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INFORMAL REPORT

SAFETY AND ENVIRONMENTAL PROTECTION DIVISION

1975 ENVIRONMENTAL MONITORING REPORT

Compiled by A. P. Hull and J. A. Ash

April, 1976

BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK 11973

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BROOKHAVEN NATIONAL LABORATORY ENVIRONMENTAL MONITORING REPORT

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INTRODUCTION

Brookhaven National Laboratory is a multidisciplinary scientific research center situated in the geographical center of Suffolk County on Long Island, about 70 miles east of New York City. Its location with regard to surrounding communities is shown in Figure 1. The principal nearby population centers are located in shoreline communities. Much of the land area within ten miles is mostly either forested or under cultivation. However it is in transition and considerable recent and projected development of surburban housing is located within the environs of the Laboratory.

The Laboratory site is shown in Figure 2. It consists of some 5265 acres, most of which is wooded, except for a central developed area of about 1000 acres. The site terrain is gently rolling, with elevations varying between 120 and 40 feet above sea level. The land lies on the western rim of the shallow Peconic River watershed, with the river itself rising in marshy areas in the north and east sections of the site.

In terms of meteorology, Brookhaven can be characterized as a well ventilated site. In common with most of the eastern seaboard, its prevailing winds are from the southwest during the summer of the year, from the northwest during the winter, and about equally from these two directions during the spring and fall. This is reflected in the annual wind distribution, as observed by the BNL Meteorology Group between 1960 - 1973, which is shown in Figure 3.

Studies of the hydrology and geology[1-3] of Long Island in the vicinity of Brookhaven indicate that the uppermost Pleistocene deposits, which are locally between 100 - 200 feet thick, are generally sandy and highly permeable. Water penetrates them readily and there is little direct run-off into surface streams except during periods of intense precipitation. The average annual precipitation is 48 inches per year. About half is lost to the atmosphere

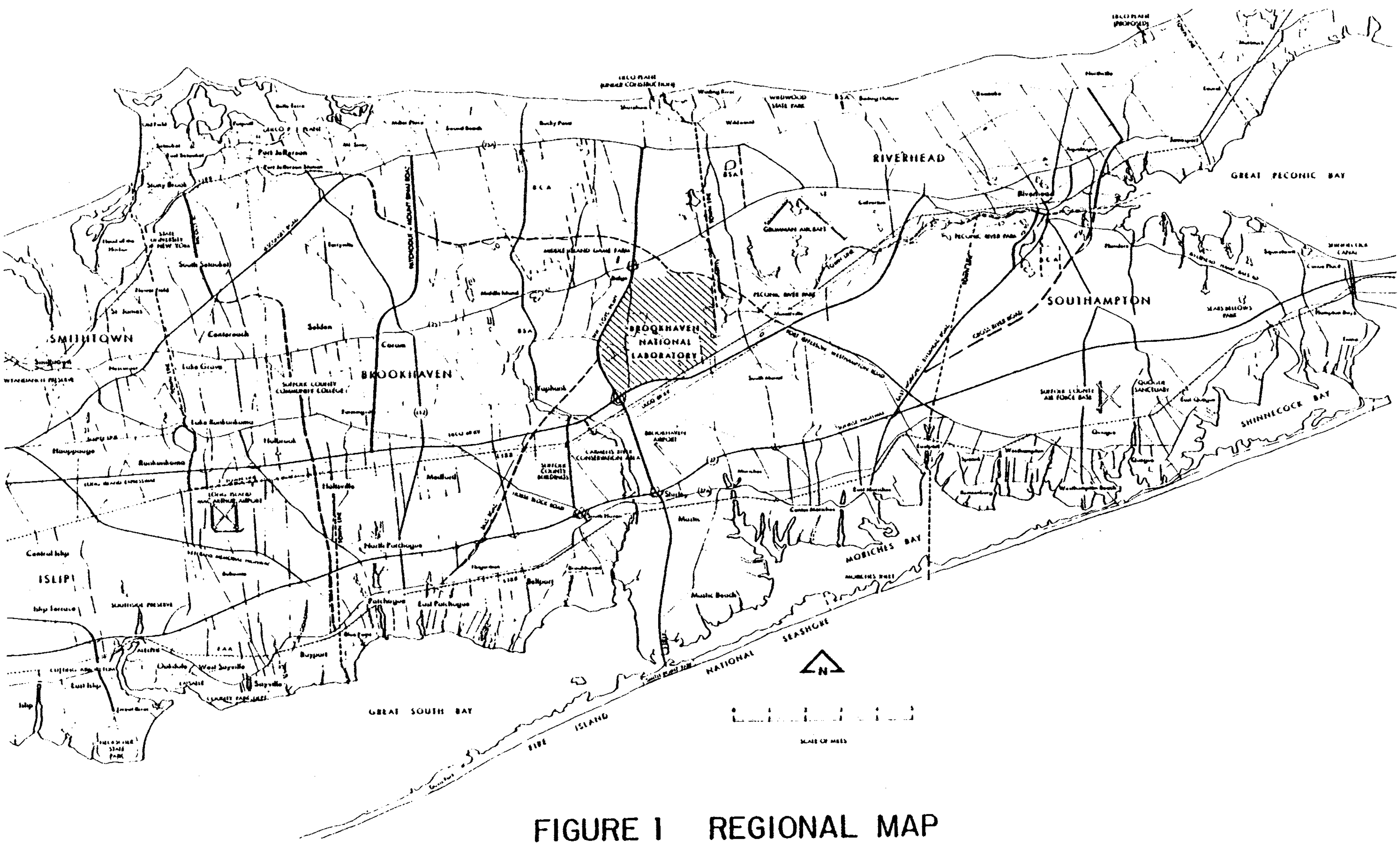
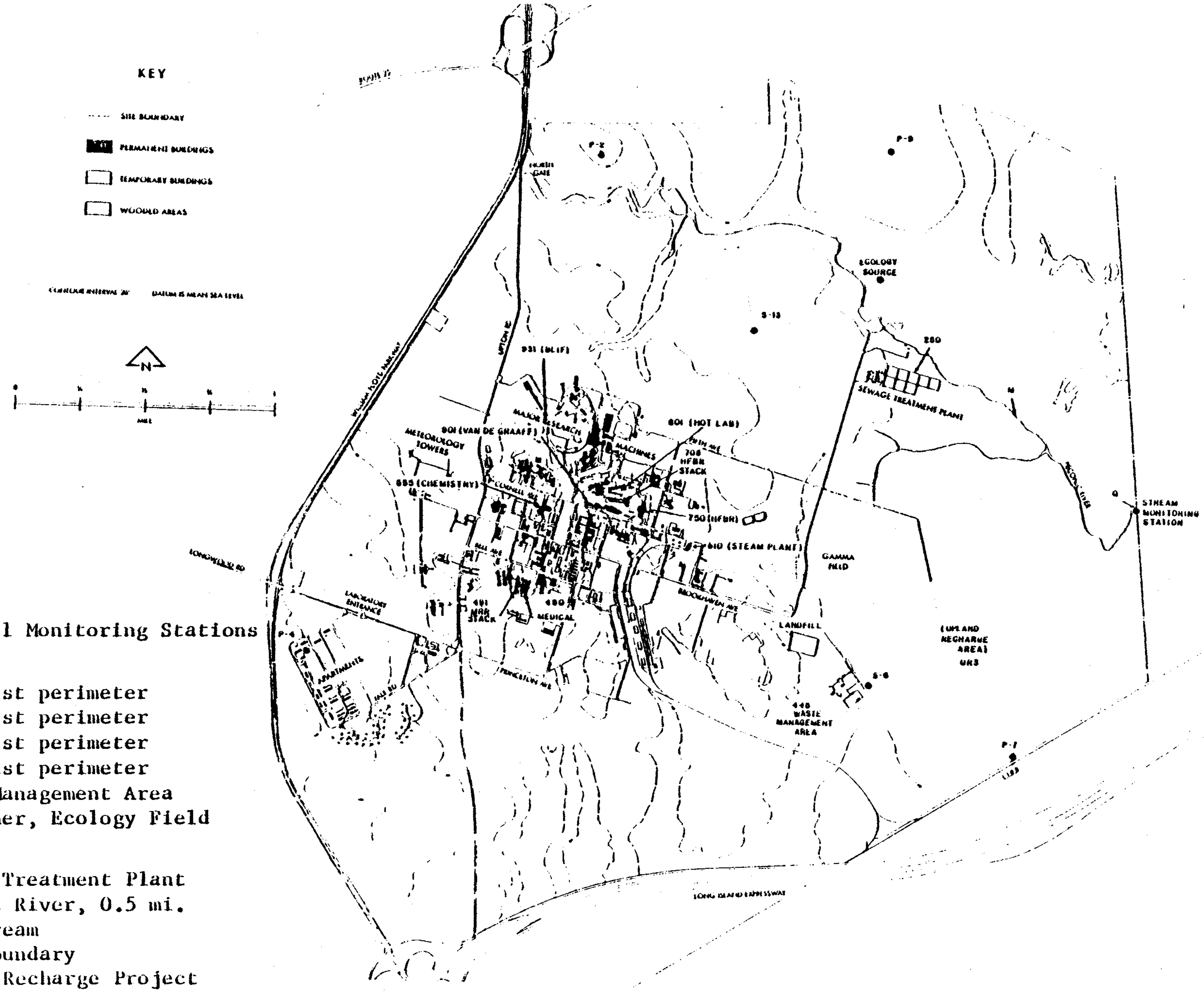


FIGURE 1 REGIONAL MAP



Environmental Monitoring Stations

Air

P-2 Northwest perimeter
P-4 Southwest perimeter
P-7 Southeast perimeter
P-9 Northeast perimeter
S-6 Waste Management Area
S-13 SW Corner, Ecology Field

Water

250 Sewage Treatment Plant
M Peconic River, 0.5 mi. downstream
Q Site Boundary
UR-3 Upland Recharge Project

FIGURE 2

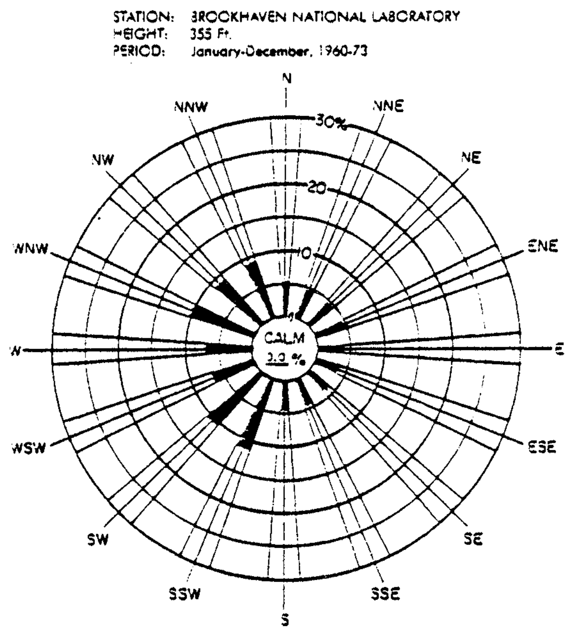

STATION: BROOKHAVEN NATIONAL LABORATORY
HEIGHT: 355 Ft.
PERIOD: January-December, 1960-73
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20
10
CALM

FIGURE 3

through evapotranspiration and half percolates to recharge ground water. As indicated in Figure 4 (from ref. 1), the ground water in Laboratory vicinity moves predominantly in a horizontal direction to the Great South Bay. This is modified toward a more easterly direction in the Peconic River watershed portion of the site. The estimated rate of movement at the ground water surface is about 6 in/day.

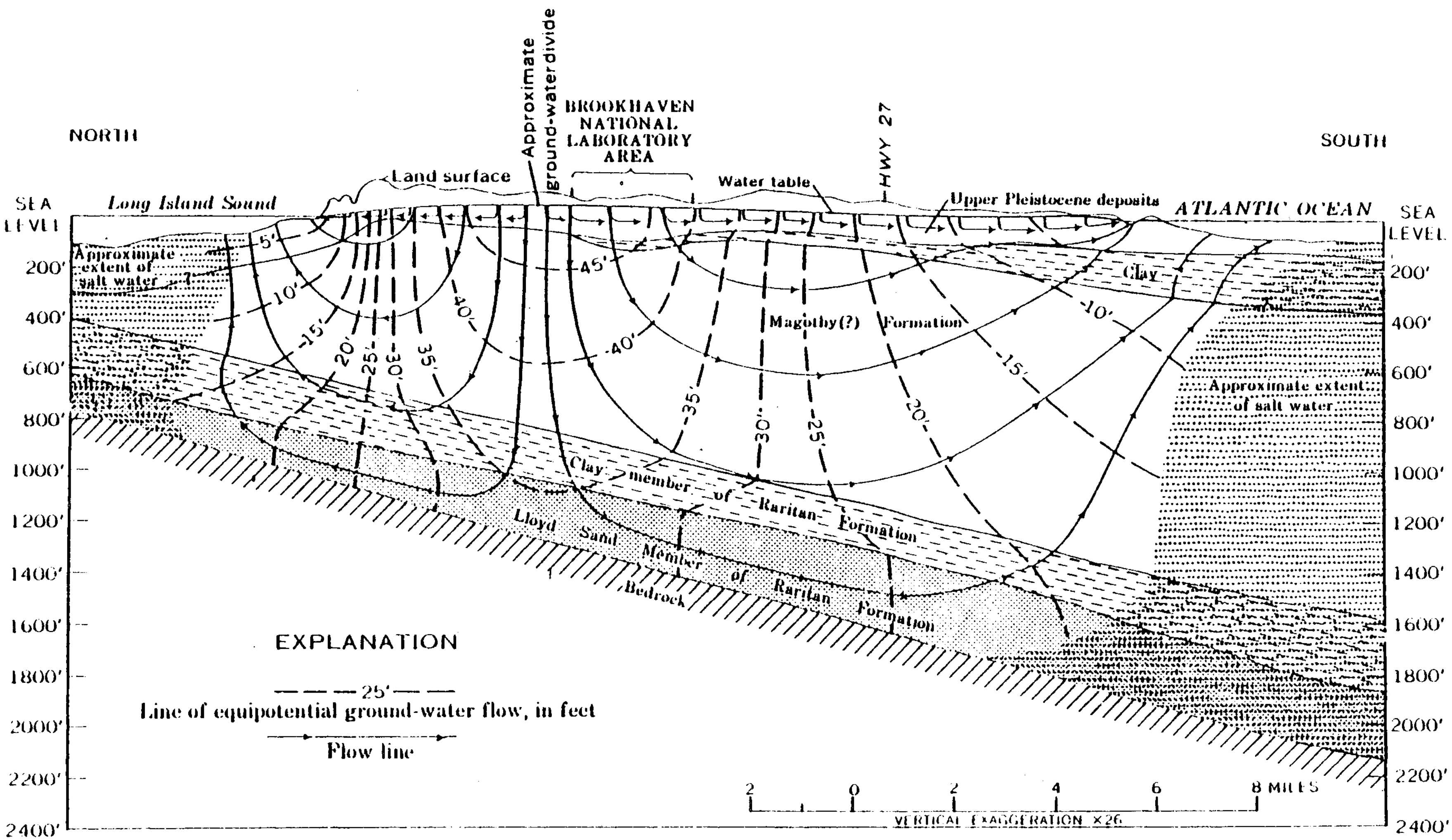
A wide variety of scientific programs are conducted at Brookhaven, including research and development in the following areas:

1) Fundamental structure and properties of matter.
2) The interactions of radiation, particles and atoms with other atoms and molecules.
3) Physical, chemical and biological effects of radiation, and of other energy-related environmental pollutants.
4) Radioisotopes and other nuclear applications.
5) Nuclear and energy-related technology.
6) Energy sources, transmission and utilization, including their environmental effects.

Among the major scientific facilities operated at Brookhaven to carry out the above programs are:

1) The High Flux Beam Reactor (HFBR) which is fueled with enriched uranium, heavy water moderated and cooled, and has a routine power level of 40 MW.
2) The Medical Research Reactor (MRR), which is an integral part of the Medical Research Center (MRC). It is enriched uranium fueled, natural water moderated and cooled, and is operated intermittently at power levels up to 3 MW.
3) The Alternating Gradient Synchrotron (AGS), a proton accelerator which operates at energies up to 33 GeV.
4) The 200 MeV Proton Linac, which serves as an injector for the AGS, but also supplies continuous currents of protons for isotope production by spallation reactions, in the Brookhaven Linac Isotopes Production Facility (BLIP).
5) The Tandem Van de Graaff, 60-inch Cyclotron, Research Van de Graaff, Vertical Accelerator and Chemistry Van de Graaff, which are used in medium energy physics investigations, as well as for special isotope production.

Additional programs involving irradiations and/or the use of radionuclides for scientific investigations are carried on at other Laboratory facilities



Schematic ground-water flow lines, central Upton area.

FIGURE 4

including the Medical Research Center, the Biology Department (including one multicurie field irradiation source), the Chemistry Department, and the Department of Applied Science. The latter includes the Hot Laboratory, where special purpose radioisotopes are developed and processed for on- and off-site use. This facility also contains a waste treatment center, which includes an evaporator for the decontamination of liquid wastes.

Most of the airborne radioactive effluents at Brookhaven originate from the HFBR, BLIP and the research Van de Graaff, with lesser contributions from the Chemistry and Medical Research Centers. The first two also produce significant fractions of the Laboratory's liquid radioactive effluents, but additional significant contributions originate from the Medical Research Center, the Hot Laboratory complex, as well as from decontamination and laundry operations.

The Department of Applied Science, in cooperation with the Town of Brookhaven, conducts the Upland Recharge and Meadow-Marsh Project, a study of the use of natural ecosystems to treat sewage and to return clean water to the ground water aquifer. This experiment is conducted in an agricultural and forested area in the southeast zone of the Laboratory site. It utilizes a portion of the flow from the sanitary waste treatment plant, and therefore constitutes a potential route for the release of small amounts of radioactivity to ground water.

SUMMARY

The environmental levels of radioactivity and other environmental pollutants found in the vicinity of Brookhaven National Laboratory during 1975 are summarized in this report. As an aid in the interpretation of the data, the amounts of radioactivity and other pollutants released in airborne and liquid effluents from Laboratory facilities to the environment are also indicated. The environmental data include external radiation levels; radioactive air particulates; tritium and iodine concentrations; the amounts and concentrations of radioactivity in precipitation; the amounts and concentrations of radioactivity in and the quality of the stream into which liquid effluents are released; the concentrations of radioactivity in sediments and biota from the stream; the concentrations of radioactivity in and the quality of ground waters underlying the Laboratory; and concentrations of radioactivity in milk, grass and soil samples obtained in the vicinity of the Laboratory.

The external radiation level for 1975 at the north boundary of the Laboratory attributable to an ecology forest irradiation source was 4.7 mrem, or 0.9% of the applicable Radiation Protection Standard.[4]*

At the boundary of the Laboratory, about 1.0 km northwest of the Alternating Gradient Synchrotron (AGS), the calculated dose due to skyshine (reflected radiation) was about 5.8 mrem/yr or 1.2% of the standard. This is too small to be measurable. Due to their limited range, the external radiations from the AGS and those from the gamma forest source do not produce a measurable additive effect at off site locations.

*The applicable Radiation Protection Standards and Radiation Concentration Guides for persons in uncontrolled areas are shown with the relevant tabulated data.

Other than tritium, there was no indication of BNL radioactive effluents in environmental air and precipitation samples. The largest concentration of tritium in air at the site boundary, 39 pCi/m^3 (3.9×10^{-11} μCi/ml) was 0.02% of the Radiation Concentration Guide (RCG). The largest average concentration of tritium in precipitation, 807 pCi/liter (8.07×10^{-7} μCi/ml) was 0.03% of the RCG for drinking water.

At the Central Steam Plant, the most recent (1974) measurement of the stack emission of air particulates indicated that the rate was 0.6 $lb/10^6$ BTU. This was 600% of the emission standard. However, a calculation based on meteorological parameters indicates that at the site boundary, the concentration of air particulates was 1.7 $\mu g/m^3$, or 2.3% of the yearly average ambient Air Quality Standard.[5] The calculated site boundary concentrations of SO_2 and NO_x emitted from the plant were 0.0014 and 0.0008 ppm, respectively, which were 4.7 and 1.6% of their respective ambient air quality standards.

About two-thirds of the liquid effluent released onto the sand filter beds of the BNL sewage treatment plant flowed directly into the Peconic River. Most of the balance is assumed to have percolated into the ground water underlying the beds. The gross beta concentration of the bed output was 44.3 pCi/liter (4.43×10^{-8} μCi/ml), or 1.5% of the RCG. The tritium concentration was 4.64 nCi/liter (4.64×10^{-6} μCi/ml) or 0.2% of the RCG.

Of the combined flow from the sand filter beds and upstream from the Peconic River, about 8% permeated into the ground water underlying the stream bed between the sewage treatment plant outfall and the Laboratory perimeter, mostly during the latter half of the year. As established at a midway stream sampling location, the gross beta concentration was 41.5 pCi/liter (4.15×10^{-8} μCi/ml) or 1.4% of the RCG, and the tritium concentration was 4.78 nCi/liter (4.78×10^{-6} μCi/ml) or 0.2% of the RCG. At the site boundary, the gross beta concentration was 23.7 pCi/liter (2.37×10^{-8} μCi/ml), or 0.8% of the RCG, and the tritium concentration was 3.0 nCi/liter (3.0×10^{-6} μCi/ml), or 0.1% of the RCG.

About 1.5% of the total flow at the clarifier was utilized by the Upland Recharge and Meadow-Marsh Project. Its average gross beta concentration was 34.2 pCi/liter (3.42×10^{-8} μCi/ml) or 1.1% of the RCG, and its tritium concentration 4.01 nCi/liter (4.01×10^{-6} μCi/ml), or 0.1% of the RCG.

The effluent utilized in part by the Upland Recharge and Meadow-Marsh Project contained Cu in a concentration of 0.8 ppm, which is twice the water purity standard, Fe in a concentration of 4.9 ppm, which is eight times the standard, and Zn in a concentration of 1.6 ppm, which is about three times the applicable water purity standard.[6] However, there is no direct runoff of these effluents and the project is designed to assess the retention of agents commonly present in sewage by various plant systems.

Except for two daily pH levels slightly below the limit, all reportable parameters, were within the limits set forth in the Laboratory's permit, issued by EPA under the National Pollution Discharge Elimination System. Before dilution the average water quality of the sewage treatment plant effluent was at or within water quality standards for the receiving body of water.[5]

Bimonthly sampling indicated a decrease of concentrations of radioactivity downstream in the Peconic. At a location 3.0 miles downstream, the average gross beta concentration as established by bimonthly "grab" sampling was 6.7 pCi/liter (6.7×10^{-9} μCi/ ml) or 0.2% of the RCG, and the tritium concentration less than 0.7 nCi/liter (0.7×10^{-6} μCi/ml) or less than 0.02% of the RCG. About 15 miles downstream, at the river's mouth, where the flow was about 25 times that at the BNL site boundary, the average concentration of gross beta activity was 9.7 Ci/liter (9.7×10^{-9} μCi/ml) and that of tritium less than 0.5 nCi/liter (5×10^{-7} μCi/ml). Thus it is apparent that the total gross beta activity in the river at that location greatly exceeded that at the BNL site boundary.

Seasonal sampling of Peconic River bottom sediments, stream vegetation and of miscellaneous aquatic fauna was conducted. The data indicated that small concentrations of ^{51}Cr, ^{60}Co, and ^{65}Zn, which are unique to BNL effluents, as well as ^{7}Be, ^{22}Na, ^{65}Zn, ^{137}Cs, and ^{144}Ce in slight excess of ambient fallout related concentrations, were present in sediments and vegetation. The data from a few fish obtained from the river between the site boundary and at a location 6.6 miles downstream, suggest the presence of small amounts of BNL effluent activity. The average concentration of ^{137}Cs, 995 pCi/kg (or 9.95×10^{-7} μCi/g), was 0.1% of the RCG, calculated on an assumed average ingestion of 50 g/day.

About 5 million gallons per day of water was used for "once through" cooling and returned to ground water in on site recharge basins. The concentration of gross beta activity in it was only very slightly greater than that of the supply wells and was less than 0.4% of the RCG. Tritium concentrations were less than the minimum detectable, which is 0.02% of the RCG.

Ground water surveillance was conducted in a network of some 75 sampling wells installed adjacent to and downstream from identified areas where there is a potential for the percolation to and migration of radioactivity and other agents in ground water. Immediately adjacent to the sand filter beds and to the Peconic River on site and at the site boundary, gross beta, tritium and ^{90}Sr concentrations approach those observed during the current or recent years in the BNL liquid effluent. These are up to a few percent of the RCG's. The largest gross alpha concentration, 1.9 pCi/liter (1.9×10^{-9} μCi/ml) was 2% of the RCG for unidentified mixtures containing alpha activity other than ^{226}Ra. It is not directly relatable to any known BNL effluent releases. The largest average gross beta concentration, 26.8 pCi/liter (2.68×10^{-8} μCi/ml) was accompanied by a ^{90}Sr concentration of 10.1 pCi/liter (1.01×10^{-8} μCi/ml), which was 3% of the controlling RCG. The largest average tritium concentration, 8.6 nCi/liter (8.6×10^{-6} μCi/ml), was 0.3% of the RCG.

Slightly larger concentrations of gross alpha and gross beta and ^{90}Sr radioactivity were found in a sampling well about 1000 feet east of the site boundary, than those at the boundary itself. The gross alpha concentration, 2.1 pCi/liter (2.1×10^{-9} μCi/ml) was 2.1% of the RCG. However, this is not directly relatable to any known current or recent Laboratory effluents. The gross beta concentration was 14.8 pCi/liter (1.48×10^{-8} μCi/ml) and the ^{90}Sr concentration 2.9 pCi/liter (2.9×10^{-9} μCi/ml). The latter was 2.9% of the RCG.

Except for pH levels slightly less than the Water Quality Standard, but within the local natural variation, most other indices of water quality in these wells were within the standards. In a limited sampling of a few on site wells immediately adjacent to the sand filter beds and to the Peconic on site, Fe and Zn were found up to six times and three times their respective Water Quality Standards. These levels exceed those found in recent BNL liquid effluents, and may be an artifact produced by the sampling well casings rather than being present in ground water itself.

On site, adjacent to the Solid Waste Management area, the landfill, the former open dump, the decontamination facility storm sewer sump, and at the Upland Recharge Project area, above ambient background concentrations of gross beta activity, ^{90}Sr and tritium were found in a number of nearby ground water surveillance wells. Much of the gross beta activity appeared to be related to ^{90}Sr.

At the Waste Management area, the largest ^{90}Sr concentration, 63.5 pCi/liter (6.35×10^{-8} μCi/ml), or 21% of the RCG, was found in a well 500 feet south of the site of a known inadvertent injection into ground water which occurred in 1960.

At the landfill, a gross alpha concentration of 12.2 pCi/liter (1.22×10^{-8} μCi/ml) or 12% of the RCG, a gross beta concentration of 466 pCi/liter (4.66×10^{-7} μCi/ml) or 16% of the RCG, and a tritium concentration of 157 nCi/liter (1.57×10^{-4} μCi/ml) or 4.2% of the RCG were the largest found. They occurred in wells between the landfill and a location 200 feet south of the boundary of the working area.

At the decontamination facility storm sewer sump, a ^{90}Sr concentration of 121 pCi/liter (1.21×10^{-7} μCi/ml) or 40% of the RCG was found in a surveillance well about 150 feet southeast of the sewer outfall into the sump.

At the Upland Recharge and Meadow-Marsh Project, the largest gross beta concentration was 14.1 pCi/liter (1.41×10^{-8} μCi/ml) or 0.5% of the RCG, and the largest tritium concentration was 5.4 nCi/liter (5.4×10^{-6} μCi/ml) or 0.2% of the RCG.

With the exception of the presence of Fe and Zn in wells adjacent to the landfill area and the 650 storm sewer sump area, all on site water quality and purity parameters were within the established standards. Immediately adjacent to the landfill, the concentration of Fe was 74 ppm, or 123 times the standard and that of Zn 1.02 ppm, or 1.7 times the standard. At the 650 sump area, Zn was found up to a concentration of 1.09 ppm or 1.8 times the ground water standard.

All of the above on site levels of radioactivity or other agents above ambient background in ground water appear to be confined to within a few hundred feet of their origin, and would require decades of travel before reaching the site boundary. Concentrations of radioactivity, and water quality parameters, in ground water from perimeter surveillance wells (other than those adjacent to the Peconic) were at or near background, and only a few percent of RCG's.

Milk samples were obtained by the New York State Department of Environmental Conservation on a monthly basis from two Suffolk dairy farms, one 10 km southeast, and one 40 km east of the BNL site. The yearly average concentration of ^{90}Sr in milk from the closer farm, 9.5 pCi/liter (9.5×10^{-9} μCi/ml) was 70% greater than in that from the more distant farm. However, this does not seem connected with BNL effluents. The data were within the variations of ^{90}Sr concentrations in recent milk samples within New York State.

Off site soil and grass samples also reflected prevailing background, while ^{60}Co and ^{137}Cs in excess of background were found adjacent to two on site BNL facilities. No pathways leading from these deposits to off site doses were apparent.

The total population dose (up to a distance of 50 miles or 80 km) attributable to BNL sources was calculated to be 6.75 person-rems, as compared to a natural background dose to the same population of about 419,000 person-rems.

MONITORING DATA COLLECTION, ANALYSIS AND EVALUATION

External Exposure Monitoring

External radiation levels at the site boundary, including natural background (as influenced by fallout) and increments attributable to BNL activity, were measured by the use of thermoluminescent dosimeters exposed for monthly periods at each of the four perimeter monitoring stations P-2, P-4, P-7 and P-9, as shown in Figure 2.

The observed monthly average radiation levels are set forth in Table I. There was no addition to the natural background attributable to BNL activities, except at the northeast perimeter. At this location, the Ecology Forest irradiation source, which contained about 6450 curies of ^{137}Cs (as of 1/1/75), produced a radiation level of 4.7 $\pm$ 4.2 mrem/yr, or 0.9% of the Radiation Protection Standard for a hypothetical individual at this location on the Laboratory perimeter.

AIRBORNE EFFLUENTS AND GROUND-LEVEL AIR PARTICULATES, TRITIUM AND RADIOIODINE MONITORING

Facilities and Effluents

The principal BNL facilities that currently discharge radioactive effluents to the atmosphere are listed in Table II, in which the installed on-line effluent monitoring and sampling devices are also indicated. The location of these facilities on the BNL site is shown in Figure 2. The types and amounts of these effluents released during 1975 are shown in Table III.

Oxygen-15 and argon-41 are radioactive gases and are environmentally significant as sources of increased external radiation. Calculations indicate that Oxygen-15, which has a half-life of two minutes, is evolved from the Linear Isotopes Production Facility (BLIP) at the rate of 0.6 Ci/min, when it is operated at full beam current of 180 μamps. Thus, at equilibrium, the largest ambient amount at any one time would be 1.75 Ci. Argon-41, which has a half-life of 110 minutes, is evolved from the Medical Reactor Stack at a rate of 1 Ci/hr when it is operated at full power of 3 MW, so that the maximum ambient amount would be 3.8 Ci. These amounts of oxygen-15 and argon-41 are too small to produce a detectable increase in radiation levels at the site boundary.

Tritium has a half-life of 12.3 years, and is a very low energy beta emitter. Its principal environmental significance is in the tritium oxide or vapor form, in which it is taken up and utilized by living systems as is water vapor. Of the 723 Ci of tritium released from BNL facilities during 1975, 465 Ci (64%) was in the gaseous form, and 258 Ci was released as tritium vapor.

The amounts of conventional pollutants released from the Central Steam Plant are shown in Table IV. Those for SO_2 and NO_X are derived from reported emission factors for comparable plants,[7] supplemented by analysis for S content of the fuel oil utilized at the plant. The amount of particulates is abased on the average concentration found in stack sampling of the principal steam boiler unit in a series of tests conducted during 1974. This stack emission rate of particulates, 0.6 lb/10^6 BTU, was above the emission limit of 0.1 lb/10^6 BTU set forth by the New York State Department of Environmental Conservation (Part 227, Stationary Combustion Installations). The Laboratory is considering measures to improve the combustion efficiency of this unit, and thereby to reduce its particulate emission rate.

Sampling and Analysis

The Brookhaven Environmental Monitoring air sampling program is conducted to distinguish between concentrations of airborne radioactivity attributable to natural sources, to activities remote from the Laboratory, i.e. above ground nuclear weapons tests, and to Laboratory activities. All of that detected during 1975 was attributable to the first two sources. There were no reported atmospheric weapons tests during the current year.

High volume (500 liters/min) positive displacement air pumps (Gast 3040) were operated at a monitoring station east of the Solid Waste Management area (Fig. 2, S-6), and at the northeast and southwest perimeter stations (P-9 and P-4). The air sampling media consisted of a 3" diameter air particulate filter (Gelman type G) followed by a 3" x 1" bed of petroleum-based charcoal (Columbia Grade LC 12/28 x mesh) for sampling of radiohalogens. Short term fluctuations in air particulate concentrations may be indicative of the presence of recent weapons tests debris. Accordingly, the Solid Waste Management area air particulate filter was changed and counted on a daily (during work week) basis. The remaining samples were changed and counted on a two week basis.

After allowing several days for the decay of short lived natural radioactivity, gross alpha counts of air particulate samples from the solid waste packaging area station were made using a 5" diameter Zn-S coated photomultiplier. After a similar delay, gross beta counts were made of air particulate samples from all locations using a 5" beta scintillator. These data are shown in Table V. A seasonal trend, with an early spring maximum, is evident. No consistent differences between sampling locations were apparent and there was no indication of BNL effluent radionuclides in air particulate samples at any location. The nearly 50% decrease from 1974 levels is attributed to the radioactive decay of previous years weapons test airborne activity and the lack of any input from this source during 1975.

Sampling for tritium vapor was accomplished at the same air sampling stations by drawing a small side stream of air (~100 cm^3/min) through silica gel cartridges. These were rotated on a monthly basis. During colder months when their absolute capacity of air for unsaturated water vapor was decreased, the sampling cycle was lengthened accordingly. The collected vapor was subsequently removed from the gel by heating. It was then condensed and assayed by beta scintillation counting. The tritium air concentration data obtained during 1975 is indicated in Table VI. The background concentration was inferred from that found in precipitation collected off site. The largest yearly average net concentration at the site boundary, about 38.8 pCi/m^3 (3.88×10^{-11} μCi/m^3), was 0.02% of the applicable Radiation Concentration Guide (RCG).

In addition to the gross beta counts indicated above, shortly after the end of each month, analyses for gamma emitting nuclides were performed on a monthly composite of all individual air particulate samples.

Additional gamma analyses were also scheduled at six month and one year post-collection to facilitate the resolution of short and long lived nuclides with photopeaks too close to be resolved by the NaI detection system employed. The charcoal samples were reanalyzed at one month post-collection to determine ^{131}I by decay in its photopeak region during this time. Available data are reported in Table VII. Since recent fission products such as ^{131}I or ^{140}Ba-La were not detectable during the year, it was assumed that 32.5 day ^{141}Ce was also absent in evaluating the reported concentrations of ^{144}Ce. The decreases in ^{95}Zr-Nb and ^{144}Ce concentrations during 1975 as compared to 1974, are confirmation of the lack of recent atmospheric nuclear weapons tests. These data did not disclose any indication of BNL effluent components.

The current BNL Environmental Monitoring program does not include air sampling for other than radioactive substances. The calculated annual average concentrations at the site boundary of the conventional pollutants released from the Central Steam Plant are indicated in Table IV. All were less than 2% of the EPA Primary Air Quality Standard for these constituents. Of the 6,313,322 gallons of fuel oil utilized by the Central Steam Plant during 1975, 8.25% was automotive waste oil. Samples were obtained on 8/75 from two oil storage tanks containing 36 and 48% automotive waste. On the basis of these analyses the average Pb content of the Central Steam Plant feed during 1975 was 392 mg/liter. From this calculated average concentration of Pb in air at the site boundary was 0.004-0.015 $\mu g/m^3$, as compared with the New York State Department of Environmental Conservation Air Quality Guide of 10 $\mu g/m^3$.[8]

Early in 1975 the emphasis of the Upland Recharge Project was shifted from spray application of a characteristic sewage effluent to agricultural and forest plots. Only the meadow-marsh features of this experiment remained in operation throughout the year. Thus the possibility of the generation of microbial aerosols was greatly reduced. The literature[9, 10] indicates an initial rapid die-off of such aerosol bacterial within a few a few hundred meters of the similar sources (trickling filter sewage plants). In view of this and the remoteness of the project from any nearby population, these aerosols do not seem to present a significant off site airborne hazard. To date, sampling for them has not been conducted, on or off site.

About 500 pounds of various pesticides, chiefly organo-phosphates, carbaryl and parathion, were applied[11] on site at Brookhaven during 1975, principally to protect crops which were grown for biological research purposes. All of these pesticides were considered biodegradable, with persistance times in the order of a week, and were furthermore applied with a "sticker" additive to minimize their subsequently becoming airborne.

Precipitation

Two pot-type rain collectors, each with a surface area of 0.33 m^2, are situated adjacent to the BNL filter beds (see Fig. 2). Two routine collections were made from these, one whenever precipitation was observed during a previous 24 hour (or weekend) period, and the other once a week whether or not precipitation occurred. Part of each collection was evaporated for gross beta counting, a small fraction composited for monthly tritium analysis, and the balance put through ion exchange columns for subsequent quarterly ^{89}Sr-^{90}Sr and gamma analyses. The data for 1975 are reported in Table VIII (with the exception of tritium). There was no detectable indication in the on site precipitation collection of the washout of BNL released airborne radioactivity. The amounts of naturally produced gamma emitters, such as ^{7}Be, ^{22}Na and ^{125}Sb are generally comparable to those observed during 1974. Those of shorter lived fission and activation products, such as ^{54}Mn, ^{65}Zn, ^{95}Zr-Nb are reduced by about half, reflecting the absence of recent inputs from weapons testing. The amounts of long lived fission products such as ^{90}Sr and ^{137}Cs were only slightly lower than in 1974.

In addition to the pot-type collectors, to obtain an indication of tritium washout, small precipitation collectors were established at the perimeter stations (P-2, P-4, P-7, P-9) and a Blue Point, some 20 km southwest of the BNL site. As indicated in Table IX, the average tritium concentration in the collectors located at station P-9 and at the sewage treatment plant (in the predominent downwind direction from BNL release locations) were two to three times those of other collectors. However, the largest concentration (on site) was 0.02% of the RCG for drinking water. The estimated total deposition of tritium on the BNL site during 1975 was 9.9 curies (using the average of on site and perimeter concentrations). The washout of BNL effluent appears to have been about 5.1 curies, or about 2% of the reported stack release of tritium vapor.

Liquid Effluent Monitoring

The basic principle of liquid waste management at BNL is confinement and containment, to minimize the volumes of liquids that could required decontamination prior to on site release or processing into solid form for off site burial. Accordingly, liquid wastes are segregated on the basis of their anticipated concentrations of radioactivity or other potentially harmful agents.

The primary water cooling systems of such facilities as the Alternating Gradient Synchrotron, the High Flux Beam Reactor, and the Medical Research Reactor, each of which contain multicurie amounts of radioactivity, are closed with no direct connection to any Laboratory waste system.

Small volumes (up to a few gallons) of concentrated liquid wastes containing radioactivity or other hazardous agents are withheld from the Laboratory waste systems. They are stored at their sources in small containers for pickup by the BNL Waste Management Group and subsequent packaging for off site disposal (in the case of hazardous agents, by an EPA licensed contractor).

Facilities which may produce larger volumes (up to several hundred gallons/batch) of radioactive or otherwise contaminated waste liquids are provided with dual waste handling systems, one for "active" (D-probably contaminated) and one for "inactive" (F-improbably contaminated) wastes. As shown in Figure 5, wastes placed into the "active" or D system are collected in holdup tanks. After sampling and analysis, they are either transferred by installed pipelines or tank truck to storage tanks adjacent to the BNL liquid waste evaporator. At this facility they are concentrated about a thousand fold and ultimately disposed of as solid wastes. If found to be of sufficiently low concentration, D wastes may be routed directly from holdup tanks to the Laboratory sanitary waste system.

As shown in Figure 5, "inactive" or F wastes are routed directly to the Laboratory sanitary waste system, where they are diluted by large quantities (approaching 1,000,000 gal/day) of cooling and other uncontaminated water routinely produced by diverse Laboratory operations. Sampling and analysis of facility holdup tanks is done to facilitate waste management; while effluent sampling to establish the concentrations and amounts of environmental releases is performed at the sewage treatment plant.

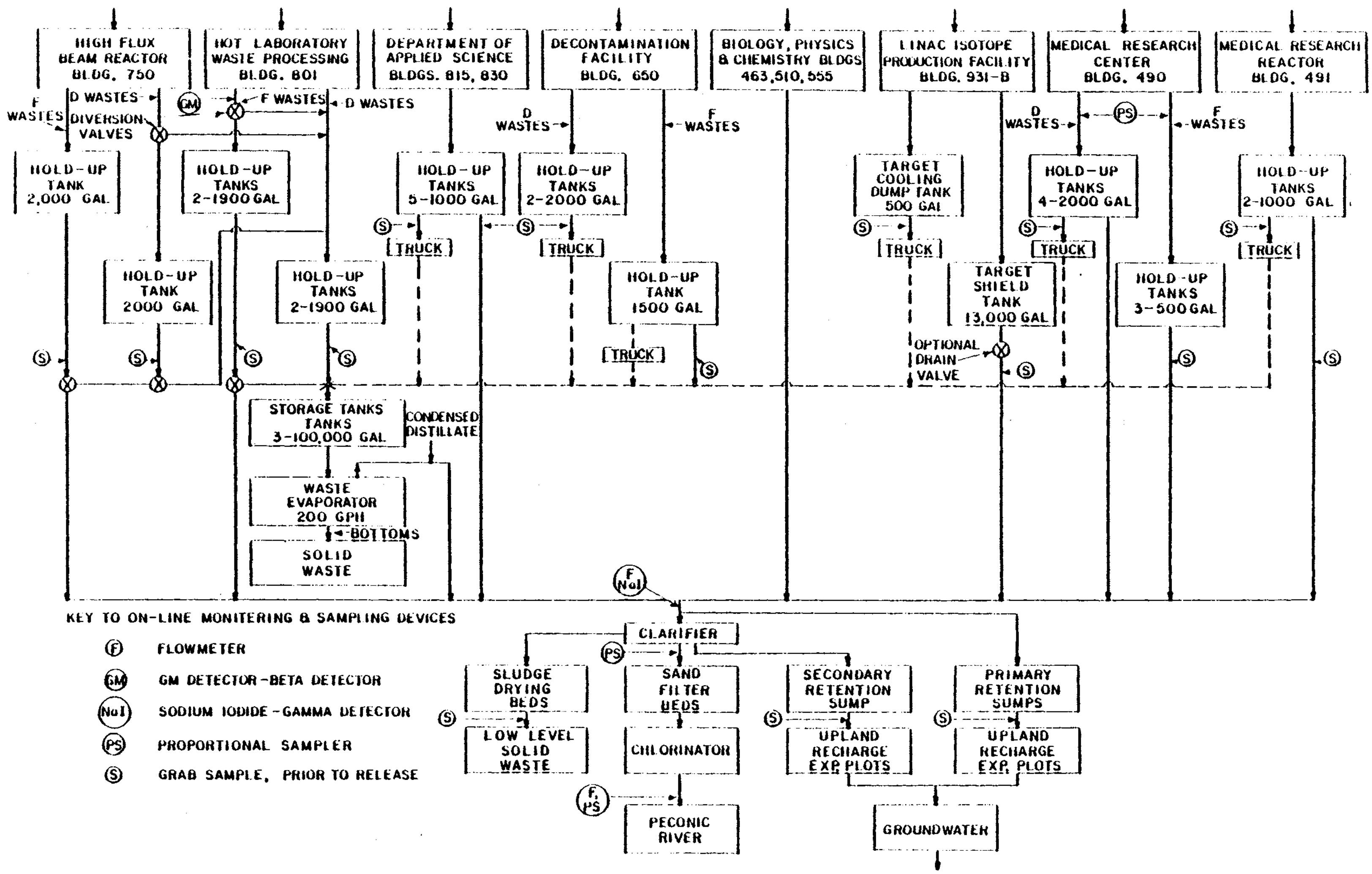

HIGH FLUX BEAM REACTOR BLDG. 750
HOT LABORATORY WASTE PROCESSING BLDG. 801
DEPARTMENT OF APPLIED SCIENCE BLDGS. 815, 830
DECONTAMINATION FACILITY BLDG. 650
BIOLOGY, PHYSICS & CHEMISTRY BLDGS 463,510,555
LINAC ISOTOPE PRODUCTION FACILITY BLDG. 931-B
MEDICAL RESEARCH CENTER BLDG. 490
MEDICAL RESEARCH REACTOR BLDG. 491
F WASTES
D WASTES
DIVERSION VALVES
HOLD-UP TANK 2,000 GAL
HOLD-UP TANKS 2-1900 GAL
HOLD-UP TANK 2000 GAL
HOLD-UP TANKS 2-1900 GAL
HOLD-UP TANKS 5-1000 GAL
HOLD-UP TANKS 2-2000 GAL
HOLD-UP TANK 1500 GAL
TARGET COOLING DUMP TANK 500 GAL
TARGET SHIELD TANK 13,000 GAL
OPTIONAL DRAIN VALVE
HOLD-UP TANKS 4-2000 GAL
HOLD-UP TANKS 3-500 GAL
HOLD-UP TANKS 2-1000 GAL
TRUCK
STORAGE TANKS TANKS 3-100,000 GAL
CONDENSED DISTILLATE
WASTE EVAPORATOR 200 GPH
BOTTOMS
SOLID WASTE
CLARIFIER
SLUDGE DRYING BEDS
LOW LEVEL SOLID WASTE
SAND FILTER BEDS
CHLORINATOR
PECONIC RIVER
SECONDARY RETENTION SUMP
PRIMARY RETENTION SUMPS
UPLAND RECHARGE EXP. PLOTS
GROUNDWATER
KEY TO ON-LINE MONITERING & SAMPLING DEVICES
F FLOWMETER
GM GM DETECTOR-BETA DETECTOR
NaI SODIUM IODIDE-GAMMA DETECTOR
PS PROPORTIONAL SAMPLER
S GRAB SAMPLE, PRIOR TO RELEASE

FIGURE 5

The small amounts of low level radioactive waste effluents that may be routinely disposed of by release into the Laboratory's sanitary waste system are established by administrative limits,[12] which correspond to those applicable to sewage systems. Within these limits, individual releases are kept as low as reasonably achievable.

Primary treatment to remove suspended solids from the liquid stream collected by the sanitary waste system is provided by a 250,000 gallon clarifier. Its liquid effluent then flows onto sand filter beds, from which about two-thirds of the water is recovered by an underlying tile field. This water is chlorinated and released into a small stream that forms one of the headwaters of the Peconic River.

A schematic of the sewage treatment plant and its related sampling arrangements is shown in Figure 6. In addition to the inplant flow measurement and sampling instrumentation, totaling flowmeters (Leopold and Stevens TF 61-2), with provision for taking a sample for each 2000 gallons of flow in combination with positive action battery operated samplers (Brailsford DU-1), are located at the chlorine house, at the former site boundary which is 0.5 miles downstream on the Peconic, and at the site boundary, 1.6 miles downstream.

An aliquot of each daily (or weekend) sample of the input to the sand filter beds and of their output to the chlorine house outfall was evaporated for gross alpha and gross beta analysis, and another was counted directly for tritium analysis. Samples from the two downstream locations were obtained three times a week. Aliquots of each sample were similarly analyzed for gross beta and for tritium; and another aliquot, proportional to the measured flow during the sampling period, was passed through ion

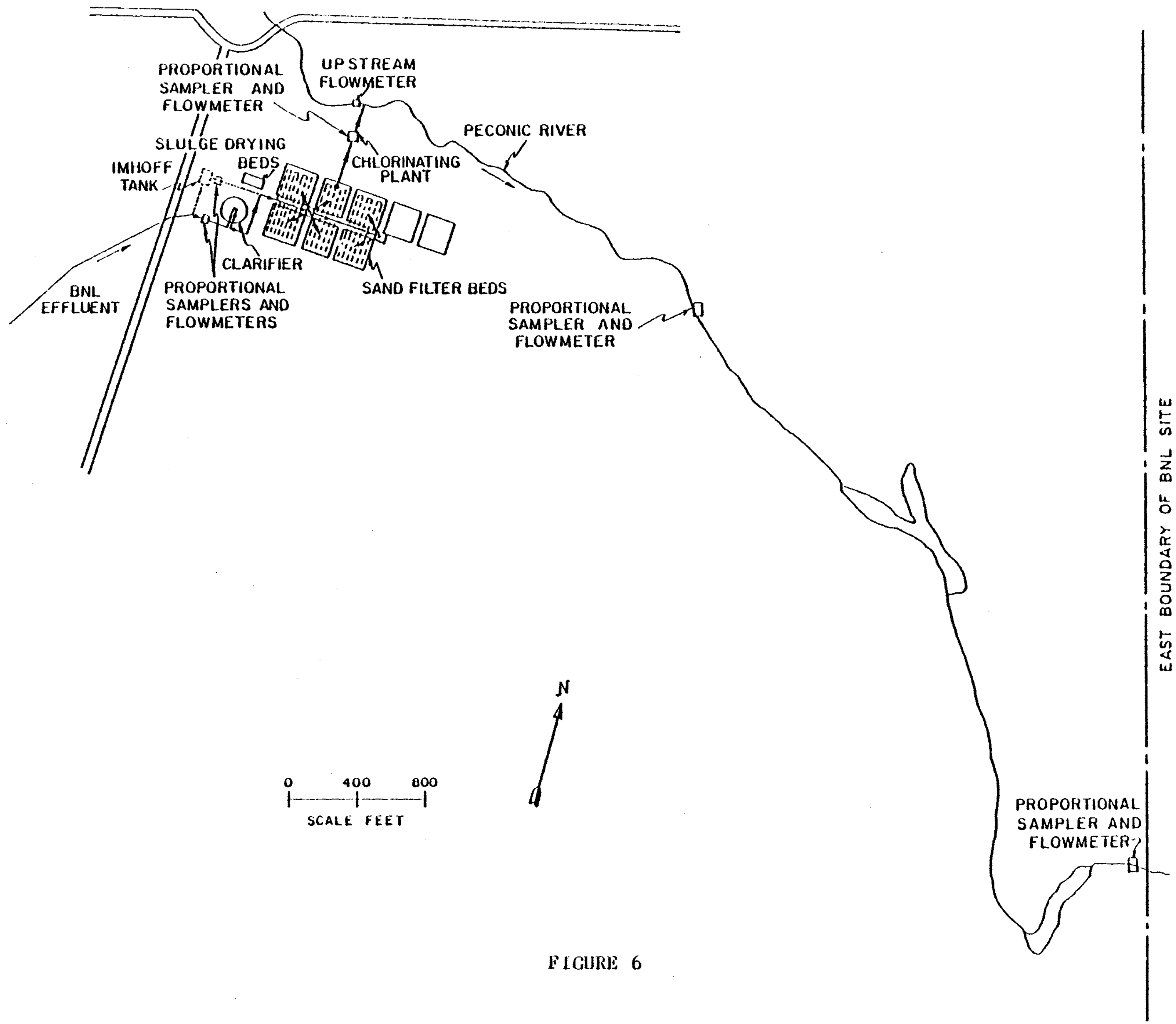

PROPORTIONAL
SAMPLER AND
FLOWMETER
UPSTREAM
FLOWMETER
PECONIC RIVER
SLULGE DRYING
BEDS
CHLORINATING
PLANT
IMHOFF
TANK
CLARIFIER
SAND FILTER BEDS
BNL
EFFLUENT
PROPORTIONAL
SAMPLERS AND
FLOWMETERS
PROPORTIONAL
SAMPLER AND
FLOWMETER
EAST BOUNDARY OF BNL SITE
N
0
400
800
SCALE FEET
PROPORTIONAL
SAMPLER AND
FLOWMETER

FIGURE 6

exchange columns for subsequent analysis of the integrated sample. Unless the gross beta count indicated a reason for more immediate identification for each location, one set of these columns was analyzed directly on a monthly or quarterly basis for gamma emitting nuclides and another was eluted for radiochemical processing for ^{90}Sr analysis.

The monthly average flow and the monthly totals of gross beta and principal nuclide activities at the clarifier (input to the filter beds) and at the chlorine house (output from the beds) are shown in Table X. Yearly totals and average concentrations are also indicated. During 1975, 67% of the liquid effluent flow into the sand filter beds appeared in the output from them and 2% was utilized by the Upland Recharge Project. The balance was assumed to have percolated to the ground water flow under the beds. Estimates of the amounts of radioactivity released to the ground water in this manner during 1975 are also shown in Table X. These were calculated on the additional assumption that the average concentrations of the contained nuclides corresponded to those in the output from the beds, as observed at the chlorine house. There was a 72% decrease from the amount of tritium found at the clarifier during 1974. This appears to be an indirect result of the reduction in the concentration of tritium in the primary system of the High Flux Beam Reactor, and thus in the liquid waste from this facility. Compared to 1974 the amounts of ^{22}Na and ^{51}Cr are markedly reduced and ^{24}Na was absent. This was due to the conversion, late in 1974, of the cooling of the Brookhaven Linear Isotopes Production Facility from a single-pass to a closed system. It may also be noted that the amounts of ^{90}Sr and ^{137}Cs in the outfall from the sand filter beds were larger than the 1975 input to the beds. This is a delayed reflection of the larger than usual input of these nuclides to the beds during December 1974.

Flow, activity and concentration information at the former site boundary sampling location, 0.5 miles downstream (see Fig. 6), and at the present site boundary are shown in Table XI. A much greater stream flow was observed at the former site boundary than at the chlorine house, reflecting the upstream addition to the BNL stream effluent, which during 1975 totaled 4.70 x 10^{11} cm^3. With the exception of tritium, there was a general decrease in the total activity in the stream between the sewage treatment plant outfall and the site boundary. This was due to radioactive decay of short lived radionuclides, stream bottom deposition. Infiltration into ground water was evident from the decrease in flow at the boundary measuring weir during the third quarter of the year. Upper limit estimates of the total activity which may in this manner have percolated to the underlying ground water during these months are also shown in Table XI. These are based on the decrease in total activity between the former site boundary and the perimeter during this period.

Analysis of monthly composite samples of the Peconic River at the former site boundary (0.5 miles downstream from the chlorine house) during this period showed that, on the average, 3% of the total activity consisted of ^{90}Sr and that no appreciable amounts of long half-life radioactive iodine or bone-seeking nuclides such as radium were present. Under these circumstances the applicable RCG was 3000 pCi/liter (3.0 x 10^{-6} μCi/ml). The gross beta concentration in the portion which percolated to ground water was 24.6 pCi/liter (2.46 x 10^{-8} μCi/ml) or 0.8% of the RCG.

At the BNL perimeter (1.6 miles downstream from the chlorine house), 7% of the yearly activity was ^{90}Sr. The applicable RCG was also 3000 pCi/liter. The observed concentration of the water released downstream was 23.7 pCi/liter (2.37 x 10^{-8} μCi/ml) or 0.8% of the RCG.

After digestion, the solids removed by the clarifier are dried on sludge drying beds. After analysis, they are transferred to the on site sanitary landfill. However, no such transfer of dried sludge was made during 1975.

As of January 31, 1975, the effluent from the Brookhaven sewage treatment plant was subject to the conditions of National Pollutant Discharge Elimination System (NPDES) Permit No. NY 000 5835. Monthly reports were prepared in accordance with this permit. A yearly summary of these data, which follows the same format as these monthly reports, is shown in Table XII-A. It includes a specification of the permit conditions. The Laboratory effluent was well within these conditions, with the exception of two daily pH levels which were only slightly below the lower level set forth in the permit and within the local natural range of ground water. These effluent data were obtained by the sewage treatment plant operators.

In addition to the above measurements, the BNL Safety and Environmental Protection Division conducts routine measurements of a number of indications of water quality and purity of the filter bed effluent, upstream of the outfall of this effluent, at the Peconic River at the former BNL perimeter (0.5 miles downstream) and at the present BNL perimeter (1.6 miles downstream). A summary of these data for 1975 is shown in Table XII-B. The outflow from the sand filter beds and into the Peconic was considerably above water quality standards for minimum DO.[6,13] Although occasionally below the standard, the pH was within the range of local ambient backgrounds. After mixing with the upstream flow, the temperature increment was within the standard[14] 0.5 miles downstream.

Monthly analyses for selected metals in the filter bed effluent were also performed. The data are shown in Table XII-C. Their yearly average concentrations were before dilution, at or within the standard for the receiving body.[6,13]

A small portion of the liquid effluent flow at the clarifier was diverted from the sand filter beds for application to the on site Upland Recharge and associated Meadow-Marsh areas. As indicated previously, early in 1975 the primary emphasis of this experiment was shifted to the latter aspect of this experiment. It utilized a simulated typical sewage treatment effluent, which was prepared by blending cesspool pumpings, gathered by scavengers in the Town of Brookhaven, with the extremely dilute BNL effluent, characteristically in a 1:5 ratio. A summary of the total flows and of the gross beta, tritium and the ^{90}Sr activities and concentrations is shown in Table XIII.

Water quality parameters of the mixtures utilized in the Meadow-Marsh were evaluated by the BNL Department of Applied Science[15] and cooperating outside agencies. These data are shown in Table XIV. The applied effluents met the standards for ground surface discharge, with the exception of the metals Cu, Fe and Zn.[6] It should be noted that the purpose of this experiment is to determine the efficiency of natural ecosystems for the removal of pollutants in the applied effluents. It was intended that the "effluent" percolate to the saturated zone (10-15' below the ground surface in the Upland Recharge area) would be within ground water quality standards.

Due to the permeable nature of the local soils, there is no surface runoff from the experimental area, and hence no direct route by which these effluents might reach a potable water supply.

Monthly "grab" water samples were obtained at on and off site locations along the upper tributary of the Peconic River, into which the Laboratory routinely discharges low level radioactive wastes. Reference "grab" samples were also obtained from other nearby streams and bodies of water

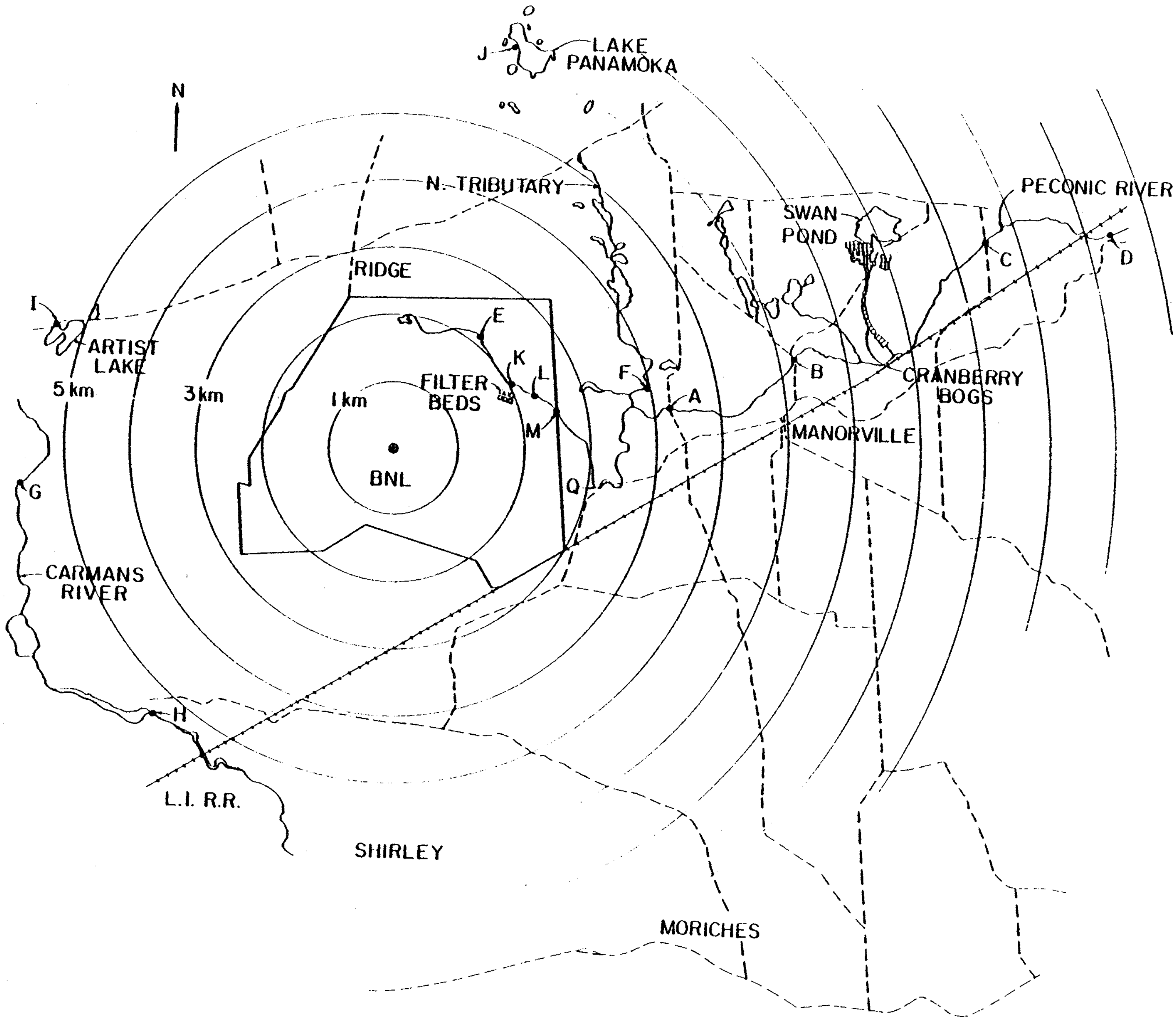

N
LAKE PANAMOKA
J
N. TRIBUTARY
PECONIC RIVER
SWAN POND
C
D
RIDGE
I
ARTIST LAKE
E
K
L
FILTER BEDS
F
A
B
CRANBERRY BOGS
5 km
3 km
1 km
M
MANORVILLE
BNL
G
Q
CARMANS RIVER
H
L.I. R.R.
SHIRLEY
MORICHES

FIGURE 7

outside the Laboratory's drainage area. The sampling locations, as shown in Figure 7, were as follows:

<u>Off Site</u> (Peconic River, proceeding downstream)

A - Peconic River at Schultz Road, 15,900 ft downstream

B - Peconic River at Wading River-Manorville Road, 23,100 ft downstream

C - Peconic River at Manorville, 35,000 ft downstream

D - Peconic River at Calverton, 46,700 ft downstream

R - Peconic River at Riverhead, 63,500 ft downstream

<u>Controls</u> (Not in BNL drainage)

E - Peconic River, upstream from BNL effluent outfall

F - Peconic River, north tributary (independent of BNL drainage)

H - Carman's River, outfall of Yaphank Lake

Individual monthly and yearly average gross beta, tritium and ^{90}Sr concentrations at downstream and control locations are shown in Table XV-A. A comparison with the on site and perimeter concentrations shown in Table XI suggests that the concentrations of BNL effluents in the Peconic diminish rapidly downstream of the outfall to near background levels at the more distant sampling locations. Considering the concentrations of radioactivity near the mouth of the Peconic at Riverhead, where the flow is about 25 times that at the BNL perimeter, it is evident that the total amounts of radioactivity at this location were much greater than those released into the Peconic at the BNL perimeter. During 1975 measurements of selected water quality and purity parameters at downstream locations on the Peconic and at control locations were initiated in order to provide some perspective on the same parameters in the BNL effluent (as reported in Table XII-B). These limited "grab" sample data are shown in Table XV-B. The effect of somewhat elevated levels of some parameters in the BNL effluent such as chlorides, dissolved solids, nitrate, and phosphorus, is not markedly apparent downstream.

During June and July of 1975 additional sampling of stream bottom sediment, of immersed vegetation, and of small stream fauna was conducted along the length of the Peconic. Control samples were obtained upstream and from off site "control" locations. Most of these locations correspond to those used for monthly water samples. In addition, samples were obtained at the following locations:

<u>On site</u> (proceeding downstream)

K - Peconic River, 250 ft below outfall

L - Peconic River, 1300 ft below outfall

M - Peconic River, 2600 ft below outfall (at former boundary)

Q' - Peconic River, 4600 ft below outfall

Q - Peconic River, 6900 ft downstream (at BNL boundary)

A' - Peconic River, 7800 ft downstream

B' - Peconic River, 25,000 ft downstream

C' - Peconic River, 36,000 ft downstream

P - Peconic Lake, 46,000 ft downstream

Z - Zeeks Pond, head of small tributary, ~1500 ft west of location F.

The sediment data are shown in Table XVI. Small concentrations of ^{60}Co, which is not generally present in the environment and is therefore attributable to BNL effluents, were apparent in a few on site and immediately downstream samples. Concentrations of ^{137}Cs in samples obtained on site and in the upper reaches of the Peconic were somewhat greater than those in downstream and control samples, and were also indicative of BNL effluent releases. The largest concentrations were found at locations where the stream was impounded. The corresponding vegetation data are shown in Table XVII. These show a similar pattern. Small concentrations of ^{60}Co, which is unique to BNL effluent releases, were found in samples obtained on site, at the BNL perimeter, and in nearby locations downstream.

There was also some indication in these samples of BNL effluent activity, insofar as larger concentrations of other nuclides were found in samples from on site, at the perimeter and in or nearby the downstream region of the Peconic, as compared with remote downstream and control samples (which reflect accumulations of some of these same nuclides from fallout of atmospheric weapons tests or from natural origin).

A few samples of fish and turtles were also obtained along the upper reaches of the Peconic. These data, which are shown in Table XVIII, are insufficient to establish to what extent, if any, the samples contained BNL effluent radioactivity. The largest concentration of ^{137}Cs found in any of these samples was 2121 pCi/kg or less than 0.2% of RCG's (calculated on the basis of an assumed intake of 50 g/day).

Potable Water and Process Supply Wells

The Laboratory's potable water wells and cooling water supply wells are screened at a depth of about 100 feet, or about 50 feet below the water table, in the Long Island surface layer of glacial outwash, sand and gravel. As apparent from Figure 8, most of these wells are located generally west to northwest, and therefore upstream in the local ground water flow pattern of the Laboratory's principal facilities. A total of about 6.5×10^6 gal/day is pumped from them.

Bimonthly grab samples were obtained from these wells. These were analyzed for gross alpha, gross beta and tritium. All gross alpha concentrations were <1 pCi/liter ($<10^{-9}$ µCi/ml), and almost all tritium concentrations were <1.0 nCi/liter ($<10^{-6}$ µCi/ml). The gross beta and tritium results are set forth in Table XIX. There were no differences in the gross beta concentrations among these wells which might be attributed to BNL effluents.

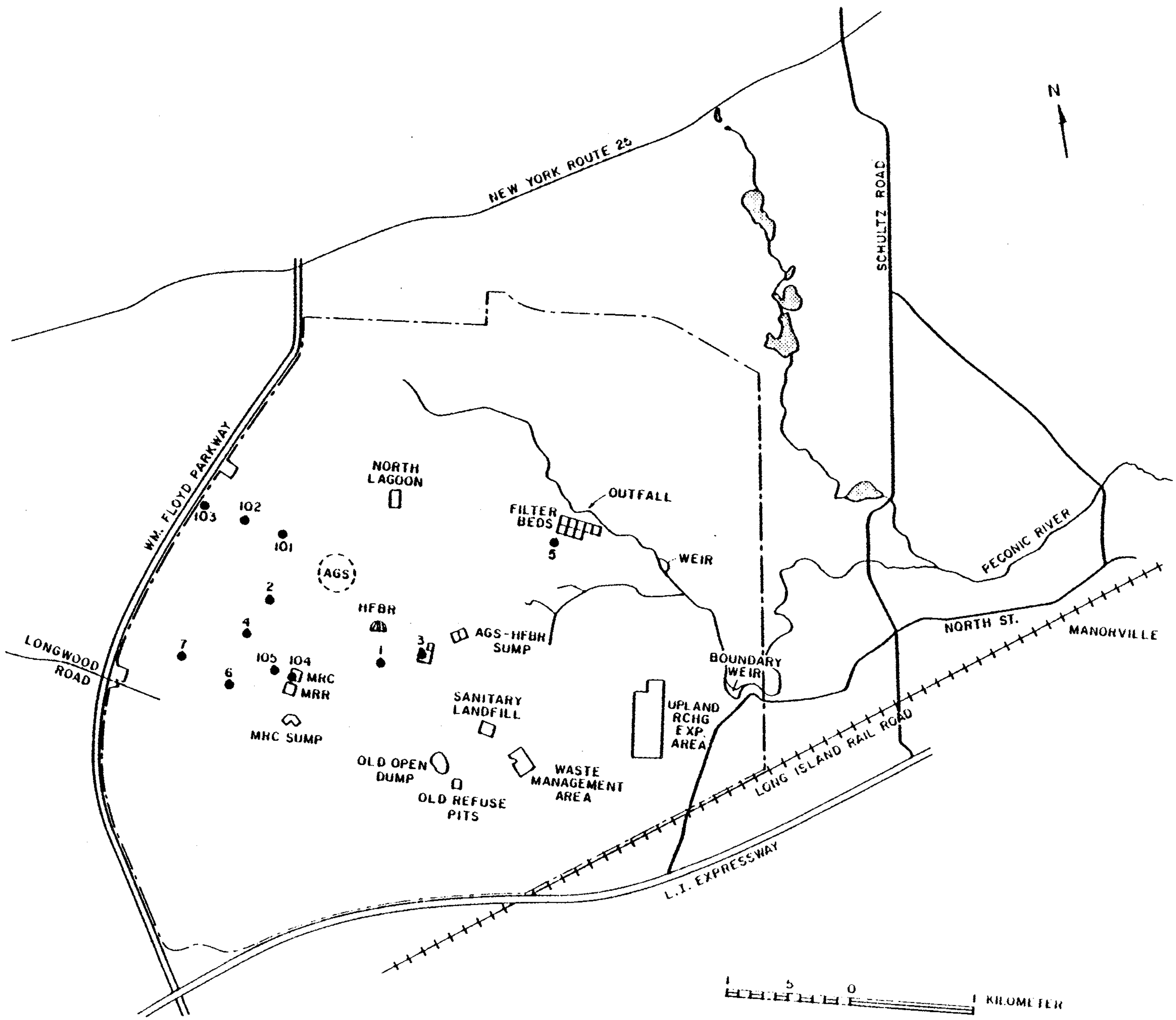

N
NEW YORK ROUTE 25
SCHULTZ ROAD
WM. FLOYD PARKWAY
LONGWOOD ROAD
NORTH LAGOON
OUTFALL
FILTER BEDS
WEIR
PECONIC RIVER
103
102
101
AGS
2
HFBR
4
7
105
104
MRC
MRR
6
MRC SUMP
1
3
AGS-HFBR SUMP
5
NORTH ST.
MANORVILLE
BOUNDARY WEIR
SANITARY LANDFILL
UPLAND RCHG EXP. AREA
OLD OPEN DUMP
OLD REFUSE PITS
WASTE MANAGEMENT AREA
LONG ISLAND RAIL ROAD
L.I. EXPRESSWAY
5
0
1 KILOMETER

FIGURE 8

During August, turbidity became apparent in the potable water in the eastern portion of the Laboratory complex (adjacent to Building 750 in Fig. 2). It was found to originate from supply well 3 which is located at the Central Steam Plant (Building 610). After analyses revealed an associated higher than acceptable bacterial count (prechlorination), the well was disconnected from the Laboratory potable water supply. During subsequent test pumping, a total of 197 mCi of tritium, as HTO, was utilized as a tracer to determine the focal point of infiltration of surface pollution. Of this, a total of about 30 mCi was recovered. It was released to a storm sewer which drains to a depression about 1000 feet east of Building 610. A leak in a small steam condensate return storage tank was identified by this procedure. It was disconnected from the steam system. The well was then disinfected and returned to the Laboratory potable supply net on January 5, 1976.

Recharge Basins

After use in "once through" heat exchangers and for process cooling, about 4.8 million gallons per day (MGD) of the water utilized by the Laboratory is returned to ground water in on site recharge basins: about 1.7 MGD to basin "N" located about 2000 feet northeast of the AGS; about 1.5 MGD to basin "O" about 2200 feet east of the HFBR; and about 1.6 MGD to basin "P" 1000 feet south of the MRR (see Fig.8). Sodium hexametaphosphate was added to the AGS cooling and process water supply, which is independent of the Laboratory potable supply, to establish a PO_4 concentration of about 2 ppm in order to keep the ambient iron in solution. Of the total AGS pumpage, about 1.4 MGD was discharged to the "N" basin, and 0.7 MGD to the "O" basin. The HFBR secondary cooling system recirculates through mechanical cooling towers. It is treated to control corrosion and the deposition of solids. Blowdown from this system, about 0.1 MGD, contains PO_4 in a concentration of about 10 ppm and benzotriazole in a concentration of 3-4 ppm. It is also discharged to the "O" sump. The MRR-MRC "once through" coolant is not routinely treated and is discharged to the "P" basin. Concentrations of radioactivity and other agents in these basins are monitored by routine weekly grab sampling. The average gross beta and tritium concentrations are shown in Table XX-A. The average gross beta concentration in the sump north of the AGS was slightly above background, due to the occasional release of short lived nuclides contained in AGS beam stops. It was 0.4% of the applicable RCG. The average gross beta and tritium concentrations in the other basins were only very slightly increased above those in the BNL supply wells, and were about 0.1% of the applicable RCG for unidentified gross beta emitters, and less than 0.02% of that for tritium in drinking water.

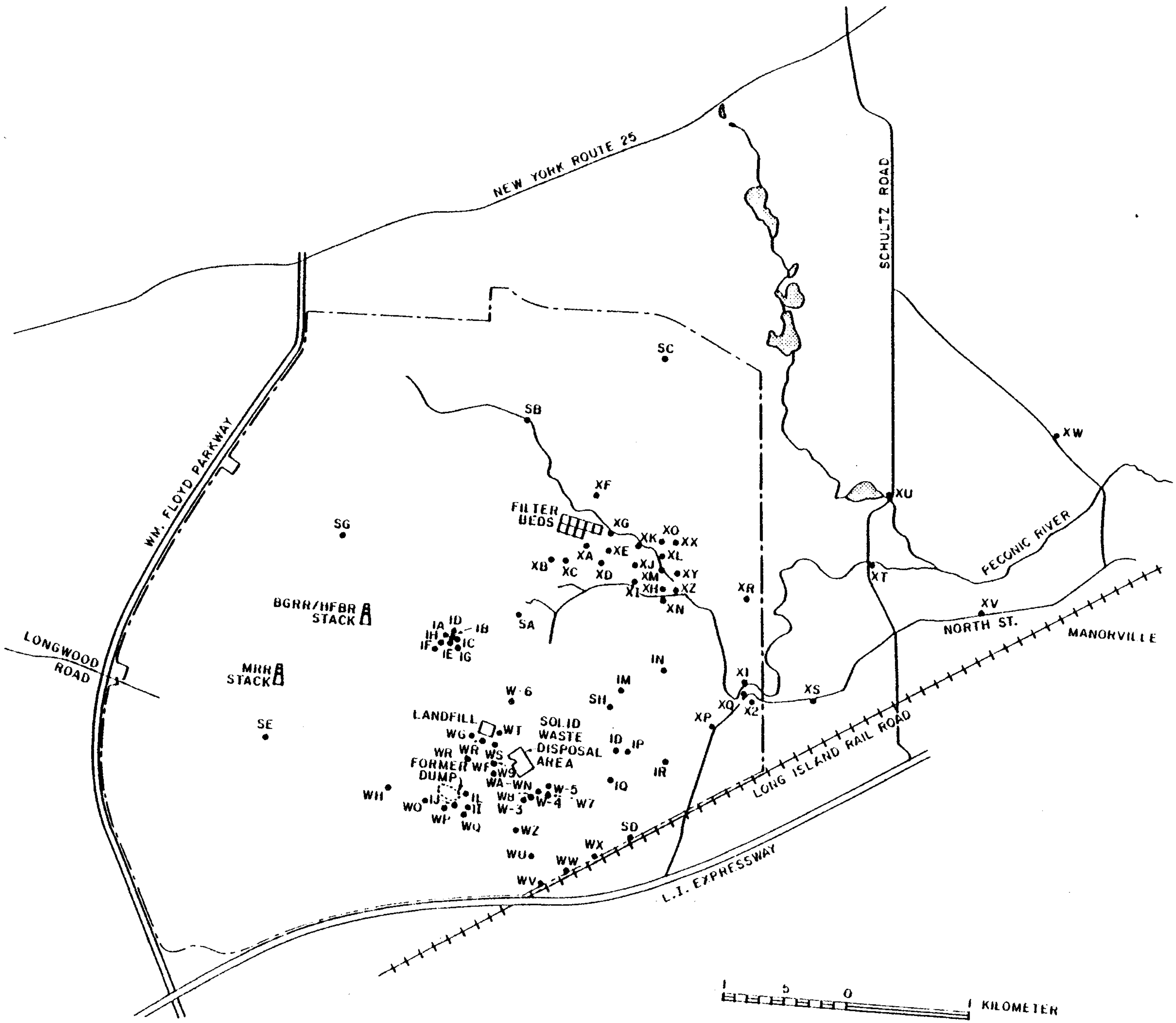
Water quality data is obtained from periodic (approximately monthly) analyses of "grab" samples from the recharge basins, and from a culvert which conducts some air conditioning tower blowdown and other storm sewer influents from the southeast Laboratory building complex to a natural sump south of the warehouse area (about 3/4 miles south of Building 610, see Fig. 2). The data for 1975 are shown in Table XX-B. All were within established standards for ground water quality.

Ground Water Surveillance

Samples of ground water were obtained from a network of shallow wells previously installed in the vicinity of several areas from which there was a potential for the percolation of radioactivity downward from the surface into the saturated zone of ground water. The included areas were adjacent to on site recharge basins, to the sand filter beds, to the downstream Peconic, to the Solid Waste Management area, to the former open dump, to the sanitary landfill, to the decontamination facility sump, and to the Upland Recharge and Meadow-Marsh Project area. The locations of most of these ground water surveillance wells are shown in Figure 9-A. The locations of the several wells installed at the landfill and Solid Waste Management area are shown in Figure 9-B, and of those installed in the Upland Recharge and Meadow-Marsh area in Figure 9-C.

For convenience in assessing the data, the wells have been divided into several groups. Yearly average gross alpha, gross beta and tritium concentrations of the wells adjacent to the sand filter beds, and downstream on the Peconic River are summarized in Table XXI. During the year, at least one sample from locations adjacent to the recharge basins and from locations most immediately adjacent to the sand filter beds and the Peconic was also analyzed for ^{90}Sr and ^{137}Cs (by gamma analysis). These data are also indicated. Corresponding information for the wells generally in the proximity of downstream of the solid waste management area, the landfill and former dump zones, and of the decontamination facility sump (about 1 km east of the HFBR) is summarized in Table XXII, and for the wells in the Upland Recharge and Meadow-Marsh Project area in Table XXIII.

From these data it appears that the spread of radioactivity from BNL operations into ground water remained limited to within a few hundred meters of the identifiable foci. Above background concentrations of beta emitters, tritium and ^{90}Sr were found on site adjacent to the sand filter beds and to the Peconic, at small fractions of the RCG's. They were generally comparable to or somewhat diminished from those of 1974.


NEW YORK ROUTE 25
SCHULTZ ROAD
PECONIC RIVER
NORTH ST.
MANORVILLE
LONG ISLAND RAIL ROAD
L.I. EXPRESSWAY
WM. FLOYD PARKWAY
LONGWOOD ROAD
FILTER BEDS
BGRR/HFBR STACK
MRR STACK
LANDFILL
SOLID WASTE DISPOSAL AREA
FORMER DUMP
SA
SB
SC
SD
SE
SG
SH
XA
XB
XC
XD
XE
XF
XG
XH
XI
XJ
XK
XL
XM
XN
XO
XP
XQ
XR
XS
XT
XU
XV
XW
XX
XY
XZ
X1
X2
IA
IB
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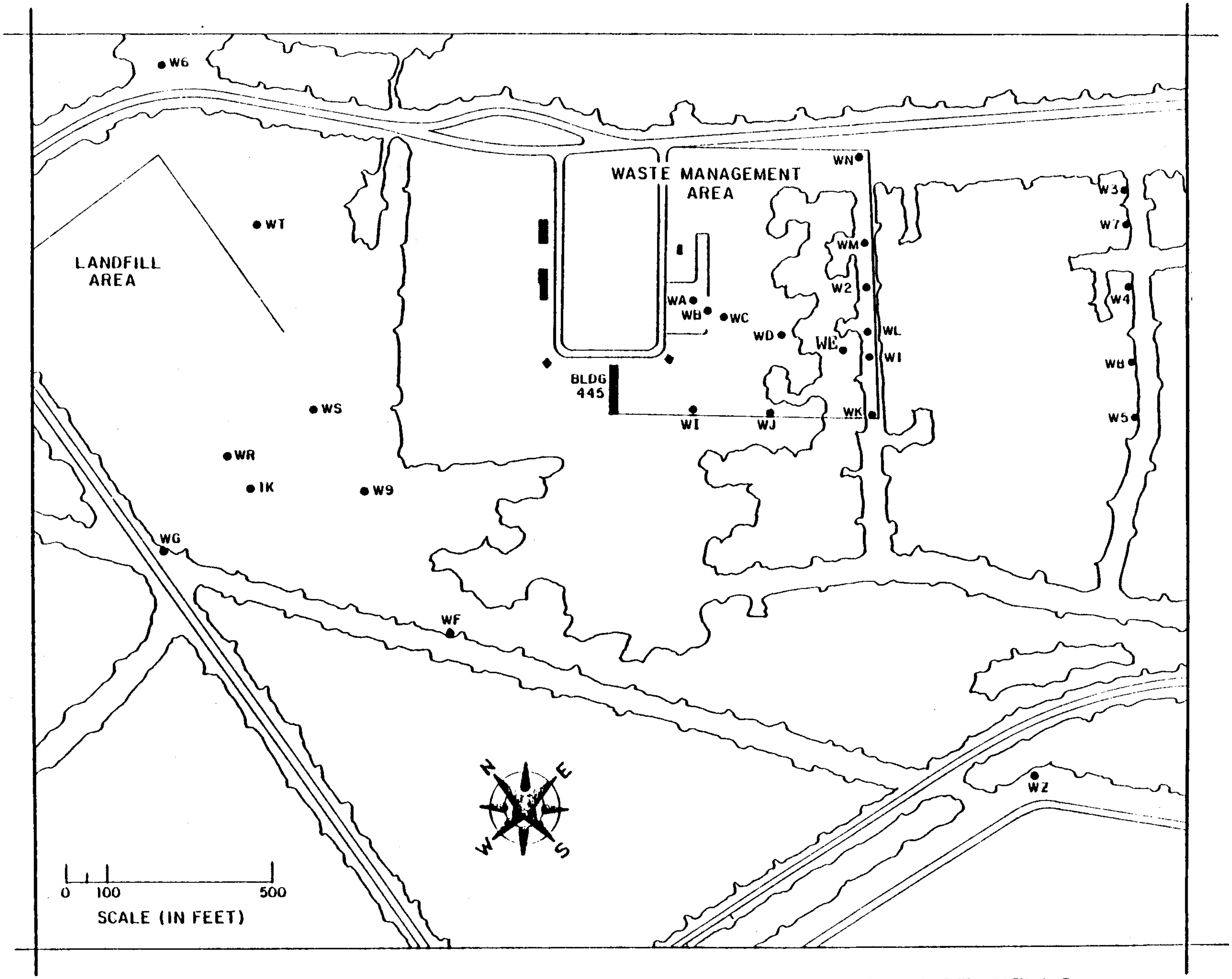
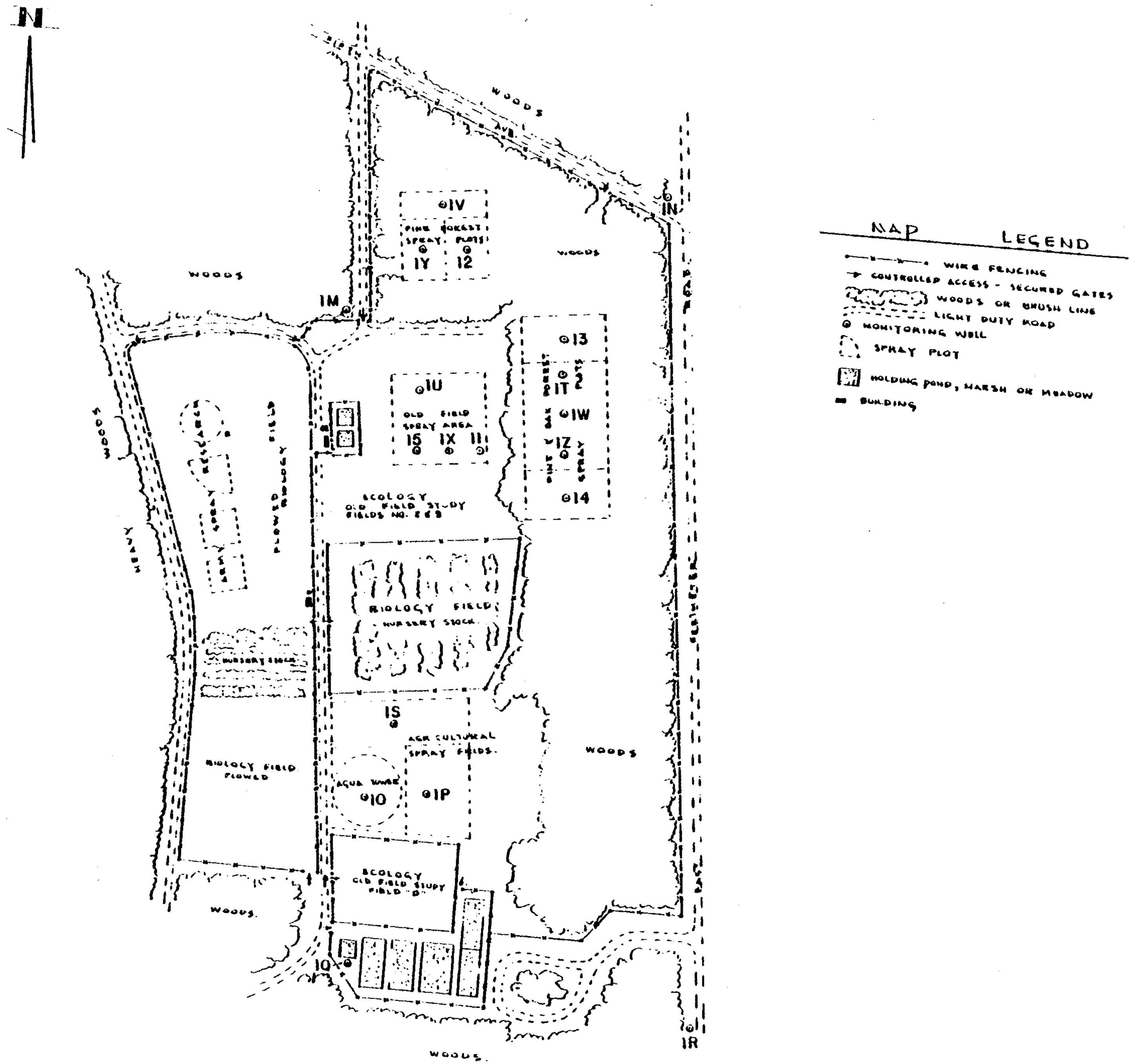
II
IJ
IL
IM
IN
IP
IQ
IR
W-3
W-4
W-5
W-6
W7
W8
W9
WA-WN
WF
WG
WH
WO
WP
WQ
WR
WS
WT
WU
WV
WW
WX
WZ
5
0
1 KILOMETER

FIGURE 9-A



LANDFILL AND WASTE MANAGEMENT AREA SURVEILLANCE WELLS

FIGURE 9-B



UPLAND RECHARGE WELLS

FIGURE 9.6

Adjacent to the Peconic at the site boundary, all concentrations were equal to or less than 0.1% of Radiation Concentration Guides. Compared with 1974, gross beta, ^{90}Sr and tritium concentrations were generally similar in several wells immediately adjacent to the Solid Waste Management area. The elevated ^{90}Sr concentrations, approaching 20% of the Radiation Concentration Guide, in wells WK, W-1, and WL, reflect an inadvertent release in the order of 1 Ci of this nuclide to ground water at well WA in 1960. Increased gross beta and tritium concentrations were also apparent in several wells immediately adjacent to the landfill area. Little change was apparent in wells adjacent to the former open dump and the decontamination facility (650) sump, except for an increase in ^{90}Sr in wells 1A and 1-E. The largest was 40% of the Radiation Concentration Guide. Tritium above minimum detectable concentration was found in several wells within the Upland Recharge Project plots, but not in the "control" wells at its area boundaries. Concentrations of radioactivity in wells on or near the site boundary, other than adjacent to the Peconic, were at or only slightly above background levels, and at small fractions of Concentration Guides.

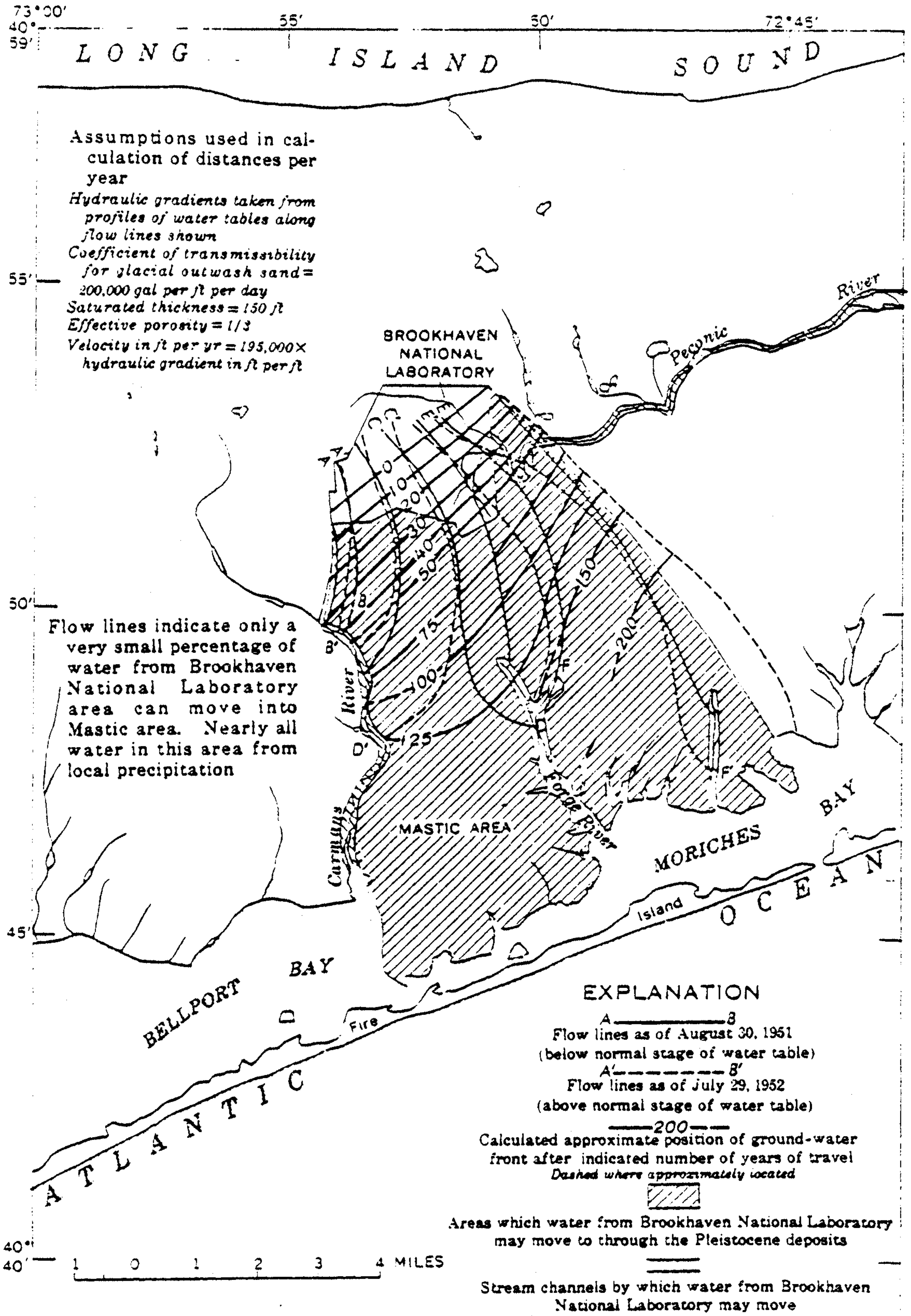
Several water quality and purity parameters were also evaluated, for all ground water surveillance wells. The data for those wells proximate to on site sumps, the sand filter beds, and downstream of the Peconic River on and off site, are shown in Table XXIV-A. Those for wells proximate to the Solid Waste Management area, the landfill and dump area and the Building 650 sump, are shown in Table XXIV-B. Those for wells in the Upland Recharge Project plots and at its outer perimeter are shown in Table XXIV-C. Analyses for selected metals were conducted for a few wells immediately adjacent to the sand filter beds, to the Peconic and to the landfill area. These data are shown in Table XXIV-D.

In general, the data were comparable to those found in 1974. With the exception of pH, all analyzed water quality parameters were well within New York State Water Quality Standards. The somewhat lower pH data appear to reflect natural ambient levels, since higher pH levels were present in the input to and output from the sewage treatment plant (see Table XIII-A). Concentrations of Fe and Zn in excess of water quality standards were found in wells immediately adjacent to the sand filter beds, the Peconic River, the landfill areas and the 650 sump area. It is not clear to what extent they may be an artifact produced by the sampling well casings, or to reflect the leaching of accumulations of these metals from past BNL releases. Much lower levels of Zn were found in the Laboratory supply wells. Several contain Fe in excess of the standard, but most of this is removed prior to use.

A generalized depiction of the direction and rate of ground water movement originally published in the U. S. Geological Survey Study, is shown in Figure 10. More recently, the Upland Recharge Project[16] has determined a ground water velocity of 5.3 in/day (13.4 cm/day), which is in good agreement with the U. S. Geological Survey Study estimate of 6.4 in/day (16.2 cm/day). Thus, it appears that many years of travel time would be required for ground water containing radioactivity or other pollutants to reach an off site well, during which considerable dilution by infiltration of precipitation would be anticipated.

Milk Sampling

Monthly samples of milk were obtained and analyzed by the New York State Department of Environmental Conservation from two local dairy farms, one located 10 km south-southeast and a "control" located 40 km east of Brookhaven. Their reported data[17] are indicated in Table XXV. As was



Direction and time of travel of ground water laterally in upper Pleistocene deposits from the Brookhaven National Laboratory area to points of discharge.

FIGURE 10

the case during recent years, the average concentration of ^{90}Sr in the milk from the farm 10 km southeast of the Laboratory, as reported by the Department, was higher than the more remote "control" location. This effect is not relatable to any BNL effluents, past or present, but appears to be related to differences in soil conditions and/or farming practices.[18-20]

Soil and Vegetation Sampling

A few soil and vegetation samples were collected from several off site farms during 1975. Soil samples were also collected from two locations on site, at which local deposition of radioactivity from past BNL operations have previously been apparent. The first was adjacent to the Solid Waste Management area, and the second in a natural sump adjacent to the Brookhaven Linear Isotopes Production Facility.

These samples were analyzed for gamma emitting nuclides. The data for both the off site and on site soil samples are shown in Table XXVI. The off site levels were comparable to or less than those found in recent years at these same locations.

At the Solid Waste Management area, ^{54}Mn, ^{60}Co, and ^{137}Cs in concentrations considerably in excess of those generally present in the environment were evident in samples collected within its fence line (see Fig. 9-B). On the average, the concentrations were less than those found during a similar 1974 survey. At the fence line, the levels of ^{60}Co were at or near the minimum detectable, and those of ^{137}Cs were at or near prevailing levels. Most of this contamination is believed to have originated during outdoor packaging of stored wastes for off site shipment and ultimate disposal. It does not represent a perceptible pathway for off site exposure, since it is locally confined to within 500 or so feet of the solid waste storage pad. Local concentrations of ^{7}Be considerably in excess of ambient background levels were found in the BLIP sump area. However, since it has a relatively short half-life (53 days), this deposit has no environmental significance.

Only two off site vegetation (pasture) samples were analyzed during 1975. The measured concentrations of ^{65}Zn, ^{137}Cs and ^{144}Ce were comparable to or less than those detected at these same locations during recent years. There were no other differences between the nearby and the more remote sample, on which to infer the deposition of any BNL effluent activity. A pattern similar to that in soil samples was found in vegetation at the Waste Management area.

OFF SITE DOSE ESTIMATES

Increased levels of radiation and concentrations of radioactivity, above ambient background, with resulting increased doses to people, result from the following four BNL sources:

Airborne radioactive effluents, primarily tritium;
Radioactive liquid effluents;
The ^{137}Cs source in the Biology Department Ecology Forest;
Skyshine from the Alternating Gradient Synchrotron (AGS).

These are discussed below, and the total off site dose (in man-rem) due to Laboratory operations during 1975 is calculated.

Doses Due to Airborne Effluents

As indicated in Table III, a total of 723 Ci of tritium was released from various BNL facilities during 1975, making it a principal source of airborne dose to persons off site.

Concentrations of tritium at the site boundary were so low that measurement was difficult. Data given in Table VI indicate an average concentration of 27 pCi/m^3 at the site boundary (~2500 meters from the HFBR stack) in addition to the background value, which equaled about 1 pCi/m^3. Continuous exposure at the radiation concentration guide (2×10^5 pCi/m^3) would result in a dose of 500 mrem/yr. Thus, the dose rate at this distance attributable to BNL air effluent tritium was $(27/2x10^5)(500)$ or 0.068 mrem/yr, or 0.014% of the Radiation Protection Standard. Since the background exposure rate in this area was about 81 mrem/yr, this tritium dose rate amounts to an increase at the site boundary of only 0.1%, which is much smaller than the temporal and spatial variations in that background.

Some 478 Ci of radioactive argon gas (^{41}A) was released from the stack of the Medical Research Reactor. This quantity is too small to produce a measurable increase in annual dose rates at the site boundary. During operation of the Brookhaven Linac Isotope Facility (BLIP), ^{15}O is released at a rate calculated as 0.6 Ci/min, for a total amount of 30,500 Ci during 1975. Its half-life was 2 minutes and its effect was not observable at the site boundary.

Routine analyses for air particulate radioactivity and for radiohalogens were made throughout 1975 on air samples collected at several locations. Although several nuclides attributable to fallout from weapons testing were found, there was no evidence of activity attributable to BNL operations.

Dose rates beyond the site boundary due to tritium in air effluents from BNL were very small, compared with background and variations in background. This should be considered in the interpretation of the computation of the population exposure in man-rem attributable to this BNL effluent, as shown in Table XXVIII. The parameter $\underline{X}/\underline{Q}$, tabulated in the second column, is the ratio of ground level concentration to rate of emission, i.e., concentration per unit emission rate, and is a function of meteorological conditions and distance from the source. The values have been calculated for the 300 m release height of the HFBR stack and are averages for a whole year and for all sixteen tabulated directions. While their use produces an underestimate at close-in distances for releases from shorter stacks, overall it results in some overestimation of population exposure, since $\underline{X}/\underline{Q}$ values in the direction of major population centers to the west of BNL are lower than the 360° averages. Values of dose rate in the third column are derived from the measured value for the 1 to 2 mile interval (0.068 mR/yr) by multiplying by the appropriate ratios of $\underline{X}/\underline{Q}$ values. The total population dose due to the BNL tritium effluent was 6.04 person-rems and due to natural background (81 mR/yr) was 419,268 person-rems.

Doses Due to Liquid Effluents

Since the Peconic River is not utilized as a drinking water supply, nor for irrigation, its waters do not constitute a direct pathway for the ingestion of radioactivity. The upper portions of the river, in which a small excess of radioactivity above background concentrations (principally ^{137}Cs) was found in sediments, vegetation and fish, is utilized for occasional recreational fishing. Making the assumption that the total catch of fish by 100 fishermen was 1×10^3 kg, and the ^{137}Cs concentration was 1000 pCi/kg (1.0×10^{-6} μCi/kg) which is representative of fish samples from the Peconic in 1975; the total ingestion would have been 1.0×10^{-6} Ci. This corresponds to an average individual dose commitment of 0.32 mrems, or 0.06% of the Radiation Protection Standard. The estimated total dose from this indirect pathway is 0.032 person-rems. It may reasonably be assumed that there was also some accumulation of ^{90}Sr from BNL effluents in these fish. Since this nuclide is concentrated principally in the inedible bone, the resulting dose appears to have been small by comparison to ^{137}Cs.

Although not directly relatable to BNL liquid effluents during 1975 , a concentration of ^{90}Sr of 2.9 pCi/liter was found in an off site surveillance well, about 1000 ft east of the BNL site boundary at the Peconic. Using dose commitment factors published by Shleien[(21)], a potential individual 50 year bone dose commitment of 13 mrem for infants and 11 mrem for adults may be calculated for a small number of people living in the adjacent area. This is about 0.3% of the Radiation Protection Standard. This calculation is based on the assumption that during 1975, all of their drinking water was obtained from shallow water supply wells, containing ^{90}Sr in a concentration equal to that of the surveillance well. It is estimated that not more than twenty-five people reside in this locality and thus that the total dose commitement did not exceed 0.33 person-rems. Their dose from natural background (including internal radiation) would have been about 2.5 person-rems during 1975.

Doses Due to the Gamma Forest ^{137}Cs Source

A 6450 curie* ^{137}Cs source is located in the northeast part of the BNL site, 1010 meters (3310 ft; 0.628 miles) from the north boundary. The dose rate at this boundary during 1975, as determined by the BNL Environmental Monitoring Group, was 4.7 mR/yr, or 0.9% of the Radiation Protection Standard.

Population doses beyond the site boundary due to this source have been computed using a population count by segments centered on the HFBR stack. Average dose rates for each population segment and for each distance from the source are given in Table XXIX.

Since the dose rate from this source decreases very rapidly with distance, only population segments located <3 miles from the source were considered. The total off site dose is 0.075 person-rem/yr, and appreciable contributions are found only in the NNE and NE sectors.

Doses Due to Alternating Gradient Synchrotron

The Alternating Gradient Synchrotron (AGS) is a 33 GeV proton synchrotron located 1180 meters from the nearest site boundary. Although the machine is heavily shielded, some neutrons do escape through it or from areas where experiments are in progress. Some of these neutrons reach off-site areas either directly, or in most cases, by scattering from the air, which is called skyshine.

Dose rates due to AGS skyshine were measured at a distance of 850 meters from the machine. The relationship between these dose rates and values of the AGS circulating beam intensity has previously been established. From thi

*As of 1/1/75.

relationship and machine operating records, the dose due to AGS operation during 1975 at a distance of 850 meters is estimated as 11.0 ± 6 mrem.

The decrease in dose rate at distances >850 meters is due to an inverse-square factor and exponential absorption by the air. Measurements of dose rate previously made at various distances out to 900 meters by the AGS Health Physics Research Group indicate that the dose rate decreases with a relaxation length of 600 meters. Values of dose rate beyond the site boundary can be computed by using the following equation:

$$\text{mrem/yr} = 2.0(854/r)^2 e^{-(r-854)/600}$$

where r = distance in meters from the AGS centroid.

Values of dose rate in mrem/year for a selection of distances from the AGS are shown in the following table:

r, km	$(854/r)^2$	$(r-854)/600$	$e^{-(r-854)/600}$	mrem/yr
1	0.73	0.243	0.784	5.78
2	0.182	1.91	0.148	0.297
3	0.0811	3.58	0.0279	0.0249
4	0.0455	5.25	0.00525	0.00262
4.5	0.0360	6.08	0.00229	0.00091
5	0.0291	6.90	0.00101	0.00032

At the site boundary nearest to the AGS, about 1.0 km to the northwest, the estimated dose was 5.8 mrem/yr, or 1.2% of the Radiation Protection Standard.

Population doses beyond the site boundary due to this source have been computed, with use of an available population count with relation to distance from the HFBR stack. Average dose rates for each population segment and for each distance from the source are also given in Table XXIX.

Since the dose rate from this source decreases rapidly with distance, only population segments with radii of 1 to 2 and 2 to 3 miles were considered. The total off site dose was 0.306 person-rem/yr, and appreciable contributions were found only in the NW and NNW sectors.

Total Population Dose

The total population dose beyond the site boundary due to BNL operations during 1975 is the sum of the values due to the five components discussed above, as shown below:

	Person-Rem
Airborne effluents	6.04
Liquid effluents	0.32
Gamma-forest source	0.08
AGS skyshine	0.31
Total	6.75

The total annual dose, due to external radiation from natural background, to the population within a 50 mile radius of BNL amounts to about 419,000 person-rems, to which about 129,000 person-rems should be added for internal radioactivity from natural sources.

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APPENDIX A

QUALITY CONTROL

The accuracy of the reported measurements of radioactivity is established by the use of standards supplied by the National Bureau of Standards (NBS), U. S. Department of Commerce. These are generally available within an uncertainty range of 1-5%. Alternatively, for nuclides not available from NBS, standards within a similar uncertainty are obtained from Amersham/Searle. Daily checks of counter and/or gamma system performance are made using point sources of ^{36}Cl, ^{60}Co, ^{137}Cs, and ^{239}Pu, as well as background counts. A tritium standard and one or more blanks is included with each run of a liquid scintillation counter (which includes an automatic sample changer).

The Analytical Laboratory of the Safety and Environmental Protection Division also participates in intercomparisons of radioactivity in samples of air filters, water and other media distributed by the International Atomic Energy Agency.

Procedures for nonradioactive contaminants are those presented in Standard Methods for the Examination of Water and Wastewater (13th ed., 1971). All standards are prepared from standard reference grade, and analytical grade reagents in accordance with the requirements of Standard Methods. Standards are run with each set of samples analyzed. At least one duplicate and blank is also run with each set.

TABLE I

1975 BNL Environmental Monitoring Background and Source Radiation Levels (mrem/wk)

Month	Location			Northeast perimeter		All stations** (background)
	P-2	P-4	P-7	Source*	Total	
January	1.66	1.56	1.58	0.04	1.61	1.60
February	1.77	1.74	1.64	0.04	1.68	1.72
March	1.53	1.61	1.61	0.05	1.63	1.58
April	1.63	1.56	1.66	0.08	1.70	1.62
May	1.60	1.59	1.71	0.17	1.80	1.63
June	1.59	1.55	1.62	0.08	1.67	1.54
July	1.54	1.53	1.58	0.21	1.74	1.55
August	1.59	1.48	1.55	0.11	1.65	1.54
September	1.42	1.42	1.51	0.07	1.55	1.45
October	1.40	1.39	1.44	0.15	1.56	1.41
November December	1.46	1.43	1.51	0.03	1.49	1.49
Average	1.56	1.53	1.58	0.09	1.64	1.56
Error (2 S.D.)	±0.22	±0.20	±0.16	±0.10	±0.09	
Total (mrem/yr)	81.3	79.6	82.5	4.7	85.5	81.1
Radiation Protection Standard(4)	--	--	--	500	±.08	

*Source level derived by subtracting average background at other stations from total measured level at northeast perimeter.

**Average of P-2, P-4 and P-7, unaffected by BNL on site radiations or effluents.

TABLE II

1975 BNL Environmental Monitoring BNL Gaseous Effluent
Release Locations and On-Line Monitoring and Sampling Devices

Building	Facility and release point radioactive effluents	Release height (ft)	Principal nuclide(s)	On-Line monitoring	Sampling devices
490	Medical Research Center Roof Stack	45	Tritium (vapor)	None	Desiccant for tritium vapor
491	Medical Research Reactor Stack	150	Argon-41	Moving tape for radio-particulates; charcoal for radioiodines	None
555	Chemistry Building Roof Stack	55	Tritium (vapor)	None	Desiccant for tritium vapor
705	High Flux Beam Reactor/ Hot Laboratory Stack	320	Tritium (vapor)	Beta scintillator for radioactive gases; Kanne chamber for tritium (gas + vapor)	Desiccant for tritium vapor; particulate filter for gross beta; charcoal cartridge for radioiodines
901	Van de Graaff Accelerator Roof	60	Tritium (gas + vapor)	Kanne chamber for tritium (gas + vapor)	Desiccant for tritium vapor*
931	Linac Isotope Facility	60	Tritium (vapor) Oxygen-15	G-M detector for radiogases	Desiccant for tritium vapor
Steam Plant Effluents					
610	Central Steam Plant Stack	65	Particulates; SO_2; NO_x	None	None

*Tritium gas evaluated from Kanne Chamber indications.

TABLE III

1975 BNL Environmental Monitoring Airborne Effluent Data
Radioactive Effluents

Building	Facility and release point	Elevation* (ft)	Nuclide	Amount (Ci)
491	Medical Research Reactor Stack	150	^{41}Ar	478.4**
490	Medical Research Center Stack	45	^{3}H (vapor)	3.0
555	Chemistry Building Stack	55	^{3}H (vapor)	72.7
705	High Flux Beam Reactor/	320	^{3}H (vapor)	170.4
	Hot Laboratory Stack	320	^{127}Xe	0.39
			Gross beta (particulate)	8.4×10^{-5}
901	Van de Graaff Accelerator Stack	60	^{3}H (gas)	464.5
			^{3}H (vapor)	12.1
931	Linac Isotope Production	60	^{3}H (vapor)	0.19
	Facility		^{15}O	30,500+

*Above ground level.

**Calculated from reported operating time and "one-time" measured emission rate at 3 MW power level.

+Calculated from reported operating time and estimated production rate at 180 μAmp full beam current.

TABLE IV

1975 BNL Environmental Monitoring Emission of SO_2, NO_x and Particulates from Central Steam Plant (Bldg. 610)

Effluent	Total kg	Calculated stack concentration	Average boundary concentration*	EPA Primary Air Quality Standard(5)
SO_2	4.614×10^5 **	358 ppm	0.0014 ppm	0.03 ppm
NO_x	2.065×10^5	208 ppm	0.0008 ppm	0.05 ppm
Particulates	2.267×10^5 †	$0.46\ g/m^3$	$1.7\ \mu g/m^3$	$75\ \mu g/m^3$

*Based on average X/Q of $2.4 \times 10^{-7}\ sec/m^3$ calculated by BNL Meteorology Group.

**Based on average 1.0% sulfur content.

†Based on measured average value during February 1974 stack sampling conducted on main steam boiler unit.

TABLE V

1975 BNL Environmental Monitoring Average Gross Alpha and Gross Beta Concentrations
Air Particulate Filters (pCi/m^3 or 10^{-12} μCi/cm^3)

Month	Location	No.	Gross Alpha Average	Gross Alpha Maximum	Gross Alpha Minimum	No.	Gross Beta Average	Gross Beta Maximum	Gross Beta Minimum
January	Waste area	22	.0005	.0017	<.000	22	.1029	.1680	.0444
	S.W. perimeter					4	.0841	.1250	.0633
	N.E. perimeter					4	.1021	.1460	.0585
February	Waste area	19	.0006	.0011	<.000	19	.1208	.2170	.0326
	S.W. perimeter					4	.1168	.1620	.0503
	N.E. perimeter					4	.1334	.1550	.1110
March	Waste area	21	.0006	.0015	<.000	21	.1660	.2320	.0749
	S.W. perimeter					5	.1978	.2170	.1660
	N.E. perimeter					5	.2130	.2360	.1960
April	Waste area	21	.0006	.0018	<.000	21	.1544	.2640	.0475
	S.W. perimeter					4	.2105	.2590	.1540
	N.E. perimeter					4	.2102	.2530	.1650
May	Waste area	20	.0002	.0008	<.000	20	.0784	.1710	.0208
	S.W. perimeter					4	.1131	.1510	.0115
	N.E. perimeter					3	.1734	.1970	.1620
June	Waste area	20	.0003	.0009	.0001	20	.0998	.1870	.0476
	S.W. perimeter					4	.0925	.1110	.0798
	N.E. perimeter					5	.0861	.1120	.0435
July	Waste area	21	.0003	.0012	<.000	21	.0801	.1480	.0380
	S.W. perimeter					0	--	--	--
	N.E. perimeter					4	.0768	.1250	.0484
August	Waste area	21	.0004	.0009	.0001	21	.0510	.1260	.0063
	S.W. perimeter					0	--	--	--
	N.E. perimeter					4	.0469	.0858	.0477
September	Waste area	15	.0003	.0010	<.000	15	.0388	.1320	.0133
	S.W. perimeter					1	.0207	.0207	.0207
	N.E. perimeter					5	.0433	.0561	.0282
October	Waste area	22	.0005	.0018	<.000	22	.0376	.1470	.0124
	S.W. perimeter					4	.0389	.0441	.0231
	N.E. perimeter					4	.0572	.0782	.0478
November	Waste area	19	.0007	.0022	.0001	19	.0589	.1410	.0352
	S.W. perimeter	4				4	.0389	.0452	.0313
	N.E. perimeter					4	.0375	.0610	.0107
December	Waste area	20	.0006	.0010	.0001	20	.0389	.1370	.0093
	S.W. perimeter					3	.0239	.0359	.0194
	N.E. perimeter					3	.0295	.0451	.0238
Average	Waste area	241	.0005	.0022	.0000	241	.0868	.2640	.0063
	S.W. perimeter					37	.0914	.2590	.0115
	N.E. perimeter					49	.0983	.2530	.0107
Estimated % error of individual sample				25				10	
Radiation Concentration Guide(4) for unidentified mixtures				0.100				100	

TABLE VI

1975 BNL Environmental Monitoring Average Tritium Vapor Concentration in Air
(pCi/m^3 or 10^{-12} $\mu Ci/ml$)

Period	Waste management area	Southwest perimeter	Northeast perimeter	Background*
12/30-3/10	< 1.4	1.4	13.4	1.7
3/21-6/30	16.2	16.3	< 2.0	0.9
6/30-7/24	62.0	62.0	< 7.0	
7/24-8/21	40.0	40.0	31.5	1.1
8/21-9/30	15.1	15.1	< 6.0	
9/30-10/31	60.5	66.5	< 9.0	
11/4-12/1	19.8	19.1	< 7.0	1.4
12/1-12/31	89.1	89.1	69.2	
Average	38.8	38.8	18.1	1.3
Radiation Concentration Guide(4)	2×10^5	2×10^5	2×10^5	

*Calculated from concentration of tritium in precipitation collected off site. Assuming average temperature of 15° C and 50% relative humidity.

TABLE VII

1975 BNL Environmental Monitoring Monthly Average Concentrations of Gross Beta Activity and of Gamma Emitting Nuclides in Monthly Composite Air Particulate and Charcoal Filters
(pCi/m^3 or 10^{-12} $\mu Ci/ml$)

Month	Average* Gβ	Sample volume m^3	Nuclides						
			^{7}Be	^{65}Zn	^{95}Zr-Nb	^{106}Ru	^{131}I**	^{137}Cs	^{144}Ce
January	0.097	47300	0.115	<0.001	0.026	0.009	<0.001	0.001	0.011
February	0.124	42690	0.104	<0.001	0.022	0.008	<0.001	0.001	0.013
March	0.192	51510	0.175	<0.001	0.039	0.018	<0.001	0.002	0.027
April	0.189	48770	0.146	<0.001	0.028	0.017	<0.001	0.003	0.024
May	0.113	43540	0.118	<0.001	0.014	0.011	<0.001	0.002	0.011
June	0.092	48790	0.107	<0.001	0.007	0.007	<0.001	0.002	0.005
July	0.078	39080	0.123	<0.001	0.004	0.003	<0.001	0.001	0.006
August	0.059	36500	0.110	<0.001	0.002	0.004	<0.001	<0.001	0.003
September	0.039	41040	0.074	<0.001	0.002	0.006	<0.001	<0.001	0.005
October	0.060	63460	0.078	<0.001	0.002	0.002	<0.001	<0.001	0.006
November	0.047	63100	0.116	<0.001	<0.001	0.001	<0.001	<0.001	0.001
December	0.032	62030	0.098	<0.001	<0.001	0.002	<0.001	<0.001	0.001
Average	0.094	--	0.114	<0.001	0.012	0.007	<0.0002	0.001	0.009
Estimated error of individual sample %	± 10		± 25	± 25	± 25	± 25	± 100	± 50	± 50
Radiation Concentration Guide(4)	100		4×10^4	2×10^3	1×10^3	200	100	500	200

*Weighted average of the S-6 Waste Management area, P-4, southwest perimeter and P-9, northeast perimeter stations.

**Charcoal filter collections, all other nuclides collected on particulate filters.

TABLE VIII

1975 Monthly Average Gross Beta Concentration
Total Gross Activity and Individual Nuclide Activity in Precipitation

Month	Rainfall (cm)	Average Gβ concentration (pCi/liter or 10^{-9} μCi/ml)	Gβ	Nuclide activity (nCi/m^2 or 10^{-3} $\mu Ci/m^2$)										
				^{7}Be	^{22}Na	^{54}Mn	^{65}Zn	^{90}Sr	$^{95}Zr\text{-}Nb$	^{125}Sb	^{131}I	^{137}Cs	$^{140}Ba\text{-}La$	^{144}Ce
January	13.85	29.0	4.01											
February	7.89	21.7	1.71	14.98	0.36	0.07	0.31	0.24	2.85	<0.08	<0.29	0.34	<0.05	0.42
March	7.55	58.8	2.94											
April	9.31	30.8	2.87											
May	5.91	49.7	2.14	10.67	0.17	0.05	0.09	0.20	1.16	0.21	<0.12	0.28	<0.02	<0.27
June	11.98	12.0	1.43											
July	7.48	8.7	0.65											
August	4.42	14.3	0.63	4.32	<0.02	<0.02	<0.11	<0.02	<0.03	<0.04	<0.20	<0.02	<0.03	<0.21
September	10.70	3.7	0.40											
October	7.33	5.8	0.43											
November	10.35	3.5	0.36	18.57	<0.04	<0.05	<0.25	0.02	<0.07	0.33	<0.20	<0.07	<0.02	<0.13
December	12.19	9.5	1.15											
Total	108.96		21.02	48.54	0.56	0.16	0.58	0.47	4.06	0.60	<0.72	0.67	<0.12	<1.03
Average		19.3												
Radiation Concentration Guide(4)*		3×10^{3}												

*For release to uncontrolled areas of mixture of radionuclides containing <10% ^{90}Sr, $^{125-133}I$ or longer lived alpha emitting nuclides.

TABLE IX

1975 BNL Environmental Monitoring Monthly Average Tritium Concentration and Activity in Precipitation
(pCi/liter or 10^{-9} μCi/ml)

Period	Location					
	P-2	P-4	P-7	P-9	BNL Sewage treatment plant	Off site
January-March	237	288	143	1190	878	276
April-June	207	238	142	242	459	143
July-September	264	145	528	759	NA	184
October-December	225	NA	NA	NA	461	NA
Yearly average*	232	230	253	741	602	207
Estimated error	±35	±35	±38	±111	±90	±55
Radiation Concentration Guide(4)**	3×10^6	3×10^6	3×10^6	3×10^6	3×10^6	3×10^6
			nCi/m^2 or 10^{-3} μCi/m^2			
Yearly total	253	314	257	807	656	226

*Quarterly concentrations weighted on basis of amount of precipitation.

**For tritium in water released to off site environment.

TABLE X

1975 BNL Environmental Monitoring Total Activities and Concentrations of Identifiable Nuclides in Liquid Effluents
(pCi/liter or 10^{-9} μCi/ml)

Month	Flow x 10^{10} cm^{3}	G3 + ν only*	Nuclides ^{3}H (HTO)	^{7}Be	^{22}Na	^{51}Cr	^{54}Mn	^{57}Co	^{60}Co	^{65}Zn	^{90}Sr	^{125}Sb	^{131}I	^{134}Cs	^{137}Cs	^{144}Ce
Clarifier (mCi)																
January	11.58	8.24	1922	1.24	0.02	1.01	0.03	0.03	0.18	0.07	0.19	<0.02	<0.05	0.16	0.44	<0.05
February	9.48	4.79	1066	0.45	0.01	0.33	0.03	<0.01	0.11	0.10	0.11	0.03	0.14	0.04	0.20	0.23
March	11.68	10.99	916	0.50	<0.01	2.90	<0.02	<0.01	0.55	<0.02	0.10	<0.01	1.51	0.12	0.10	<0.18
April	11.81	6.62	748	0.38	<0.01	0.43	<0.01	<0.02	0.56	0.31	0.10	<0.01	0.21	0.41	2.00	<0.05
May	14.17	4.76	424	0.27	<0.02	0.60	<0.02	<0.06	0.12	0.41	0.01	<0.01	0.81	0.05	0.10	<0.05
June	15.92	6.39	387	0.28	0.03	0.57	0.03	<0.01	0.19	<0.02	0.09	<0.01	1.41	<0.03	0.45	<0.05
July	17.66	5.65	238	<0.16	<0.03	0.76	<0.04	<0.01	0.22	<0.05	0.13	<0.01	3.84*	<0.04	0.08	<0.05
August	16.95	6.13	699	0.21	<0.01	0.54	0.25	<0.01	0.16	0.50	0.17	<0.01	0.37	0.07	0.20	<0.05
September	10.45	3.13	351	0.12	0.01	0.14	0.03	<0.01	<0.11	0.13	0.45	<0.01	<0.01	0.03	0.05	<0.06
October	9.75	2.00	267	0.28	0.05	0.10	0.01	0.02	0.10	<0.02	0.18	0.04	<0.02	<0.02	<0.06	<0.06
November	8.97	1.55	148	0.07	<0.01	0.08	0.01	0.08	0.02	<0.01	0.41	<0.01	<0.01	0.01	0.03	<0.03
December	8.80	2.63	214	0.11	0.08	0.15	0.12	0.09	0.02	<0.08	0.06	<0.06	0.05	0.01	0.03	<0.03
Total	147.22	62.88	7380	3.99	0.25	7.61	0.56	0.32	2.34	1.62	1.99	0.23	8.39	0.96	3.71	<0.89
Average concentration (pCi/liter or 10^{-9} μCi/ml)		42.7	501	2.7	0.1	5.2	0.4	0.2	1.6	1.1	1.4	0.2	5.7	0.7	2.5	<0.6
% of total		100	-	6	<1	12	1	1	4	3	3	<1	13	2	6	<2
Groundwater (Sand Filter Beds) (mCi)																
Total	46.81	20.74	2170	0.87	0.09	1.08	<0.08	0.06	0.11	<0.11	1.51	<0.05	0.34	0.69	6.74	<0.35
Average concentration (pCi/liter or 10^{-9} μCi/ml)		44.3	4635	1.9	0.2	2.4	<0.2	0.1	0.3	<0.2	3.3	<0.1	0.7	1.5	14.4	<0.3
% of total		100	-	4	<1	5	<1	<1	1	<1	7	<1	2	3	32	<2
Radiation Concentration Guide(4) (pCi/liter or 10^{-9} μCi/ml)		3×10^{3}**	3×10^{6}	2×10^{6}	4×10^{4}	2×10^{6}	1×10^{5}	5×10^{5}	5×10^{4}	1×10^{5}	300	1×10^{5}	300	9x103	2×10^{4}	1×10^{4}
Chlorine House (mCi)																
January	7.34	4.85	1092	0.44	0.04	0.47	0.02	<0.01	0.03	<0.02	1.15	<0.01	<0.05	00.10	0.73	<0.08
February	6.14	3.46	720	0.10	0.02	0.18	0.02	0.02	0.02	0.02	0.59	<0.01	0.02	0.04	0.72	0.12
March	7.25	3.58	593	0.79	0.02	0.15	0.02	<0.01	0.01	0.02	0.37	<0.01	0.11	0.06	0.90	<0.05
April	6.87	4.12	438	<0.10	<0.01	0.14	0.02	<0.01	0.10	<0.02	0.26	<0.01	<0.02	0.16	1.36	<0.05
May	10.05	4.77	322	<0.10	<0.02	0.36	0.02	<0.01	0.02	<0.02	0.07	<0.01	0.15	0.18	1.71	<0.05
June	10.77	5.68	290	<0.10	<0.02	0.32	<0.01	<0.01	0.02	<0.02	0.10	<0.01	0.13	0.20	2.08	<0.05
July	10.91	5.51	131	0.16	0.02	0.48	<0.01	<0.01	0.02	<0.02	0.08	<0.01	0.23	0.21	1.70	<0.05
August	10.40	4.33	347	0.11	0.02	0.12	<0.01	<0.01	<0.01	<0.02	0.02	<0.01	<0.02	0.16	1.73	<0.08
September	9.20	2.86	275	<0.07	0.02	<0.08	<0.01	<0.01	<0.01	<0.02	0.25	<0.01	<0.01	0.13	1.29	<0.08
October	2.14	0.54	112	<0.03	<0.01	0.06	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	0.03	0.19	<0.03
November	8.91	2.24	121	0.07	0.02	<0.04	<0.01	<0.01	<0.01	0.04	0.21	<0.01	<0.01	0.06	0.89	<0.05
December	8.14	1.54	108	<0.04	<0.04	<0.04	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	0.10	0.83	<0.05
Total	98.13	43.48	4549	1.89	0.21	2.36	<0.17	<0.13	0.25	<0.24	3.18	<0.12	0.71	1.45	14.13	<0.74
Average concentration (pCi/liter or 10^{-9} μCi/ml)		44.31	4635	1.93	0.22	2.40	<0.17	0.13	0.25	<0.24	3.23	<0.12	0.72	1.48	14.40	<0.75
% of total		100	-	4	<1	5	<1	<1	1	<1	7	<1	2	3	32	<2
Upland and Lowland Recharge																
Total	2.28	0.74	109	0.05	<0.01	0.09	0.01	<0.01	0.04	0.02	0.02	<0.01	0.10	0.01	0.04	<0.01
Average concentration (pCi/liter or 10^{-9} μCi/ml)		34.2	4010	2.2	0.1	4.1	0.3	0.2	1.3	0.9	1.1	0.1	4.6	0.5	2.0	<0.05
% of total		100	-	<1	<1	5	<1	<1	1	<1	7	<1	2	3	32	<2
Radiation Concentration Guide(4) (pCi/liter or 10^{-9} μCi/ml)		3×10^{3}**	3×10^{6}	2×10^{6}	4×10^{4}	2×10^{6}	1×10^{5}	5×10^{5}	5×10^{4}	1×10^{5}	300	1×10^{5}	300	9×10^{3}	2×10^{4}	1×10^{4}

*Includes gamma only emitters, does not include tritium.

**For mixtures of radionuclides containing <10% ^{90}Sr, $^{125-133}I$, or long lived alpha emitters.

TABLE XI

1975 BNL Environmental Monitoring Total Activities and Average Concentrations of Identifiable Nuclides in Liquid Effluents

Month	Flow x 10^{10} cm^3	Gβ + γ only*	^3H HTO	^7Be	^{22}Na	^{51}Cr	^{54}Mn	^{57}Co	^{60}Co	^{65}Zn	^{90}Sr	^{131}I	^{134}Cs	^{137}Cs	^{144}Ce
Former Perimeter (mCi)															
January	11.84	4.87	1249	0.18	0.03	0.31	<0.01	<0.01	0.02	0.02		0.17	0.07	0.63	<0.07
February	11.48	3.53	771	0.15	0.03	0.19	0.02	<0.01	0.03	0.02	2.11	0.02	0.05	0.73	0.15
March	13.77	3.04	431	0.09	0.01	0.17	0.01	<0.01	0.02	<0.01		0.07	0.05	0.46	<0.05
April	16.25	4.87	672	0.17	0.02	0.18	<0.02	<0.01	0.07	<0.03		<0.03	0.23	1.11	<0.13
May	17.47	4.37	252	0.09	0.01	0.23	<0.01	<0.01	0.02	<0.02	0.72	0.09	0.10	1.10	<0.10
June	16.43	4.62	257	<0.08	<0.01	0.22	<0.01	<0.01	0.02	<0.02		0.05	0.14	1.48	<0.09
July	14.25	4.66	125	0.14	0.02	0.21	0.01	<0.01	0.03	<0.01		0.07	0.10	1.12	<0.06
August	11.72	3.46	348	<0.08	0.01	0.13	<0.01	<0.01	<0.01	<0.01	0.17	<0.03	0.18	1.58	<0.10
September	7.66	1.94	240	<0.07	<0.01	<0.08	<0.01	<0.01	<0.01	<0.02		<0.02	<0.02	1.09	<0.10
October	6.29	1.18	174	0.05	<0.01	<0.03	<0.01	<0.01	0.01	<0.01		<0.01	0.06	0.26	0.19
November	9.70	2.91	97	<0.04	0.01	0.09	<0.01	<0.01	<0.01	0.03	0.24	<0.01	0.10	0.91	<0.05
December	11.46	2.11	162	<0.05	<0.01	0.34	<0.01	<0.01	<0.01	0.04		0.24	0.11	0.98	<0.07
Total	148.32	41.56	4779	1.03	0.16	2.13	<0.14	<0.12	0.24	<0.24	3.24	0.92	1.20	11.45	<1.16
Average concentration (pCi/liter or 10^{-9} μCi/ml)		28.02	3222	0.69	0.11	1.43	<0.09	<0.08	0.16	<0.16	2.19	0.62	0.81	7.72	<0.78
% of Total		100	--	2	<1	5	<1	<1	1	<1	8	2	3	28	<3
Site Boundary															
January	10.45	4.01	1373	0.26	0.06	0.15	<0.01	<0.01	0.05	<0.02		0.08	0.04	0.49	<0.07
February	12.43	3.95	659	0.25	0.07	0.16	0.02	<0.01	0.05	<0.01	0.53	0.02	0.05	0.41	<0.09
March	18.65	3.42	785	0.16	0.05	0.07	0.01	<0.01	0.03	<0.01		<0.01	0.03	0.31	<0.05
April	22.46	4.74	810	0.19	0.03	0.04	<0.01	<0.01	0.04	<0.01		<0.01	0.06	0.45	<0.05
May	22.91	4.47	280	0.19	0.03	0.16	<0.01	<0.01	0.02	0.02	1.51	<0.02	0.10	0.75	<0.09
June	21.35	4.71	345	0.14	0.01	0.25	<0.01	<0.01	0.03	<0.02		<0.02	0.08	0.50	<0.07
July	18.15	4.99	87	<0.09	0.02	0.18	<0.01	<0.01	0.05	<0.03		0.10	0.11	1.32	<0.11
August	7.50	1.85	132	<0.05	<0.01	<0.07	<0.01	<0.01	<0.01	<0.01	0.43	<0.02	0.07	0.74	<0.07
September	3.31	0.89	100	0.05	<0.01	0.05	<0.01	<0.01	<0.01	<0.01		<0.01	0.06	0.38	<0.03
October	2.20	0.35	74	<0.01	0.03	0.02	<0.01	<0.01	<0.01	<0.01		<0.01	0.01	0.19	<0.01
November	10.13	2.44	103	<0.05	<0.01	<0.06	<0.01	<0.01	<0.01	<0.02	0.28	<0.02	<0.01	0.82	<0.07
December	13.85	2.94	233	0.13	<0.01	0.12	<0.01	<0.01	<0.01	<0.01		<0.02	0.10	0.89	<0.06
Total	163.39	38.76	4981	1.47	0.32	1.27	<0.13	<0.12	<0.30	<0.18	2.75	0.34	0.63	7.25	<0.77
Average concentration (pCi/liter or 10^{-9} μCi/ml)		23.72	3048	0.9	0.2	0.8	<0.1	<0.1	0.2	<0.1	1.7	0.2	0.4	4.4	<0.5
% of Total				4	1	3	<1	<1	1	<1	7	1	2	19	<2
Ground Water (Stream Bed)															
Total	12.66	3.12	375	0.06	<0.01	0.08		<0.01	<0.01	<0.02	<0.08	<0.02	0.12	1.36	0.07
% of Total				2	<1	3		<1	<1	<1	3	<1	4	44	2
Radiation Concentration Guide(4) (pCi/liter or 10^{-9} μCi/ml)		$3x10^3$**	$3x10^6$	$2x10^6$	$4x10^4$	$2x10^6$	$1x10^5$	$5x10^5$	$5x10^4$	$1x10^5$	300	300	$9x10^3$	$2x10^4$	$1x10^4$

*Includes gamma only emitters, does not include tritium.

**For mixtures of radionuclides containing <10% ^{90}Sr, $^{125-133}I$, or long lived alpha emitters.

TABLE XII-A

1975 BNL Environmental Monitoring National Pollution Discharge Elimination System
Summary of Monthly Report Data

Parameter	Status	Quantity					Concentration						
		Minimum	Average	Maximum	Units	No. ex	Minimum	Average	Maximum	Units	No. ex	Frequency of analysis	Sample type
Flow	Reported	0.21	0.74	1.17	MGD	0	XX	XX	XX	XX	0	Cont.	NA
	Permit condition	XX	2.3	XX		-	XX	XX	XX	XX	-	Cont.	NA
pH In flow	Reported	5.4	XX	7.8	Std.	0	XX	XX	XX	XX	0	5/7	Grab
	Permit condition	XX	XX	XX	Units.	-	XX	XX	XX	XX	-	Daily	Grab
pH Effluent	Reported	5.6	XX	7.0	Std.	2	XX	XX	XX	XX	0	5/7	Grab
	Permit condition	5.8	XX	9.0	Units	-	XX	XX	XX	XX	-	Daily	Grab
BOD_5 Influent	Reported	136	290	428	lbs/	0	18.6	32.6	55.2	mg/l	0	Weekly	8 hr
	Permit condition	XX	XX	XX	day	-	XX	XX	XX		-	Monthly	8 hr
BOD_5 Effluent	Reported	4.4	9.5	14.5	lbs/	0	0.3	1.5	7.7	mg/l	0	Weekly	8 hr
	Permit condition	XX	575	XX	day	-	XX	30	45		-	Monthly	8 hr
Percent removal, BOD_5	Reported	89	97	98	%	0	XX	XX	XX	XX	0	XX	XX
	Permit condition	XX	85	XX		-	XX	XX	XX	XX	-	XX	XX
Suspended solids, Influent	Reported	44	392	2385	lbs/	0	4.0	44.1	276	mg/l	0	Biweekly	8 hr
	Permit condition	XX	XX	XX	day	-	XX	XX	XX		-	Monthly	8 hr
Suspended solids, Effluent	Reported	0	9.2	48	lbs/	0	0.0	1.5	12	mg/l	0	Biweekly	8 hr
	Permit condition	XX	575	863	day	-	XX	30	45		-	Monthly	8 hr
Percent removal, Suspended solids	Reported	86	98	100	%	0	XX	XX	XX	XX	0	XX	XX
	Permit condition	XX	85	XX		-	XX	XX	XX	XX	-	XX	XX
Settleable solids, Influent	Reported	XX	XX	XX	XX	0	0.2	1.4	8.1	ml/l	0	5/7	Grab
	Permit condition	XX	XX	XX		-	XX	XX	XX		-	Daily	Grab
Settleable solids, Effluent	Reported	XX	XX	XX	XX	0	0.0	0.0	0.0	ml/l	0	5/7	Grab
	Permit condition	XX	XX	XX		-	XX	XX	XX		-	Daily	Grab
Residual chlorine, Effluent	Reported	XX	XX	XX	XX	0	0.0	0.8	1.7	mg/l	0	5/7	Grab
	Permit condition	XX	XX	XX		-	XX	XX	XX		-	Daily	Grab
Temperature, Effluent	Reported	5	15.6	26	^oC	0	XX	XX	XX	XX	0	5/7	Grab
	Permit condition	XX	XX	XX		-	XX	XX	XX	XX	-	Daily	Grab
Fecal coliform, Effluent	Reported	0	1	120	n/100	0	XX	XX	XX	XX	0	Weekly	Grab
	Permit condition	XX	575	XX	ml	-	XX	XX	XX	XX	-	Monthly	Grab

XX indicate not required.

TABLE XII-B

1975 BNL Environmental Monitoring Liquid Effluent Quality and Purity

Location	Sample	Chlorides* (ppm)	Chlorine residual (ppm)	Coliform** total (no./100 ml)	Coliform** fecal (no./100 ml)	Dissolved oxygen (ppm)	Dissolved solids (ppm)	Nitrate* nitrogen (ppm)	Total* phosphorus (ppm)	pH	Temperature °C
Sand Filter Bed Effluent	No.	52	233	233	233	233	12	52	52	233	233
	Average	27.0	0.9	2†	1†	8.8	122	3.62	0.72	6.3†	16.5
	Maximum	40.2	2.0	450	100	13.6	165	4.70	1.03	6.4	25
	Minimum	21.8	0.0	0	0	6.2	70	2.30	0.41	5.4	5
Upstream of Outfall	No.	12	-	102	102	102	12	12	12	102	102
	Average	10.0	-	214†	10†	7.8	35	0.18	<0.11	5.7†	10.9
	Maximum	27.1	-	5700	1840	14.2	160	1.25	0.34	7.3	20
	Minimum	5.3	-	20	0	1.5	24	<0.10	<0.05	5.1	0
Former Perimeter (0.5 mi down-stream)	No.	52	156	156	156	156	12	52	52	156	156
	Average	19.3	0	156†	10†	9.2	81	1.95	0.50	6.1†	13.2
	Maximum	30.5	0	TNTC**	TNTC**	14.0	136	3.10	0.82	6.7	25
	Minimum	11.7	0	0	0	3.2	36	0.49	0.32	5.7	2
BNL Perimeter (1.6 mi down-stream)	No.	52	-	156	156	156	12	52	52	156	156
	Average	18.2	-	209†	17†	9.9	74	1.05	0.47	6.6†	11.8
	Maximum	27.7	-	2000	1680	>15.0	119	2.25	0.65	9.1	25
	Minimum	13.3	-	6	0	0.7	42	0.46	0.25	6.1	0
Water Quality Standard (6,13)	ppm	-	-	-	-	$\geq$ 4.0	-	-	-	6.5-8.5	ΔT (16) < +2.8 Tmax <30

*Weekly composite samples.

**During period for maintenance purposes, sewage treatment on temporary bypass of chlorinator treatment of effluent, 10/6-28/75.

†Geometric mean.

TABLE XII-C

1975 BNL Environmental Monitoring Concentrations of Metals in Filter Bed Effluent

	Parts per million						
Sample period*	Ag	Cd	Cr	Cu	Fe	Pb	Zn
January	<0.008	0.0012	<0.010	0.078	0.051	0.0048	0.264
February	<0.005	0.0012	<0.008	0.071	0.055	0.0050	0.250
March	<0.005	0.0009	<0.008	0.072	0.077	0.0084	0.308
April	<0.005	0.0016	<0.008	0.165	0.231	<0.0050	0.403
May	<0.005	0.0012	<0.010	0.083	0.291	0.0072	0.288
June	<0.004	0.0011	<0.009	0.144	0.076	0.0041	0.293
July	<0.005	0.0015	0.014	0.100	0.126	0.0110	0.300
August	<0.005	0.0011	<0.010	0.061	0.069	0.0050	0.180
September	<0.005	0.0011	<0.010	0.062	0.118	0.0050	0.243
October	<0.008	0.0007	<0.010	0.041	0.250	0.0090	0.160
November	<0.008	0.0012	<0.010	0.085	0.079	0.0050	0.360
December	<0.009	0.0007	<0.009	0.088	0.189	0.0092	0.370
Average	<0.006	0.0012	<0.010	0.093	0.140	0.0066	0.300
Water Quality** Standards (6,13)	--	0.300	--	--	--	--	0.300

*Monthly composite samples.

**Standards are applicable to Class "C" receiving waters, which also prohibit the discharge of other substances injurious to fish life or other best usages within this class.

TABLE XIII

1975 BNL Environmental Monitoring Gross Beta, ^{3}H (HTO) and ^{90}Sr in Effluent Applied to Upland Recharge and Meadow Marsh Experimental Plots

Month	Flow 10^9 cm^3	Gross beta* Concentration pCi/liter (or 10^{-9} μCi/ml)	Gross beta* Amount μCi	^{3}H (HTO) Concentration nCi/liter (or 10^{-6} μCi/ml)	^{3}H (HTO) Amount mCi	^{90}Sr Concentration pCi/liter (or 10^{-9} μCi/ml)	^{90}Sr Amount μCi
Upland Recharge							
January	5.31	57	302	13.3	70.5	1.3	7.0
Meadow Marsh							
January	1.17	57	67	13.3	15.5	1.3	1.5
February	1.06	41	43	9.0	9.5	0.9	1.0
March	1.17	75	88	6.2	7.3	0.7	0.8
April	1.46	45	65	5.1	7.4	0.7	1.0
May	-	-	-	-	-	-	-
June	2.12	32	68	1.9	4.1	0.4	0.9
July	2.35	26	60	1.1	2.5	0.6	1.4
August	2.35	29	68	3.3	7.8	0.8	1.9
September	2.27	24	54	2.7	6.1	3.4	7.8
October	2.35	17	39	2.2	5.1	1.5	3.5
November	2.27	14	31	1.3	3.0	3.7	8.3
December	2.35	24	56	2.0	4.6	0.6	1.3
Subtotal	20.92		639		72.9		29.4
Average		31		3.5		1.4	
Total	26.23	36	941	5.5	143.4	1.4	36.4
Radiation Concentration Guide(4)		3000**		3000		300	

*Includes gamma emitters only, does not include HTO.

**For mixture of radionuclides containing <10% ^{90}Sr, $^{125-133}I$, or long lived alpha emitters.

TABLE XIV

1975 Upland Recharge and Meadow-Marsh Project Water Quality and Purity

Parameter	Units	No. samples	Average	Minimum	Maximum	Water Quality Standard (6)
BOD	ppm	21	320	11	2700	--
Chlorides	ppm	23	34.8	27.0	110	500
MBAS	ppm	23	0.47	<0.02	1.92	1.5
pH	*	85	6.6	4.8	6.9	6.5-8.5**
Suspended solids	ppm	21	587	16	4300	--
Dissolved solids	ppm	21	236	131	1000	500
Total N	ppm	14	31.8	0.89	13.3	20.0
Cr	ppm	23	0.09	<0.01	0.32	0.1
Cu	ppm	23	0.83	0.34	3.42	0.4
Fe	ppm	23	4.93	1.73	20.1	0.6
Zn	ppm	23	1.61	0.17	3.50	0.6

*Geometric mean.

**Or natural range.

TABLE XV-A

1975 BNL Environmental Monitoring Downstream and Control Water Samples

Month	Downstream locations A	B	C	D	R*	Control locations E	F	H
GROSS BETA (pCi/liter or 10^{-9} μCi/ml)								
January	4.9	4.2	4.4	4.1	--	5.1	6.7	3.9
February					--			
March	7.1	4.2	3.8	3.9	--	3.9	3.6	2.2
April								
May	6.6	6.5	4.6	6.2	21.3	3.0	3.0	3.6
June	--	--	--	--	8.8	--		
July	5.1	4.6	13.1	8.8	8.8	3.3	2.5	2.2
August	--	--	--	--	8.9	--	--	
September	9.3	3.8	3.2	3.0	6.8	--	3.0	2.9
October	--	--	--	--	6.8	--		
November	6.7	6.9	4.9	4.8	6.6	6.4	3.4	2.4
December								
Average	6.4 ±1.7	5.0 ±1.3	5.7 ±3.7	5.1 ±2.1	9.7 ±5.2	4.3 ±1.4	3.7 ±1.5	2.9 ±0.7
TRITIUM (HTO) (nCi/liter or 10^{-6} μCi/ml)								
January	1.7	1.0	0.9	0.7	--	0.5	<0.4	0.7
February								
March	<0.7	<0.5	<0.5	0.9	--	<0.7	<0.7	<0.7
April					<0.4	--		
May	<0.5	<0.7	<0.7	<0.5	<0.4	<0.5	<0.5	<0.5
June	--				<0.4	--		
July	<0.5	<0.5	<0.5	<0.5	<0.4	<0.5	<0.5	<0.5
August					<0.4			
September	<0.5	<0.5	<0.5	<0.5	<0.4		<0.5	<0.5
October	--							
November	<0.5	<0.5	<0.5	<0.5	<0.4	<0.5	<0.5	<0.5
December								
Average	<0.7	<0.6	<0.6	<0.6	<0.4	<0.5	<0.5	<0.6
^{90}SR (pCi/liter or 10^{-9} μCi/ml)								
May	--	--	--	--	} 0.50 (May–June)			
June	--	--	--	--				
July	0.98	0.59	<0.12	0.11	} 0.98 (July–September)	1.14	0.53	--
August	--	--	--					
September	--							
October	--				} 1.67 (October–November)			
November	--							
Radiation Concentration Guide(4)*	Gross β 3000 pCi/liter**; HTO 3000 nCi/liter; ^{90}Sr 300 pCi/liter							

*Average weekly composite samples (May-November).

**For mixtures of radionuclides containing < 10% ^{90}Sr, $^{125-133}$I and long lived alpha emitters.

TABLE XV-B

1975 BNL Environmental Monitoring Downstream and Control Water Quality and Purity

Location	Sample	Chlorides ppm	Coliform total no./100 ml	Coliform fecal no./100 ml	Dissolved oxygen ppm	Dissolved solids ppm	Nitrate nitrogen ppm	Phosphorus total ppm	pH*	Temperature °C
A	No.	3	4	4	4	3	3	3	4	4
	Average	9.6	293*	51*	4.7	46	0.49	0.17	6.3*	14.3
	Maximum	9.2	5680	100	6.4	50	0.52	0.62	6.4	23
	Minimum	8.8	88	10	2.2	41	0.45	0.11	6.2	10
B	No.	5	5	6	12	4	5	5	12	12
	Average	8.4	129*	21*	5.6	50	0.46	0.17	6.2*	13.3
	Maximum	10.1	350	106	10.8	56	0.83	0.49	6.4	22
	Minimum	7.5	60	<1	1.5	38	0.30	<0.05	5.6	1
C	No.	5	4	5	5	4	5	5	5	5
	Average	8.3	75*	10*	8.5	43	0.36	<0.09	6.7*	16.8
	Maximum	8.8	250	56	11.6	51	0.50	0.16	6.8	25
	Minimum	7.7	24	5	5.8	28	0.15	<0.05	6.5	5
D	No.	5	4	5	5	4	5	5	5	5
	Average	7.9	218*	48*	6.5	42	0.35	10.07	6.3*	15.4
	Maximum	8.7	2000	126	12.2	53	0.50	0.15	6.7	24
	Minimum	6.6	37	3	4.0	26	0.15	<0.05	6.1	2
R	No.**	15	15	16	16	14	16	15	17	16
	Average	8.9	381*	95*	9.1	62	0.44	0.16	7.0*	18.1
	Maximum	10.7	1450	316	11.6	119	1.45	0.22	7.4	25
	Minimum	5.5	20	5	5.4	51	0.13	<0.05	6.6	7
E	No.	See TABLE XII-B								
	Average									
	Maximum									
	Minimum									
F	No.	5	4	5	14	4	5	5	14	14
	Average	6.6	144*	34*	5.0	37	0.48	<0.17	6.0*	15.0
	Maximum	7.0	340	146	9.2	45	0.83	0.65	7.0	25
	Minimum	5.8	36	0	0.7	30	0.25	<0.05	5.2	2
H	No.	5	4	5	5	5	5	5	5	5
	Average	8.9	147*	20*	9.8	62	0.44	<0.05	6.8*	15.4
	Maximum	10.9	1944	1632	12.0	73	1.10	<0.05	7.3	26
	Minimum	7.7	20	<1	8.4	50	0.70	<0.05	6.3	2
I	No.	3	3	3	3	3	3	3	3	3
	Average	18.4	425*	87*	9.3	54	0.25	<0.05	7.3*	19.6
	Maximum	19.4	912	232	9.6	70	0.40	<0.05	7.6	28
	Minimum	17.2	280	74	9.0	33	<0.10	<0.05	7.0	12
Water Quality Standard(6,13) (ppm)					>4.0				6.5-8.5	T_{max} <30

* Geometric mean.

** Continuous biweekly sampling.

TABLE XVI

1975 BNL Environmental Monitoring Concentrations of Selected Gamma Emitting Nuclides in Peconic River Sediments
(pCi/kg or 10^{-9} μCi/g, wet weight)

Location	No. samples	Nuclides								K
		^{7}Be	^{22}Na	^{60}Co	^{54}Mn	^{65}Zn	^{134}Cs	^{137}Cs	^{144}Ce	g/kg
Peconic River										
K	1	147	NA	67	NA	NA	NA	618	NA	NA
L	1	<50	NA	<5	NA	NA	NA	1530	NA	NA
M	1	5440	104	119	572	164	175	659	6.9	1.0
Q'	1	<50	NA	389	NA	NA	NA	5120	NA	NA
Q	1	<50	NA	48	NA	NA	NA	657	NA	1.6
A'	1	4330	NA	379	NA	NA	NA	9570	NA	NA
A	1	60	<100	16	72	<50	<50	277	NA	NA
B	1	459	NA	<5	64	NA	NA	142	NA	1.2
B'	1	<50	NA	6				430		
C	1	125	NA	6	<10	NA	NA	804	NA	NA
C'	1	<50	NA	<5	NA	NA	NA	103	NA	NA
P	1	<50	NA	<5	NA	NA	NA	77	NA	NA
R	1	486	NA	<5	NA	NA	NA	96	NA	2.0
Reference										
E	1	<50	NA	<5	NA	NA	NA	24	NA	NA
H	1	<100	NA	<5	NA	NA	NA	6	NA	NA
Z	1	1550	NA	<5	NA	NA	NA	1018	NA	NA
Estimated error at 95% confidence level	or	±25% 100	±25% 50	±10% 5	±25%	±50%	±25	±10%	±50%	±25%

TABLE XVII

1975 BNL Environmental Monitoring Concentrations of Selected Gamma Emitting Nuclides in Peconic River and Reference Vegetation (pCi/kg or 10^{-9} μCi/g, wet weight*)

Location**	Nuclides ^{7}Be	^{22}Na	^{51}Cr	^{54}Mn	^{60}Co	^{65}Zn	^{134}Cs	^{137}Cs	K g/kg
					Peconic River				
L	509	53	273	384	72	120	140	982	0.4
L'	798	120	227	825	147	241	195	1313	0.2
M	206	69	190	451	121	128	120	952	0.4
Q'	2428	103	<621	975	1049	<161	<111	1436	1.6
Q	3194	200	<1020	1787	1418	<332	<75	1684	0.8
A'	2810	84	<916	851	667	<201	107	2735	1.3
A	1796	59	<397	354	264	<94	46	1075	1.4
B	1387	60	<344	299	121	<58	75	473	0.6
C	1310	NA	NA	NA	NA	NA	NA	335	0.4
C'	561	26	<466	163	136	74	34	588	3.4
P	288	19	459	109	57	83	29	367	2.6
R	51	NA	NA	NA	NA	NA	NA	13	1.7
				Reference					
E	600	12	<71	36	11	25	10	118	0.3
H	441	NA	NA	NA	NA	NA	NA	46	2.0
Z	111	NA	NA	NA	NA	NA	NA	238	-0.7
Estimated error at 95% confidence level	±25%	±25%	±25%	±25%	±25%	±25%	±25%	±25%	±25%
or	50	25	25	25	10	25	25	25	0.2

*Wet weight. Analyses made on dried samples. Data adjusted on the basis of assumed 90% moisture content.

**No. of samples: 1.

TABLE XVIII

1975 BNL Environmental Monitoring Concentrations of Gamma Emitting Nuclides
in Animals Obtained from Peconic River
(pCi/kg or 10^{-9} μCi/g)

Location	No. samples	Type	Nuclides								
			^{7}Be	^{22}Na	^{51}Cr	^{54}Mn	^{60}Co	^{65}Zn	^{134}Cs	^{137}Cs	K g/kg
L	1	Snapping turtle	224	NA	NA	NA	NA	NA	NA	407	0.8
M	1	Frogs	412	<25	<250	176	<83	<144	107	676	1.9
	1	Painted turtle	2470	204	<195	524	159	99	171	889	NA
	1	Muskrat	<285	43	<269	<32	42	113	59	2121	1.5
Q'	2	Frogs	589	83	<300	--	<123	<198	<50	660	1.2
Q	1	Catfish	127	NA	NA	NA	NA	NA	NA	994	1.6
	1	Frogs	868	53	<200	<25	<63	<98	NA	487	NA
A'	2	Painted turtle	545	96	--	176	<29	<23	--	522	--
	1	Catfish	NA	NA	NA	NA	NA	NA	NA	1016	1.7
B'	2	Frogs	493	NA	NA	128	NA	NA	NA	278	1.8
	1	Catfish	NA	NA	NA	NA	NA	NA	NA	707	2.2
	1	Bluegill sunfish	847	NA	NA	15	NA	NA	NA	1600	2.1
C	1	Painted turtle	NA	NA	NA	NA	NA	NA	NA	818	1.1
	1	Catfish	339	NA	NA	NA	NA	NA	NA	830	2.9
	1	Sunfish	NA	NA	NA	NA	NA	NA	NA	824	1.6
	1	Clams	<250	<25	410	230	<27	<49	<50	48	1.0
C'	3	Painted turtles	NA	NA	NA	NA	NA	NA	NA	787	NA
P	1	Clams	33	NA	NA	NA	NA	NA	NA	29	0.1
	1	Snails	NA	33	230	180	NA	NA	NA	112	0.3
	2	Musk turtles	877	NA	NA	NA	NA	NA	NA	620	6.1
Estimated error at 95% confidence level			±25%	±50%	±50%	±50%	±50%	±50%	±50%	±25%	±25%
Radiation Concentration Guide(4)*			$9x10^7$	$2x10^6$	$9x10^7$	$4x10^6$	$2x10^6$	$4x10^6$	$4x10^8$	$9x10^5$	--

*Assumed intake of 50 g/day.

TABLE XIX

1975 BNL Environmental Monitoring Gross Beta and Tritium Concentrations in Potable Water and Cooling Water Supply Wells

Month	Wells 1	2	3	4	5	6	7	101	102	103	104	105	W&R
GROSS Beta (pCi/liter or 10^{-9} μCi/ml)													
February	1.9	2.5	4.7	1.8	1.1	1.9	0.9	2.8	2.3	2.0	2.8	2.8	2.6
April	2.1	2.6	9.5	2.6	1.3	1.9	<0.9	3.2	0.9	--	--	--	1.6
June	1.8	2.1	7.8	3.6	1.5	3.5	<1.0	--	--	--	2.0	2.1	3.5
August	2.2	9.6	8.4	3.4	1.0	4.0	<0.9	1.5	1.7	--	2.3	--	5.7
October	2.0	1.5	6.1*	<1.0	0.8	2.7	1.4	<0.6	0.8	--	--	2.8	3.4
December	1.4	2.3	*	1.8	0.7	3.8	1.2	1.6	0.9	1.3	2.5	2.6	2.2
Average	1.9± 0.3	3.4± 3.0	7.3± 1.9	2.4± 1.0	1.1± 0.3	3.0± 0.9	1.1± 0.2	1.9± 1.1					
Radiation Concentration Guide(4): 3000 pCi/liter (3.0×10^{-6} μCi/ml) for unidentified nuclides in absence of ^{90}Sr, ^{228}Ra or ^{129}I.													
HTO (nCi/liter or 10^{-6} μCi/ml)													
February	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
April	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	--	--
June	<0.6	<0.5	<0.5	<0.5	2.6	<0.5	<0.5	--	--	--	<0.5	<0.5	<0.5
August	<0.5	<0.5	<0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	--	<0.5
October	<0.5	<0.5	<0.5*	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	0.5	0.7
December	<0.6	<0.6	0.5	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Average	<0.6	<0.6	<0.6	<0.6	<0.7	<0.6	<0.6	<0.6	<0.6	<0.7	<0.7	<0.6	<0.6
Radiation Concentration Guide(4): 3000 nCi/liter or 3×10^{-3} μCi/ml													

*Well #3 disconnected from Laboratory from September on, due to high bacterial count.

TABLE XX-A

1975 BNL Environmental Monitoring Monthly Sump Samples
Gross Beta and ^3H Concentrations

Month	N North of AGS No. samples	N North of AGS Concentration	O East of HIRDL No. samples	O East of HIRDL Concentration	P Medical No. samples	P Medical Concentration
GROSS BETA (pCi/liter or 10^{-9} μCi/ml)						
January	2	3.5	2	2.7	1	1.1
February	4	9.7	4	3.6	4	2.9
March	3	27.8	3	3.5	3	2.5
April	4	9.0	4	4.7	4	4.9
May	4	4.1	4	4.4	4	2.1
June	4	4.9	4	6.8	4	2.1
July	4	4.3	4	4.9	4	3.6
August	4	10.9	4	2.5	4	3.4
September	4	5.9	4	4.3	4	1.9
October	5	20.0	5	3.9	5	7.0
November	4	9.1	4	2.0	3	2.5
December	4	15.2	4	6.7	2	8.2
Total	46		46		42	
Average		10.5 ± 0.5		4.2 ± 0.4		3.6 ± 0.4
Radiation Concentration Guide(4): 3000 pCi/liter or 3×10^{-6} μCi/ml						
TRITIUM (nCi/liter or 10^{-6} μCi/ml						
January	2	<0.5	2	<0.5	1	<0.4
February	4	<0.6	4	<0.5	4	<0.5
March	3	<1.0	3	<1.0	3	<1.0
April	4	<0.6	4	<0.5	4	<0.5
May	4	<0.5	4	<0.5	4	<0.5
June	4	<0.5	4	<0.5	4	<0.5
July	4	<0.5	4	<0.5	4	<0.5
August	4	<0.5	4	<0.5	4	<0.5
September	4	<0.6	4	<0.5	4	<0.5
October	5	<0.6	5	<0.5	5	<0.5
November	4	<0.5	4	<0.5	3	<0.5
December	4	<0.5	4	<0.5	2	<0.5
Total	46		46		42	
Average		<0.6		<0.5		<0.5
Radiation Concentration Guide(4): 3000 nCi/liter or 3×10^{-3} μCi/ml						

TABLE XX-B

1975 BNL Environmental Monitoring Recharge Basin Water Quality and Purity

Basin	Sample	Chlorides ppm	Coliform total no./100 ml	Dissolved oxygen ppm	Dissolved solids ppm	Nitrate nitrogen ppm	Total P ppm	pH	Temperature °C
N	No.	12	13	45	13	12	12	46	46
North of AGS	Average	18.9	18*	9.8	84	0.43	0.25	7.1*	16
	Maximum	33.7	648	11.6	107	0.58	1.45	8.8	23
	Minimum	10.6	<1	8.6	64	0.25	<0.05	6.6	8
O	No.	12	13	46	13	12	12	46	46
East of HFBR	Average	19.3	12*	9.2	86	0.43	0.73	6.8*	17
	Maximum	26.0	267	11.0	154	0.90	1.28	8.9	27
	Minimum	14.8	<1	5.6	58	0.20	0.11	6.2	12
P	No.	12	12	42	12	12	12	42	42
South of MRR	Average	24.4	5*	6.3	120	1.22	0.06	6.4*	15
	Maximum	36.6	160	9.4	156	1.52	0.09	7.1	17
	Minimum	7.7	<1	4.4	77	0.40	<0.05	6.0	11
S	No.	7	7	7	7	7	7	7	7
South of Warehouse	Average	51.2	>898*	10.3	141	1.53	0.66	7.2*	8
	Maximum	11.7	TNTC	8.0	263	5.75	2.06	7.5	19
	Minimum	11.0	80	12.4	72	0.15	<0.05	6.8	0
Water Quality Standard(6)		500	--		1000	20.0	--	6.5-8.5	-

*Geometric mean.

TABLE XX-C

1975 BNL Environmental Monitoring Concentrations in Metals in Recharge Basins (ppm)

Basin	No. samples	Metals						
		Ag	Cd	Cr	Cu	Fe	Pb	Zn
O	1	<0.008	<0.0006	<0.010	0.015	1.080	<0.005	0.023
S	1	<0.008	<0.0006	<0.010	0.017	0.140	0.016	0.540
Water Quality Standard[6]		0.100	0.020	0.100	0.400	0.600	0.100	0.600

TABLE XXI

1975 Environmental Monitoring Sand Filter Bed, Peconic River Area, and Miscellaneous On-Site Surveillance Wells Gross Alpha, Gross Beta, Tritium, ^{90}Sr and ^{137}Cs Average Concentrations

Well	No. samples	Gross α pCi/liter	Gross β pCi/liter	HTO nCi/liter	^{90}Sr* pCi/liter	^{137}Cs pCi/liter	Remarks
			Sand Filter Bed and Peconic River Areas				
XA	6	<0.3	21.1 ± 1.4	6.6 ± 0.2	1.5 ± 0.2	<0.5	
XB	6	<0.2	2.0 ± 0.6	0.3 ± 0.2	0.2 ± 0.1	<0.5	
XC	6	0.8 ± 0.2	4.1 ± 0.8	<0.5	0.5 ± 0.1	<0.5	
XD	6	<0.2	1.2 ± 0.6	<0.5	0.5 ± 0.1	<0.5	
XE	7	0.3 ± 0.2	<0.8	<0.5	0.1 ± 0.1	<0.5	
XG	7	0.4 ± 0.2	5.1 ± 0.6	<0.5	1.7 ± 0.2	<0.2	A
XH	4	<0.2	<0.8	<0.5	<0.1	<0.5	
XI	2	<0.2	3.2 ± 1.2	<0.5	--	--	
XJ	2	<0.2	3.7 ± 1.2	<0.5	1.5 ± 0.2	--	
XK	6	0.5 ± 0.4	14.8 ± 1.2	6.4 ± 0.3	4.6 ± 0.5	<0.2	B
XL	6	1.6 ± 0.4	26.8 ± 1.4	6.8 ± 0.3	10.1 ± 1.0	<0.5	
XM	6	<0.2	17.7 ± 1.2	2.7 ± 0.2	3.1 ± 0.3	2.0 ± 0.2	C
XN	6	1.9 ± 0.6	11.7 ± 1.0	<0.5	0.3 ± 0.1	<1.6	
XO	6	0.5 ± 0.1	4.9 ± 0.8	<0.5	1.8 ± 0.2	<0.5	
XP	2	<0.3	<1.0	0.5 ± 0.4	0.1 ± 0.1	<0.5	
XQ	5	<0.2	11.8 ± 1.2	8.6 ± 0.4	1.5 ± 0.2	<0.6	D
XR	2	0.6 ± 0.4	3.9 ± 1.2	<0.5	2.1 ± 0.2	--	
XS	2	2.1 ± 1.0	14.8 ± 1.8	<0.5	2.9 ± 0.3	<0.3	
XT	4	<0.3	3.5 ± 0.8	<0.5	--	--	
XU	1	<0.3	2.3 ± 1.4	<0.5	--	--	
XV	1	<0.3	60.0 ± 0.6	<0.5	--	--	
XW	2	<0.4	2.6 ± 1.2	<0.5	0.2 ± 0.1	--	
XX	6	0.3 ± 0.2	10.1 ± 1.0	1.7 ± 0.5	3.3 ± 0.3	--	
XY	6	0.3 ± 0.2	9.0 ± 0.9	3.1 ± 0.3	--	<0.3	
XZ	6	<0.1	<0.6	<0.5	--	--	
X1	6	<0.3	1.0 ± 0.6	<0.5	1.1 ± 0.1	--	
X2	6	<0.2	0.8 ± 0.6	1.7 ± 0.3	—	<0.5	
			Miscellaneous On Site				
SA	2	<0.3	3.6 ± 1.2	<0.5	0.7		
SB	1	<0.4	<0.7	<0.5	<0.1		
SC	2	<0.3	<0.7	<0.7	<0.1		
SD	2	<0.3	1.3 ± 1.2	<0.5	--		
SE	2	<0.3	1.2 ± 1.0	<0.5	0.3		
SG	2	<0.3	7.1 ± 1.5	<0.7	--		
Radiation Concentration Guide(4)		100**	3000+	3000	300	20,000	

*^{90}Sr and ^{137}Cs concentrations established from assay of one sample; if total number of samples <11. Assay from 2 samples of total number of samples >4.

**If ^{226}Ra and ^{220}Ra <10% of activity.

+If 125-^{133}I, and ^{90}Sr not present.

Remarks: A, well XG, ^{22}Na, 0.4 ± 0.1 pCi/liter; B, well XK, ^{22}Na, 1.7 ± 0.1 pCi/liter; C, well XM, ^{7}Be, 7.5 ± 2.6 pCi/liter, ^{22}Na, 5.7 ± 0.2 pCi/liter, ^{60}Co, 1.2 ± 0.2 pCi/liter; D, well XQ, ^{22}Na, 1.4 ± 0.2 pCi/liter.

TABLE XXII

1975 BNL Environmental Monitoring Solid Waste Management Area, Landfill and Dump Area and 650 Sump Area
Gross Alpha, Gross Beta, Tritium, ^{90}Sr and ^{137}Cs

Well	No. samples	Gross α pCi/liter	Gross β pCi/liter	HTO nCi/liter	^{90}Sr* pCi/liter	^{137}Cs pCi/liter	Remarks
WB	4	0.5 ± 0.2	40.0 ± 2.0	1.4 ± 0.3	3.6 ± 0.9	<0.5	
WC	4	0.7 ± 0.4	36.0 ± 2.0	1.7 ± 0.2	9.8 ± 1.0	<0.2	
WD	4	0.3 ± 0.2	27.7 ± 1.8	3.4 ± 0.3	3.0 ± 0.3	<0.5	
WE	4	<0.4	7.4 ± 1.0	<0.9	<0.1	<0.5	
WI	4	0.4 ± 0.2	5.6 ± 1.0	<0.5	<0.1	<0.7	
WJ	2	<0.5	6.0 ± 1.4	<0.5	0.6 ± 0.1	<0.5	
WK	4	<0.4	195 ± 4	12.4 ± 0.5	63.5 ± 6.0	<0.2	A
W1	5	0.5 ± 0.2	50.7 ± 2.2	14.6 ± 0.4	14.2 ± 1.0	<0.5	B
WL	4	<0.5	128 ± 4.0	1.5 ± 0.3	52.7 ± 5.3	<0.5	C
W2	1	<0.4	6.4 ± 2.0	<0.5			
WM	1	<0.4	7.1 ± 2.0	<0.5	<0.1	<0.5	
W3	1	<0.2	<0.8	<0.4	<0.1	<0.5	
W4	1	<0.3	3.1 ± 1.6	<0.6	<0.1	<0.5	
W5	2	<0.5	3.6 ± 1.2	<0.4	0.5 ± 0.1	<0.5	
W7	2	<0.3	1.4 ± 1.0	<0.5	0.4 ± 0.1	<0.5	
W8	2	<0.4	4.8 ± 1.2	<0.5	0.4 ± 0.1	<0.5	
WV	1	<0.4	1.4 ± 1.4	<0.5	<0.1	<0.5	
WW	1	<0.4	2.6 ± 1.4	<0.5	<0.1	<0.5	
WX	1	<0.2	2.1 ± 1.4	<0.5	<0.1	<0.5	
WZ	2	<0.4	1.2 ± 1.0	<0.5	<0.1	<0.5	
			Landfill Area				
WF	2	<0.3	1.9 ± 1.0	<0.5	<0.1	<0.5	
WG	2	<0.3	2.9 ± 1.0	<0.5	<0.1	--	
WR	2	12.2 ± 5.2	103 ± 6.0	9.5 ± 0.5	3.0 ± 0.3	<0.5	D
WS	2	8.0 ± 4.0	466 ± 12.0	132 ± 1.0	5.6 ± 0.6	9.3 ± 5.6	E
WT	2	1.1 ± 0.6	3.6 ± 1.6	0.7 ± 0.5	0.4 ± 0.1	<0.5	
W6	2	<0.7	3.1 ± 1.3	<0.6	<0.1	--	
W9	2	12.0 ± 3.6	96.8 ± 5.8	157 ± 2.0	--	<0.3	
1K	4	12.0 ± 3.6	41.3 ± 2.5	10.4 ± 0.4	1.1 ± 0.5	<0.3	F
			Former Dump Area				
WH	2	<0.3	4.1 ± 0.7	<0.5	0.6 ± 0.1	<0.5	
WO	1	<0.3	<1.3	<0.5	<0.1	<0.5	
WP	1	<0.6	3.3 ± 1.8	<0.5	<0.1	<0.5	
WQ	1	<0.3	<1.4	<0.5	<0.1	<0.5	
1I	2	<0.3	<1.2	0.9 ± 0.5	--	<0.5	
1J	3	<0.3	0.9 ± 0.8	<0.5	<0.1	<0.5	
			650 Sump Area				
1-A	2	<0.2	160 ± 6.0	<0.7	63.6 ± 6.4	<0.3	
1-B	2	<0.2	6.8 ± 1.4	<0.5	0.5 ± 0.1	<0.5	
1-C	2	<0.5	2.3 ± 1.0	<0.5	0.8 ± 0.1	<0.5	
1-D	2	<0.2	2.8 ± 1.1	<0.5	0.3 ± 0.1	<0.5	
1-E	2	<0.5	260 ± 7.0	6.0 ± 0.5	121 ± 10.2	<0.5	
1-F	1	<0.5	1.9 ± 1.4	0.6 ± 0.5	<0.1	<0.3	
1-G	2	<0.3	2.6 ± 1.0	<<0.5	<0.1	<0.5	
1-H	2	<0.4	209 ± 6.0	<0.5	54.6 ± 5.5	<0.5	
Radiation Concentration Guide(4)		100**	3000+	3000	300	2×10^4	

*^{90}Sr and ^{137}Cs concentrations established from assay of one sample, if total number of samples <2; from two samples if total >2.

**If ^{226}Ra and ^{220}Ra absent.

+If $^{125-133}I$ and ^{90}Sr absent.

Remarks: A, ^{22}Na, 0.8 ± 0.3 pCi/liter; ^{60}Co, 1.0 ± 0.2 pCi/liter. B, ^{22}Na, 1.0 ± 0.2 pCi/liter. C, ^{22}Na, 0.9 ± 0.2 pCi/liter. D, ^{22}Na, 1.9 ± 0.2 pCi/liter; ^{58}Co, 2.1 ± 0.4 pCi/liter; ^{60}Co, 2.0 ± 0.4 pCi/liter. E, ^{7}Be, 134 ± 2.4 pCi/liter; ^{22}Na, 176 ± 3.3 pCi/liter; ^{60}Co, 16.4 ± 4.0 pCi/liter. F, ^{22}Na, 0.8 ± 0.2 pCi/liter.

TABLE XXIII

1975 BNL Environmental Monitoring Upland Recharge Surveillance Wells, Gross Alpha, Gross Beta, and Tritium Concentrations

Well	No. samples	Gross α (pCi/liter or 10^{-9} μCi/ml)	Gross β (pCi/liter or 10^{-9} μCi/ml)	HTO (nCi/liter)
1M	3	<1.4	<6.0	<0.5
1N	3	<1.4	<5.0	<0.5
1O	3	<1.7	<5.0	<0.5
1P	3	<1.8	0.7 ± 0.5	3.6 ± 0.7
1Q	2	<0.9	10.3 ± 5.0	<0.6
1R	2	<0.9	<6.4	<0.6
1S	3	<1.2	<5.0	<0.5
1T	3	<1.4	14.1 ± 5.0	3.6 ± 0.5
1U	3	<1.9	<10.0	<0.5
1V	3	<1.5	<6.0	<0.5
1W	3	<1.2	<6.0	1.3 ± 0.5
1X	3	<1.9	<6.0	2.7 ± 0.6
1Y	3	<1.0	10.8 ± 5.0	4.4 ± 0.6
1Z	3	<1.6	7.6 ± 0.6	<0.5
11	3	<2.2	<6.0	2.6 ± 0.5
12	3	<1.9	9.3 ± 4.8	4.8 ± 0.6
13	3	<1.1	<6.0	<0.5
14	3	<1.6	5.0 ± 4.0	5.4 ± 0.6
15	3	<3.1	7.7 ± 4.0	3.7 ± 0.6
Radiation Concentration Guide(4)		100*	3000**	3000

*If long lived alpha emitters not present.

**If ^{90}Sr, $^{125-133}I$ not present.

Note: The spray project was discontinued after the first quarter. Averages posted are from monthly samples for the first quarter.

TABLE XXIV-A

1975 BNL Environmental Monitoring Sand Filter Beds, Peconic River and Miscellaneous On Site Ground Water Surveillance Wells, Water Quality and Purity

Well	No. samples	pH	Chlorides ppm	Coliforms no./100 ml	DO ppm	Dissolved solids ppm	Nitrate nitrogen ppm	Total P ppm	Temperature °C
				Sand Filter Bed and Peconic River Area					
XA	6	5.9	25.5	112*	6.1	117	3.9	<0.05	18
XB	6	6.5	6.1	--	6.0	45	0.1	<0.05	10
XC	6	5.7	5.7	--	2.0	34	<0.1	<0.05	11
XD	6	5.8	6.6	--	4.8	30	<0.1	<0.05	12
XE	7	5.4	8.7	--	6.9	50	0.3	<0.05	14
XG	7	5.8	7.6	--	4.7	52	0.2	0.17	12
XH	4	5.7	5.3	--	5.4	26	0.2	<0.05	11
XI	2	5.3	6.2	--	4.1	37	0.1	<0.05	11
XJ	1	5.3	5.3	--	2.6	112	<0.1	<0.05	13
XK	6	6.3	22.2	--	2.1	108	0.2	0.10	12
XL	6	6.1	22.1	--	2.7	102	0.3	<0.05	12
XM	6	5.9	21.2	--	6.7	90	1.1	0.08	13
XN	6	4.6	5.7	56*	1.9	60	0.5	<0.05	10
XQ	6	6.0	20.1	--	2.9	82	<0.1	<0.05	14
XR	2	5.6	3.6	--	4.9	33	<0.1	<0.05	11
XS	2	5.5	10.4	--	7.2	105	0.1	0.05	10
XT	4	7.2	5.0	--	1.1	75	0.1	0.23	12
XU	1	5.0	4.0	--	0.6	43	<0.1	<0.05	12
XV	1	6.3	9.2	--	2.8	176	2.0	<0.05	12
XW	2	5.4	36.1	--	2.3	64	<0.1	<0.05	13
XX	6	5.5	11.2	--	2.1	69	<0.1	<0.05	12
XY	5	5.2	11.8	--	2.1	61	0.1	<0.05	12
XZ	6	5.7	4.8	--	4.5	51	0.6	<0.05	11
X-1	6	5.1	5.9	--	3.6	44	0.2	<0.05	12
X-2	6	5.6	25.7	--	1.6	70	0.1	<0.05	12
				Miscellaneous On Site					
SA	2	5.6	16.0	51*	3.8	59	0.4	<0.05	14
SB	1	5.8	6.0	--	1.5	36	<0.1	<0.05	11
SC	2	5.8	5.2	--	7.2	80	<0.1	<0.05	11
SD	2		6.0	--	8.1	32	0.2	<0.05	11
SE	2	6.4	27.5	--	7.4	93	1.5	<0.05	14
SG	2	6.2	13.7	--	8.1	85	0.3	<0.05	11
Estimated error		± 0.1	± 0.5	--	± 0.3	± 10	± 0.1	± 0.05	± 1
Water Quality Standard[5]		6.5-8.5	500			1000	20.0		

*One sample indicated this amount, all the rest were less than 1.

TABLE XXIV-B

1975 BNL Environmental Monitoring Solid Waste Management Area, Landfill and Dump Area, and 650 Sump Area Groundwater Wells, Water Quality and Purity*

Well	No. samples	pH	Chlorides ppm	DO ppm	Dissolved solids ppm	Nitrate nitrogen ppm	Total P ppm	Temperature °C
			Solid Waste Management Area					
WB	4	5.4	7.7	4.7	63	0.7	<0.05	15
WC	4	5.4	6.5	4.9	57	0.8	<0.05	13
WD	4	5.5	10.3	6.2	78	1.7	<0.05	12
WE	4	5.7	5.6	8.8	48	1.0	<0.05	12
WI	4	5.6	4.7	6.4	55	0.2	<0.05	12
WJ	2	5.6	7.3	8.5	57	0.6	<0.05	11
WK	4	5.6	10.5	7.7	68	0.7	<0.05	11
WL	4	5.7	3.8	9.2	44	0.5	<0.05	12
WM	1	6.2	5.3	6.8	98	0.3	0.08	13
W-1	5	5.7	3.7	8.8	34	0.4	<0.05	11
W-2	1	5.6	4.4	7.2	46	0.7	<0.05	11
W-3	2	6.0	7.6	7.6	52	0.8	<0.05	11
W-4	1	5.7	3.9	9.0	39	<0.1	<0.05	12
W-5	2	5.5	4.4	9.4	31	<0.1	<0.05	11
W-7	2	6.0	6.3	7.1	55	0.5	<0.05	11
W-8	2	5.5	4.4	9.1	43	0.1	<0.05	11
WV	1	5.6	4.3	8.4	32	0.1	<0.05	10
WW	1	5.6	10.1	9.0	58	0.3	<0.05	10
WX	1	6.0	8.0	6.6	48	0.2	<0.05	12
WZ	2	6.1	7.9	8.7	45	<0.1	<0.05	10
			Landfill Area					
WF	2	5.4	6.8	8.3	39	<0.1	<0.05	12
WG	2	5.9	5.4	7.6	38	0.2	<0.05	12
WR	2	6.7	4.2	2.0	339	0.5	<0.05	15
WS	2	6.8	4.0	2.3	272	0.2	<0.05	13
WT	2	5.7	8.9	3.0	60	0.2	<0.05	13
W-6	2	7.0	14.9	2.4	83	0.2	<0.05	10
W-9	2	7.0	75.2	2.1	487	0.2	<0.05	12
1-K	4	6.6	43.1	2.5	246	0.2	0.1	14
			Former Dump Area					
WH	5	5.7	11.5	7.5	58	0.5	<0.05	13
WO	1	5.9	2.9	8.2	79	<0.1	<0.05	11
WP	1	5.4	7.4	2.8	112	0.9	0.07	11
1-I	2	5.7	6.3	12.1	36	0.7	<0.05	10
1-J	3	6.0	5.8	10.4	59	<0.1	<0.05	10
			650 Sump Area					
1-A	2	6.3	10.8	6.9	71	0.4	0.06	16
1-B	2	6.5	15.9	6.3	72	0.7	0.07	15
1-C	2	6.3	19.0	7.7	80	0.9	<0.05	15
1-D	2	6.5	18.3	7.7	72	0.4	0.06	16
1-E	2	6.1	13.4	6.1	52	0.7	<0.05	14
1-F	1	6.3	17.7	7.0	90	0.3	0.11	14
1-G	2	6.4	15.8	6.7	75	0.4	<0.05	15
1-H	2	6.0	13.2	5.9	64	0.6	<0.05	14
Water Quality Standard(6)		6.5-8.5**	500		1000	20.0		

*Each sample analyzed for fecal coliforms. All results were less than 1 colony/100 ml.
**Or natural background range.

TABLE XXIV-C

1975 BNL Environmental Monitoring Samples, Upland Recharge Project, Groundwater Surveillance Wells, Quality and Purity

Plot	Type	Map no.	No. samples	pH*	Chlorides ppm	Conductance µmho/cm	Nitrate N	Total P ppm	Sulfate S	MBAS	Total coliforms: No. positive samples	Total coliforms: MPN/100*	COD: No. samples	COD: Average ppm
Boundary	Control	1M	3	5.5	20.3	113	<0.1	<0.02	5.4	<0.02	0	<2	-	-
	Control	1N	3	5.5	6.3	49	<0.1	<0.02	2.6	<0.02	1	1	-	-
	Control	1Q	3	5.3	2.8	90	0.1	<0.02	9.4	<0.02	0	<2	1	11.6
	Control	1R	3	5.3	3.7	42	0.43	<0.02	2.3	<0.02	0	<2	-	-
Pine and Oak Forest	Primary	1W	3	5.4	18.3	119	4.3	<0.02	<1.5	<0.02	1	1.4		
	Secondary	1Z	3	5.4	6.8	69	0.1	<0.02	3.1	<0.02	0	<2	-	-
	Control	1-4	3	5.5	24.0	156	5.7	<0.02	3.5	<0.02	1	1.3	1	11.7
	Control	1T	3	4.9	29.7	228	15.4	<0.02	1.2	<0.02	0	<2		
	Control	1-3	3	4.7	4.3	43	--	<0.02	2.3	<0.02	0	<2		
Pine Forest	Primary	1Y	3	5.5	31.3	246	11.8	<0.02	4.8	<0.02	0	<2	-	-
	Secondary	1-2	3	5.4	24.5	145	2.1	<0.02	5.2	<0.02	0	<2	1	7.8
	Control	1V	3	5.7	8.8	66	<0.1	<0.02	3.8	<0.02	0	<2	-	-
Old Field Spray Area	Primary	1-5	3	5.5	30.5	239	11.0	<0.02	6.5	<0.02	0	<2	1	5.9
	Primary	1X	3	5.6	16.5	104	00.7	<0.02	4.4	<0.02	0	<2	1	7.8
	Secondary	1-1	3	5.5	35.8	174	1.6	<0.02	4.1	<0.02	0	<2	-	-
	Control	1U	3	5.7	3.0	51	0.90	<0.02	3.3	<0.02	1	1.7	-	-
Agricultural Spray Field	Primary	1-O	3	5.6	23.3	229	5.1	<0.02	10.1	<0.02	1	1.7	1	11.7
	Secondary	1-P	3	5.7	22.5	168	0.91	<0.02	8.1	<0.02	2	6.5	-	-
	Control	1-S	3	5.9	26.5	193	0.2	<0.02	13.3	<0.02	0	<2	2	9.8
Estimated error				±0.1	±0.5	±10	±0.1	±0.01	±0.5	±0.02		±1		±0.5
Water Quality Standard(6)				6.5-8.5**	500	†	20		500	1500				

*Geometric mean.

**Or natural range.

†Approximately 0.8 x conductance indicates upper limit of dissolved solids, for which standard is 1000 ppm.

TABLE XXIV-D

1975 BNL Environmental Monitoring Groundwater Surveillance Wells, Water Quality-Metals

Well	No. samples	Metals (in ppm) Ag	Cd	Cr	Cu	Fe	Pb	Zn
		Sand Filter Beds						
XA	1	<0.005	<0.0006	<0.01	<0.009	0.950	0.006	0.240
XC	1	<0.005	<0.0006	<0.01	<0.009	0.173	<0.006	0.860
XE	1	<0.005	0.0006	<0.01	<0.009	0.103	<0.006	0.620
XX	1	<0.008	0.0006	<0.01	<0.012	2.500	<0.005	0.260
		Peconic Downstream						
XP	1	<0.005	0.0008	<0.01	<0.009	2.940	0.016	0.580
XO	1	<0.005	0.0012	<0.01	<0.009	2.480	0.009	0.317
XR	1	<0.005	<0.0006	<0.01	<0.009	0.036	0.010	1.970
XW	1	<0.008	0.0013	<0.01	<0.012	2.500	0.005	0.240
		Waste Management						
WB	1	<0.008	0.0011	<0.01	0.013	0.048	0.011	0.820
WC	1	<0.008	<0.0006	<0.01	0.016	0.229	0.002	0.381
WD	1	<0.008	0.0011	<0.01	0.014	0.163	0.022	1.020
WE	1	<0.008	<0.0006	<0.01	<0.006	0.051	0.004	0.477
		Landfill and Former Dump						
WH	1	<0.008	0.0019	<0.01	0.012	0.170	0.013	0.660
WS	1	<0.008	0.0006	<0.01	<0.012	74.0	0.028	0.170
		650 Sump Area						
1A	1	<0.008	0.0015	<0.01	<0.052	0.960	0.005	0.970
1C	1	<0.008	0.0024	<0.01	<0.012	0.160	0.010	0.750
1H	1	<0.008	0.0030	<0.01	<0.012	0.055	0.015	1.090
		Potable Supply						
1	1	<0.005	<0.0008	<0.008	0.122	0.061	0.004	0.045
2	1	<0.005	<0.0008	<0.008	0.009	1.240	0.004	<0.020
3	3	<0.006	<0.0006	<0.009	0.175	5.860	0.015	0.066
4	1	<0.005	<0.0008	<0.008	<0.006	1.620	0.051	<0.030
5	1	<0.005	<0.0008	<0.008	<0.006	0.013	0.004	0.067
6	1	<0.005	<0.0008	<0.008	0.039	0.370	0.011	<0.020
7	1	<0.005	<0.0008	<0.008	0.012	2.840	0.020	<0.020
101	1	<0.005	<0.0008	<0.008	0.015	1.570	0.003	<0.020
102	1	<0.005	<0.0008	<0.008	0.135	5.700	0.009	<0.020
103	1	<0.005	<0.0008	<0.008	0.013	3.870	0.006	0.029
104	1	<0.005	<0.0008	<0.008	<0.006	0.210	0.005	0.011
105	1	<0.005	<0.0008	<0.008	<0.062	0.450	0.003	<0.020
W+R	1	<0.005	<0.0008	<0.008	<0.006	2.830	0.007	0.059
Water Quality Standard(6)		0.100	0.020	0.100	0.400	0.600	0.100	0.600

TABLE XXV

1975 BNL Environmental Monitoring Concentrations of ^{90}Sr, ^{131}I and ^{137}Cs in Milk*

		Farm C--10 km SE					Farm H--40 km E				
Quarter	Sample	HTO	^{90}Sr	^{131}I	^{137}Cs	K g/liter	HTO	^{90}Sr	^{131}I	^{137}Cs	K g/liter
1	No.	3	6	3	3	3	3	6	3	3	3
	Average	<233	7.2	<2.3	<11.2	1.51	<327	4.3	<1.7	<9.9	1.49
	Maximum	<300	10.0	<3.0	15.0	1.66	<400	5.8	<2.0	11.0	1.55
	Minimum	<200	5.4	<2.0	<9.0	1.30	<200	3.2	<1.0	<9.0	1.43
2	No.	3	5	3	3	3	3	4	3	3	3
	Average	<333	7.1	<1.5	15.7	1.41	<267	6.5	<1.1	12.0	1.50
	Maximum	400	8.0	<2.0	20.0	1.55	<300	7.1	<1.4	17.0	1.67
	Minimum	<300	6.0	<1.0	11.0	1.19	<200	5.7	<1.0	9.0	1.31
3	No.	3	3	3	3	3	3	3	3	3	3
	Average	<233	15.3	<1.6	23.0	1.45	<267	6.2	<1.6	15.7	1.41
	Maximum	<300	19.0	<2.0	25.0	1.50	300	7.0	<2.0	24.0	1.46
	Minimum	<200	13.0	<1.2	20.0	1.37	<200	5.3	<1.2	10.0	1.30
4	No.	2	2	2	2	2	2	2	2	2	2
	Average	<200	13.3	<3.5	<14.0	1.35	<250	5.8	<2.5	14.5	1.51
	Maximum	<200	13.6	<5.0	17.0	1.39	300	6.2	<3.0	19.0	1.55
	Minimum	<200	13.0	<1.9	<11.0	1.31	<200	5.3	<2.0	10.0	1.46
Yearly	No.	11	16	11	11	11	11	15	11	11	11
	Average	<255	9.5	<2.1	<16.2	1.44	<280	5.5	<1.7	<12.9	1.47
	Maximum	400	19.0	<5.0	25.0	1.66	<400	7.1	<3.0	24.0	1.55
	Minimum	<200	5.4	<1.0	<9.0	1.19	<200	3.2	<1.0	<9.0	1.30
Radiation Concentration Guide(4)		$3x10^6$	200**	100**	$4x10^4$	--	$3x10^6$	200**	100**	$4x10^4$	--

*Data from sampling and analyses by New York State Department of Environmental Conservation.

**Based on Federal Radiation Council Guide(22) Range II, upper limit, and on assumed intake of 1 liter/day.

TABLE XXVI

1975 BNL Environmental Monitoring Concentrations of Gamma Emitting Nuclides in Soil
(pCi/kg or 10^{-9} μCi/g)

Location		Month	No. samples	Nuclide				
				^{54}Mn	^{60}Co	^{65}Zn	^{137}Cs	^{144}Ce
				Off Site				
Farm A	3 km NW	June	1	<100	<100	<100	<100	NA
Farm C	10 km SE	June	1	<100	<100	<150	280 ± 75	NA
Farm D	15 km NW	June	1	<200	<35	<100	592 ± 30	<300
Farm H	40 km E	June	1	<100	<100	<100	198 ± 51	NA
				On Site				
Waste Management Area		June + July	69	Avg.	16,000*	NA	247,000	NA
				Max.	202,000	NA	6,337,000	NA
				Min.	<100	NA	800	NA
					^{7}Be			
Adjacent to Linear Isotope Production Facility (Bldg. 931)		July	6	Ave.	352,000			
				Max.	1,324,000			
				Min.	3,200			

*Based on 30 samples that showed greater than minimum detectable activity of 100 pCi/kg.

TABLE XXVII

1975 BNL Environmental Monitoring Concentrations of Gamma Emitting Nuclides in Vegetation
(pCi/kg or 10^{-9} μCi/g)

Location		Month	No. samples	Nuclides ^{60}Co (pCi/kg or 10^{-9} μCi/g)	^{65}Zn (pCi/kg or 10^{-9} μCi/g)	^{131}I (pCi/kg or 10^{-9} μCi/g)	^{137}Cs (pCi/kg or 10^{-9} μCi/g)	^{144}Ce (pCi/kg or 10^{-9} μCi/g)	K g/kg
					Off Site				
Farm C	10 km SE	June	1	--	<200	<75	904±100	<4000	2.0±1.3
Riverhead	Town	June	1	--	<147	<47	278± 69	<2000	1.9±0.8
					On Site				
Adjacent to "Q" station		May	1	3799			3430		*
Waste Management area		June-July	Avg.	3880±4100**			31830±56650		14±9†
			Max.	10,450			290,000		36
			Min.	100			700		1

*Not analyzed for.

**Result of 6 positive samples, 43 less than minimum detectable.

†Result of 29 samples.

TABLE XXVIII

1975 BNL Environmental Monitoring Incremental Population Exposure Due to BNL Airborne Effluents Compared with Background

Distance from HFBR stack (mi.)	X/Q	Dose rate mrem/yr	Population	Annual dose person-rem	Background dose, person-rem
1-2	2.4×10^{-7}	0.0680	1,672	0.114	136
2-3	1.0×10^{-7}	0.0290	5,710	0.166	464
3-4	6.0×10^{-8}	0.0166	11,030	0.183	895
4-5	3.9×10^{-8}	0.0108	19,300	0.208	1,565
5-10	1.7×10^{-8}	0.0048	258,710	1.241	20,981
10-15	8.0×10^{-9}	0.0023	241,240	0.544	19,565
15-20	5.5×10^{-9}	0.0015	184,250	0.277	14,943
20-30	3.8×10^{-9}	0.0010	994,060	0.997	80,618
30-40	2.7×10^{-9}	0.0008	1,502,900	1.131	121,885
40-50	2.1×10^{-9}	0.0006	1,948,920	1.140	158,057
1-50	-	-	5,167,792	6.040	419,109

TABLE XXIX

1975 BNL Environmental Monitoring Off Site Dose Rates and Doses due to BNL Gamma Forest and AGS

		Gamma forest				AGS			
Sector	r miles	Distance miles	Dose rate mR/yr	Population	Man rem	Distance miles	Dose rate mR/yr	Population	Man rem
SSW	1-2	--	--	0	--	--	--	0	--
	2-3	>3	$<10^{-12}$	310	$<10^{-13}$	2.73	1.1×10^{-3}	310	3.4×10^{-4}
SW	1-2	--	--	0	--	--	--	0	--
	2-3	>3	$<10^{-12}$	215	$<10^{-13}$	2.67	1.4×10^{-3}	215	3.0×10^{-4}
WSW	1-2	--	--	0	--	--	--	0	--
	2-3	>3	$<10^{-12}$	495	$<10^{-13}$	2.48	3.6×10^{-3}	495	1.3×10^{-3}
W	1-2	2.7	3×10^{-12}	200	1.6×10^{-2}	1.55	8.0×10^{-2}	200	1.4×10^{-2}
	2-3	>3	$<10^{-12}$	990	$<10^{-12}$	2.39	3.6×10^{-3}	990	3.6×10^{-3}
WNW	1-2	2.6	2.0×10^{-1}	255	$\sim10^{-11}$	1.33	2.0×10^{-2}	255	5.1×10^{-3}
	2-3	>3	$<10^{-12}$	735	$<10^{-12}$	2.26	5.5×10^{-3}	735	4.0×10^{-3}
NW	1-2	2.1	1.5×10^{-11}	255	8.4×10^{-2}	1.22	3.3×10^{-1}	255	8.4×10^{-3}
	2-3	>3	$<10^{-12}$	175	$<10^{-13}$	2.17	8.0×10^{-3}	175	1.4×10^{-3}
NNW	1-2	1.73	1.2×10^{-6}	200	1.8×10^{-7}	1.22	0.33	200	6.6×10^{-2}
	2-3	>3	$<10^{-12}$	86	$<10^{-13}$	2.15	8.0×10^{-3}	86	6.9×10^{-4}
N	1-2	1.31	3×10^{-9}	335	7.5×10^{-5}	1.44	0.13	335	4.4×10^{-2}
	2-3	--	--	0	--	--	--	0	--
NNE	1-2	0.84	0.051	200	0.0077	1.55	8.0×10^{-2}	200	1.1×10^{-2}
	2-3	1.48	3×10^{-5}	495	1.1×10^{-5}	2.26	5.5×10^{-3}	495	2.7×10^{-3}
NE	1-2	0.73	0.91	99	0.0673	1.77	3.4×10^{-2}	99	3.4×10^{-3}
	2-3	1.22	6×10^{-4}	240	1.1×10^{-4}	2.15	5.5×10^{-3}	240	1.3×10^{-3}
ENE	1-2	--	--	0	--	--	--	0	--
	2-3	--	--	0	--	--	--	0	--
E	1-2	--	--	0	--	--	--	0	--
	2-3	1.72	1.5×10^{-6}	135	1.5×10^{-7}	2.51	2.5×10^{-3}	135	3.3×10^{-4}
ESE	1-2	--	--	0	--	--	--	0	--
	2-3	2.2	2×10^{-9}	280	$\sim10^{-9}$	2.70	1.3×10^{-3}	280	3.6×10^{-4}
SE	1-2	--	--	0	--	--	--	0	--
	2-3	--	--	0	--	--	--	0	--
SSE	1-2	2.5	1.5×10^{-10}	63	$\sim10^{-11}$	2.11	1.0×10^{-2}	63	6.3×10^{-4}
	2-3	>3	$<10^{-12}$	700	$<10^{-12}$	2.79	9.0×10^{-4}	700	6.3×10^{-4}
S	1-2	2.7	3×10^{-12}	63	$\sim10^{-12}$	2.03	1.3×10^{-2}	63	8.2×10^{-4}
	2-3	>3	$<10^{-12}$	855	$\leq10^{-12}$	2.79	9.0×10^{-3}	855	7.7×10^{-3}
Total					0.075				0.306

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