01, with a maximum concentration of 0.04 mg/L. Ground water analyses for VOCs indicated that 18 of 27 surveillance wells and four of five extraction wells had detectable concentrations of VOCs at least once during 1992. Of the 27 surveillance wells, 15 wells had VOC concentrations above NYS DWS at least once during 1992. No VOCs were detected in the upgradient Wells 88-03 and 88-01 during 1992. Of the surveillance wells within and downgradient of the HWMF that exceeded NYS DWS: TCA was detected (maximum values observed) in Well 88-04 (11 μg/L), Well 98-19 (5 μg/L),

Table 49
BNL Site Environmental Report for Calendar Year 1992
Hazardous Waste Management Facility
Ground Water Surveillance Wells, Water Quality Data

Well No.	No. of Samples(c)	pH (SU)	Conductivity Max.	Conductivity Avg.	Chlorides Max.	Chlorides Avg.	Sulfates Max.	Sulfates Avg.	Nitrate-Nitrogen(b) Max.	Nitrate-Nitrogen(b) Avg.
			(µmhos/cm)		<--------		mg/L			-------->
HWMF										
88-09(a)	2	5.66	75.	65.	7.3	6.8	8.1	7.9	ND	ND
98-01(a)	4	5.65	115.	93.	16.9	13.8	8.3	7.4	ND	ND
88-04	3 (0)	5.77	120.	117.	NA	----	NA	----	NA	---
98-04	3 (0)	5.97	135.	123.	NA	----	NA	----	NA	---
98-07	3 (0)	6.18	110.	90.	NA	----	NA	----	NA	---
98-11	1	6.06	79.	----	4.7	----	9.6	----	ND	---
98-19	3 (0)	6.30	106.	100.	NA	----	NA	----	NA	---
98-21	3 (0)	6.68	110.	100.	NA	----	NA	----	NA	---
98-22	3 (0)	6.17	110.	94.	NA	----	NA	----	NA	---
98-30	3 (0)	5.97	92.	91.	NA	----	NA	----	NA	---
98-32	3 (1)	6.13	100.	86.	11.3	----	11.9	----	ND	---
98-36	2 (2)	6.64	97.	95.	10.9	----	13.3	----	ND	ND
99-01	1	6.40	133.	----	7.2	----	19.5	----	ND	---
99-02	2	6.65	79.	78.	5.8	ND	6.5	6.4	ND	ND
99-04	3 (0)	6.46	110.	97.	NA	----	NA	----	NA	---
99-05	4 (0)	6.20	110.	95.	NA	----	NA	----	NA	---
99-06	3 (0)	6.23	110.	100.	NA	----	NA	----	NA	---
107-10	3 (0)	6.58	110.	99.	NA	----	NA	----	NA	---
107-11	3 (0)	6.59	120.	98.	NA	----	NA	----	NA	---
107-12	3 (0)	6.57	90.	87.	NA	----	NA	----	NA	---
107-13	2 (0)	6.45	110.	104.	NA	----	NA	----	NA	---
107-14	3 (0)	6.49	100.	85.	NA	----	NA	----	NA	---
108-01	3 (0)	6.15	110.	94.	NA	----	NA	----	NA	---
108-03	3 (0)	6.62	100.	88.	NA	----	NA	----	NA	---
108-05	3 (0)	6.29	110.	91.	NA	----	NA	----	NA	---
108-07	4 (1)	5.85	100.	80.	11.3	----	12.6	----	ND	---
108-08	3 (0)	6.20	84.	81.	NA	----	NA	----	NA	---
108-12	3 (0)	6.13	110.	94.	NA	----	NA	----	NA	---
108-13	3 (0)	6.16	90.	80.	NA	----	NA	----	NA	---
108-14	2 (0)	6.27	100.	94.	NA	----	NA	----	NA	---
108-17	3 (0)	6.28	110.	90.	NA	----	NA	----	NA	---
108-18	3 (0)	5.98	120.	94.	NA	----	NA	----	NA	---
NYS Drinking Water Standards		6.5 - 8.5	(d)		250.0		250.0		10.0	
Typical MDL		--	10.		4.0		4.0		1.0	

NA: Not analyzed.
ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) Holding time expired for all samples.
(c) Number in parenthesis represents number of samples analyzed for Chlorides, Sulfates, and Nitrates-nitrogen.
(d) Standard not specified.

Table 50
BNL Site Environmental Report for Calendar Year 1992
Hazardous Waste Management Area
Ground Water Surveillance Wells, Metals Data

Well No.	No. of Samples	Ag Max.	Ag Avg.	Cd Max.	Cd Avg.	Cr Max.	Cr Avg.	Cu Max.	Cu Avg.
		<---- mg/L							
HWMF									
88-03(a)	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05
98-01(a)	4	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05
98-04	3	<0.025	<0.025	0.0131	0.0046	<0.005	<0.005	<0.05	<0.05
98-07	3	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05
98-11	1	<0.025	----	<0.0005	----	<0.005	----	<0.05	----
98-36	1	<0.025	----	0.0013	----	<0.005	----	<0.05	----
99-01	1	<0.025	----	0.0006	----	<0.005	----	<0.05	----
99-02	2	<0 025	<0.025	0.0009	<0.0005	<0.005	<0.005	<0.05	<0.05
All Others (n=28)	76	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05
NYS Drinking Water Standard		0.05		0.01		0.05		1.3	
Typical MDL		0.025		0.0005		0.005		0.05	

Well No.	No. of Samples	Fe Max.	Fe Avg.	Hg Max.	Hg Avg.	Na Max.	Na Avg.	Pb Max.	Pb Avg.	Zn Max.	Zn Avg.
		mg/L									---->
HWMF											
88-03(a)	2	<0.075	<0.075	<0.0002	<0.0002	6.5	5.9	<0.002	<0.002	<0.02	<0.02
98-01(a)	4	2.330	2.013	<0.0002	<0.0002	8.7	7.3	0.005	<0.002	0.10	0.08
98-04	3	2.911	2.080	<0.0002	<0.0002	6.8	5.3	0.067	0.027	2.30	1.77
98-07	3	<0.075	<0.075	<0.0002	<0.0002	7.6	7.2	0.103	0.034	<0.02	<0.02
98-11	1	3.810	----	<0.0002	----	4.2	---	0.008	----	1.50	----
98-36	1	2.230	----	<0.0002	----	5.0	---	0.274	----	14.0	----
99-01	1	0.680	----	<0.0002	----	5.0	---	<0.002	----	0.70	----
99-02	2	0.470	0.340	<0.0002	<0.0002	4.0	3.6	0.010	0.005	0.95	0.86
All Others (n=28)	76	<0.075	<0.075	<0.0002	<0.0002	10.1	6.8	0.049	<0.002	0.05	<0.02
NYS Drinking Water Standard		0.3		0.002		(b)		0.015		5.0	
Typical MDL		0.075		0.0002		1.0		0.002		0.02	

MDL: Minimum detection limit.
(a) Upgradient well.
(b) No standard specified.

Table 51
BNL Site Environmental Report for Calendar Year 1992
Hazardous Waste Management Area
Ground Water Surveillance Wells, Chlorocarbon Data

Well No.	No. of Samples	TCA		TCE		PCE		DCA		DCE		Chloroform	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		<------------------------						μg/L					------------------------>
HWMF													
88-03(a)	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-01(a)	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
88-04	2	11.0	8.5	ND	ND	38.0	29.0	ND	ND	ND	ND	ND	ND
98-19	2	5.0	2.5	2.0	ND	10.0	5.0	ND	ND	ND	ND	3.0	ND
98-22	2	4.0	2.0	ND	ND	ND	ND	10.0	5.0	ND	ND	ND	ND
99-04	2	7.0	3.5	3.0	ND	3.0	ND	ND	ND	ND	ND	ND	ND
107-10	2	7.0	6.0	3.0	ND	3.0	ND	ND	ND	ND	ND	ND	ND
107-11	2	13.0	9.5	3.0	ND	3.0	ND	ND	ND	ND	ND	2.0	2.0
107-12	2	15.0	9.0	4.0	2.0	5.0	2.5	ND	ND	ND	ND	2.0	2.0
107-13	2	10.0	7.0	2.0	ND	ND	ND	9.0	4.5	ND	ND	3.0	ND
108-07	3	22.0	8.3	3.0	ND	3.0	ND	ND	ND	2.0	ND	7.0	3.0
108-08	2	6.0	3.0	2.0	ND	6.0	3.0	ND	ND	ND	ND	5.0	4.5
108-12	2	18.0	16.0	3.0	ND	3.0	ND	ND	ND	ND	ND	3.0	2.5
108-13	2	21.0	14.5	2.0	ND	2.0	ND	ND	ND	ND	ND	3.0	2.5
108-14	2	21.0	11.0	2.0	ND	ND	ND	ND	ND	ND	ND	4.0	2.0
108-17	2	57.0	33.0	16.0	11.0	8.0	6.0	ND	ND	6.0	3.0	110.0	58.5
108-18	2	220.0	112.0	16.0	8.0	ND	ND	ND	ND	24.0	12.0	4.0	2.0
All Others (n=14)	27	3.0	ND	2.0	ND	2.0	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.		5.		100.	
Typical MDL		2.		2.		2.		2.		2.		2.	

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit, all samples analyzed by H2M, Inc.
(a) Upgradient well.

Table 52
BNL Site Environmental Report for Calendar Year 1992
Hazardous Waste Management Area
Ground Water Surveillance Wells, BETX Data

Well No.	No. of Samples	Benzene Max.	Benzene Avg.	Ethylbenzene Max.	Ethylbenzene Avg.	Toluene Max.	Toluene Avg.	Xylene Max.	Xylene Avg.
		<--------	--------	--------	µg/L	--------	--------	--------	-------->
HWMF									
88-03(a)	2	ND	ND	ND	ND	ND	ND	ND	ND
98-01(a)	4	ND	ND	ND	ND	ND	ND	ND	ND
107-11	2	ND	ND	ND	ND	5.0	2.5	ND	ND
108-18	2	ND	ND	ND	ND	7.0	3.5	ND	ND
All Others (n=32)	59	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.	5.
Typical MDL		2.		2.		2.		2.	2.

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.

Well 99-04 (7 μg/L), Well 107-10 (7 μg/L), Well 107-11 (13 μg/L), Well 107-12 (15 μg/L), Well 107-13 (10 μg/L), Well 108-07 (22 μg/L), Well 108-08 (6 μg/L), Well 108-12 (18 μg/L), Well 108-13 (21 μg/L), Well 108-14 (21 μg/L), Well 108-17 (57 μg/L), and Well 108-18 (220 μg/L); TCE was detected in Well 108-17 (16 μg/L) and Well 108-18 (16 μg/L); PCE was detected in Well 88-04 (38 μg/L), Well 98-19 (10 μg/L) and Well 107-12 (5 μg/L), Well 108-08 (6 μg/L), and Well 108-07 (8 μg/L); DCA was detected in Wells 98-22 and 107-13 at maximum observed concentrations of 10 μg/L and 9 μg/L, respectively; DCE was detected in Wells 108-17 and 108-18 at maximum observed concentrations of 6 μg/L and 24 μg/L, respectively; and chloroform was detected in Well 108-17 at a maximum observed value of 110 μg/L. The ground-water extraction wells are part of the Aquifer Restoration Spray Aeration Project which was initiated by BNL in 1986. After having been removed from service in the Spring of 1990, due to regulatory concerns regarding spray efficiency and operational procedures, a pilot study under the guidance of the EPA, NYSDEC, and DOE, was initiated to test the efficiency of the spray system, examine ground water flow directions during operation, and to better delineate the contaminant plume(s) emanating from the HWMF. The Spray Aeration System was reactivated in November 1991 and remained in service through February 1992. During 1992 one round of pre- and post-spray ground-water samples were collected from each extraction well and spray fields (Table 53). Pre-spray samples collected from four of the five extraction wells had detectable concentrations of VOC contamination, with three of the five extraction wells having pre-spray VOC concentrations above NYS DWS. The TCA was detected in extraction Wells 98-05, and 108-09 at maximum concentrations of 9 μg/L and 15 μg/L, respectively, and DCA was detected in Well 98-16 at a maximum concentration of 5 μg/L . Benzene, ethylbenzene, toluene, and xylene were not detected in the extraction wells. None of the post-spray samples showed concentrations above NYS DWS. During the SCDHS cooperative ground-water investigation described previously, three on-site temporary wells were installed downgradient of the HWMF and near the southern boundary. Both TCA and PCE were detected at concentrations that exceeded the NYS DWS. The TCA was detected in all three temporary wells at concentrations up to 23 μg/L, and PCE was detected in one well at a maximum concentration of 11 μg/L. During this study, three additional wells were installed downgradient of the HWMF, in an area south of the Long Island Expressway. Analyses of ground-water samples collected in these off-site wells indicate that VOCs emanating from the HWMF appear to have migrated beyond the BNL southeastern boundary. In two of the temporary off-site wells (SCDHS Wells A and C), TCA and PCE were detected at concentrations that exceeded NYS DWS. In temporary Well A, TCA and PCE were detected at a maximum concentrations of 14 μg/L and 7 μg/L, respectively. In temporary Well C, TCA was detected at a maximum concentration of 6 μg/L.

Central Steam Facility/Major Petroleum Facility Area: The surveillance well networks at the CSF and MPF consist of a total of 17 shallow Upper Glacial aquifer wells. The MPF is the holding area for most fuels used at the CSF. The five shallow wells monitoring the MPF were installed as part of the licensing requirements for this facility, and are screened across the water table to allow for the detection of free product (i.e., oil floating on top of the ground water). The surveillance wells at the CSF were installed primarily to monitor ground water contamination resulting from a 1977 fuel oil/solvent leak at this facility. The CSF/MPF area is the subject of a RI/FS (OU IV) started in the Fall of 1992 under the IAG. At the CSF and MPF area, all 17 surveillance wells were monitored for water quality, metals, VOCs, and the five MPF wells were sampled for floating petroleum products during 1992 (Tables 54 - 57). Water quality data indicate that pH was typically below the lower limit of the NYS DWS of 6.5 -8.5, with a median pH of 5.98. Other water quality parameters were below the

Table 53
BNL Site Environmental Report for Calendar Year 1992
Hazardous Waste Management Area
Ground Water Surveillance Wells, Chlorocarbon Data

Well No.	No. of Samples	TCA		TCE		PCE		DCA		DCE		Chloroform	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		<--- µg/L --->											
Pre-spray													
98-05	1	9.0	--	ND	--	ND	--	ND	--	ND	--	ND	--
98-16	1	4.0	--	ND	--	3.0	--	5.0	--	ND	--	ND	--
98-25	1	ND	--	ND	--	ND	--	ND	--	ND	--	ND	--
108-02	1	4.0	--	2.0	--	2.0	--	ND	--	ND	--	2.0	--
108-09	1	15.0	--	3.0	--	3.0	--	ND	--	ND	--	8.0	--
Post-spray													
98-05	1	ND	--	ND	--	ND	--	ND	--	ND	--	ND	--
98-16	1	ND	--	ND	--	ND	--	ND	--	ND	--	ND	--
98-25	1	ND	--	ND	--	ND	--	ND	--	ND	--	ND	--
108-02	1	ND	--	ND	--	ND	--	ND	--	ND	--	ND	--
108-09	1	2.0	--	ND	--	ND	--	ND	--	ND	--	2.0	--
NYS Drinking Water Standard		5.		5.		5.		5.		5.		100.	
Typical MDL		1.0(a)		1.0(a)		1.0(a)		1.0(a)		1.0(a)		1.0(a)	

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit.
(a) Samples analyzed by H2M, Inc.

Table 54
BNL Site Environmental Report for Calendar Year 1992
Major Petroleum Facility/Central Steam Facility
Ground Water Surveillance Wells, Water Quality Data

Well No.	No. of Samples	pH (SU)	Conductivity Max. (µmhos/cm)	Conductivity Avg. (µmhos/cm)	Chlorides Max. (mg/L)	Chlorides Avg. (mg/L)	Sulfates Max. (mg/L)	Sulfates Avg. (mg/L)	Nitrate-Nitrogen Max. (mg/L)	Nitrate-Nitrogen Avg. (mg/L)
MPF										
66-08(a)	0	5.89	112.	104.	9.7	7.2	29.8	24.2	2.5	2.4
76-16	2	5.18	110.	102.	6.3	5.8	16.6	15.8	5.0	4.6
76-17	2	5.44	155.	152.	7.5	7.4	29.4	26.5	7.2	6.9
76-18	2	5.78	78.	74.	ND	ND	16.9	15.4	1.2	1.2
76-19	2	5.98	137.	123.	10.6	9.6	22.5	18.6	1.7	ND
CSF										
65-01(a)	2	6.00	343.	325.	50.0	48.1	36.6	32.6	2.3	1.9
76-02	2	6.76	130.	116.	17.5	17.1	11.6	10.6	ND	ND
76-04	2	6.24	169.	158.	26.4	20.2	16.5	14.9	ND	ND
76-05	2	5.99	206.	206.	27.7	25.9	23.7	22.6	2.0	1.8
76-06	2	6.41	312.	269.	42.6	32.9	28.9	23.1	1.2	1.1
76-07	2	6.14	115.	114.	19.8	17.6	14.0	12.3	ND	ND
76-08	2	5.90	129.	121.	8.9	7.3	20.3	12.2	ND	ND
76-09	2	6.13	139.	128.	18.5	16.8	16.3	15.9	ND	ND
76-10	2	5.84	123.	116.	8.3	7.0	25.4	21.8	1.9	1.5
76-19	2	5.98	137.	123.	10.6	9.6	22.5	18.6	1.7	ND
76-20	2	5.98	313.	239.	42.1	30.8	31.5	24.5	2.9	1.9
76-21	2	5.94	123.	117.	8.0	7.6	13.9	12.1	ND	ND
NYS Drinking Water Standards		6.5 - 8.5	(c)		250.0		250.0		10.0	
Typical MDL		--	10.		4.0		4.0		1.0	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) Holding time expired for all samples.
(c) No standard specified.

Table 55
BNL Site Environmental Report for Calendar Year 1992
Major Petroluem Facility and Central Steam Facility
Ground Water Surveillance Wells, Metals Data

Well No.	No. of Samples	Ag Max.	Ag Avg.	Cd Max.	Cd Avg.	Cr Max.	Cr Avg.	Cu Max.	Cu Avg.	Fe Max.	Fe Avg.	Hg Max.	Hg Avg.	Na Max.	Na Avg.	Pb Max.	Pb Avg.	Zn Max.	Zn Avg.
		<--							mg/L										-->
Major Petroleum Facility																			
66-08(a)	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	8.8	6.9	<0.002	<0.002	<0.02	<0.02
All Others (n=4)	8	<0.025	<0.025	<0.0005	<0.0005	0.0075	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	12.8	9.0	<0.002	<0.002	<0.02	<0.02
Central Steam Facility																			
65-01(a)	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	1.312	0.996	<0.0002	<0.0002	33.2	29.8	<0.002	<0.002	<0.02	<0.02
76-04	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	8.46	6.8	<0.0002	<0.0002	9.8	9.2	<0.002	<0.002	<0.02	<0.02
76-06	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	1.34	0.67	<0.0002	<0.0002	27.5	23.1	<0.002	<0.002	0.02	<0.02
76-21	2	<0.025	<0.025	0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	4.39	3.36	<0.0002	<0.0002	4.5	4.5	<0.002	<0.002	<0.02	<0.02
All Others (n=8)	16	<0.025	<0.025	0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.090	<0.075	<0.0002	<0.0002	34.2	14.2	<0.002	<0.002	<0.02	<0.02
NYS Drinking Water Standard		0.05		0.01		0.05		1.3		0.3		0.002		(b)		0.015		5.0	
Typical MDL		0.025		0.0005		0.005		0.5		0.075		0.0002		1.0		0.002		0.02	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) No standard specified.

Table 56
BNL Site Environmental Report for Calendar Year 1992
Major Petroluem Facility and Central Steam Facility
Ground Water Surveillance Wells, Chlorocarbon Data

Well No.	No. of Samples	TCA Max.	TCA Avg.	TCE Max.	TCE Avg.	PCE Max.	PCE Avg.	DCA Max.	DCA Avg.	DCE Max.	DCE Avg.	Chloroform Max.	Chloroform Avg.
		<----					µg/L						---->
Major Petroleum Facility													
66-08(a)	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
76-19	2	ND	ND	ND	ND	5.0	2.5	ND	ND	ND	ND	ND	ND
All Others (n=3)	6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Central Steam Facility													
65-01(a)	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
76-04	2	83.0	46.8	110.0	98.0	66.2	ND	ND	ND	ND	ND	ND	ND
76-05	2	ND	ND	ND	ND	15.0	10.5	ND	ND	ND	ND	ND	ND
76-08	2	3.0	ND	52.0	26.0	50.0	47.5	ND	ND	ND	ND	ND	ND
76-21	2	9.0	7.0	12.0	6.0	88.0	53.5	ND	ND	ND	ND	ND	ND
Other Wells (n=7)	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.		5.		100.	
Typical MDL		2.		2.		2.		2.		2.		2.	

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit.
NA: Not analyzed.
(a) Upgradient well.

Table 57
BNL Site Environmental Report for Calendar Year 1992
Major Petroluem Facility and Central Steam Facility
Ground Water Surveillance Wells, BETX Data

Well No.	No. of Samples	Benzene Max.	Benzene Avg.	Ethylbenzene Max.	Ethylbenzene Avg.	Toluene Max.	Toluene Avg.	Xylene Max.	Xylene Avg.
		<------	------	------	------ µg/L ------	------	------	------	------>
Major Petroleum Facility(b)									
66-08(a)	2	ND	ND	ND	ND	ND	ND	ND	ND
All Others (n=4)	8	ND	ND	ND	ND	ND	ND	ND	ND
Central Steam Facility									
65-01(a)	2	ND	ND	ND	ND	ND	ND	ND	ND
76-04	4	ND	ND	1400.0	890.0	9100.0	5492.5	5100.0	3350.0
76-08	2	ND	ND	ND	ND	ND	ND	95.0	73.5
76-21	2	3.0	ND	220.0	117.5	10.0	5.0	600.0	485.0
All Others (n=8)	16	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.	5.
Typical MDL		2.		2.		2.		2.	2.

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) As required by the MPF license, these wells were monitored by BNL monthly for free product. No free product was observed.

applicable NYS DWS. Results from metals analyses of ground water samples indicate that most metals concentrations were below the applicable NYS DWS, except for elevated iron concentrations detected in ground water samples from upgradient Well 65-01 (maximum concentration of 1.31 mg/L), and in three wells near the 1977 spill site: Well 76-04 (8.46 mg/L), 76-06 (1.34 mg/L), and Well 76-21 (4.39 mg/L). Analyses for VOCs in ground water samples from the five wells monitoring the MPF indicated that detectable concentrations of PCE were present only in Well 76-19 with a maximum observed concentration of 5 μg/L. No BETX compounds were detected. The five surveillance wells at the MPF were examined for floating petroleum products on a monthly basis. As with previous years, no floating petroleum products were observed during 1992. Of the twelve CSF surveillance wells sampled during 1992, four wells (76-04, 76-05, 76-08, and 76-21) had VOCs at concentrations above NYS DWS: TCA was detected in Wells 76-04 and 76-21 at maximum concentrations of 83 μg/L and 9 μg/L, respectively; TCE was detected in Wells 76-04, 76-08, and 76-21 at maximum concentrations of 110 μg/L, 52 μg/L, and 12 μg/L, respectively; PCE was detected in Wells 76-04, 76-05, 76-08, and 76-21 at maximum concentrations of 66 μg/L, 15 μg/L, 50 μg/L, and 88 μg/L, respectively; ethylbenzene was detected in Wells 76-04 and 76-21 at maximum concentrations of 1,400 μg/L and 220 μg/L, respectively; Toluene was detected in Wells 76-04 and 76-21 at maximum concentrations of 9,100 μg/L and 10 μg/L, respectively; and xylene was detected in Wells 76-04, 76-08, and 76-21 at concentrations of 5,100 μg/L, 95 μg/L, and 600 μg/L, respectively.

Alternating Gradient Synchrotron Area: The surveillance well network for the AGS area consists of seven shallow Upper Glacial aquifer wells which primarily monitor ground water near and downgradient of the AGS Bubble Chamber. The Bubble Chamber area, which has been the location of numerous accidental chemical releases to the environment, will be the subject of a RI/FS (OU III) conducted under the IAG. During 1992, ground water samples were collected from the seven AGS area surveillance wells, and were analyzed for water quality, VOCs, and metals (Tables 58 - 61). Water quality analyses indicate that the pH of the ground water samples collected was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 6.13. Other water quality parameters were below the applicable NYS DWS. Results for metals analyses indicated that except for samples collected from Well 54-01, all metals were at concentrations below the applicable NYS DWS. Metals analyses from Well 54-01 (a carbon steel well) indicate above NYS DWS for iron (1.14 mg/L), cadmium (0.033 mg/L, and zinc (18.7 mg/L). Analyses for VOCs of ground water samples collected from this area indicate that only TCA was detected in concentrations that exceeded NYS DWS. The TCA was detected above NYS DWS in Wells 54-01 and 64-01 at maximum concentrations of 50 μg/L and 10 μg/L, respectively.

Waste Concentration Facility Area: The surveillance well network monitoring the WCF consists of five shallow Upper Glacial aquifer wells. Soil and ground water contamination at the WCF area has been confirmed, and the WCF area will be the subject of a RI/FS (OU II) conducted under the IAG. At the WCF (D-Tanks area), three downgradient surveillance wells were sampled during 1992 (Tables 62 - 65). Water quality analyses indicate that the pH of the ground water samples collected was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 5.90. Other water quality parameters were below the applicable NYS DWS. Results from metals and VOC analyses of ground water from this area indicated that all metals and VOC concentrations were below the applicable NYS DWS.

Building 830 Area: The surveillance well network near Building 830 consists of three shallow Upper Glacial aquifer wells which were installed to investigate the effects of a radioactive waste pipe line leak. Soil and ground water contamination will be assessed during a RI/FS (OU III) to be conducted under the IAG. During 1992, ground water samples were collected from the three Building 830 area surveillance wells, and were analyzed for water quality, VOCs, and metals (Tables 62 - 65). Water quality analyses indicate that the pH of the ground water samples collected was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 6.17. Other water quality parameters were below the applicable NYS DWS. Results from metals and VOC analyses of ground water from this area indicated that all metals and VOC concentrations were below the applicable NYS DWS.

Photography and Graphic Arts Area: The surveillance well network near the P&GA area consists of two shallow Upper Glacial aquifer wells which were installed to investigate the effects of the release of TCE to soil near Building T-111. Soil and ground water contamination will be assessed during a RI/FS (OU III) to be conducted under the IAG. During 1992, ground water samples were collected from the P&GA area surveillance wells, and were analyzed for water quality, VOCs, and metals (Tables 62 - 65). Water quality analyses indicate that the pH of the ground water samples collected was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 6.22. Other water quality parameters were

Table 58
BNL Site Environmental Report for Calendar Year 1992
AGS, Linac, Army Landfill, and RHIC
Ground Water Surveillance Wells, Water Quality Data

Well No.	No. of Samples	pH (SU)	Conductivity (µmhos/cm)		Chlorides		Sulfates		Nitrate-Nitrogen(b)	
			Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
					<---- mg/L					---->
AGS										
44-01(a)	2	5.54	82.	78.	5.0	ND	20.1	17.7	ND	ND
44-02(a)	2	5.58	81.	66.	5.5	ND	17.4	15.0	1.0	ND
54-01	1	6.66	212.	----	13.4	----	14.6	----	1.4	---
54-05	2	5.60	128.	120.	6.2	ND	26.8	25.2	2.4	1.2
54-06	2	6.16	252.	248.	14.8	14.2	32.5	26.2	2.4	1.2
54-07	1	6.81	234.	----	8.3	----	16.5	----	2.7	---
64-01	1	6.57	248.	----	32.8	----	23.9	----	3.2	---
Linac										
54-03	3	6.28	173.	150.	23.5	18.3	33.2	23.9	5.0	1.7
Army Landfill (X-26)										
53-01	1	5.39	56.	----	7.0	----	10.6	----	ND	---
53-02	1	5.50	48.	----	6.9	----	7.1	----	ND	---
53-03	1	5.47	74.	----	6.2	----	8.7	----	1.1	---
53-04	1	5.41	50.	----	7.2	----	9.4	----	ND	---
RHIC										
37-01	2	5.24	70.	56.	5.3	4.6	14.3	12.8	ND	ND
NYS Drinking Water Standards		6.5 - 8.5	(c)		250.0		250.0		10.0	
Typical MDL		--	10.		4.0		4.0		1.0	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) Holding time expired for all samples.
(c) No standard specified.

Table 59
BNL Site Environmental Report for Calendar Year 1992
AGS, Linac, Army Landfill, and RHIC
Ground Water Surveillance Wells, Metals Data

Well No.	No. of Samples	Ag Max.	Ag Avg.	Cd Max.	Cd Avg.	Cr Max.	Cr Avg.	Cu Max.	Cu Avg.	Fe Max.	Fe Avg.	Hg Max.	Hg Avg.	Na Max.	Na Avg.	Pb Max.	Pb Avg.	Zn Max.	Zn Avg.
		<---							mg/L										--->
AGS																			
44-01(a)	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	3.0	2.9	<0.002	<0.002	<0.02	<0.02
44-02(a)	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	3.2	3.0	<0.002	<0.002	<0.02	<0.02
54-01	1	<0.025	----	0.033	----	<0.005	----	<0.05	----	1.140	----	<0.0002	----	11.2	---	0.008	----	18.7	----
All Others (n=4)	7	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	26.1	12.4	<0.002	<0.002	<0.02	<0.02
Linac																			
54-03	3	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.16	<0.075	<0.0002	<0.0002	15.9	13.8	0.007	0.003	0.02	<0.02
Army Landfill (X-26)																			
All Wells (N=4)	4	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.210	<0.075	<0.0002	<0.0002	6.0	5.2	0.005	<0.002	<0.02	<0.02
RHIC																			
37-01	2	<0.025	<0.025	0.0007	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	2.8	2.5	<0.002	<0.002	<0.02	<0.02
NYS Drinking Water Standard		0.05		0.01		0.05		1.3		0.3		0.002		(b)		0.015		5.0	
Typical MDL		0.025		0.0005		0.005		0.05		0.075		0.0002		1.0		0.002		0.02	

MDL: Minimum detection limit.
(a) Upgradient well.
(b) No standard specified.

Table 60
BNL Site Environmental Report for Calendar Year 1992
AGS, Linac, Army Landfill, and RHIC
Ground Water Surveillance Wells, Chlorocarbon Data

Well No.	No. of Samples	TCA		TCE		PCE		DCA		DCE		Chloroform	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		<------------------------------ µg/L ------------------------------>											
AGS													
44-01(a)	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
44-02(a)	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
54-01	1	50.0	--	ND	--	ND	--	ND	--	3.0	--	ND	--
54-05	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
54-06	2	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
54-07	1	2.0	--	ND	--	ND	--	ND	--	ND	--	ND	--
64-01	2	10.0	7.5	ND	--	ND	--	ND	--	ND	--	ND	--
Linac													
54-03	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Army Landfill (X-26)													
All Wells (n=4)	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
RHIC													
37-01	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.		5.		100.	
Typical MDL		2.		2.		2.		2.		2.		2.	

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit.
NA: Not analyzed.
(a) Upgradient well.

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Centimeter

Inches

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3 of 3

Table 61
BNL Site Environmental Report for Calendar Year 1992
AGS, Linac, Army Landfill, and RHIC
Ground Water Surveillance Wells, BETX Data

Well No.	No. of Samples	Benzene Max.	Benzene Avg.	Ethylbenzene Max.	Ethylbenzene Avg.	Toluene Max.	Toluene Avg.	Xylene Max.	Xylene Avg.
		<------	------	------	μg/L	------	------	------	------>
AGS									
44-01(a)	2	ND	ND	ND	ND	ND	ND	ND	ND
44-02(a)	2	ND	ND	ND	ND	ND	ND	ND	ND
All Others (n=5)	8	ND	ND	ND	ND	ND	ND	ND	ND
Linac									
54-03	2	ND	ND	ND	ND	ND	ND	ND	ND
Army Landfill									
All Wells	4	ND	ND	ND	ND	ND	ND	ND	ND
RHIC									
37-01	2	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.	
Typical MDL		2.		2.		2.		2.	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.

Table 62
BNL Site Environmental Report for Calendar Year 1992
Waste Concentration Facility, Building 830, and Photography and Graphic Arts
Ground Water Surveillance Wells, Water Quality Data

Well No.	No. of Samples	pH (SU)	Conductivity (µmhos/cm) Max.	Conductivity Avg.	Chlorides Max. (mg/L)	Chlorides Avg. (mg/L)	Sulfates Max. (mg/L)	Sulfates Avg. (mg/L)	Nitrate-Nitrogen(b) Max. (mg/L)	Nitrate-Nitrogen(b) Avg. (mg/L)
WCF										
65-06(a)	0	----	----	----	----	----	----	----	---	---
65-02	2	6.08	224.	208.	32.0	25.4	29.1	25.1	2.7	2.2
65-03	2	6.23	226.	188.	29.7	22.4	23.0	19.9	5.2	3.4
65-04	2	6.20	212.	196.	35.5	28.6	24.1	22.0	1.9	ND
Building 830										
66-07(a)	1	5.96	123.	----	17.1	----	16.9	----	ND	---
66-08	2	5.89	112.	104.	9.7	7.2	29.8	24.2	2.5	2.4
66-09	1	6.04	129.	----	17.8	----	16.7	----	ND	---
Photography & Graphics Arts										
75-01	2	6.29	269.	260.	45.5	40.0	38.7	30.3	3.8	3.4
75-02	2	6.16	238.	228.	32.3	29.6	38.6	37.4	5.0	4.8
NYS Drinking Water Standards		6.5 - 8.5	(c)		250.0		250.0		10.0	
Typical MDL		--	10.		4.0		4.0		1.0	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) Holding time expired for all samples.
(c) No standard specified.

Table 63
BNL Site Environmental Report for Calendar Year 1992
Miscellaneous Area of BNL Site
Ground Water Surveillance Wells, Metals Data

Well No.	No. of Samples	Ag		Cd		Cr		Cu		Fe		Hg		Na		Pb		Zn	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		<--- mg/L --->																	
WCF																			
65-06(a)	0	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
All Others (n=4)	6	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	18.9	15.4	<0.002	<0.002	<0.02	<0.02
Bldg. 830																			
66-07(a)	1	<0.025	----	<0.0005	----	<0.005	----	<0.05	----	<0.075	----	<0.0002	----	19.1	---	<0.002	----	<0.02	----
66-08	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	8.8	6.9	<0.002	<0.002	<0.02	<0.02
66-09	1	<0.025	----	<0.0005	----	<0.005	----	<0.05	----	<0.075	----	<0.0002	----	16.0	---	<0.002	----	<0.02	----
P&GA																			
75-01	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.080	<0.075	<0.0002	<0.0002	32.8	28.9	0.009	0.004	<0.02	<0.02
75-02	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	18.2	17.6	<0.002	<0.002	<0.02	<0.02
NYS Drinking Water Standard		0.05		0.01		0.05		1.3		0.3		0.002		(b)		0.015		5.0	
Typical MDL		0.025		0.0005		0.005		0.05		0.075		0.0002		1.0		0.002		0.02	

MDL: Minimum detection limit.
(a) Upgradient well.
(b) No standard specified

Table 64
BNL Site Environmental Report for Calendar Year 1992
Miscellaneous Areas of BNL Site
Ground Water Surveillance Wells, Chlorocarbon Data

Well No.	No. of Samples	TCA		TCE		PCE		DCA		DCE		Chloroform	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		<----------					µg/L						---------->
WCF													
65-06(a)	0	--	--	--	--	--	--	--	--	--	--	--	--
All Others (n=4)	6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bldg. 830													
66-07(a)	1	ND	--	ND	--	ND	--	ND	--	ND	--	ND	--
66-08	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
66-09	1	ND	--	ND	--	ND	--	ND	--	ND	--	ND	--
P&GA													
75-01	2	4.0	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
75-02	2	5.0	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.		5.		100.	
Typical MDL		2.		2.		2.		2.		2.		2.	

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.

Table 65
BNL Site Environmental Report for Calendar Year 1992
Miscellaneous Areas of BNL Site
Ground Water Surveillance Wells, BETX Data

Well No.	No. of Samples	Benzene Max.	Benzene Avg.	Ethylbenzene Max.	Ethylbenzene Avg.	Toluene Max.	Toluene Avg.	Xylene Max.	Xylene Avg.
		<------------			μg/L				------------>
WCF									
65-06(a)	0	--	--	--	--	--	--	ND	--
All Others (n=4)	6	ND	ND	ND	ND	ND	ND	ND	ND
Bldg. 830									
66-07	1	ND	--	ND	--	ND	--	ND	--
66-08	2	ND	ND	ND	ND	ND	ND	ND	ND
66-09	1	ND	--	ND	--	ND	--	ND	--
P&GA									
75-01	2	ND	--	ND	--	ND	--	ND	--
75-02	2	ND	--	ND	--	ND	--	ND	--
NYS Drinking Water Standard		5.		5.		5.		5.	
Typical MDL		2.		2.		2.		2.	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.

below the applicable NYS DWS. Results from metals analyses of ground water from this area indicated that all metals concentrations were below the applicable NYS DWS. Analyses for VOCs of ground water samples collected from this area indicate that only TCA was detected, with maximum TCA concentrations of 4 μg/L and 5 μg/L detected in Wells 75-01 and 75-02, respectively.

Supply and Material Area: The surveillance well network near the Supply and Material area consists of six shallow Upper Glacial aquifer wells and one middle Upper Glacial well. There have been several documented spill events within the Supply and Material area: a TCA release to the sanitary system and soils in the vicinity of Building 208, and a leaking underground fuel oil tank near Building 457). Soil and ground water contamination will be assessed during a RI/FS (OU III) to be conducted under the IAG. During 1992, five of the wells were sampled for water quality, VOCs, and metals (Tables 66 - 69). Water quality analyses indicate that the pH of the ground water samples collected was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 5.84. Other water quality parameters were below the applicable NYS DWS. Results from metals analyses of ground water from this area indicated that all metals concentrations were below the applicable NYS DWS. Analyses of ground water samples for VOCs indicated that TCA was detected above NYS DWS in two shallow wells: TCA was detected in Well 85-03 at 53 μg/L and in Well 96-06 at a concentration of 9 μg/L.

Building 479 Area: During 1992, a single shallow Upper Glacial aquifer well (95-04) was installed to investigate a lubricating oil spill in the heavy machine shop located in Building 479. During 1992, Well 95-04 was sampled for water quality, VOCs, metals, and floating product (Tables 66 - 69). Water quality analysis indicated that the pH of the ground water sample collected was 5.75, which is below the lower limit of the NYS DWS of 6.5 - 8.5. Other water quality parameters were below the applicable NYS DWS. No floating product was observed, and the results from VOC and metals analyses of the ground water sample indicated that all VOC and metals concentrations were below the applicable NYS DWS. Additionally, as the result of an extensive PCB/hydrocarbon contaminated soil removal action in the Building 479 area, ground water contamination in the Building 479 area will be assessed in greater detail during a RI/FS (OU III) to be conducted under the IAG.

North Boundary Area: Along the north boundary of BNL, seven surveillance wells monitor background (ambient) water conditions. These wells consist of shallow, intermediate, and deep Upper Glacial aquifer wells. During 1992, these wells were sampled for water quality, VOCs, and metals (Tables 70 - 73). Water quality analyses indicate that the pH of the ground water samples collected was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 6.20. Other water quality parameters were below the applicable NYS DWS. Results for metals analyses indicated that iron concentrations exceeded NYS DWS in Wells 07-03 (a carbon steel well) and 18-01 at maximum observed concentrations of 3.74 mg/L and 2.31 mg/L, respectively. The NYS DWS for zinc was also exceeded in Well 07-03 with a maximum observed concentration of 7 mg/L. Analysis of ground water samples for VOCs indicate that TCA and DCA were detected at Well 18-03 at maximum concentrations of 8 μg/L and 6 μg/L, respectively.

Table 66
BNL Site Environmental Report for Calendar Year 1991
Supply and Materiel Area, Building 479
Ground Water Surveillance Wells, Water Quality Data

Well No.	No. of Samples	pH (SU)	Conductivity (µmhos/cm)		Chlorides		Sulfates		Nitrate-Nitrogen(b)	
			Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
					<---------- mg/L					--------->
Supply and Materiel										
85-01(a)	2	5.70	123.	100.	18.6	18.1	17.8	15.6	ND	ND
85-02(a)	2	6.02	94.	91.	11.6	10.3	7.6	7.4	ND	ND
85-03	1	5.80	143.	----	16.1	----	15.1	----	3.5	---
86-01	1	5.87	129.	----	19.3	----	19.9	----	2.1	---
96-06	1	5.82	164.	----	33.0	----	18.5	----	1.4	---
Building 479										
95-04	1	5.75	128.	----	36.7	----	15.2	----	1.2	---
NYS Drinking Water Standards		6.5 - 8.5	(c)		250.0		250.0		10.0	
Typical MDL		--	10.		4.0		4.0		1.0	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) Holding time expired for all samples.
(c) No standard specified.

Table 67
BNL Site Environmental Report for Calendar Year 1992
Supply and Materiel Area, Building 479
Ground Water Surveillance Wells, Metals Data

Well No.	No. of Samples	Ag Max.	Ag Avg.	Cd Max.	Cd Avg.	Cr Max.	Cr Avg.	Cu Max.	Cu Avg.	Fe Max.	Fe Avg.	Hg Max.	Hg Avg.	Na Max.	Na Avg.	Pb Max.	Pb Avg.	Zn Max.	Zn Avg.
		<----								mg/L									---->
Supply and Materiel/NSLS																			
85-01(a)	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.09	0.04	<0.0002	<0.0002	10.3	9.4	0.002	<0.002	<0.02	<0.02
85-02(a)	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.08	<0.075	<0.0002	<0.0002	7.5	6.9	0.003	<0.002	0.02	<0.02
All Others (n=3)	3	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	22.6	18.3	0.002	<0.002	<0.02	<0.02
Bldg. 479																			
95-04	1	<0.025	----	<0.0005	----	<0.005	----	<0.05	----	<0.075	----	<0.0002	----	21.8	---	<0.002	---	<0.02	----
NYS Drinking Water Standard		0.05		0.01		0.05		1.3		0.3		0.002		(b)		0.015		5.0	
Typical MDL		0.025		0.0005		0.005		0.05		0.075		0.0002		1.0		0.002		0.02	

MDL: Minimum detection limit.
(a) Upgradient well.
(b) No standard specified.

Table 68
BNL Site Environmental Report for Calendar Year 1992
Supply and Materiel Area, Building 479
Ground Water Surveillance Wells, Chlorocarbon Data

Well No.	No. of Samples	TCA		TCE		PCE		DCA		DCE		Chloroform	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		<------	-----	-----	-----	-----	µg/L	-----	-----	-----	-----	-----	------>
Supply and Materiel													
85-01(a)	2	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
85-02(a)	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
85-03	1	53.0	--	ND	--	ND	--	ND	--	4.0	--	ND	--
86-01	1	ND	--	ND	--	ND	--	ND	--	ND	--	ND	--
96-06	1	9.0	--	ND	--	ND	--	ND	--	ND	--	ND	--
Bldg. 479													
95-04	1	ND	--	ND	--	ND	--	ND	--	ND	--	ND	--
NYS Drinking Water Standard		5.		5.		5.		5.		5.		100.	
Typical MDL		2.		2.		2.		2.		2.		2.	

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.

Table 69
BNL Site Environmental Report for Calendar Year 1992
Supply and Materiel Area, Building 479
Ground Water Surveillance Wells, BETX Data

Well No.	No. of Samples	Benzene		Ethylbenzene		Toluene		Xylene	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		<------------------	------------------	------------------	------------------ µg/L	------------------	------------------	------------------	------------------>
Supply and Materiel									
85-01(a)	2	ND	ND	ND	ND	ND	ND	ND	ND
85-02(a)	2	ND	ND	ND	ND	ND	ND	ND	ND
All Others (n=3)	3	ND	ND	ND	ND	ND	ND	ND	ND
Bldg. 479									
95-04	1	ND	--	ND	--	ND	--	ND	--
NYS Drinking Water Standard		5.		5.		5.		5.	
Typical MDL		2.		2.		2.		2.	

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.

Table 70
BNL Site Environmental Report for Calendar Year 1992
North Boundary, West Sector, and South Boundary
Ground Water Surveillance Wells, Water Quality Data

Well No.	No. of Samples(c)	pH (SU)	Conductivity Max. (µmhos/cm)	Conductivity Avg. (µmhos/cm)	Chlorides Max. (mg/L)	Chlorides Avg. (mg/L)	Sulfates Max. (mg/L)	Sulfates Avg. (mg/L)	Nitrate-Nitrogen(c) Max. (mg/L)	Nitrate-Nitrogen(c) Avg. (mg/L)
North Boundary(a)										
07-03	1	6.66	50.	--	5.1	--	ND	--	ND	--
13-01	3	5.48	48.	43.	5.0	4.7	6.1	5.9	ND	ND
18-01	3	5.31	64.	52.	24.2	9.8	17.6	11.0	1.3	ND
18-02	3	5.85	52.	45.	5.5	ND	8.0	7.8	ND	ND
18-03	3	7.10	177.	166.	14.4	12.7	12.7	11.1	1.7	1.1
25-03	3	5.67	55.	52.	8.9	7.3	9.4	8.5	ND	ND
25-02	3	5.72	80.	73.	13.2	11.7	13.1	11.9	ND	ND
West Sector										
72-01	2	5.63	55.	54.	6.9	6.2	9.6	9.4	ND	ND
83-01	2	6.35	119.	119.	19.3	19.0	10.7	10.4	ND	ND
83-02	2	6.37	125.	112.	16.9	15.5	11.6	11.2	ND	ND
84-01	2	5.82	208.	187.	28.2	24.8	24.7	22.8	2.7	2.4
101-01	2	5.64	164.	142.	37.3	28.8	14.4	13.2	ND	ND
102-01	2	5.11	106.	100.	8.1	7.9	16.8	16.6	3.5	3.2
South Boundary(b)										
118-01	2	5.78	71.	70.	11.9	10.4	10.2	9.9	ND	ND
118-02	2	5.94	103.	101.	21.4	15.8	11.2	9.5	ND	ND
122-01	2	5.79	30.	27.	8.6	6.8	6.8	5.5	ND	ND
122-02	2	5.85	94.	92.	17.3	17.2	15.3	13.1	ND	ND
126-01	2	5.59	43.	34.	8.2	6.7	9.2	7.6	ND	ND
130-02	2	5.85	149.	144.	24.3	14.7	19.3	13.6	1.5	ND
NYS Drinking Water Standards		6.5 - 8.5	(d)		250.0		250.0		10.0	
Typical MDL		--	10.		4.0		4.0		1.0	

ND: Not detected.
MDL: Minimum detection limit.
(a) North Boundary wells monitor background water quality for Site.
(b) South Boundary wells monitoring the HWMF and Current Landfill not included.
(c) Holding time expired for all samples.
(d) Standard not specified.

Table 71
BNL Site Environmental Report for Calendar Year 1992
North Boundary, West Sector, and South Boundary
Ground Surveillance Wells, Metals Data

Well No.	No. of Samples	Ag Max.	Ag Avg.	Cd Max.	Cd Avg.	Cr Max.	Cr Avg.	Cu Max.	Cu Avg.	Fe Max.	Fe Avg.	Hg Max.	Hg Avg.	Na Max.	Na Avg.	Pb Max.	Pb Avg.	Zn Max.	Zn Avg.
		<------							mg/L										------>
North Boundary(a)																			
07-03	1	<0.025	----	0.0012	----	<0.005	----	<0.05	----	3.745	----	NA?	----	1.9	----	0.007	----	7.0	----
18-01	3	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	2.31	0.92	<0.0002	<0.0002	3.6	3.2	<0.002	<0.002	0.06	0.02
All Others (n=5)	15	<0.025	<0.025	<0.0005	<0.0005	0.0194	<0.005	<0.05	<0.05	0.10	<0.075	<0.0002	<0.0002	11.7	6.0	0.005	<0.002	0.03	<0.02
West Sector																			
83-02	2	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	0.56	0.39	<0.0002	<0.0002	10.3	10.2	<0.002	<0.002	<0.02	<0.02
All Others (n=5)	10	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	24.4	11.7	<0.002	<0.002	<0.02	<0.02
South Boundary																			
All Wells (n=6)	11	<0.025	<0.025	<0.0005	<0.0005	<0.005	<0.005	<0.05	<0.05	<0.075	<0.075	<0.0002	<0.0002	17.5	7.6	<0.002	<0.002	<0.02	<0.02
NYS Drinking Water Standard		0.05		0.01		0.05		1.3		0.3		0.002		(c)		0.015		5.0	
Typical MDL		0.025		0.0005		0.005		0.05		0.075		0.0002		1.0		0.002		0.02	

MDL: Minimum detection limit.
(a) North Boundary wells monitor background water quality for site.
(b) South Boundary wells monitoring Hazardous Waste Management Facility and Current Landfill not included.
(c) No standard specified.

Table 72
BNL Site Environmental Report for Calendar Year 1992
North Boundary, West Sector, and South Boundary
Ground Water Surveillance Wells, Chlorocarbon Data

Well No.	No. of Samples	TCA		TCE		PCE		DCA		DCE		Chloroform	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
		<------ µg/L ------>											
North Boundary													
18-03	3	8.0	2.7	ND	ND	ND	ND	6.0	2.0	ND	ND	ND	ND
All Others (n=6)	16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
West Sector													
83-02	2	26.0	21.5	ND	ND	ND	ND	ND	ND	3.0	1.5	6.0	4.0
84-01	2	17.0	8.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
All Others (n=4)	8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	18.0	2.2
South Boundary													
130-02	2	14.0	12.5	4.0	3.5	ND	ND	ND	ND	5.0	2.5	ND	ND
All Others (n=5)	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.		5.		100.	
Typical MDL		2.		2.		2.		2.		2.		2.	

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.

Table 73
BNL Site Environmental Report for Calendar Year 1992
North Boundary, West Sector, and South Boundary
Ground Surveillance Wells, BETX Data

Well No.	No. of Samples	Benzene Max.	Benzene Avg.	Ethylbenzene Max.	Ethylbenzene Avg.	Toluene Max.	Toluene Avg.	Xylene Max.	Xylene Avg.
		μg/L							
North Boundary(a)									
All Wells (n=7)	19	ND	ND	ND	ND	ND	ND	ND	ND
West Sector									
All Wells (n=6)	12	ND	ND	ND	ND	ND	ND	ND	ND
South Boundary(b)									
All Wells (n=6)	12	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standard		5.		5.		5.		5.	
Typical MDL		2.		2.		2.		2.	

ND: Not detected.
MDL: Minimum detection limit.

West Sector Area: The west sector of BNL is monitored by six shallow to deep Upper Glacial aquifer surveillance wells. During 1992, all six wells were sampled for water quality, metals, and VOCs (Tables 70 - 73). Water quality analyses indicate that the pH of the ground water samples collected was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 5.65. All other water quality parameters were below applicable NYS DWS. Metals analyses indicate that all metals concentrations were below the applicable NYS DWS except for iron, which was detected at a concentration of 0.56 mg/L in Well 83-02. The VOC analyses indicate that two wells exceeded the NYS DWS for TCA, with a maximum observed concentration of 26 μg/L in Well 83-02 and 17 μg/L in Well 84-01. Soil and ground water contamination will be assessed in the west sector area, specifically in the vicinity of the Paint Shop, Potable Well 4, and Process Supply Wells 104 and 105, during a RI/FS (OU III) to be conducted under the IAG.

South Boundary Area: The surveillance well network along BNL's southern (downgradient) boundary, consists primarily of six well couplets or triplets which monitor shallow, intermediate, and deep portions of the Upper Glacial aquifer. (South Boundary surveillance wells monitoring the Current Landfill and HWMF are not included in this summary.) During 1992, all six wells were sampled for water quality, metals, and VOCs (Tables 70 - 73). Water quality analyses indicate that the pH of the ground water samples collected was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with a median pH of 5.80. All other water quality parameters were below applicable NYS DWS. Metals analyses indicate that all metals concentrations were below the applicable NYS DWS. The VOC analyses indicate that TCA detected in Well 130-02 exceeded the NYS DWS, with a maximum observed concentration of 14 μg/L, and DCE was detected at the DWS with a maximum concentration of 5 μg/L. Ground water contamination detected at Well 130-02, and off-site contamination detected in wells downgradient of Well 130-02, will be subject to a RI/FS (OU III) under the IAG.

5.1.2.3 Trend Studies

Trend plots of principal radionuclides, gross beta, Sr-90, and tritium observed at the HWMA and the Current/Old Landfill were plotted for the years 1988 to 1992. These are shown in Figures 37 and 38. Location of these wells are shown in Figure 36.

At the HWMA, tritium in most of the wells shows a pattern of decreasing concentration, and currently seems to be asymptotic to the "X" axis, i.e., time. Well 88-03 shows an increase in concentration whereas Well 98-30 is patterned after the rest of the wells. The Aquifer Restoration Project, that was operative from 1986 to early 1992, may have been responsible for the lowering of the concentrations of tritium in all the wells except 88-04. Gross beta and Sr-90 pattern after each other and seem to be fairly constant indicating the slow movement of the these radionuclides in ground water. Only Well 88-04 has shown these radionuclides to be increasing with time. This well is in proximity to the 1960 discharge of mixed fission products into a well which was adjacent to Well 88-04.

At the Current and Old Landfill areas the pattern of radionuclide concentrations is different from that observed at HWMA. The fact that the Landfill has been shut down since December 1990, and vegetation has been well developed as land cover may be contributing to pattern differences by affecting rainfall movement through the top soil. Tritium concentrations are constant over the years except for Wells 98-34 and 97-14, which have, however, returned to conform with the rest of the wells. Gross beta and Sr-90 have the same pattern, except that the rate of decrease of Sr-90 seems to be faster than that of gross beta.

HAZARDOUS WASTE MANGEMENT AREA

RADIONUCLIDES IN GROUND WATER - TREND STUDIES

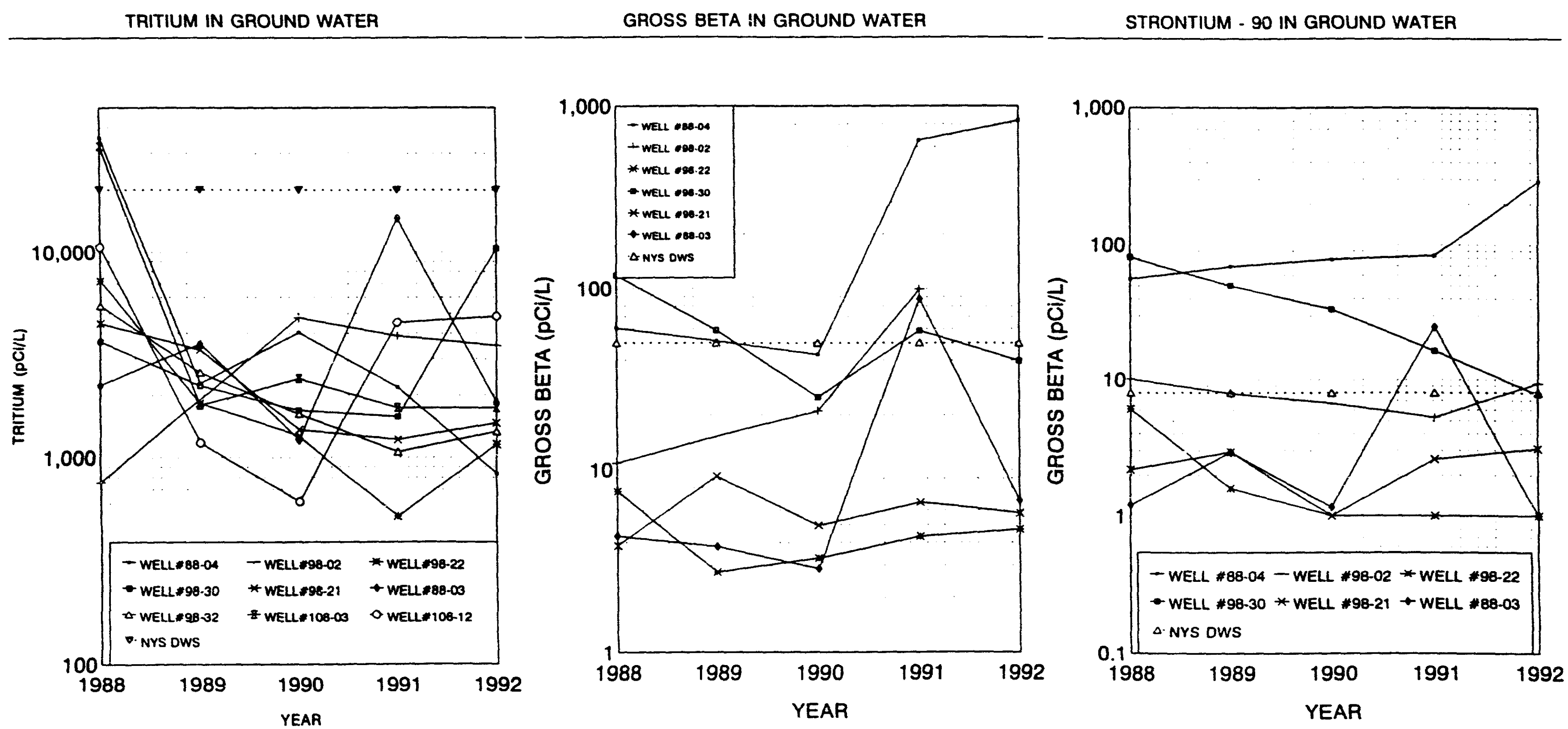


Figure 37: Hazardous Waste Management Area, Radionuclides in Ground Water Trend Studies.

CURRENT LANDFILL/OLD LANDFILL AREAS

RADIONUCLIDES IN GROUND WATER - TREND STUDIES

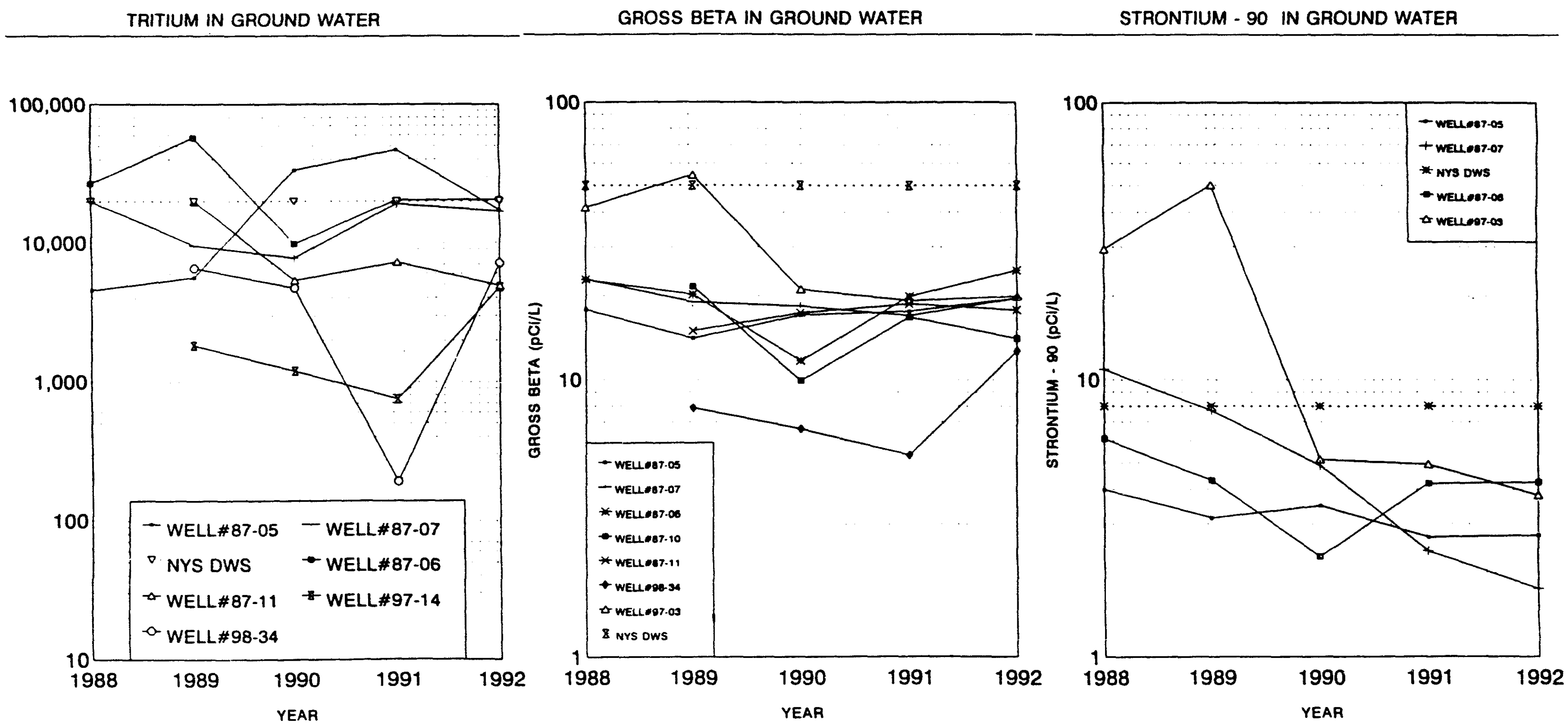


Figure 38: Current Landfill/Old Landfill Areas, Radionuclides in Ground Water Trend Studies.

6.0 OFF-SITE DOSE ESTIMATES

6.1 Dose Equivalents due to Airborne Effluents

The major radionuclides released from BNL airborne effluent discharge points were tritium, oxygen-15, and argon-41. The measured tritium concentrations and dose-equivalents at the site boundary are shown in Table 74. The highest annual average site boundary concentration of tritium vapor was 3.6 pCi/m^3 (0.13 Bq/L) at Monitoring Locations 16T (NNW Sector) and the committed effective dose equivalent (inhalation and skin absorption) was 0.0028 mrem (0.000028 mSv) for the hypothetical individual residing at that location. The exposure rates due to argon-41 and oxygen-15 were not measured at the site boundary. The dose-equivalent rates for these radionuclides, calculated using CAP88, are presented in Table 75. The maximum site-boundary dose-equivalent from argon-41 and oxygen-15 was calculated to be 0.095 mrem/yr (0.00095 mSv/yr). The maximum site boundary dose from all three radionuclides was 0.097 mrem/yr (0.000097 mSv/yr).

The collective (population) dose-equivalent was estimated for radionuclides released to the airborne environment using measured effluent release data and recorded BNL meteorological parameters. Using actual source terms and meteorological data at the given release point should yield the best projection of airborne concentrations, and thus dose to the general population. This approach also minimizes the effects of local micrometeorological conditions which may exist, resulting in differences between the measured and expected tritium concentrations at the perimeter monitoring stations.

Collective whole body doses resulting from the radionuclides released from each facility are presented in Table 76. Argon-41 contributed a collective dose equivalent of 2.6 person-rem (0.026 person-Sv) which is essentially the entire collective dose equivalent for the site. This is comparable to the value calculated for 1991. The dose equivalent contributions from tritium and cobalt-60 were 0.029 and 3.26E-3 person-rem (0.00029 and 3.26E-5 person-Sv), respectively. This is depicted graphically in Figure 39. The fraction of collective dose as a function of facility is presented graphically in Figure 40. The 1992 population collective dose-equivalent resulting from the release of airborne radionuclides by the Laboratory was 2.65 person-rem (0.027 person-Sv). This can be compared to the population collective dose-equivalent due to cosmic and terrestrial natural background of 291,000 person-rem (2,910 person-Sv). The Laboratory airborne releases comprised 0.00091% of the total dose due to natural background.

6.2 Dose Equivalents due to Liquid Effluents

Since the Peconic River is not used as a drinking water supply,[2] nor for irrigation, its waters do not constitute a direct pathway for the ingestion of radioactivity. However, the Peconic River does recharge the aquifer and acts as a limited source for sport fishing. In 1992, the collective dose equivalent resulting from the discharge of radioactive materials to the Peconic River has been computed by evaluating private potable water.

Table 74
BNL Site Environmental Report for Calendar Year 1992
Committed Effective Dose Equivalent at Site Boundary
Due to Tritium

Location	Sector ID	Flow wght'd average (pCi/m3)	Committed Effective Dose Equivalent (mrem)
1T	N	NM	NM
2T	NNE	2.37	0.0019
3T	NE	2.57	0.0020
4T	ENE	1.36	0.0011
5T	E	0.87	0.0007
6T	ESE	0.86	0.0007
7T	SE	1.93	0.0015
8T	SSE	0.82	0.0006
9T	S	2.66	0.0021
10T	SSW	-0.29	-0.0002
11T	SW	-0.14	-0.0001
12T	WSW	0.04	0.0000
13T	W	0.73	0.0006
14T	WNW	0.24	0.0002
15T	NW	2.45	0.0019
16T	NNW	3.55	0.0028
20T	Central Site	0.74	0.0006
Maximum Site Perimeter Dose			0.0028

Note: Committed Effective Dose Equivalent includes the inhalation and submersion pathways. The ICRP Publication No. 30 dose conversion factors used.

NM: Not measured due to vandalism.

Table 75
BNL Site Environmental Report for Calendar Year 1992
Ar-41 and O-15 Site Boundary Dose Equivalents

Location	Ar-41 mrem/yr	O-15 mrem/yr	Total mrem/yr
N	0.051	0.008	0.059
NNE	0.086	0.009	0.095
NE	0.051	0.005	0.056
ENE	0.037	0.005	0.042
E	0.042	0.007	0.049
ESE	0.066	0.015	0.081
SE	0.066	0.015	0.081
SSE	0.062	0.009	0.071
S	0.054	0.005	0.059
SSW	0.048	0.003	0.051
SW	0.049	0.003	0.052
WSW	0.041	0.009	0.050
W	0.045	0.003	0.048
WNW	0.039	0.004	0.043
NW	0.038	0.006	0.044
NNW	0.030	0.006	0.036

Note: All values are individual dose equivalent rates at a distance of 1,550 meters from the center of the site.

Table 76
BNL Site Environmental Report for Calendar Year 1992
Collective Dose - Radioactive Airborne Emissions

Nuclide	Total Ci released	Total p-rem/yr	HFBR p-rem/yr	801 A p-rem/yr	801 NA p-rem/yr	BMRR p-rem/yr	Incinerator p-rem/yr	BLIP p-rem/yr	Chemistry p-rem/yr	Compactor p-rem/yr
Ar-41	1.49E+03	2.61E+00				2.61E+00				
As-74	1.20E-06	5.83E-08		5.83E-08						
Au-199	2.01E-06	3.64E-08					3.64E-08			
Be-7	7.13E-03	5.76E-04						5.76E-04		
Br-77	7.95E-03	5.06E-05	1.40E-05	1.36E-08	3.66E-05					
Br-82	6.04E-04	2.21E-05	1.87E-05		3.35E-06					
C-14	2.80E-04	8.13E-06					8.13E-06			
Ce-143	1.02E-05	1.18E-07		1.18E-07						
Co-56	8.07E-05	5.82E-04			1.19E-07			5.82E-04		
Co-57	7.43E-05	9.55E-05			1.53E-05		5.89E-06	7.43E-05		
Co-58	1.88E-04	3.25E-04			3.65E-05			2.88E-04		
Co-60	3.38E-05	3.26E-03		1.49E-10	2.22E-04			3.04E-03		
Cr-51	1.56E-04	4.86E-06					4.86E-06			
Cs-137	1.00E-05	4.72E-06	5.88E-07	7.56E-07	1.39E-06			1.99E-06		
Cu-67	2.00E-06	5.12E-08					5.12E-08			
Fe-55	1.00E-07	2.62E-09					2.62E-09			
Ga-68	2.83E-02	3.61E-05		3.84E-07	3.57E-05			2.23E-08		
Ge-69	2.07E-02	6.60E-05		1.92E-07	6.58E-05					
H-3	7.01E+01	2.87E-02	2.84E-02				7.65E-07	2.86E-04	4.48E-06	1.22E-09
I-124	3.82E-05	5.37E-06		5.37E-06						
I-125	5.31E-05	1.55E-05					1.55E-05			
I-126	3.85E-05	1.21E-05	1.07E-07	1.19E-05				7.59E-08		
Mn-54	2.47E-04	1.79E-03	2.61E-07					1.79E-03		
Na-22	5.18E-05	2.70E-03						2.70E-03		
O-15	7.97E+02	1.95E-04						1.28E-04		
Sn-113m	5.60E-06	8.61E-07					8.61E-07			
Sn-117m	6.75E-05	4.18E-06					4.18E-06			
Sn-125	2.00E-05	7.12E-08						7.12E-08		
Sr-85	1.71E-05	8.79E-07					8.79E-07			
Xe-127	4.74E-04	2.58E-07		2.47E-10	1.88E-07			7.01E-08		
Xe-133	2.84E-05	1.50E-09	1.50E-09							
Xe-135	3.34E-04	1.08E-07	1.08E-07							
Y-88	2.60E-05	6.63E-06					6.63E-06			
Zn-65	2.25E-05	9.41E-05						9.41E-05		
Totals	2.42E+03	2.65E+00	2.84E-02	1.52E-06	4.34E-04	2.61E+00	4.78E-05	9.56E-03	4.48E-06	1.22E-09

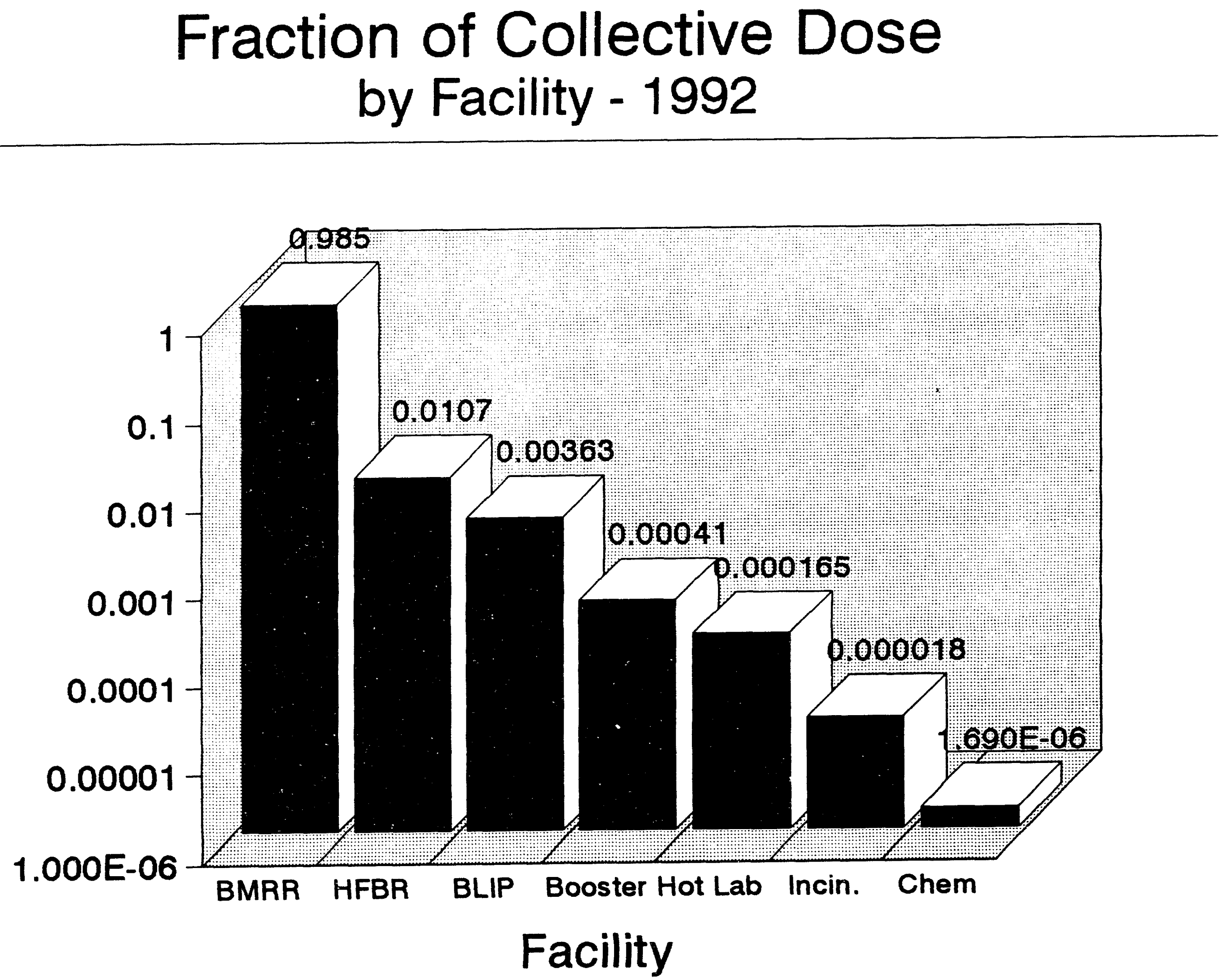


Figure 39: Collective Dose-Nuclide Specific 1992 Airborne Emissions.

Collective Dose - Nuclide Specific
1992 Airborne Emissions

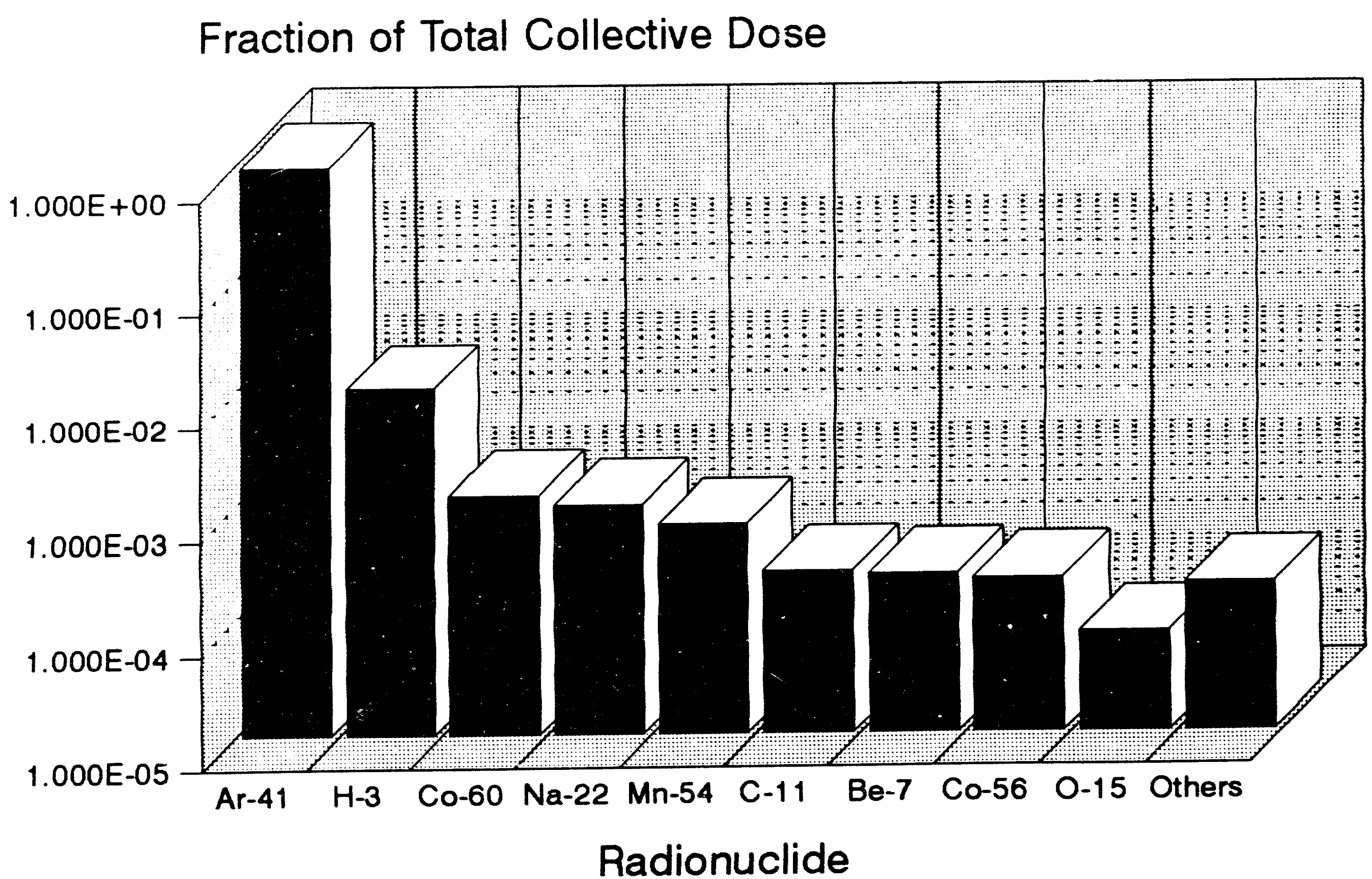


Figure 40: Fraction of Collective Dose by Facility - 199[illegible].

For the drinking water pathway, only tritium was detected in off-site potable wells. The highest annual average concentration for a single residence was 818 pCi/L (30.3 Bq/L). The average concentration for the group of positive tritium concentrations at private potable wells was 561.6 pCi/L (20.6 Bq/L). The NYS DWS for tritium is 20,000 pCi/L. This corresponds to a committed effective dose equivalent to the maximum individual of 0.038 mrem (0.00038 mSv) and a collective dose equivalent to the population at risk (assumed to be not more than 500 persons) of 0.0189 person-rem (0.00019 person-Sv). The data are summarized in Table 77.

The cesium-137 concentrations in fish samples collected from Peconic River and control locations are reported in Table 27. Using the method described in Appendix B, the maximum individual committed collective dose equivalent was calculated to be 0.22 mrem (0.0022 mSv). The population collective dose equivalent was calculated to be 0.137 person-rem (0.0014 person-Sv). The water and fish pathway dosimetric results are summarized in Table 77.

6.3 Collective (Population) Dose Equivalent

The collective (population) dose equivalent (total population dose) beyond the site boundary, within a radius of 80 km, attributed to Laboratory operations during 1992, was 3.2 person-rem (0.032 person-Sv) and was obtained by the summation of the doses from the pathways discussed previously in this report. The data are summarized in Table 78.

The collective dose equivalent to the population within an 80-km radius of the Laboratory, due to external radiation from natural background, amounts to about 291,000 person-rem/yr (2,910 person-Sv/yr), to which about 97,000 person-rem/yr (970 person-Sv/yr) should be added for internal radioactivity from natural sources.

Table 77
BNL Site Environmental Report for Calendar Year 1992
Collective and Individual Committed Effective Dose Equivalent (CEDE) from the Water Pathway

Pathway	Nuclide	Maximum Individual CEDE (mrem)	Collective CEDE (person-mrem)
Drinking Water	H-3	0.038	19
Fish	Cs-137	0.22	137
	Sr-90	0.65	406
All Ingestion Pathways		0.91	562

Note: Sr-90 CEDE estimated from 1992 Cs data and a ratio based on Cs:Sr values estimated over previous years.

Table 78
BNL Site Environmental Report for Calendar Year 1992
Collective Dose From All Pathways

Pathway	Maximum Individual CEDE (mrem)	Annual Background Dose Equiv. (mrem)	Maximum Individual Annual Dose Limit (mrem)	Collective CEDE (person-mrem)	Collective Background Dose Equiv (person-mrem
Air (a)	0.100	58	10	2650	2.9E+08
Water	0.038	ND	4	19	ND
Fish	0.87	0.206	NA	543	1.0E+02
All Pathways	1.00	58	100	3212	2.9E+08

(a) Direct exposure from plume passage included in air component.
ND: Not Detected.
NA: Not Applicable.

7.0 LABORATORY QUALITY ASSURANCE

The EM program, which includes surveillance monitoring as well as compliance monitoring, utilizes on-site radiological and analytical chemistry laboratories as well as off-site contractor laboratories. Standard Operating Procedure's are established for the calibration of instrumentation, analysis of samples, and performance of quality control checks. Depending on the analytical method, quality control checks include analysis of blanks or background concentrations, use of Amersham or National Institute for Standards and Technology (NIST) traceable standards, and analysis of reference check standards, spiked samples, and duplicate samples. The respective laboratory managers review all analytical and quality control results before the data is reported and incorporated into the database.

7.1 Radiological Laboratory

The S&EP Radiological Laboratory performs analysis of both environmental and facility samples for gross alpha, gross beta, gamma, and tritium. The laboratory participates in the DOE Environmental Measurements Laboratory (EML) QA Program and the EPA Nuclear Radiation Assessment Division, Environmental Monitoring Systems Laboratory, Las Vegas (EMSL-LV) Intercomparison Study. The results of these studies are presented in Tables 79 and 80, respectively.

Twenty-six of thirty-four EML analyses were within ± 20% of the known value; seven of thirty-four were within ± 30%; and one analyses fell outside the acceptance limits of ± 50%. Further investigation of this EML analysis revealed a photomultiplier tube degradation which resulted in an instrument repair. Results of the EMSL-LV intercomparisons showed twenty-nine of thirty-six acceptable analyses, within ± 3σ of the known value. Investigation of the unacceptable analyses showed two of the seven analyses were within 2 and 3σ of the grand average implying an error in the known value. Three analyses revealed the need for protocol changes such as a self-adsorption correction factor, a detector bias check, and review of non-routine calculations, which resulted in improvements to the measurement process. Lastly, a decision was made to no longer report isotopes that were not routinely analyzed in the BNL laboratory.

Figures 41 and 42 summarize the internal quality control program performance for the radiological laboratory instrumentation. Figure 41 shows the annual mean and 99% confidence interval for the alpha, beta, and tritium instrument efficiencies as determined by a daily calibration standard. It is noted that the tritium analysis process included a change in scintillation cocktail and a photomultiplier tube failure which contributed to the interval. Figure 42 compares the mean and 99% confidence intervals of the Cs^{137} energy measured for each gamma detector as measured by a daily calibration standard. The plot indicates the theoretical energy of 661.65 KeV, and shows the performance of each detector within ± 1.16 KeV.

Table 79
BNL Quality Assessment Program Results
Environmental Measurements Laboratory

Matrix	Units	Isotope	Date	EML	BNL	BNL/EML Ratio
Water	$Bq \cdot L^{-1}$	H^3	3/92	227	293	1.29
			9/92	118	224	1.90
		Mn^{54}	3/92	56.6	55.8	.99
			9/92	33.3	35.1	1.05
		Co^{60}	3/92	94	99.9	1.06
			9/92	27.8	29.4	1.06
		Cs^{134}	3/92	71.8	74.3	1.03
			9/92	44.1	49.9	1.13
		Cs^{137}	3/92	84.6	88.3	1.04
			9/92	29.0	32.3	1.11
		Ce^{144}	3/92	189	202	1.07
			9/92	51.2	55.1	1.08
Air Filter	Bq/Filter	Mn^{54}	3/92	5.97	5.20	.87
			9/92	25.9	23.5	.91
		Co^{57}	3/92	7.93	5.90	.74
			9/92	6.4	4.9	.77
		Co^{60}	3/92	5.81	4.90	.84
			9/92	3.06	2.90	.95
		Cs^{134}	3/92	4.44	3.80	.86
			9/92	3.72	2.80	.75
		Cs^{137}	3/92	5.76	5.00	.87
			9/92	5.20	5.82	.89
		Ce^{144}	3/92	63.9	57.3	.90
			9/92	43.3	32.8	.76
		Be^7	3/92	28.6	23.2	.81
			9/92	308	262	.85
Vegetation	$Bq \cdot g^{-1}$	Cs^{137}	3/92	24.6	25.0	1.02
			9/92	29.2	28.8	.99
		K^{40}	3/92	294	335	1.14
			9/92	1010	987	.98
Soil	$Bq \cdot g^{-1}$	Cs^{137}	3/92	5.23	5.20	.99
			9/92	285	207	.73
		K^{40}	3/92	719	774	1.08
			9/92	384	285	.74

Table 80
BNL Intercomparison Study Results
Environmental Monitoring Systems Laboratory

Matrix	Units	Isotope	Date	EMSL	BNL	BNL/EMSL Ratio
Water	$pCi \cdot L^{-1}$	Gross Alpha	1/92	30.0	NA	-
			4/92	40.0	25.7	.64
			5/92[c]	15.0	10.9	.73
			9/92	45.0	23.0	.51[a]
			10/92	29.0	20.7	.72
		Gross Beta	1/92	30.0	NA	-
			4/92	140.0	113.7	.81
			5/92	44.0	42.0	.95
			9/92	50.0	44.7	.89
			10/92	53.0	48.3	.91
		H^3	2/92	7904	7637	.97
			6/92	2125	2047	.96
		Co^{60}	2/92[c]	40.0	39.8	1.00
			4/92	56.0	64.0	1.14
			6/92	20.0	21.3	1.07
			10/92	15.0	24.0	1.60[b]
		Cs^{134}	2/92[c]	31.0	30.0	.97
			4/92	24.0	23.0	.96
			6/92	15.0	14.7	.98
			10/92	5.0	ND	-
		Cs^{137}	2/92[c]	49.0	50.6	1.03
			4/92	22.0	29.0	1.32
			6/92	15.0	13.3	.89
			10/92	8.0	10.7	1.34
		Zn^{65}	2/92[c]	148.0	151.3	1.02
			6/92	99.0	121.0	1.22[a]
		Ba^{133}	2/92[c]	76.0	68.8	.91
			6/92	98.0	84.0	.86
		Ru^{106}	2/92[c]	203.	149.2	.73[a]
			6/92	141.	170.0	1.21[a]
		Sr^{90}	4/92	17.0	NA	-
			10/92	10.0	NA	-
Air	pCi/Filter	Alpha	3/92	7.0	7.7	1.10
			8/92	30.0	32.3	1.07
		Beta	3/92[c]	41.0	42.7	1.04
			8/92	69.0	78.0	1.13
		Cs^{137}	3/92	10.0	13.7	1.37
			8/92	18.0	26.0	1.44
		Sr^{90}	3/92	15.0	NA	-
			8/92	25.0	NA	-
Milk	$pCi \cdot L^{-1}$	I^{131}	4/92	78.0	119.7	1.53[b]
		Cs^{137}	4/92	39.0	39.7	1.02
		Sr^{90}	4/92	29.	NA	-
	$mg \cdot L$	K	4/92[c]	1710.	2117.	1.23[b]

NA: Not analyzed.
ND: Not detected.
[a] Outside $\pm 3\sigma$ control limit.
[b] Determined to be an outlier.
[c] BNL result shown was corrected due to calculation error.

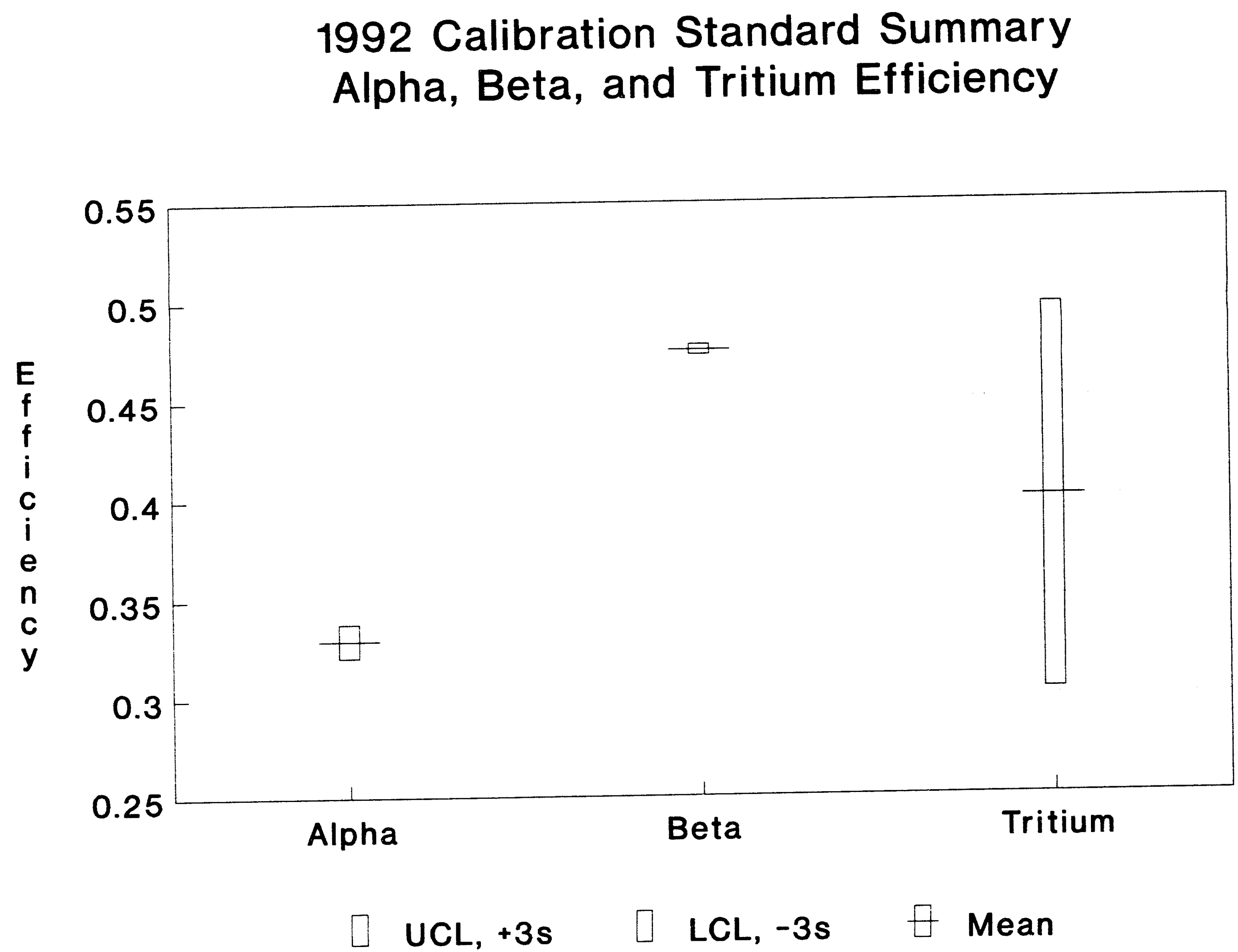


Figure 41: 1992 Calibration Standard Summary.

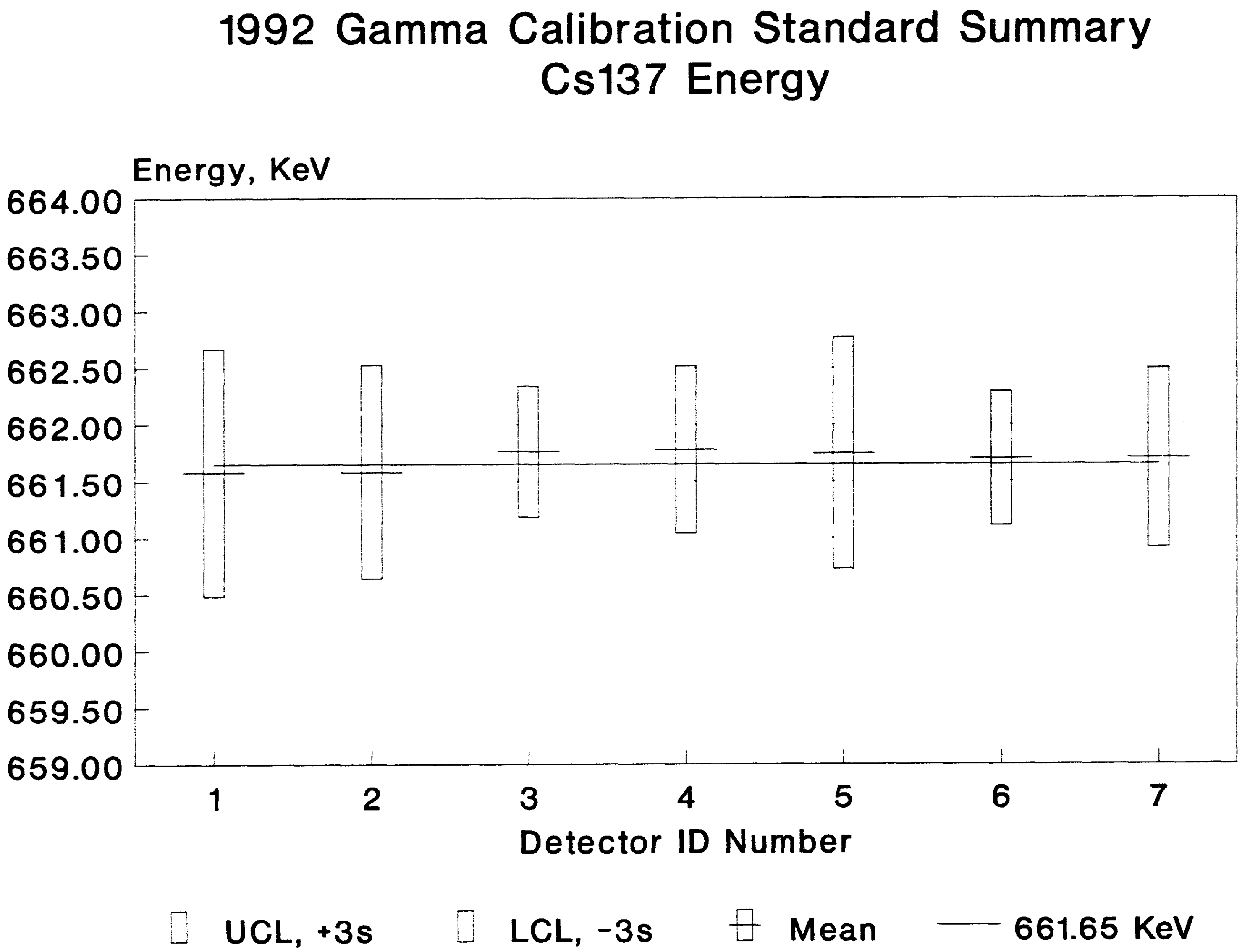


Figure 42: 1992 Gamma Calibration Standard Summary.

7.2 Non-Radiological Laboratory

The S&EP Analytical Chemistry Laboratory is certified by NYSDOH for metals and anions under potable water analyses and specific purgeable organic compounds under non-potable water analyses. These compounds are BTX, ethylbenzene, chloroform, DCA, DCE, TCA, TCE, and PCE. The Laboratory participates in the NYSDOH Environmental Laboratory Approval Program. The results for organic and inorganic analyses are presented in Tables 81 and 82, respectively.

Good agreement, within ± 15%, was noted in twenty-seven of twenty-eight organic analysis tests; while one test fell within ± 24% of the known value. Results from the inorganic proficiency samples showed excellent agreement, within ± 5, in forty-four of the fifty-two analyses; good agreement, within ± 15% in six analyses; and two analyses within ± 18%. It is noted that shortly after a lead analysis was rated as unacceptable at + 18%, NYSDOH revised their acceptance limits to ± 30%.

Figure 43 presents the annual summary of the recoveries measured by the reference check sample analyzed in each metals or anions batch. The results show the anions to be ± 15% and the metals at ± 13% of the target value, with the exception of mercury which was measured at ± 18%. Figure 44 summarizes the recoveries of the organic analysis reference check data by presenting the mean and 99% confidence interval for each of the primary volatile organic compounds and two PCB controls. The figure shows a slight negative bias, within - 5%, for all volatile organics, and variability of ± 16% about that mean.

Samples collected for regulatory compliance purposes such as SPDES discharge monitoring reports, water treatment plant monthly reports, and the CSF semiannual reports are analyzed by off-site contractor laboratories certified in the respective analytes of interest. Contractors are also used to augment the capabilities of the on-site laboratories, for example Sr-90 and TCLP. When necessary, they are used to offset workload demands placed on the S&EP Analytical Chemistry Laboratory. The laboratory manager specifies the contract requirements for each analytical method and ensures the incoming data package complies with those specifications before the data is reported. Audits are performed periodically by the respective laboratory supervisor and EP QA Officer on these commercial laboratories to ensure competence in analytical methodology and implementation of a comprehensive QA program. In 1992, two such audits were performed.

Lastly, the contract laboratory responsible for analyzing the SPDES samples is required to participate in the NPDES Performance Evaluation Study. The results of this audit are presented in Table 83. All analyses except zinc were acceptable. Investigation into the zinc analysis revealed no unusual conditions.

Table 81
BNL Non-potable Water Chemistry Proficiency Test Results
Environmental Laboratory Approval Program

Analyte	Date	ELAP ($\mu g \cdot L^{-1}$)	BNL ($\mu g \cdot L^{-1}$)	BNL/ELAP Ratio
Benzene	1/92	45.3	40.0	.88
		27.1	23.6	.87
	7/92	23.4	23.3	1.00
		37.1	37.9	1.02
Ethyl Benzene	1/92	22.8	21.2	.93
		53.5	47.9	.90
	7/92	35.8	33.9	.95
		26.9	25.7	.96
Total Xylenes	1/92	22.7	23.5	1.04
		53.9	57.1	1.06
	7/92	33.8	37.0	1.09
		25.4	28.0	1.10
Chloroform	1/92	39.5	34.4	.87
		93.8	89.0	.95
	7/92	44.5	45.7	1.03
		59.0	58.9	1.00
Tetrachloroethene	1/92	85.7	72.9	.85
		51.8	44.5	.86
	7/92	51.0	48.1	.94
		84.0	83.6	1.00
1,1,1-Trichloroethane	1/92	66.9	60.5	.90
		40.7	34.8	.86
	7/92	42.9	40.9	.95
		70.4	73.6	1.05
Trichloroethene	1/92	38.8	35.7	.92
		92.6	83.9	.91
	7/92	61.7	61.4	1.00
		46.0	57.0	1.24

Table 82
BNL Potable Water Chemistry Proficiency Test Results
Environmental Laboratory Approval Program

Analyte	Date	ELAP ($\mu g \cdot L^{-1}$)	BNL ($\mu g \cdot L^{-1}$)	BNL/ELAP Ratio
Cloride	4/92	25.2	24.1	.96
		99.8	95.3	.95
	10/92	99.3	99.8	1.01
		179.0	176.0	.98
Nitrate (as N)	4/92	0.510	0.488	.96
		6.50	6.32	.97
	10/92	2.51	2.49	.99
		7.53	7.28	.97
Sulfate	4/92	110.0	107.7	.98
		35.3	33.8	.96
	10/92	70.4	69.8	.99
		160.	157.	.98
Cadmium	4/92	10.2	10.0	.98
		4.16	4.12	.99
	10/92	7.50	7.40	.99
		2.50	2.38	.95
Copper	4/92	607.	607.	1.00
		202.	202.	1.00
	10/92	500.	530.	1.06
		375.	388.	1.03
Lead	4/92	32.6	38.5	1.18[a]
		16.7	17.2	1.03
	10/92	5.0	4.76	.95
		25.0	24.6	.98
Manganese	4/92	40.0	40.9	1.02
		10.1	10.0	.99
	10/92	50.2	53.1	1.06
		25.1	26.3	1.05
Silver	4/92	20.3	20.1	.99
		39.8	39.2	.98
	10/92	24.7	24.4	.99
		12.3	12.0	.98
Zinc	4/92	599.	592.	.99
		991.	973.	.98
	10/92	252.	254.	1.01
		750.	753.	1.00
Chromium	4/92	20.1	19.0	.95
		14.8	14.0	.95
	10/92	50.0	51.4	1.03
		12.5	12.8	1.02
Iron	4/92	304.	303.	1.00
		102.	101.	.99
	10/92	205.	200.	.98
		102.	101.	.99
Mercury	4/92	1.06	1.02	.96
		.824	.740	.90
	10/92	0.50	.43	.86
		1.00	.84	.84
Sodium	4/92	1030.	1027.	1.00
		327.	301.	.92
	10/92	281.	282.	1.00
		527.	592.	1.12

[a]Outside acceptance limit of ±15%

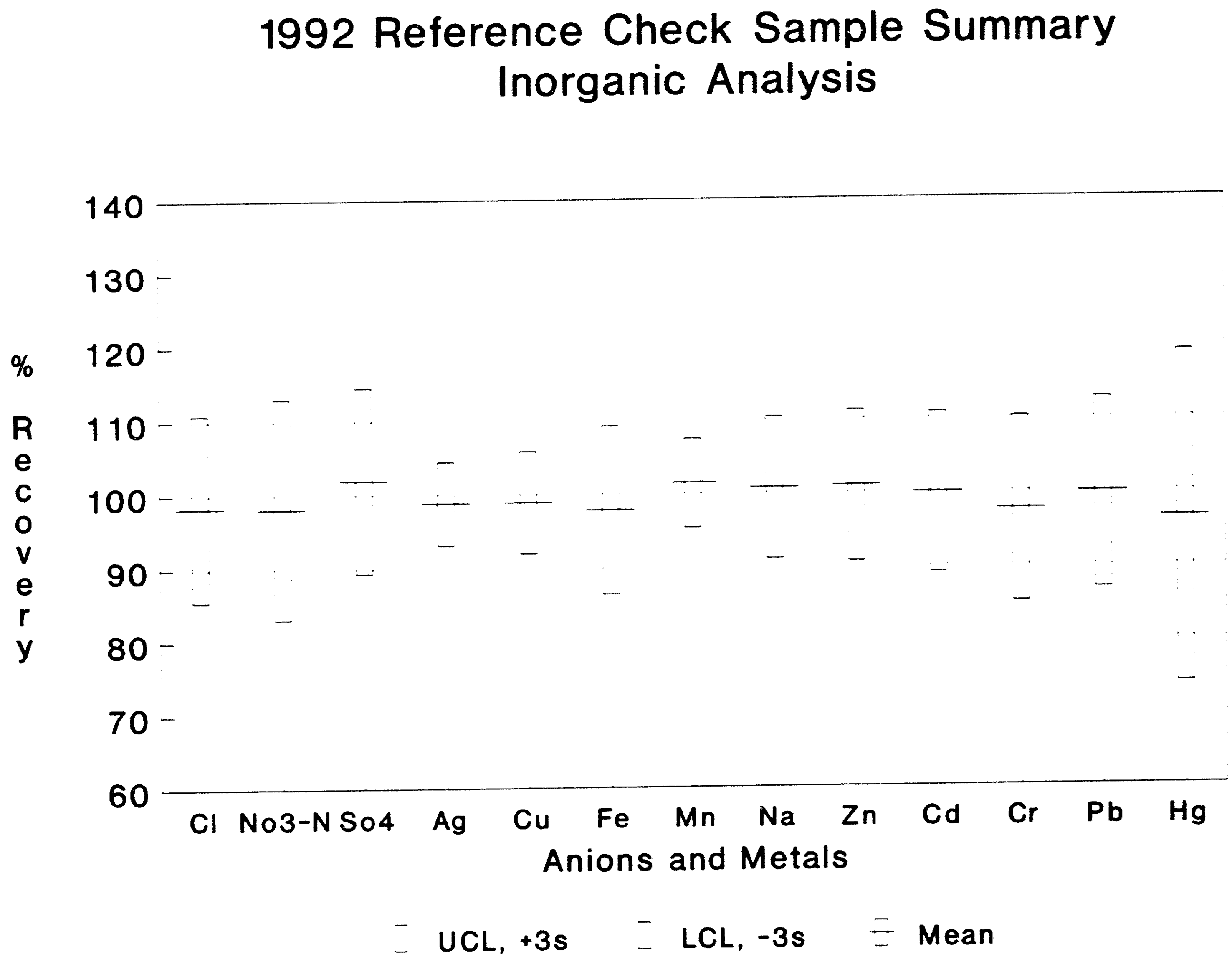
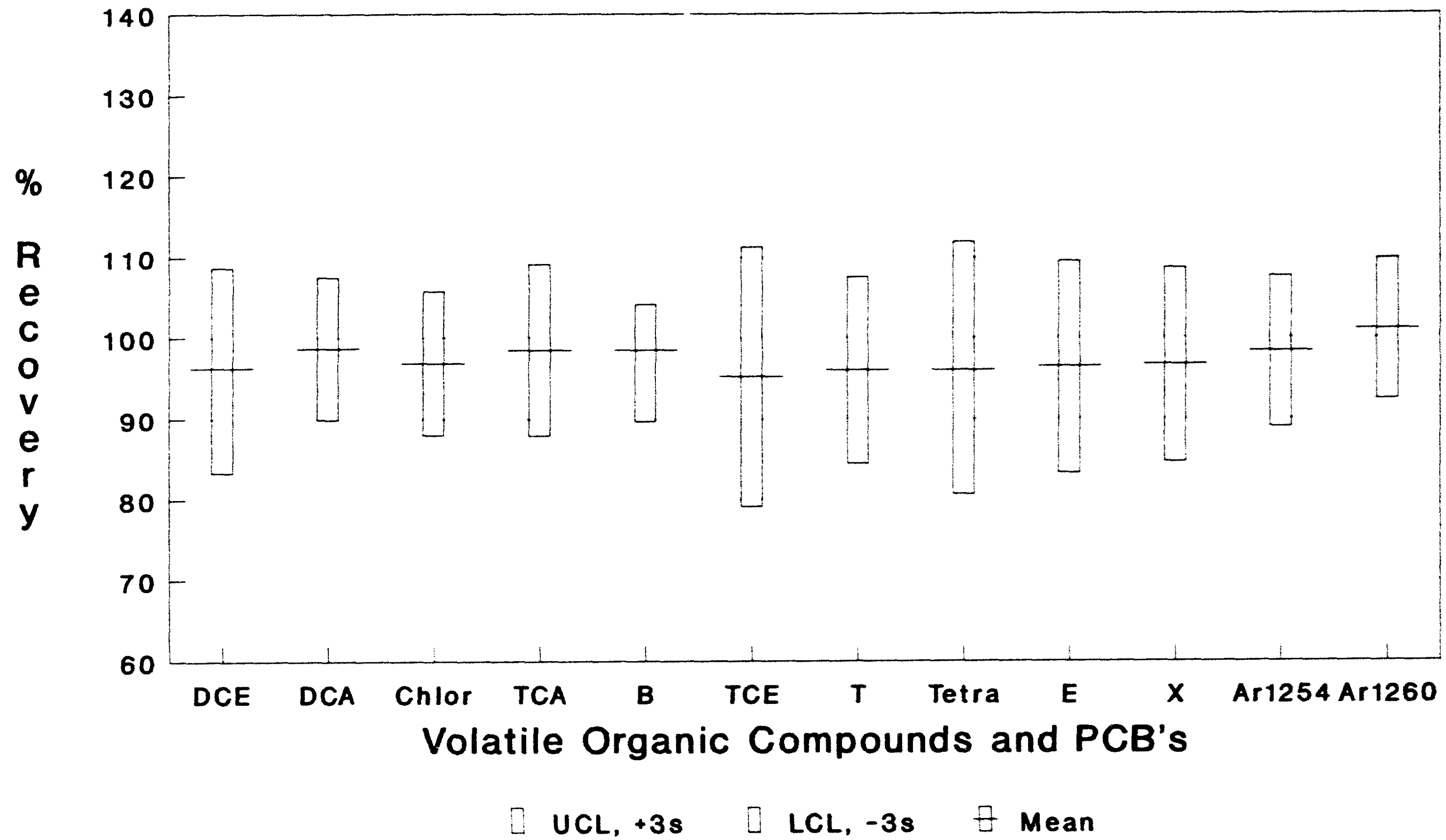


Figure 43: 1992 Reference Check Sample Summary.

1992 Reference Check Sample Summary
Organic Analysis



Chlor=Chloroform; B=Benzene;
E=Ethyl benzene; T=Toluene;
Tetra=Tetra-chloroethylene; X=o-Xylene.

Figure 44: 1992 Reference Check Sample Summary.

Table 83
BNL National Pollutant Discharge Elimination System (NPDES)
Performance Evaluation Report

Analyte	Units	Date	NPDES	BNL	BNL/NPDES Ratio
Cu	$\mu g \cdot L^{-1}$	4/92	790	830	1.05
Fe	$\mu g \cdot L^{-1}$	4/92	1500	1460	.97
Pb	$\mu g \cdot L^{-1}$	4/92	550	593	1.08
Zn	$\mu g \cdot L^{-1}$	4/92	360	296	.82[a]
pH	pH units	4/92	9.40	9.20	.98
TSS	$mg \cdot L^{-1}$	4/92	25.0	27.0	1.08
Ammonia-N	$mg \cdot L^{-1}$	4/92	2.50	2.60	1.04
NO_3-N	$mg \cdot L^{-1}$	4/92	15.0	14.9	.99
Kjeldahl-N	$mg \cdot L^{-1}$	4/92	34.0	34.4	1.01
5-Day BOD	$mg \cdot L^{-1}$	4/92	36.0	35.0	.97
Total Residual Cl	$mg \cdot L^{-1}$	4/92	.44	.45	1.02

[a]Outside acceptance limit of ± 15%

APPENDIX A

A.1 Glossary of Terms

AGS	- Alternating Gradient Synchrotron
ALF	- Alternate Liquid Fuels
AOC	- Area of Concern
ATF	- Accelerator Test Facility
AUI	- Associated Universities Inc.
BHO	- Brookhaven Area Office
BLIP	- Brookhaven LINAC Isotope Production Facility
BNL	- Brookhaven National Laboratory
BETX	- Benzene Ethylbenzene Toluene Xylene
BOD	- Biochemical Oxygen Demand
CAA	- Clean Air Act
CBS	- Chemical Bulk Storage
CERCLA	- Comprehensive Environmental Response, Compensation & Liability Act
CLP	- Contract Laboratory Program
CFC	- Chlorofluorocarbon
CH	- Chicago
CO	- Certificates to Operate
CSF	- Central Steam Facility
CY	- Calendar Year
CWA	- Clean Water Act
DAS	- Department of Applied Science
DCA	- Dichloroethane
DCE	- Dichloroethylene
DCG	- Derived Concentration Guide
DMR	- Discharge Monitoring Report
DOE	- Department of Energy
DOT	- Department of Transportation
ECL	- Environmental Conservation Law
EM	- Environmental Monitoring
EMG	- Environmental Monitoring Group
EML	- Environment Measurements Laboratory
EMSL-LV	- Environmental Measurements Systems Laboratory - Las Vegas
EP	- Environmental Protection
EPA	- Environmental Protection Agency
EPIP	- Environmental Protection Implementation Plan (EPIP)
EPS	- Environmental Protection Section
ES&H	- Environmental, Safety, and Health
ESP	- Employee Suggestion Program
GC/MS	- Gas Chromatography Mass Spectrometer
HFBR	- High Flux Beam Reactor
HSBSR	- Hazardous Substance Bulk Storage Registration
HWMA	- Hazardous Waste Management Area
HWMF	- Hazardous Waste Management Facility
HWMG	- Hazardous Waste Management Group
HWMS	- Hazardous Waste Management Section

A.1 Glossary of Terms (Continued)

IAG	- Interagency Agreement
LEPC	- Local Emergency Planning Committee
LFS	- Light Feed Stocks
LINAC	- Linear Accelerator
LSC	- Liquid Scintillation Counting
MDC	- Minimum Detection Concentration
MDL	- Minimum Detection Limit
MLD	- Million Liters per Day
MOU	- Memorandum of Understanding
MPF	- Major Petroleum Facility
MRC	- Medical Research Center
MRR	- Medical Research Reactor
NA	- Not Analyzed
NPDES	- National Pollutant Discharge Elimination System
ND	- Not Detected
NEPA	- National Environmental Policy Act
NESHAPs	- National Emission Standards for Hazardous Air Pollutants
NIST	- National Institute for Standards and Technology
NOV	- Notice of Violation
NPL	- National Priority List
NR	- Not Reported
NS	- Not Sampled
NSLS	- National Synchrotron Light Source
NYCRR	- New York Code of Rules and Regulations
NYS	- New York State
NYSDEC	- New York State Department of Environmental Conservation
NYSDOH	- New York State Department of Health
NYS DWS	- New York State Drinking Water Standard
OER	- Office of Environmental Restoration
OU	- Operational Unit
PCB	- Polychlorinated biphenyls
PCE	- Tetrachloroethylene
PC	- Permit to Construct
P&GA	- Photography and Graphic Arts
PE	- Plant Engineering
PNA	- Polynuclear Aromatics
POC	- Principal Organic Compound
PVC	- Polyvinyl Chloride
QA	- Quality Assurance
RAC	- Remedial Action Committee
RADWG	- Research and Development Working Group
RCG	- Radiation Concentration Guide
RCRA	- Resource Conservation Recovery Act
RI/FS	- Remedial Investigation/Feasibility Study
RHIC	- Relativistic Heavy Ion Collider
RSD	- Response Strategy Document
SARA	- Superfund Amendments and Reauthorization Act

A.1 Glossary of Terms (Continued)

SCDHS - Suffolk County Department of Health Services
SDWA - Safe Drinking Water Act
SEAPPM - Safety and Environmental Administrative Policy and Procedures Manual
SEPD - Safety and Environmental Protection Division
SER - Site Environmental Report
SERC - (New York) State Emergency Response Committee
S&EP - Safety and Environmental Protection
S&M - Supply and Materiel
SOP - Standard Operating Procedures
SPCC - Spill Prevention Control and Counter Measures
SPDES - State Pollutant Discharge Elimination System
STP - Sewage Treatment Plant
STHIM - Short Term High Intensity Monitoring
TCA - 1,1,1-Trichloroethane
TCE - Trichloroethylene
TCLP - Toxic Characteristic Leachate Procedure
TLD - Thermoluminescent Dosimeters
TPH - Total Petroleum Hydrocarbons
TSCA - Toxic Substance Control Act
TTA - Tiger Team Assessment
USFWS - United States Fish and Wildlife Service
UST - Underground Storage Tank
VOC - Volatile Organic Compound
WCF - Waste Concentration Facility
WSRRSA - Wild, Scenic, and Recreational River Systems Act
WTP - Water Treatment Plant

A.2 Glossary of Units

Bq	- Becquerel
Bq/L	- Becquerel per liter
Bq/M^3	- Becquerel per cubic meter
°C	- Degrees Centigrade
cc	- Cubic centimeter
Ci	- Curie
$CiMW^{-1}h^{-1}$	- Curie per megawatt hour
cm	- Centimeter
cm^3	- Cubicmeter
cm/d	- Centimeters per day
m^3/min	- cubic meters per minute
d	- Day
gal	- Gallon
GBq	- Giga Becquerel
GeV	- Giga electron volt
GeV/amu	- Giga electron volt per atomic mass unit
gph	- Gallon per hour
ha	- Hectare
kg/yr	- Kilogram per year
km	- Kilometer
L/d	- Liters per day
m	- Meter
mCi	- Millicurie
MeV	- Mega electron volt
mg/L	- Milligram per liter
ml	- Milliliter
MLD	- Million liters per day
mrem	- Millirem
mrem/yr	- Millirem per year
mSv	- milli seivert
mSv/yr	- milli seivert/year
MW	- Megawatts
nCi/L	- Nanocuries per liter
pCi/kg	- Picocuries per kilogram
pCi/L	- Picocuries per liter
pCi/m^3	- Picocuries per cubic meter
pH	- Hydrogen ion concentration
rem	- Unit of radiation dose equivalent
Sv	- Seivert
TBq	- Tera Becquerel
µCi	- Microcuries
µCi/L	- Microcuries per liter
µg/L	- Micrograms per liter

APPENDIX B

METHODOLOGIES

1. Methodology for Dose-Equivalent Calculations - Atmospheric Release Pathway

Dispersion was calculated for release elevations as listed in Table 6, at each of the 16 directional sectors, and for 6 distance increments (site boundary, 1.6-16 km, 16-32 km, 32-48 km, 48-64 km, and 64-80 km) from the center of the site using CAP88. The 1990 site meteorology as measured at 10 and 100 meter elevations was used to calculate the annual average dispersion for the midpoint of a given sector and distance. The radionuclide specific release rates (Ci/yr) from the HFBR stack, the Chemistry Building roof vent, the Van de Graaff roof vent, the BLIP stack, and the Hazardous Waste Management Incinerator stack were used to determine the annual emission rate for each radionuclide. The site boundary and collective data were obtained from the CAP88 computer code printout. The CAP88 calculates the total dose due to contributions from the submersion, ingestion, shoreline, and recreational pathways as a result of an atmospheric release. In 1990, two percent of the tritium atmospheric release from the 100 m stack was added to the 10 meter tritium source term in an effort to account for down-draft at the 100 meter stack.

2. Method for Tritium Dose-Equivalent Calculations - Potable Water Ingestion Pathway

The method used to calculate the maximum individual committed effective dose equivalent and the collective dose equivalent are present along with the basic assumptions used in the calculation. For the maximum individual, the highest annual average tritium concentration, as measured from a single potable well was used to calculate the total quantity of tritium ingested via the drinking water pathway. For the collective dose equivalent calculation, the annual average tritium concentration was obtained by averaging all positive results from potable wells which were in the demographic region adjacent to the Laboratory. The annual intake of tritium via the drinking water pathway was calculated from the following equation:

$$AI = 1 \times 10^{-6}\ C \cdot IR \cdot T$$

where: AI = Activity Intake, μCi

C = annual average water concentration, pCi/L

IR = Ingestion Rate (2) L/d

T = Time, 365 d

The committed effective-dose equivalent was calculated from the following equation:

$$H = AI \cdot DCF \cdot P$$

where: H = committed effective dose-equivalent, rem

AI = Activity Intake, μCi

DCF = Dose Conversion Factor, Rem/μCi (6.3E-5 rem/μCi)

P = Population at risk

To determine the maximum individual dose, the population parameter was set to unity. For the collective dose calculation, the population at risk in this area was assumed to be approximately 500.

3. Methodology for Dose-Equivalent Calculations - Fish Ingestion Pathway

In order to estimate the collective-dose equivalent from the fish consumption pathway, the following procedure was utilized:

a. Radionuclide data for fish samples were all converted to pCi/kg wet weight, as this is the form in which the fish is used.

b. The average fish consumption for an individual who does recreational fishing in the Peconic River was based on a study done by the NYSDEC which suggests that the consumption rate is 7 kg/yr.[50]

c. Committed Dose Equivalent Tables[51] were used to get the 50 year Committed Dose Equivalent Factor - rem/μCi intake.

The factors for the ingestion pathway for the radionuclides identified were:

^{3}H: 6.3E-05 rem/μCi intake

^{90}Sr: 1.3E-01 rem/μCi intake

^{137}Cs: 5.0E-02 rem/μCi intake

d. Calculation:

Intake (7 kg/yr) x Activity in flesh μCi/kg
x Factor rem/μCi intake = rem

e. Because there is a cesium-137 background as determined by the control location data, this background was subtracted from all data prior to use for dosimetric purposes.

f. As the Sr-90 analyses of fish samples were delayed, an estimate of Sr-90 concentrations in fish for 1992 were obtained by determining a Cs-137:Sr-90 ratio from Cs-137 and Sr-90 data of previous years. This factor was then used to estimate the Sr-90 concentration for use in dosimetric assessment.

4. Data Processing

Analytical results of the environmental and effluent monitoring programs are reported in tables that accompany the text. The data presented in these tables were generated as described below.

First, gross alpha, beta, and tritium results are reported as the net measured quantity. When only one sample was analyzed, results could be positive, zero, or negative. When the average concentration is reported, the average was computed by averaging the volume-weighted measured quantity. Because measured quantities were used throughout the report for these parameters, the reader should examine Appendix C to determine the typical analytical sensitivity for a particular parameter prior to deciding the importance of a result. Data which are less than the Minimum Detection Concentration (MDC) of the analytical technique should not be considered as positive results. Only data which exceed the MDC were used as positive results.

Second, gamma spectroscopy, strontium-90, and chemical analytical results were not converted to the new data presentation format; measured concentrations that were less than or equal to the MDC, while reported, were not used to compute average concentration levels. All MDC values were evaluated as if the results were zero. This explains occasional instances where the MDC is several times larger than the calculated annual average concentration.

Finally, if an analysis was performed and the result was less than the MDC of the system, the concentration was generally reported as not detected (ND). Appendix C presents typical MDCs for the analyses performed on environmental and effluent samples.

The following is a list of typical Minimum Detectable Limits (MDL) and Concentrations for the various analyses performed on environmental and effluent samples.

Nuclide	Matrix	Aliquot (ml)	MDC (μCi/ml)	MDL (μCi)
Gross alpha	water	1	2E-7	3E-7
		100	2E-9	
		500	5E-10	
Gross beta	water	1	6E-7	6E-7
		100	6E-9	
		500	1E-9	
Tritium	water	1	1.3E-6	1.3E-6
		7	3.0E-7	

Nuclide	300g MDL μCi/g	300ml MDL μCi/ml	12000ml MDL μCi/ml	Charcoal MDC μCi
^{7}Be	7.4E-8	9.8E-8	1.6E-9	9.3E-6
^{22}Na	9.4E-9	1.2E-8	2.0E-10	1.4E-6
^{40}K	1.8E-7	2.3E-7	3.9E-9	2.7E-5
^{48}Sc	1.1E-8	1.4E-8	2.3E-10	1.6E-6
^{51}Cr	7.6E-8	1.0E-7	1.6E-9	9.0E-6
^{54}Mn	8.4E-9	1.1E-8	1.8E-10	1.1E-6
^{56}Mn	2.2E-7	2.8E-7	4.7E-9	3.1E-5
^{57}Co	7.2E-9	9.2E-9	1.4E-10	7.5E-7
^{58}Co	8.3E-9	1.1E-8	1.8E-10	1.1E-6
^{60}Co	1.1E-8	1.4E-8	2.3E-10	1.5E-6
^{65}Zn	2.1E-8	2.2E-8	4.5E-10	3.0E-6
^{134}Cs	1.1E-8	1.4E-8	2.2E-10	1.4E-6
^{137}Cs	9.5E-9	1.2E-8	2.0E-10	1.3E-6
^{226}Ra	2.6E-8	3.0E-8	5.0E-10	2.9E-6
^{228}Th	2.1E-8	2.7E-8	4.3E-10	2.4E-6
^{82}Br	1.2E-8	1.6E-8	2.6E-10	1.6E-6
^{113}Sn	1.2E-8	1.6E-8	2.6E-10	1.4E-6
^{124}I	1.3E-8	1.7E-8	2.7E-10	1.7E-6
^{126}I	2.3E-8	3.3E-8	5.2E-10	2.8E-6
^{131}I	9.4E-9	1.3E-8	2.1E-10	1.1E-6
^{133}I	1.2E-8	1.6E-8	2.6E-10	1.6E-6
^{123}Xe	6.6E-7	8.6E-7	1.3E-8	7.3E-5
^{127}Xe	1.0E-8	1.3E-8	1.0E-10	1.2E-6

Constituent	(All concentration values in mg/L except where noted)
Ag	0.025
Cd	0.0005
Cr	0.005
Cu	0.05
Fe	0.075
Hg	0.0002
Mn	0.05
Na	1.0
Pb	0.005
Zn	0.02
Ammonia-N	0.02
Nitrite-N	0.01
Nitrate-N	1.5
Specific Conductance	10 umhos/cm
Chlorides	6.0
Sulfates	6.0
1,1,1-trichloroethane	0.002
trichloroethylene	0.002
tetrachloroethylene	0.002
chloroform	0.003
chlorodibromomethane	0.002
bromodichloromethane	0.002
bromoform	0.002
benzene	0.002
toluene	0.002
xylene	0.002

APPENDIX C
INSTRUMENTATION AND ANALYTICAL METHODS

The analytical laboratory of S&EP Division is divided into 1) radiological, and 2) non-radiological sections to facilitate analysis of specific parameters in each category. The following analytes are analyzed in each category.

1) Radiological: Gross alpha, gross beta, gamma, tritium, and Sr^{90}.

2) Non-radiological: Purgeable aromatics, Purgeable halocarbons, PCBs, anions, and metals.

A brief description of methods and instrumentation for each category is given below. Only validated and regulatory referenced methods are used during the analysis. All samples are collected and preserved by trained technicians according to appropriate referenced methods. Well qualified and trained analysts are involved in performing different analysis. The analytical laboratory is certified by NYSDOH for all radiological and non-radiological parameters, except for PCBs. The radiological laboratory participates in:

1a) Gross Alpha and Gross Beta Analysis - Water Matrix

Water samples are collected in one liter polyethylene containers. No preservatives are added prior to sample collection. If the samples are effluent or surface stream samples from Locations DA, EA, HM, or HQ or Building 535B daily process samples then 100 ml are extracted for analysis. Ground water samples are typically analyzed using a 500 ml aliquot. Due to high iron content, 100 ml aliquots of ground water samples from the landfill areas may be used in this analysis. The aliquot is evaporated to near dryness in a glass beaker. The beaker is rinsed to remove the solids and the combined solids and rinsate are transferred to a 5 cm diameter planchet. The planchettes are evaporated to dryness, allowed to cool and then are counted in a gas flow proportional counter for 50 minutes. Samples are normally processed in batch mode. The first sample of each batch is a background that is subtracted from the raw data prior to computation of net concentration. System performance is checked daily with an americium-241 and chlorine-36 source.

1b) Gross Alpha and Gross Beta Analysis - Air Particulate Matrix

Air particulate samples are collected on 50 mm filters at a nominal flow rate of 15 liters per minute. At the end of the collection period, particulate filters are returned to the analytical laboratory for assay. Filter papers are counted twice in a gas flow proportional counter for 50 minutes. The first count occurs immediately upon receipt in the analytical laboratory. This count is used to screen the samples for unusual levels of air particulate activity. The filters are then recounted approximately one week later. The week delay permits decay of the short-lived radon/thoron daughters. The second analysis is used for environmental assessments. The first sample of each batch is a blank filter paper that is subtracted from the raw data prior to computation of net concentration. System performance is checked daily with an americium-241 and chlorine-36 source.

1c) Tritium Analysis - Water Matrix

Water samples are collected in one liter polyethylene containers. No preservatives are added prior to sample collection. If the samples are effluent or surface stream samples from Locations DA, EA, HM, or HQ or Building 535B daily process samples then 1 ml is extracted for analysis. Ground water and potable water samples are typically analyzed using a 7 ml aliquot. Liquid scintillation cocktail is then added to the sample aliquot so that the final volume in the liquid scintillation counting vial is 1 or 7 ml of sample plus 10 ml of cocktail. Samples are then counted in a low background liquid scintillation counter for 50 to 100 minutes. Samples are normally processed in batch mode. The first sample of each batch is a background that is subtracted from the raw data prior to computation of net concentration. The second sample in each batch is a standard that is used to compute system performance and efficiency. Each sample is also checked for quenching. Corrections for background, quenching, and current system efficiency for the sample matrix and size are factored into the final net concentrations for each sample.

1d) Tritium Analysis - Air Matrix

Ambient and facility tritium air concentrations are measured by drawing the air at a rate of approximately 200 cc/m through a desiccant. At the end of each collection period, typically one week, the desiccant is brought to the analytical laboratory for processing. The desiccant is dried in a glass manifold system. Effluent samples have dedicated glassware as do environmental samples. The off gas containing moisture from the sampled air is collected by means of a liquid nitrogen trap. This water is then assayed for tritium content. A 7 ml aliquot is used for analysis. Liquid scintillation cocktail is then added to the sample aliquot so that the final volume in the liquid scintillation counting vial is 17 ml. Samples are then counted in a low background liquid scintillation counter for 100 minutes. Samples are normally processed in batch mode. The first sample of each batch is a background that is subtracted from the raw data prior to computation of net concentration. The second sample in each batch is a standard that is used to compute system performance and efficiency. Each sample is also checked for quenching. Corrections for background, water recovery, air sample volume, quenching, and current system efficiency for the sample matrix and size are factored into the final net concentrations for each sample.

1e) Strontium-90 Analysis

Strontium-90 analyses are currently performed on water, soil, and aquatic biota samples. Typically, at least four liters of liquid and one kilogram of solid sample is shipped to the contractor laboratory. The analysis proceeds by using the HASL-300 procedure which utilizes wet chemistry techniques to isolate strontium-90 from the sample. Samples are counted twice to verify strontium-90 and yttrium-90 ingrowth. Chemical recoveries are determined by a combination of gravimetric and strontium-85 standard addition techniques. Samples are typically process in a batch. Backgrounds and system performance are verified with each batch. Chemical recoveries for both strontium-90 and yttrium-90 are determined for each sample.

1f) Gamma Spectroscopy Analysis

Surface, potable, and ground water surveillance samples are typically 12 liter samples that are placed in polyethylene bottles without preservatives. Samples are then passed through a mixed bed ion exchange column at a rate of 20 cc/m until all 12 liters have passed through the column. The column is then removed, placed in a teflon coated aluminum can, and counted for 50,000 seconds. Where effluent sampling is performed in a flow proportional manner, 10 cc aliquots are passed through the mixed bed column on an as needed basis. Typically samples sizes for this type of sample tend to approach the 50 to 100 liter size. Air particulate filter papers are counted directly on the detector for 10,000 seconds. Charcoal filter canisters are also counted directly on the detector with a count time of 10,000 seconds. Soil, vegetation, and aquatic biota are all processed following collection. Typically, 50g, 100g, or 300g aliquots are taken, placed in a teflon lined canister, and directly counted. For gamma spectroscopy analyses, backgrounds are collected once per week and system performance is verified daily. Analytical results reflect net activity that has been corrected for background and system response of the detection medium.

2a) Purgeable Aromatics and Purgeable Halocarbons

Water samples are collected in 40 ml glass vials with removable teflon-lined caps without any headspace and stored at 4° C and analyzed within 14 days.

Ten (10) purgeable compounds (benzene, toluene, ethyl benzene, total xylenes, chloroform, 1,1-dichloroethane, 1,1-dichloroethylene, tetrachloroethylene, 1,1,1-trichloroethane, and trichloroethylene) are analyzed under this category following EPA Method 624 protocols using GC/MS. These ten compounds were chosen as the target compounds since they are known or suspected to be present in the monitoring wells based on the DOE survey of the site in 1988[52] and a comprehensive analysis of 51 new monitoring wells using EPA's Contract Laboratory Program (CLP)[48,53] procedures in 1989. There are currently two Hewlett-Packard GCMS instruments. One instrument is exclusively used for the analysis of purgeable compounds and the other for screening extractables and other extraneous compounds in non-routine samples. Since ground water under BNL is classified as a sole source aquifer, the detection limits reported for the compounds are close to drinking water standards.

The method involves purging a 25 ml aliquot of the sample with ultra pure helium in a specially designed sparger using Purge and Trap technique. Each sample is spiked with known concentration of internal standards and surrogates before purging to facilitate identification, quantitation, and determination of the extraction efficiency of analytes from the matrix. The purged analytes are trapped on to a specially designed trap and thermally desorbed on to the DB-624 megabore capillary chromatographic column by back flushing the trap with helium. The compounds are separated into individual compounds with a temperature program of the GC and enter the mass spectrometer where they undergo fragmentation to give characteristic mass spectra. The unknown compounds are identified by comparing their mass spectra and retention times with reference compounds, and quantitated by internal standard method. The quantitation data is supported by extensive amount of QA/QC such as tuning mass spectrometer to meet bromofluorobenzene criteria, initial and continuing calibrations verifying daily response factors, method blanks, surrogate recoveries, duplicate analysis, matrix spike and matrix spike duplicate analysis and performing reference standard analysis to verify the daily working standard.

2b) PCB Analysis

Samples are collected in 50-100 ml glass containers with teflon-lined lid and stored at 4° C and analyzed within 14 days.

Transformer oil, mineral oil, hydraulic fluid, waste oil, and spill wipe samples are analyzed for PCBs using gas chromatography-electron capture detector (GC-ECD) method. This method is similar to EPA method 608 and is targeted to identify and quantitate seven different mixtures of PCB congeners in the samples.

The method consists of diluting a known weight of the sample with isooctane and removing the interfering compounds with one or more aliquots of concentrated sulfuric acid till the acid layer is almost colorless. All the oil matrix along with other interfering polar compounds are selectively removed from the sample, leaving PCBs in isooctane solvent.

There are two GC-ECD instruments for the analysis of PCBs. Each GC-ECD instrument is calibrated with different concentrations of each PCB mixture to establish linearity. The PCBs found in the samples are identified and quantitated by comparing the retention times and chromatographic patterns with the standards. Methods blanks, duplicates, spikes, and reference standards are run as part of QA/QC.

2c) Anions

Chloride, nitrate-N, and sulfate are analyzed using Dionex Ion-chromatography (IC) with ion suppression and conductivity detection technique.

Monitoring well samples are collected in 500 - 1000 ml polypropylene bottles, cooled to 4° C, and analyzed within 28 days. For nitrate analysis in drinking water analysis, samples are supposed to be analyzed within 48 hrs. However, even though holding times were exceeded for nitrate analysis of monitoring well samples, it is expected that the depletion of nitrate will be negligible.

The anions are passed through a anion-exchange polymer column and eluted with carbonate/bicarbonate solution. Then the eluent passes through a ion-suppressing column where the background contribution from the eluent is suppressed, leaving the target anions to be detected by conductivity meter.

Initially, the IC system is calibrated with standards to define the working range of the system. The target anions in the samples are identified and quantitated by comparing the retention times and areas with the standards. Method blanks, duplicates, replicates, spikes, and reference standards are routinely analyzed as a part of QA/QC.

2d) **Metals**

Samples are collected in 1000 ml polypropylene bottles and stabilized with ultra-pure nitric acid to a pH of <2. The samples are analyzed within 6 months, except for mercury, in which case the samples are analyzed within 28 days.

Cadmium, chromium, lead (furnace), copper, iron, manganese, silver, sodium, zinc (flame), and mercury (manual cold vapor) are analyzed with Perkin-Elmer atomic absorption spectrometer. Using the flame technique, the sample containing the target element is nebulized and atomized in an oxy-acetylene flame. At the same time, a beam of light from a element-specific hollow cathode lamp corresponding to the absorption frequency of target element is passed through the flame. The atomized element absorbs the energy specific to that element from the cathode lamp and the intensity of absorption is proportional to the concentration of the element in the sample. Calibration curves are run to establish the linearity of the system and samples are quantitated by comparing with standards.

Using the furnace technique, chemical interference is eliminated in two stages: first by heating the sample at 105 - 110° C to remove moisture and then at 600 - 900° C to burn out any organic matrix. Final atomization is achieved by heating the furnace to 2400 - 2700° C. The rest of the technique is similar to the flame method mentioned above. Using this furnace technique, sub-ppb detection limits are possible for water samples.

Using cold vapor technique for mercury, a 100 ml aliquot of the sample is digested with potassium permanganate/persulfate oxidizing solution at 95° C for 2 hours to oxidize any organically-bound and/or monovalent mercury to mercury (II) ion state. Excess oxidizing agent is destroyed with hydroxylamine hydrochloride. The mercuric ion later is reduced to elemental mercury with excess stannous chloride which is purged with helium into the absorption cell. The absorption is directly proportional to the concentration of mercury in the sample.

All the above mentioned atomic absorption techniques involve initial calibrations to define the calibration range, continuing calibrations, method blanks, duplicates, replicates, matrix spikes, and reference standard analysis as a part of QA/QC.

APPENDIX D

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