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Formal Report

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT FOR BROOKHAVEN NATIONAL LABORATORY 1967-1970

by

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PREFACE

Brookhaven National Laboratory (BNL) was established in 1947 on the former Army Camp Upton site located in central Long Island, New York. From the very beginning, BNL has monitored the environment on and around the Laboratory site to assess the effects of its operations on the environment.

Early monitoring focused on radiation, and data were reported in various internal documents and in publications presented at scientific meetings. They were also summarized in the Laboratory's annual progress reports, which were submitted to the U.S. Atomic Energy Commission (AEC). The AEC was a predecessor to the U.S. Department of Energy, which funds BNL today.

In 1960, the AEC instituted a program for public reporting of radioactivity data collected in the vicinity of major AEC installations. As part of that program, BNL began issuing to major Long Island newspapers reports on radiation levels measured in the environment.

In 1963, BNL pioneered the development of an annual environmental monitoring report. The first report was for calendar year 1962.[1] Reports were also prepared for calendar years 1963,[2] 1964,[3] 1965,[4] and 1966.[5]

Because these reports were not required by the AEC, they were completed when time and staff resources were available. As a result, BNL did not compile annual reports for the years 1967 through 1970, although environmental monitoring continued as usual.

In 1971, for the first time, annual site environmental reports became a contractual obligation for all AEC facilities. Thus, BNL has prepared a site monitoring report every year from 1971 onward.

This document summarizes the environmental data collected for the years 1967, 1968, 1969, and 1970. Thus, it fills a gap in the series of BNL annual environmental reports beginning in 1962.

The data in this document reflect measurements for those four years of concentrations and/or amounts of airborne radioactivity, radioactivity in streams and ground water, and external radiation levels in the vicinity of BNL. Also included are estimates, made at that time, of BNL's contribution to radioactivity in the environment.

Information in this document comes primarily from internal monthly reports from the Environmental Monitoring Group Leader to the Health Physics Division head.[6] Additional data were obtained from monthly Health Physics and Safety summary reports[7] and from handwritten notes by the Environmental Monitoring staff.

1. INTRODUCTION

Brookhaven National Laboratory (BNL) is a scientific research center situated in Suffolk County on Long Island, about 70 miles east of New York City. Its location and the surrounding communities are shown in Figure 1. During 1967 to 1970, the largest nearby populations were the shoreline communities. The land area within ten miles of BNL was mostly forested or under cultivation.

Figure 2 shows the BNL site and the principal sources of environmental radiation, as well as monitoring stations. During the period covered by this report (1967-70), the site was expanded from about 3,600 acres to about 5,300 acres (as shown in Figure 2). Most of the site is wooded, except for a central area of less than 1,000 acres. The terrain is gently rolling, with elevations varying between 40 and 120 feet above sea level. The land area lies on the west rim of the shallow Peconic River watershed, with the River itself rising in marshy areas in the north and east sections of the site.

Figure 3 shows the annual wind distribution as observed by the BNL Meteorology Group between 1960 and 1973. In terms of meteorology, BNL can be characterized as a well-ventilated site. Prevailing winds are from the southwest during the summer, from the northwest during the winter, and about equally from these two directions during the spring and fall.

Studies of the hydrology and geology[8,9] of Long Island in the vicinity of BNL indicate that the top soil of the Pleistocene deposits, which are locally between 100-200 feet thick, is generally sandy and highly permeable. Water penetrates readily and there is little direct runoff into surface streams, except during periods of intense precipitation. The average annual rainfall is about 45 inches per year. This is subsequently about equally divided between evapotranspiration and ground water recharge. As indicated in Figure 4, the ground water in the BNL region moves predominantly to the south. This flow is modified toward a more easterly direction in the Peconic River watershed portion of the site.

During 1967 to 1970, a wide variety of scientific programs were conducted at BNL, including research or development in the following areas:

1. Structure and properties of matter,
2. Physical, chemical, and biological effects of radiation,
3. Radioisotope production and other nuclear applications,
4. Nonweapons-related nuclear and other energy-related technology,
5. Energy sources, transmission, and utilization, including their environmental effects.

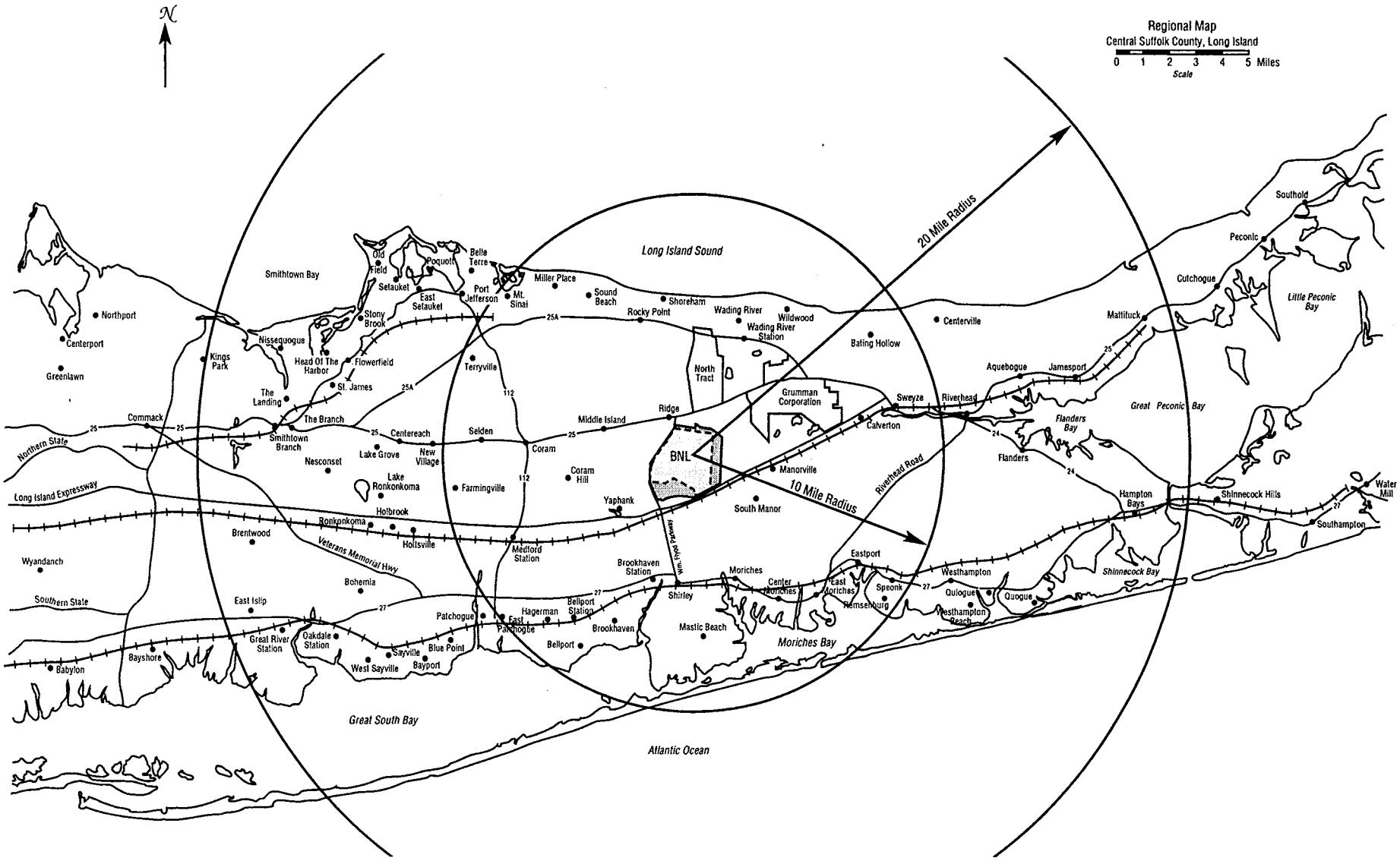

Figure 1. Central Suffolk County, showing the area around Brookhaven National Laboratory

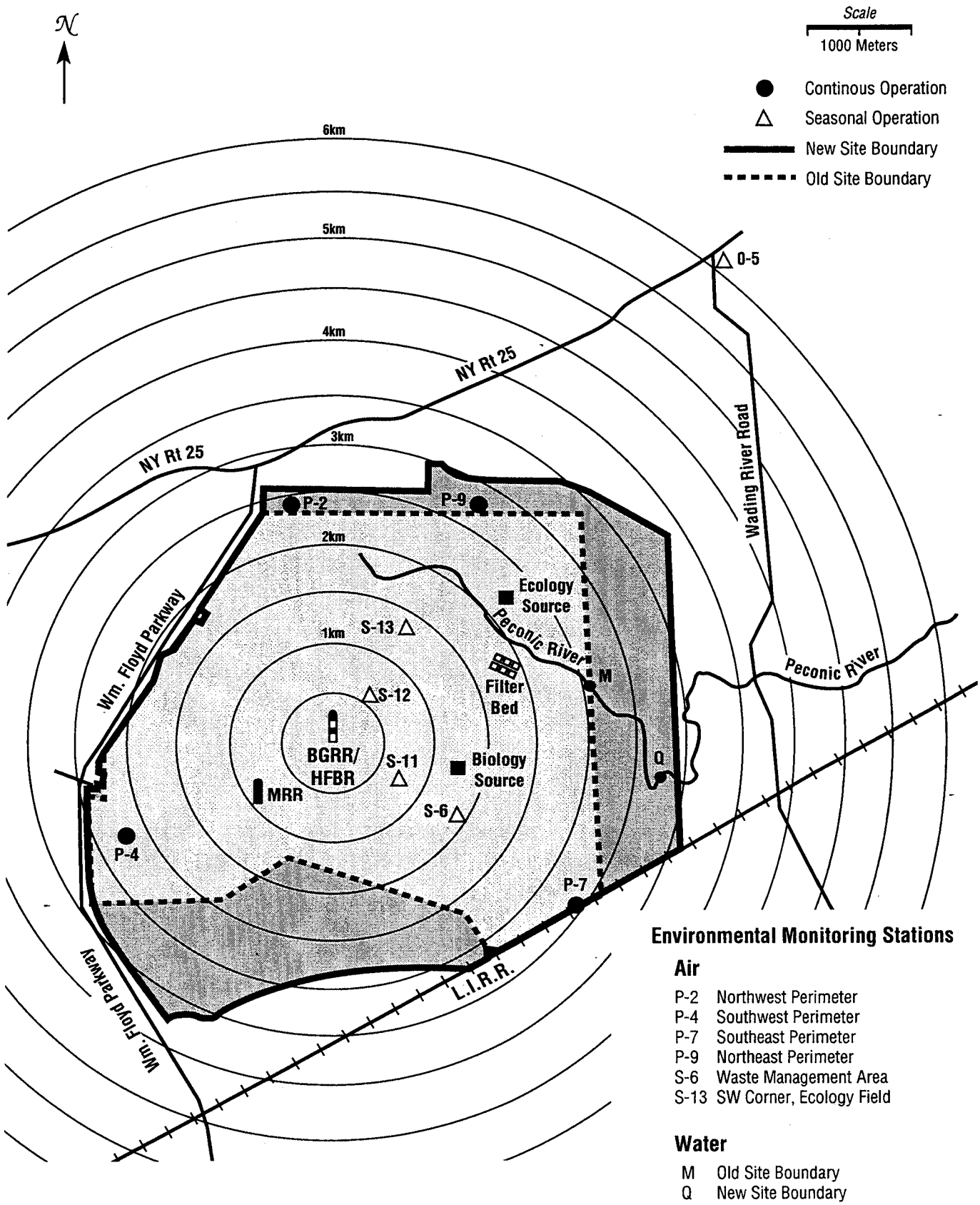

Figure 2. Principal Laboratory Sources of and Monitoring Stations for Environmental Radiation

STATION: BROOKHAVEN NATIONAL LABORATORY
HEIGHT: 355 ft.
PERIOD: January-December, 1960-73

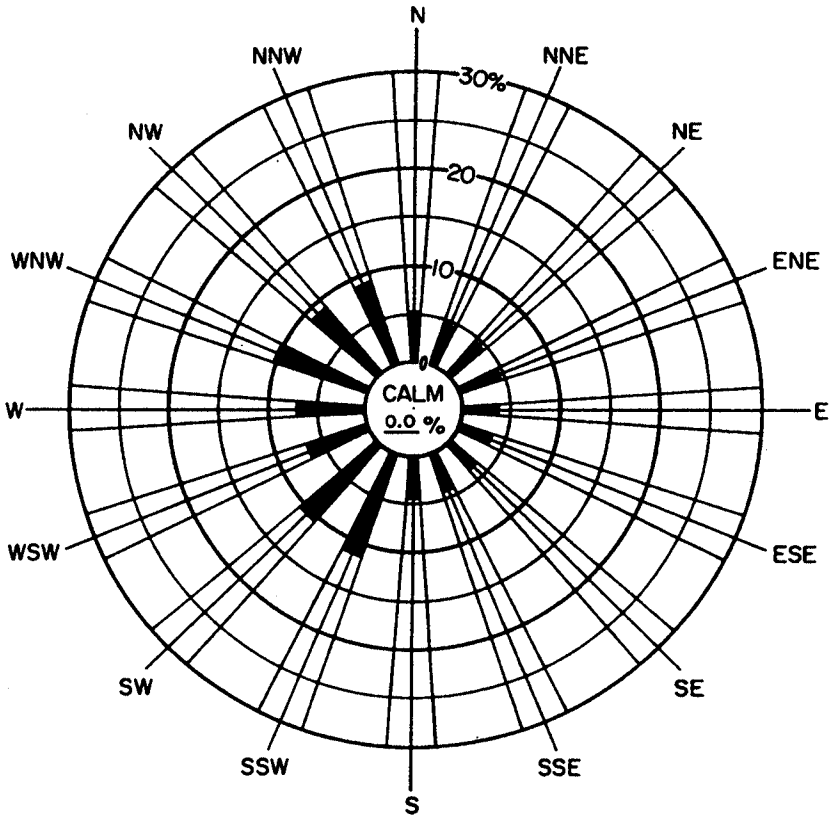

Figure 3. Annual Wind Distribution, 1960-73

Notes:

1. The arrow heads formed by the wedges indicate the direction that the wind blew *towards*. This diagram indicates that the predominant wind directions were towards the north-northeast and east-southeast.

2. Each concentric circle represents a 5% frequency, so, for example, the wind blew towards the NEE approximately 12% of the time.

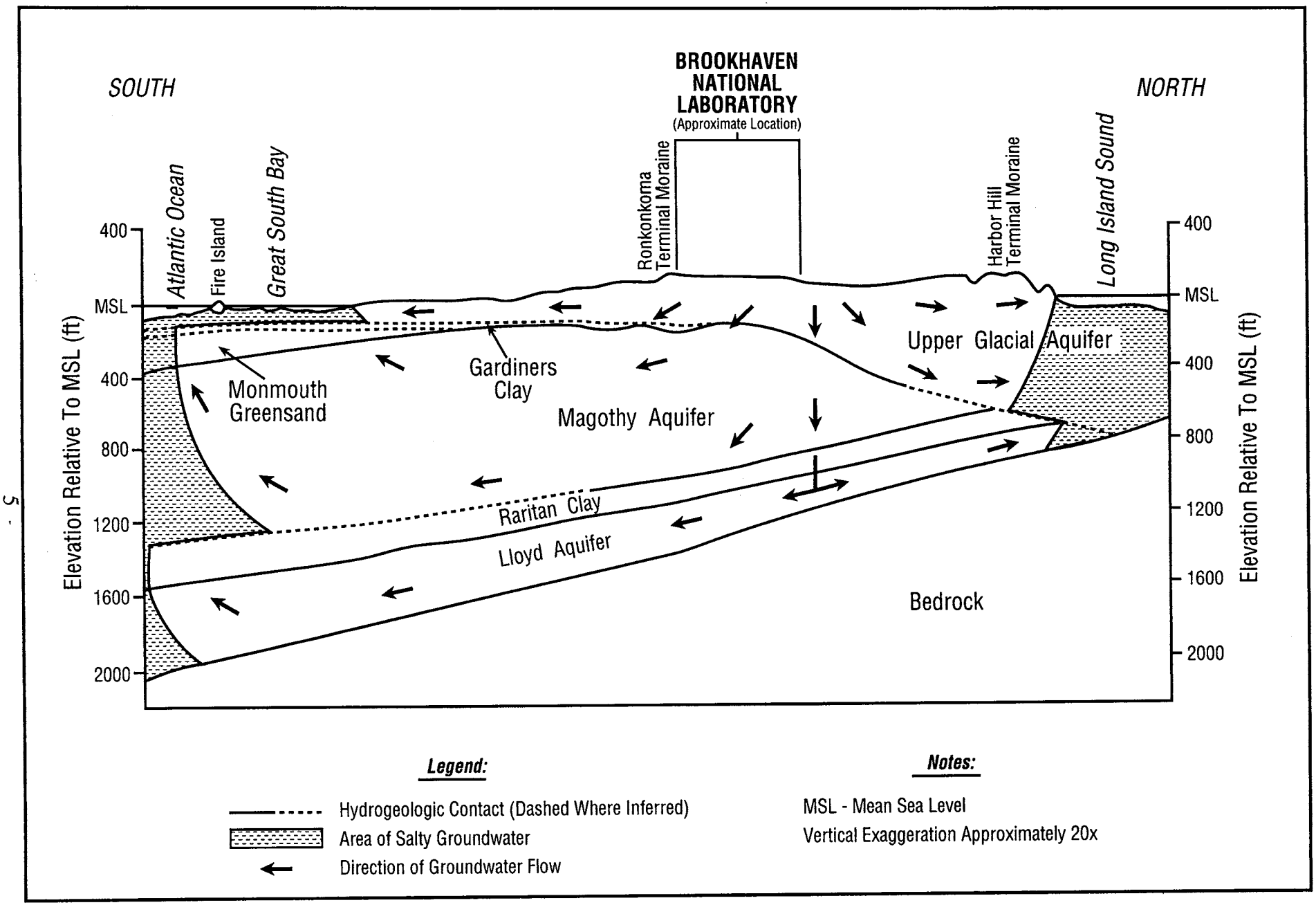

Figure 4. Schematic Groundwater Flow Lines, Brookhaven National Laboratory

Among the major scientific facilities operated at BNL to carry out the above programs during the period covered by this report were:

1. The High Flux Beam Reactor (HFBR). Fueled with enriched uranium, it is heavy-water moderated and cooled, and operated in 1967-70 at a routine power level of 40 MW.

2. The Medical Research Reactor (MRR) is an integral part of the Medical Research Center (MRC). It is an enriched-uranium fueled, natural-water moderated and cooled, and was operated intermittently at power levels up to 3 MW.

3. The Brookhaven Graphite Research Reactor (BGRR). It was fueled with enriched uranium with a graphite moderator and reflector. It was air-cooled and had a routine power level of about 20 MW. The BGRR went on standby status in June 1968 and subsequently operated only intermittently at reduced power levels during November 1968. It operated occasionally for the first six months of 1969, then ran at essentially zero power levels for training and testing purposes until September, after which it was permanently shut down.

4. The Alternating Gradient Synchrotron (AGS) is a proton accelerator which operated in 1967-70 at energies up to 33 GeV.

5. The 60-inch Cyclotron, Research Van de Graaff, Vertical Accelerator, and Chemistry Van de Graaff were used for research and for special isotope production.

Other programs involving irradiations and the use of radionuclides for scientific investigations were carried out at other BNL facilities, including the Medical Research Center, the Biology Department (including two multi-curie field-irradiation sources), the Chemistry Department, and the Department of Nuclear Engineering. The latter included the Hot Laboratory, where special-purpose radioisotopes produced were processed for on- and off-site use.

Most of the airborne radioactive effluents at BNL originated from the BGRR, HFBR, and MRR, with smaller contributions from the Research Van de Graaff and the Chemistry and Medical Research Centers. The BGRR and HFBR also contributed to BNL's liquid radioactive effluents. Additional contributions originated from the Medical Research Center, the Hot Laboratory complex, as well as from decontamination and hot-laundry operations.

2. MEASUREMENTS AND ASSESSMENTS

The measurements and assessments of radioactivity in air and water and levels of external radiation exposure in the vicinity of BNL include those levels associated with naturally occurring radioactive elements and cosmic radiation, those resulting from fallout from atmospheric nuclear weapons tests, and those attributable to the operations of BNL. Table 1 briefly summarizes the applicable radiation protection standards in effect during the period covered by this report.

Table 1. Radiation Protection Guides Reflected in this Report*

1. External radiation limit for members of the public	500 mrem/y
2. Average airborne ^{131}I limit for continuous exposure of the public	100 pCi/m^3
3. Airborne tritiated water limit for continuous exposure of the public	2 x 10^5 pCi/m^3
4. Limit for concentration in water for the public	1. Gross Beta Emitters (unidentified) 3 x 10^3 pCi/ℓ 2. Tritiated Water 3 x 10^6 pCi/ℓ

*Taken from Standards for Radiation Protection (U.S. AEC Manual, Chapter 0524, 1968)[10].

While the natural radioactivity levels were quite consistent, those associated with atmospheric weapons tests were highly variable. For example, during 1967 to 1970, fallout from two Chinese atmospheric nuclear weapons tests, one on December 24, 1967 and one on December 28, 1968, elevated the radioactive material measurements in the air-particulate samples significantly over the succeeding months. Impacts were also evident from Chinese weapons tests of October 27, 1966, December 28, 1966, January 17, 1967, September 29, 1969, and October 4, 1970.

In an attempt to reflect the uncertainty in measured and calculated values in this report, they are given to only two significant figures.

2.1 External Radiation

External radiation is an expression used to denote exposure to man from radioactive sources outside the body, as opposed to internal exposure, which results from exposure to radioactivity within the body.

External radiation levels, including natural background (as influenced by fallout) and the increments attributable to reactor cooling-air effluent and to the multicurie field gamma sources, were monitored continuously at six fixed monitoring stations. As shown in Figure 2, one of these stations was on site and four were at the perimeter. Off-site station O-6 was located 8.7 km north of the BGRR-HFBR stack.

Each station's equipment included an ion chamber and dynamic capacitor electrometer assembly, described in detail elsewhere.[11] These units were capable of accurately measuring less than 10 μR/hr and of detecting changes of the order of 1 μR/hr. Although information about the instantaneous dose rates up to about 0.5 mR/hr could have been obtained from these units, normally the integrated radiation over 4-hour periods was used to obtain weekly averages. These, in turn, were used to compute the monthly data tabulated in this report.

Natural background at a given station, excluding radon and its progeny, was determined from the radiation level prevailing when no obvious BNL contributions were detectable at that station. The potential error in making this determination was minimized by reference to meteorological data (to establish the direction of the reactor plume) and to the log book indications of the gamma field sources. These background measurements are approximately 30% higher than the values obtained today because many of the weapons fallout radionuclides with short and intermediate half-lives have decayed away, and the detectors used during the period covered by this report contained small quantities of naturally occurring radionuclides in the insulating material of the ion chamber.

The only measurable increase in external radiation above natural background attributable to BNL operations at most of the monitoring stations was caused by the radioactive ^{41}Ar component of the BGRR effluent cooling air.

Two multicurie field gamma sources were routinely exposed 20 hr/day. One, a ^{60}Co source that contained about 3,600 Ci, was used primarily for plant irradiations in a cultivated plot. The other, a ^{137}Cs source that contained about 8,000 Ci, was used to irradiate an otherwise undisturbed wooded area for ecological studies (the Ecology Forest). The ^{137}Cs source produced a measurable dose rate at stations P-9 and S-13. Monthly average radiation levels at these stations attributable to the sources are given in this report. Their locations are shown in Figure 2.

The exposure values for external radiation are given in millroentgens (mR) in the tables. In the text, these values are given in millirem (mrem), primarily to aid in making comparisons with the radiation protection standards.

2.1.1 <u>1967</u>

The highest annual average perimeter external radiation level attributable to BNL's operations in 1967 was measured at the northeast perimeter station (P-9). It was 101 mrem/y, or

20% of the applicable radiation protection guide of 500 mrem/y.[12] The contributors to this exposure were the ^{41}Ar releases from the BGRR and the Ecology Forest ^{137}Cs source (Table A-1).

The external exposure from natural sources and weapons testing fallout averaged 95 mrem/y (Table A-1).

2.1.2 1968

In 1968, the external radiation level at the northeast perimeter due to BNL operations was about 93 mrem/y, or 18% of the applicable radiation protection guide. The lower level in 1968 compared to 1967 resulted from decreases in radiation from ^{41}Ar after the BGRR was placed on standby status in mid-June. Thereafter, it operated only during several days in November at low power levels (Table B-1).

The contributions to external exposure from natural radiation sources and weapons testing fallout averaged 95 mrem/y (Table B-1).

2.1.3 1969

In 1969, as a result of the expansion of the Laboratory site, BNL's northeast perimeter was relocated about 775 feet north. The exposure rate at the new perimeter which was due to the Ecology Forest source was determined with portable instruments to be approximately 20% of that measured at station P-9, which remained at the former perimeter. Although some reduction should be applicable to estimate the ^{41}Ar site perimeter exposure, the analysis is less certain, so the measured values at station P-9 are used as the estimate of the ^{41}Ar exposure levels at the new site perimeter. In addition, the BGRR ran at reduced power levels for parts of January, February, March, May, and June, and at essentially zero power levels through September. Due to these changes, the external radiation levels at the northeast perimeter in 1969 attributable to BNL operations was approximately 18 mrem/y (20% of 84 mrem/y at station P-9 due to the Ecology Forest, plus 1 mrem/y from ^{41}Ar) (Table C-1), or 3.6% of the applicable radiation protection guide.

The external exposure from natural sources and weapons testing fallout averaged 89 mrem/y (Table C-1).

2.1.4 1970

In 1970, the external radiation level at the new northeast perimeter attributable to BNL operations resulted from the Ecology Forest source. The annual external exposure was about 17 mrem (Table D-1), or 3.4% of the applicable radiation protection guide.

The resulting average perimeter value from natural and weapons testing fallout for 1970 was approximately 95 mrem (Table D-1).

2.2 Environmental Airborne Particulate Radionuclides

"High volume" (20 ft^3/min) positive displacement air pumps (Gast 3040) were operated at monitoring stations P-4, P-7, P-9, and S-13 (Figure 2). The air sampling media consisted of a 3-inch diameter air-particulate filter followed by a 3" x 1" bed of charcoal for sampling of radiohalogens. The samples were changed and counted on a two-week basis. After allowing several days for the decay of short-lived natural radioactivity, gross beta counts were made using a 5-inch beta scintillator.

These measurement techniques were designed and developed primarily to monitor fallout deposition and to detect unusual releases to the environment from BNL operations. Therefore, the sensitivity of the system and the overwhelming influence of weapons tests fallout made it virtually impossible to utilize routine field measurements to estimate emissions of other than the ^{41}Ar from the BGRR-HFBR stack.

2.2.1 1967

In 1967, air-particulate filter samples at all stations at BNL indicated that the gross beta concentration averaged 0.24 pCi/m^3 over the year (Table A-2). The somewhat higher concentrations seen early in 1967 reflect the effect of Chinese weapons tests of October 1966, December 1966, and January 1967. The similar increase in concentrations in December reflects a Chinese weapons test in late 1967.

2.2.2 1968

In 1968, air-particulate filter samples at all stations at BNL showed that the gross beta concentration averaged 0.24 pCi/m^3 over the year (Table B-2). During 1968, the gross beta particulate concentrations remained rather constant, which reflected the absence of an atmospheric weapons test in 1968. However, low levels of weapons test fallout continued to be seen. This resulted from the debris from the 1966 and 1967 weapons tests having been injected into the stratosphere where it had been circulated around the world. Eventually, this material enters the lower atmosphere where deposition is enhanced.

2.2.3 1969

In 1969, air-particulate filter samples at all stations at BNL recorded a gross beta concentration that averaged 0.22 pCi/m^3 over the year (Table C-2). During 1969, the transfer of fallout material from the stratosphere to the lower atmosphere, which was enhanced during the

summer months, resulted in somewhat higher concentrations in August. By this time, the BGRR had ceased operation.

2.2.4 1970

In 1970, air-particulate filter samples at the monitoring stations indicated that the gross beta concentration at all stations averaged 0.21 pCi/m^3 (Table D-2). The occurrence of measurable quantities of gross beta particulate activity in 1970 is the clearest indication that fallout produced from weapons tests was the source of this radioactivity.

2.3 Radionuclides in Precipitation

Since the early 1950s, BNL has participated in a nationwide network of fallout monitoring stations. An important part of this effort was the measurement of activity deposited in rain, snow, and settled dust.

Two pot-type rain collectors, each with a surface area of 0.33 m^2, were situated adjacent to the Meteorology Building, 1,300 m and 90° west of the BGRR-HFBR stack. This location was chosen to minimize the possible effect of releases from the BGRR-HFBR stack in assessing the fallout produced from weapons tests. Two routine collections were made. A sample from one collector was picked up at 0900 only if precipitation had been observed during the previous 24 hours (or weekend); the other was picked up each Monday morning whether or not precipitation had occurred. A standard amount of distilled water was used to wash down the collector if no precipitation was falling at the time the sample was terminated.

Part of each collection was evaporated for gross beta counting. Weekly samples were analyzed for identifiable gamma-emitting isotopes and monthly composite samples for ^{89}Sr and ^{90}Sr. The monthly averages for gross beta activity and for individual isotopes in precipitation are given in this report (Tables A-3, B-3, C-3, and D-3).

2.3.1 1967

Radioactivity measurements of rain and settled dust samples for 1967 are given in Table A-3. The yearly total gross beta activity deposited at the sampling stations averaged 2.1 x 10^3 nCi/m^2. The unusually large deposition in January and December correlated closely with the Chinese weapons tests of December 28, 1966 and December 24, 1967.

2.3.2 1968

Radiation measurements for 1968 of rain and settled dust are given in Table B-3. The yearly gross beta activity deposited at the sampling stations totaled 84 nCi/m^2.

2.3.3 1969

Radioactivity measurements for 1969 of rain and settled dust are given in Table C-3. The yearly total gross beta activity deposited at the sampling stations totaled 83 nCi/m^2.

2.3.4 1970

Radioactivity measurements for 1970 of rain and settled dust are given in Table D-3. The yearly gross beta activity deposited at the sampling stations totaled 74 nCi/m^2.

These values were consistent with measurements of atmospheric fallout in the northeastern part of the United States. In particular, as with the data for the gross beta concentrations given in section 2.2, they correlated with the Chinese weapons tests which occurred on October 27, 1966, December 28, 1966, January 17, 1967, December 24, 1967, December 28 and 29, 1969, and October 14, 1970.

3. CORRELATION OF BGRR-HFBR STACK RELEASES AND ENVIRONMENTAL EXPOSURES

Routine monitoring of the BGRR-HFBR stack effluent was conducted by the Reactor Health Physics Group. The equipment used included an air-particulate sampler with a continuous tape of filter medium (HV-70), and a beta scintillation detector which was positioned to measure the air particulate gross beta activity which had been collected on the filter medium twenty minutes earlier. In addition, a Sill-type charcoal cartridge[13] which was routinely changed every other day and counted in a NaI well detector one week post-collection was used to determine ^{131}I effluent concentrations. A silica-gel trap was used to collect water vapor for weekly liquid scintillation analysis for tritiated water. The average monthly gross beta, ^{131}I, and tritiated water concentrations in the BGRR-HFBR stack effluent, as established by this routine sampling program, are given in Tables A-4, B-4, C-4, and D-4.

Note particularly that ^{131}I, ^{41}Ar, and particulate gross beta activity track very closely with the BGRR's operating schedule, which ended almost completely in late June 1968, while the tritiated water vapor (HTO) releases corresponded only broadly with the HFBR operating history since these releases occurred primarily as a result of maintenance activities.

The 1966 Environmental Monitoring Report[5] discussed the results of a detailed study that explored the relationship between measured releases from the BGRR-HFBR stack and the environmental airborne concentrations.[14] Argon-41 emissions were not included in this study since these exposures were measured directly.

3.1 Iodine-131

Aside from ^{41}Ar, ^{131}I was the most important radionuclide discharged to the atmosphere from the BGRR. The 1966 report indicated that ^{82}Br and ^{133}I were released in somewhat larger concentrations. However, calculations indicate that due to their shorter half-life and other dosimetric properties, the resulting doses from ^{133}I would have been about half that of ^{131}I, and the doses from ^{82}Br less than 20% of the ^{131}I.

In 1966, 2,500 mCi of ^{131}I were emitted from the BGRR-HFBR stack, with the resulting highest average annual concentration at the northeast site perimeter station being 0.0042 pCi/m^3.[5] (This value is reasonably close to the value of 0.0029 pCi/m^3 obtained using the same source term, together with meteorological transport codes based on measured parameters.) This provides a rough means of calculating the concentration at the site perimeter, which could be expected from a given annual release of ^{131}I. This technique suggested that a perimeter concentration of about 2×10^{-6} pCi/m^3 could have been expected if 1 mCi of ^{131}I were released from the BGRR-HFBR stack.

3.1.1 1967

In 1967, 570 mCi of ^{131}I were released from the BGRR-HFBR stack (Table A-4). This implies an average annual concentration of approximately 0.0012 pCi/m^3 at the perimeter of the site (station P-9), which is .0012% of the applicable radiation protection guide of 100 pCi/m^3.

3.1.2 1968

In 1968, 120 mCi of ^{131}I were released from BGRR-HFBR stack (Table B-4). This implies an average annual concentration of approximately 0.00024 pCi/m^3 at station P-9. This was approximately 0.00024% of the applicable radiation protection guide.

3.1.3 1969

In 1969, approximately 7.6 mCi of ^{131}I were released from the BGRR-HFBR stack (Table C-4). This implies an average annual concentration of approximately 0.000015 pCi/m^3 at station P-9. This was approximately .000015% of the applicable radiation protection guide.

3.1.4 1970

In 1970, there was no longer a measurable release of ^{131}I from the BGRR-HFBR stack. This result, together with the lower levels in 1968 and 1969 compared with 1967, reflect the phase-out of BGRR operations.

3.2 Particulate Gross Beta Activity

Fallout from nuclear weapons tests obscured the contributions of any airborne particulate gross beta activity from BNL operations as measured at the field stations. However, in 1966, as part of a detailed analysis of particulate activity released from the stack, gamma-emitting radionuclides in air samples from the stack were analyzed daily. That study, reported in detail in the 1966 Environmental Monitoring Report,[5] showed that the gross beta particulate activity results primarily from short-lived radioactivity. For example, in 1966, the particulate activity discharged from the BGRR-HFBR stack was 323 Ci. The daily analysis showed that less than 0.2 Ci (about 0.06%) of this total was due to intermediate- and long-lived radionuclides, i.e., those with half-lives of several hours to many days.[15] The field-station values seen in 1966 were dominated by weapons testing fallout. Iodine-131, ^{133}I, ^{82}Br, and ^{41}Ar were the only radionuclides attributable to BNL operations which were discernible at the field stations.

3.3 Tritiated Water Vapor

The predominant source of tritiated water vapor in the BGRR-HFBR stack effluent was due to HFBR operations and maintenance. During the period covered by this report, field techniques for monitoring tritiated water vapor were under development so there were no reliable measurements. However, the 1974 Environmental Monitoring Report[16] gave the first available measurements of tritiated water vapor at the field stations. That data can be used to estimate airborne tritiated water concentrations as a result of releases in 1967-70. In Table II of that report, tritium release values are given for several BNL facilities, each with different stack heights. Approximately 430 Ci of tritiated water vapor were released from these various stacks with heights ranging from 45 to 320 feet. About 300 Ci of tritiated water vapor were released from the BGRR-HFBR stack (320 feet). As a conservative approximation, a correlation can be made between the 300 Ci emitted from the stack in 1974 and the average ground-level concentrations measured at the site perimeter stations given in Table VI of that 1974 report. The average concentration at the southwest and northeast perimeter stations was about 35 pCi/m^3. This would suggest that for each curie of tritiated water vapor emitted from the BGRR-HFBR stack, the average air concentration would be 0.12 pCi/m^3 (35 pCi/m^3 divided by 300 Ci) at the perimeter stations. This approach will overestimate the concentration per curie emitted from the BGRR-HFBR stack, since some of the remaining 130 Ci of the tritiated water vapor which was released at lower elevations may also have been measured at the field stations.

3.3.1 <u>1967</u>

In 1967, 210 Ci of the tritiated water vapor were released from the BGRR-HFBR stack, implying an annual average concentration of less than 25 pCi/m^3 at the perimeter of the site (Table A-4). This was approximately .013% of the applicable radiation protection guide of 2×10^5 pCi/m^3.

3.3.2 <u>1968</u>

In 1968, 380 Ci of the tritiated water vapor were released from the BGRR-HFBR stack, implying an annual average tritiated water vapor concentration of less than 47 pCi/m^3 at the perimeter of the site (Table B-4). This was approximately .024% of the applicable radiation protection guide.

3.3.3 <u>1969</u>

In 1969, 380 Ci of the tritiated water vapor were released from the BGRR-HFBR stack; from this we deduce an annual average tritiated water vapor concentration of less than 45 pCi/m^3 at the perimeter of the site (Table C-4), approximately .023% of the applicable radiation protection guide.

3.3.4 1970

In 1970, 690 Ci of the tritiated water vapor were released from the BGRR-HFBR stack. This implies an annual average tritiated water vapor concentration of less than 83 pCi/m^3 at the perimeter of the site (Table D-4), approximately 0.042% of the applicable radiation protection guide.

A major fraction of the tritiated water vapor released in 1970 (~ 240 Ci) took place between January 5 and January 12, 1970 when the Reactor heat exchanger was repaired. To evaluate the ground-level deposition of this release, samples of hard-packed snow (which had fallen on January 6-7) were taken at 40° intervals on arcs of 500, 1,000, 2,000, 4,000, and 5,000 meters from the stack. A well-defined pattern of deposition existed both on and off the BNL site. The snow samples were melted and the activity levels reported in pCi/ℓ. The liquid concentration was at a maximum for snow obtained adjacent to Building 535 (~500 meters southeast of the Reactor stack) with a value of 35,000 pCi/ℓ. The pattern of deposition indicated that the concentrations in water from melted snow off the Laboratory site would be less than 3,000 pCi/ℓ. The highest value measured in water obtained from melted snow off-site was ~2,000 pCi/ℓ. This sample was obtained from a location 4,000 meters south-southeast of the Reactor stack.

4. RADIOACTIVITY IN LIQUID EFFLUENTS

4.1 Liquid Waste System

Small amounts of low-level radioactive liquid wastes were routinely disposed of by release into the Laboratory's sanitary waste system, where they were diluted by a large volume of uncontaminated water. This liquid waste passed through an Imhoff Tank or the Clarifier, which removed most of the solids. The effluent flowed onto sand filter-beds, from which most of it was directed by an underlying tile field, chlorinated, and discharged into a small stream which forms one of the headwaters of the Peconic River.

The pathway indicated by the dashed lines at the Sewage Treatment Plant in Figure 5 reflects the situation until late 1967 when the effluent stream was redirected through a newly installed Clarifier as shown by the solid line through the Sewage Treatment Plant.

The schematic illustration of the sewage treatment plant, shown in Figure 5, includes the related monitoring arrangements. In addition to the in-plant flow measurement and sampling instrumentation, totalizing flow meters (Leopold & Stevens TF 61-2), which include provision for actuating a sampler with each 2,000 gallons of flow in combination with a positive-action battery-operated sampler (Brailsford DU-1), were installed at the Chlorinating Plant at the former site perimeter 0.5 miles downstream on the Peconic, and in 1969 at the present site perimeter (1.6 miles downstream).

For 1967, the only available tritiated water concentrations were at the former perimeter (station M). These same concentrations were used at station Q. For estimating the tritiated water concentrations at the Imhoff Tank/Clarifier and at the Chlorinating Plant, the concentrations at station M and Q were adjusted to reflect additional upstream flow.

4.1.1 <u>1967</u>

In 1967, the total waste-water flow as measured at the Imhoff Tank/Clarifier was approximately 1.2×10^9 liters (approximately 300 million gallons). About 89% of the liquid effluent discharged onto the sand filter-beds at the Sewage Treatment Plant was directed to the headwaters of the Peconic River as measured at the Chlorinating Plant.

The concentration of gross beta emitters in the effluent discharged onto the sand filter-beds was 68 pCi/ℓ, and the tritiated water concentration was ~11,000 pCi/ℓ (Table A-5).

The concentration of gross beta emitters in the water released to the headwaters of the Peconic River (at the Chlorinating Plant) was 46 pCi/ℓ (Table A-6), which was 1.5% of the applicable radiation protection guide of 3,000 pCi/ℓ. The tritiated water concentration was ~10,000 pCi/ℓ (Table A-6), which was 0.3% of the applicable radiation protection guide of 3×10^6 pCi/ℓ. The change in the concentration of the beta emitters through the sand filter-beds was primarily due to holdup in the top few inches of the beds.

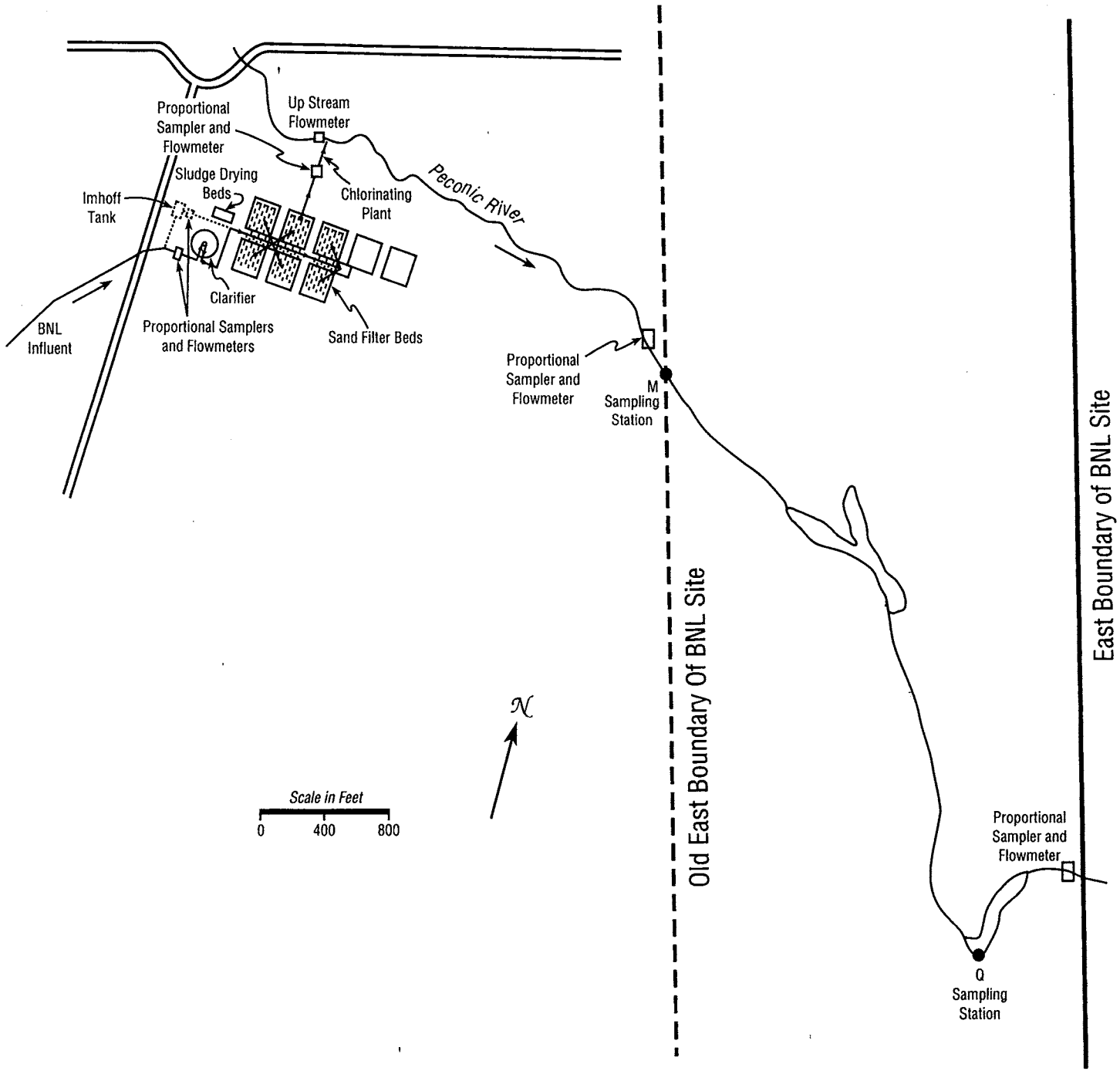

Figure 5. Brookhaven National Laboratory Sanitary Waste System

At the site perimeter (station M in 1967), due to upstream flow, the total River flow exceeded the flow at the Chlorinating Plant by about 1.2 x 10^7 liters (about 0.5%). The yearly average concentration of gross beta emitters at station M was 45 pCi/ℓ (Table A-7), which was 1.5% of the applicable radiation protection guide. The yearly average tritiated water concentration was 9,100 pCi/ℓ (Table A-7), which was 0.3% of the radiation protection guide.

At station Q, the total flow was .9 x 10^9 liters. The concentration of gross beta emitters was 49 pCi/ℓ (Table A-8), which was 1.6% of the applicable radiation protection guide. The tritiated water concentration was 9,900 pCi/l ℓ, which was 0.33% of the radiation protection guide.

The unusually high values for tritiated water in December shown in Tables A-5, A-6, A-7, and A-8 are attributable to a planned release from the Medical Research Center. The unusually high value for gross beta concentrations in March, as shown in Tables A-5, A-6, and A-7 are attributable to an unplanned release of Tungsten-185 from the Metallurgy Building (Building 480).

4.1.2 <u>1968</u>

In 1968, of the total waste-water flow discharged onto the sand filter-beds of 1.5 x 10^9 liters (396 million gallons), 77% was directed to the headwaters of the Peconic River. The concentration of gross beta emitters in the effluent discharged onto the sand filter-beds was 15 pCi/ℓ, and the average tritiated water concentration was 15,000 pCi/ℓ (Table B-5).

The concentration of gross beta emitters in the water released to the headwaters of the Peconic River (at the Chlorinating Plant) was 16 pCi/ℓ (Table B-6), which was 0.53% of the applicable radiation protection guide of 3,000 pCi/ℓ; and the tritiated water concentration was 13,000 pCi/ℓ (Table B-6), which was 0.44% of the applicable radiation protection guide of 3 x 10^6 pCi/ℓ.

At the site perimeter station M, the total flow was 1.3 x 10^9 liters in 1968. The concentration of the gross beta emitters there was 15 pCi/ℓ (Table B-7), which was 0.5% of the applicable radiation protection guide. The tritiated water concentration was 12,000 pCi/ℓ (Table B-7), which was 0.4% of the applicable radiation protection guide.

At station Q, the total flow was 1.0 x 10^9 liters. The concentration of gross beta emitters was 16 pCi/ℓ (Table B-8), which was 0.53% of the applicable radiation protection guide. The tritiated water concentration was 12,000 pCi/ℓ, which was 0.4% of the applicable radiation protection guide.

The unusually high values for tritiated water in March, April, September, and October (Tables B-5, B-6, B-7, and B-8) were primarily attributable to the operation of the Evaporator. In October, there was a one-day release of 3.6 Ci from the HFBR, and in November, a one-day release of 1.6 Ci from the Medical Research Center.

4.1.3 1969

The total BNL wastewater flow discharged onto the sand filter-beds in 1969 was 1.6×10^9 liters, or 420 million gallons. About 80% of the volume of the liquid effluent was directed to the headwaters of the Peconic River. The concentration of gross beta emitters in the effluents released to the sand filter-beds was 15 pCi/ℓ, and the average tritiated water concentration was 11,000 pCi/ℓ (Table C-5).

The concentration of gross beta emitters in the water released to the headwaters of the Peconic River (at the Chlorinating Plant) was 13 pCi/ℓ (Table C-6), which was 0.43% of the applicable radiation protection guide of 3,000 pCi/ℓ, and the tritiated water concentration was 12,000 pCi/ℓ (Table C-6), which was 0.4% of the applicable radiation protection guide.

In 1969, the site perimeter and the monitoring station at the site perimeter were moved downstream about 1,000 meters. At this location, station Q, the flow is occasionally less than at station M at the old site perimeter, but the concentration of radionuclides in the remaining surface water was nearly the same. In 1969, the concentration of the gross beta emitters at the former perimeter station M was 12 pCi/ℓ (Table C-7), which was 0.39% of the applicable radiation protection guide. The tritiated water concentration was 11,000 pCi/ℓ (Table C-7), which was 0.33% of the applicable radiation protection guide. At the new site perimeter, station Q, the concentration of the gross beta emitters was 14 pCi/ℓ (Table C-8), which was .47% of the applicable radiation protection guide. The tritiated water concentration was 7,700 pCi/ℓ (Table C-8), which was 0.26% of the applicable radiation protection guide.

The somewhat elevated levels of tritiated water concentration in May are due to a 1.13 Ci "spike" released from the HFBR. In addition, the HFBR released 2.5 Ci in October and 1.34 Ci in November. Evaporator operations during May, July, October, and November contributed to the elevated tritiated water concentration in the effluent stream (Tables C-5, C-6, C-7, and C-8).

4.1.4 1970

In 1970, the total waste-water flow at the Clarifier was 1.7×10^9 liters (450 million gallons). About 85% of the total volume of liquid effluent discharged onto the sand filter-beds at the Sewage Treatment Plant was redirected to the headwaters of the Peconic River. The balance is assumed to have percolated into the ground water underlying the bed. The concentration of gross beta emitters in the effluent discharged onto the sand-filter beds was 26 pCi/ℓ, and the tritiated water concentration was 21,000 pCi/ℓ (Table D-5).

The gross concentration of the beta emitters in water released to headwaters of the Peconic River at the Chlorinating Plant was 18 pCi/ℓ (Table D-6), which was about 0.6% of the applicable radiation protection guide. The tritiated water concentration was 21,000 pCi/ℓ, which was about 0.71% of the applicable radiation protection guide.

In 1970, the concentration of the gross beta emitters at the former perimeter, station M, was 17 pCi/ℓ (Table D-7), which was about 0.56% of the applicable radiation protection guide. The tritiated water concentration was 19,000 pCi/ℓ (Table D-7), which was 0.6% of the applicable radiation protection guide.

At the new perimeter (station Q), the concentration of the gross beta emitters was 16 pCi/ℓ (Table D-8), which was 0.5% of the applicable radiation protection guide. The tritiated water concentration was 19,000 pCi/ℓ (Table D-8), which was 0.63% of the applicable radiation protection guide. The unusually high values for the March tritiated water concentration (Tables D-5 to D-7) are attributable to unusually frequent operations at the Waste Concentration Facility during the month (~ 9.5 Ci). In addition, somewhat smaller contributions resulted from Evaporator operations in February (~2.4 Ci), April (~ 2.0 Ci), May (~ 3.5 Ci), June (~1.8 Ci), and October (~ 1.4 Ci).

4.2 Peconic River Grab Samples

Monthly grab water samples were obtained at on- and off-site locations along the upper tributary of the Peconic River, into which BNL routinely discharges low-level radioactive wastes. Reference grab samples were also obtained from other nearby streams and bodies of water outside the Laboratory's drainage area. The sampling locations, as shown in Figure 6, were as follows.

Peconic River, proceeding downstream (within the Laboratory drainage area)

- K Peconic River just below BNL effluent outfall
- L Peconic River 1,300 ft. below effluent outfall
- M Peconic River, 2,600 ft. below BNL effluent outfall (old BNL perimeter)
- Q Peconic River, 6,900 ft. downstream from BNL effluent outfall (new BNL perimeter)
- 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

Controls (not within the Laboratory drainage area)

- 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
- I Artist's Lake (maintained by water table, no surface flow)
- J Lake Panamoka (maintained by water table, no surface flow)

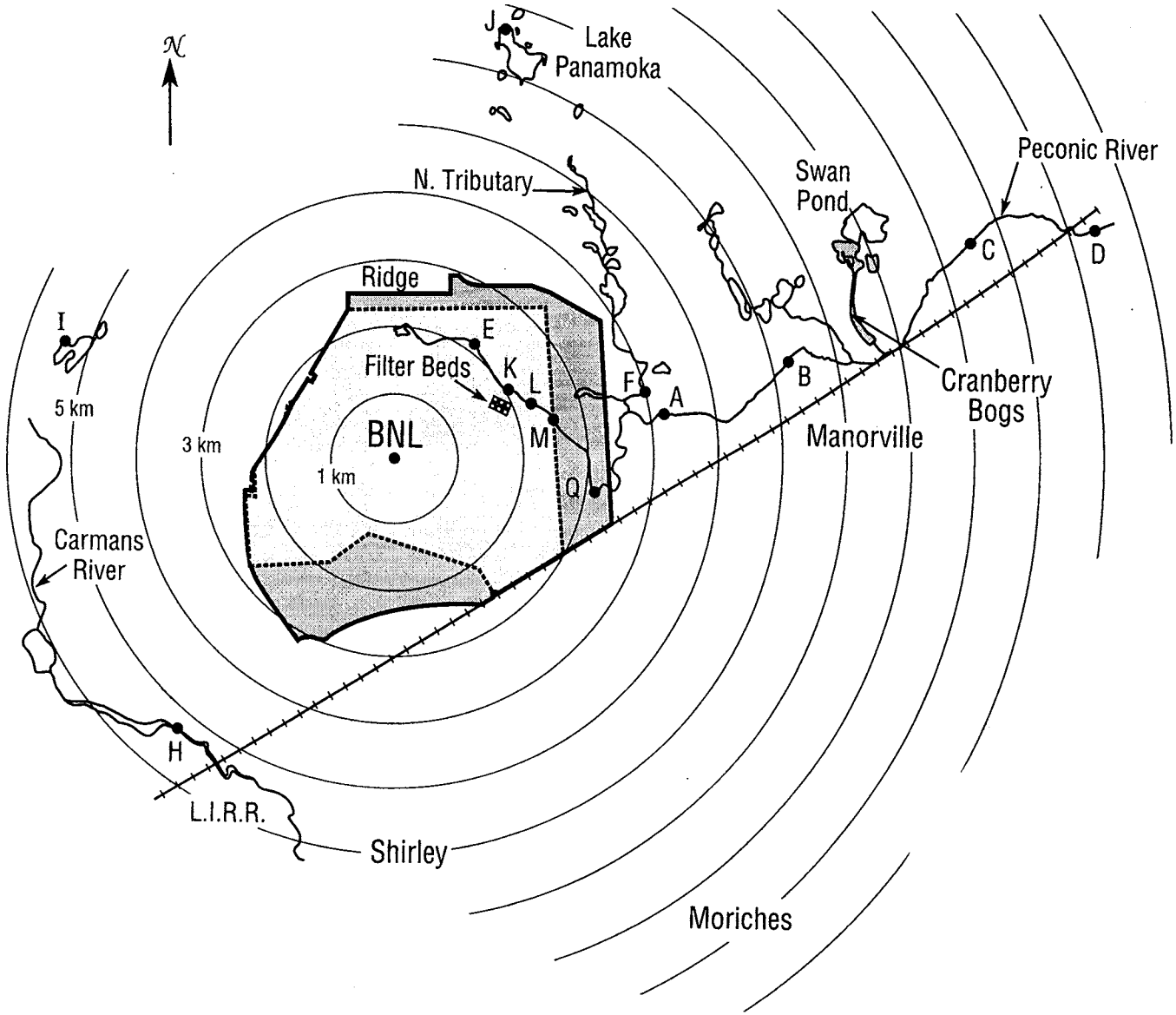

Figure 6. Peconic River Sampling Locations.

The individual monthly and yearly average gross beta and tritium concentrations at the downstream and control locations are given in Tables A-9, B-9, C-9, and D-9.

4.2.1 1967

The largest yearly average gross beta concentration seen in monthly grab downstream samples in 1967 was 32 pCi/ℓ at sampling station K (Table A-9), which was 1.1% the applicable radiation protection guide. The largest yearly average tritiated water concentration was <5,900 pCi/ℓ at sampling station L (Table A-9), which was about 0.2% of the applicable radiation protection guide. The unexplained high values at station F (Table A-9) for January and March are puzzling since this sampling station is located on a tributary which arises from Lake Panamoka and flows into the Peconic River beyond the site perimeter. A similar question exists for Station I in the first quarter of the year.

4.2.2 1968

The largest yearly average gross beta concentration seen in monthly grab downstream samples in 1968 was 18 pCi/ℓ at sampling station Q (Table B-9), which was 0.6% of the applicable radiation protection guide of 3,000 pCi/ℓ. The largest yearly average tritiated water concentration was 12,000 pCi/ℓ at sampling station M (Table B-9), which is 0.4% of the applicable radiation protection guide.

4.2.3 1969

The largest yearly average gross beta concentration in monthly grab stream samples in 1969 was 15 pCi/ℓ at sampling station L (Table C-9), which was 0.5% of the applicable radiation protection guide. The largest yearly average tritiated water concentration was 27,000 pCi/ℓ at sampling station Q (Table C-9), which was 0.9% of the applicable radiation protection guide.

As noted in section 4.1.3, 1.13 Ci of tritiated water was released from the HFBR on May 5, 1969. The effects of this release are seen in the elevated tritiated water concentrations seen in May at stations M and Q.

4.2.4 1970

The largest yearly average gross beta concentration seen in monthly grab stream samples in 1970 was 20 pCi/ℓ at sampling station K (Table D-9), which was 0.7% of the applicable radiation protection guide. The largest yearly average tritiated water concentration was 24,000 pCi/ℓ at sampling station M (Table D-9), which was 0.8% of the applicable radiation protection guide.

The elevated tritiated water concentrations seen in February and March at stations K, L, M, and Q are thought to be due to work on the Evaporator Facility.

4.3 River Bottom, Vegetation, and Fauna Sampling

Seasonal samples were taken of the Peconic River bottom, vegetation growth in or on the River bank, and fish and other animals in the River habitat.

Seasonal sampling of Peconic River bottom sediments was conducted in March and July 1968, and in October and November 1969. Peconic River vegetation samples were taken in July 1968 and August 1969, and the fauna were obtained for analysis of gamma-emitting radionuclides in July 1968 and August 1969. In 1968, bottom sediment samples were obtained from the North Lagoon (N) and the AGS-HFBR (O) sumps. The locations of these sumps are shown on Figure 7.

4.3.1. 1967

Data for 1967 could not be located.

4.3.2 1968

The March 1968 Peconic River bottom sediment samples showed the largest concentration for ^{60}Co at station M, with a value of 24 pCi/g. The largest concentration of ^{137}Cs was also at station M, with a value of 13 pCi/g (Table B-10). The largest July 1968 River bottom-sample concentrations were at station M, with a value of 11 pCi/g of ^{60}Co, and 8.3 pCi/g for ^{137}Cs (Table B-10). The highest concentrations in sump bottom sediment was 2.1 pCi/g of ^{137}Cs, 1.6 pCi/g of ^{95}Zr-Nb, and 0.5 pCi/g of ^{144}Ce in the North Lagoon sump (N). The highest concentration of ^{60}Co was 0.2 pCi/g in the AGS-HFBR sump (O) (Table B-10).

In July 1968, the largest concentration of ^{60}Co in the fauna sampled was in tadpoles collected at station M, with a concentration of 2.7 pCi/g. The largest concentration for ^{137}Cs also was at station M, with a concentration in frogs of 14 pCi/g (Table B-11).

The largest concentrations in stream vegetation for ^{137}Cs was at station A, with a value of 1.6 pCi/g, and for ^{60}Co at station L, with a value of 1.4 pCi/g. No radioactivity attributable to BNL operations was seen beyond sampling point B (Table B-11).

4.3.3 1969

The November bottom sediment samples indicated that the largest concentrations occurred at station M; the value for ^{137}Cs was 1.6 pCi/g, and 0.89 pCi/g for ^{60}Co (Table C-10).

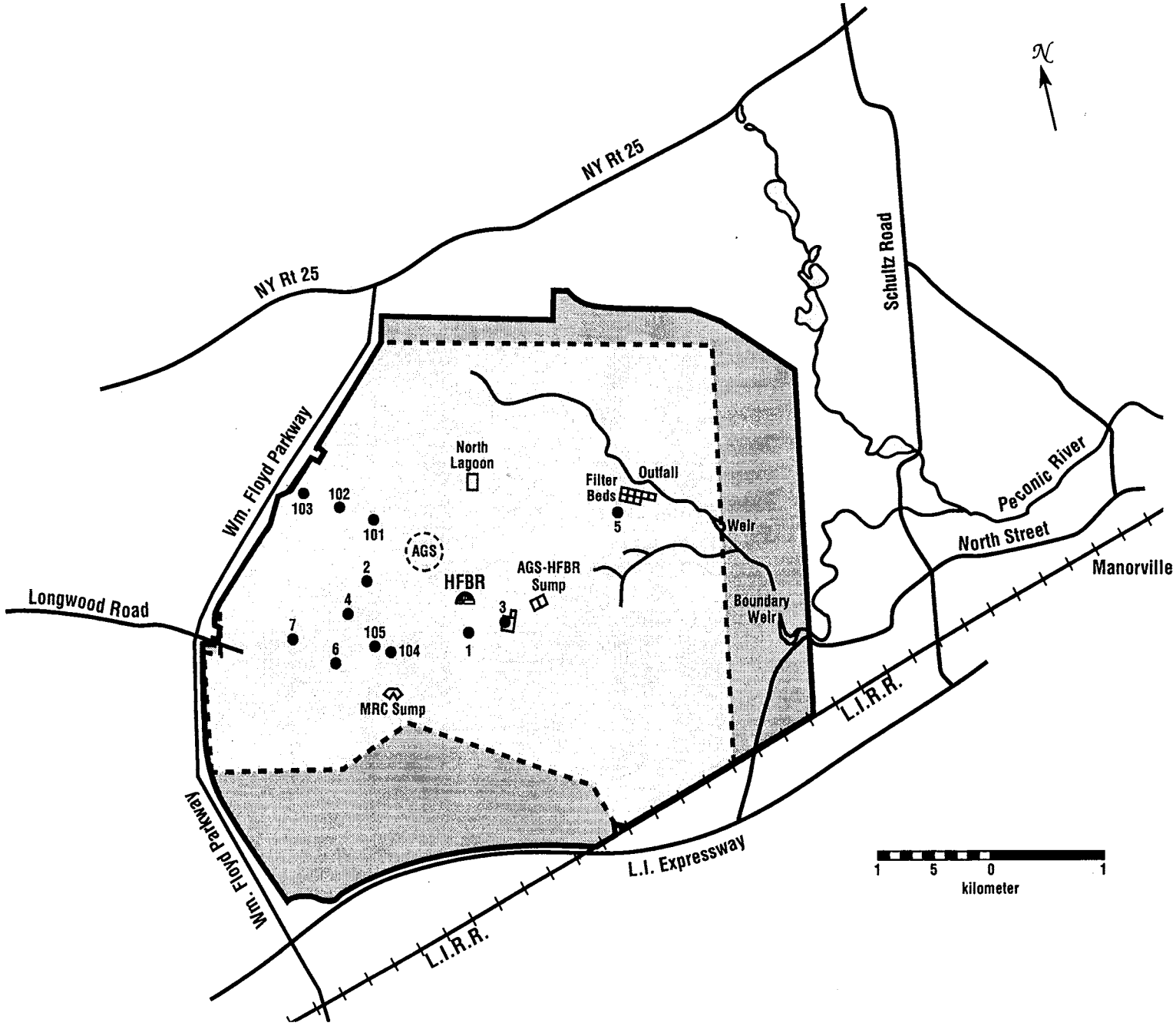

Figure 7. Potable and Cooling Water Supply Wells and Recharge Basins. Single-digit Designations are Potable Water Supply Wells and 3-digit Destinations are Cooling Water.

Vegetation samples were obtained in 1969 along the Peconic River between the Chlorinating Plant and Riverhead. The highest average concentration of ^{60}Co was at 6 pCi/g, and ^{137}Cs at 1.1 pCi/g at sampling station K (Table C-11).

For fish obtained in April at station Q, the new site perimeter, the largest concentration of ^{60}Co was 0.036 pCi/g and for ^{137}Cs, 1.6 pCi/g. In August, the largest concentration of ^{60}Co in the fauna was 0.75 pCi/g in snails, and 1.8 pCi/g for ^{137}Cs in catfish (Table C-11).

4.3.4 1970

The River bottom sediment samples taken at station L indicated ^{60}Co concentration of 23 pCi/g and ^{137}Cs concentration of 8 pCi/gm (Table D-10).

Cobalt-60 and ^{137}Cs concentrations (above fallout backgrounds) in vegetation at sampling station M were 2.3 pCi/g for ^{60}Co and 4.3 pCi/g for ^{137}Cs (Table D-11).

4.4 BNL Potable and Cooling Water Supply Wells

BNL's potable and cooling water supply wells were sampled routinely. These wells are screened at depths from 100 to 150 feet below land surface (50 to 100 feet into the water table). Their locations are given in Figure 7. Drinking-water supplies are designated with single digits, and cooling-water supplies with three digits.

4.4.1 1967

In 1967, the largest yearly average gross beta concentration in the supply wells was less than 3.6 pCi/ℓ (Table A-10), about 0.12% of the applicable radiation protection guide. For tritiated water, the largest annual average concentration was about 1,200 pCi/ℓ (Table A-10) or less than .04% of the applicable radiation protection guide.

4.4.2 1968

In 1968, the largest yearly average gross beta concentration in the supply wells was 4.1 pCi/ℓ (Table B-12), which was 0.14% of the radiation protection guide. For tritiated water, the largest annual average concentration was less than 1,700 pCi/ℓ (Table B-12), or 0.06% of the applicable radiation protection guide.

4.4.3 1969

In 1969, the highest yearly average gross beta concentration in the supply wells was 2.3 pCi/ℓ (Table C-12), which was .08% of the applicable radiation protection guide. The maximum annual tritiated water concentration was about 1,200 pCi/ℓ (Table C-12), less than .04% of the applicable radiation protection guide.

4.4.4 1970

In 1970, the largest yearly gross beta concentration in the supply wells was less than 3.9 pCi/ℓ (Table D-12), which was about 0.13% of the applicable radiation protection guide. For tritiated water, the largest annual concentration was about 1,100 pCi/ℓ (Table D-12), less than .037% of the applicable radiation protection guide.

4.5 Recharge Basins (Sumps)

About 4 x 10^6 gallons per day of the water withdrawn from the aquifer is returned to three recharge basins designated N (North Lagoon), O (AGS-HFBR sump), and P (MRC sump), as shown on Figure 7.

4.5.1 1967

Data for 1967 could not be located.

4.5.2 1968

For 1968, the highest annual average gross beta concentration was ~4.5 pCi/ℓ (Table B-13) or 0.1% of the applicable radiation protection guide and the largest annual tritiated water concentration was less than 1,100 pCi/ℓ; less than .037% of the radiation protection guide (Table B-13).

4.5.3 1969

For 1969, the highest annual average gross beta concentration was ~8.6 pCi/ℓ (Table C-13) or ~0.3% of the applicable radiation protection guide. The tritiated water concentrations again were less than 1,100 pCi/ℓ; less than .037% of the radiation protection guide (Table C-13).

4.5.4 1970

For 1970, the highest annual average gross beta concentration was ~8.6 pCi/ℓ (Table D-13) or ~0.29% of the applicable radiation protection guide. The tritiated water concentrations again were less than 1,100 pCi/ℓ; less than .037% of the radiation protection guide (Table D-13).

4.6 Ground Water Monitoring

Ground water down gradient of a Waste Management area well which was accidentally contaminated in 1960 was monitored during this period. The data on this incident are contained in previously reported documentation.[17]

In 1969, the storm drain for the outside decontamination pad at Building 650, which was not in active use, was found to be discharging to an open sump rather than into the sanitary waste system. Several sampling wells were subsequently installed, and the resulting data are discussed in previously reported documentation.[17]

5. MILK SAMPLING

In 1968 and 1969, monthly milk samples were obtained from the three active Suffolk County dairy farms located 6 km southwest, 10 km southeast, and 15 km northwest of the site.

The milk data show that the occurrences of ^{131}I in the milk follows Chinese weapons tests quite closely, while ^{137}Cs, which persists for longer times both in the atmosphere and in the food chain, occurs in the milk later and is more evenly distributed in time.

In both cases, farming practices such as fertilization frequency, crop rotation, and whether the cows are given stored feed or are in pastures, have an effect on the uptake of radionuclides and their subsequent appearance in milk.

5.1 1967

Data for 1967 could not be located.

5.2 1968

In 1968, monthly milk samples were obtained from the three active Suffolk County dairy farms located 8 km southwest, 10 km southeast, and 15 km northwest of the site. The average value in milk was 1.8 pCi/ℓ of ^{131}I, and 11 pCi/ℓ of ^{137}Cs. The highest value for ^{131}I of 5 pCi/ℓ was seen in January, and the highest ^{137}Cs value of 20 pCi/ℓ in August (Table B-14). The elevated iodine values seen in January reflect the Chinese weapons test of December 24, 1967, while the cesium values reflect deposition throughout the year from the worldwide distribution of the fallout from this test.

The unusual results of 29 to 42 pCi/ℓ of ^{65}Zn in August and October reflect a realization that ^{65}Zn was an unexpected addition to the radionuclides in the fallout from the Chinese weapons test of December 1967.[18]

5.3 1969

In 1969, monthly milk samples were obtained from the three active Suffolk County dairy farms located 8 km southwest, 10 km southeast, and 15 km northwest of the site. The average value in milk was ~3 pCi/ℓ of ^{131}I and ~15 pCi/ℓ of ^{137}Cs. The highest value for ^{131}I of 9 pCi/ℓ was seen in November 1969, shortly after the Chinese atomic nuclear weapons test of September 29. The highest value for ^{137}Cs was 28 pCi/ℓ seen in June (Table C-14).

The results of the 1969 milk samples are particularly instructive in that the BGRR operations had ceased in June of 1969. The September 29 Chinese weapons test, therefore, can be considered the source of the ^{131}I and ^{65}Zn found in these samples.

5.4 1970

In 1970, only two dairies were sampled, one located 8 km southwest and the other 10 km southeast of the site (Table D-14). The annual average ^{131}I concentration in milk was 1.6 pCi/ℓ. For ^{137}Cs, the average value was 26 pCi/ℓ and the maximum value 38 pCi/ℓ occurred in July and August. The averaged tritium concentration was <1,000 pCi/ℓ.

6. GRASS, VEGETATION, AND SOIL SAMPLING

Grass, vegetation, and soil samples were obtained from five farms at various compass points and at distances from 3 to 15 km from the site. The results of the grass and vegetation samples taken in 1968, 1969, and 1970 are given in Tables B-15, C-15, and D-15. The results for soil sampling are given in Tables B-16, C-16, and D-16.

The data for 1967 could not be located. However, there is a study of radioactive ^{65}Zn found in corn mentioned in the August Health Physics and Safety Summary. That study suggested that "trace" concentrations found in corn at a farm 6 kilometers northeast of BNL were in reasonable agreement with those expected based on the average concentrations of ^{65}Zn in the BGRR-HFBR stack effluents.

However, the data for 1968, 1969, and 1970 given in the tables show that there is no significant difference between the samples obtained from farms generally upwind of BNL from those generally downwind from the site. Once again, the consistency of the results between times when the BGRR was operating and after it ceased operation, and the report of ^{65}Zn resulting from the Chinese weapons tests,[18] support the conclusion that there was no measurable deposition from BNL operations.

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APPENDIX A

1967 TABLES

Table A-1. 1967 Background and Source Radiation Levels at the Laboratory Perimeter (mR/week)

Station:	P-2		P-4		P-7		P-9			S-13			O-6	
	Northwest Perimeter		Southwest Perimeter		Southeast Perimeter		Northeast Perimeter			On site			Off site	
Month	Background	^{41}Ar	Background	^{41}Ar	Background	^{41}Ar	Background	^{41}Ar	Ecology Source	Background	^{41}Ar	Ecology Source	Background	^{41}Ar
January	1.9	0.04	2.1	0.28	2.0	0.52	2.3	0.52	1.2	2.2	0.84	0.76	1.9	0.01
February	1.9	0.04	1.7	0.10	1.8	0.24	1.8	0.53	1.2	1.9	0.86	0.62	1.6	0.01
March	1.7	0.09	1.6	0.32	1.7	0.25	1.6	0.40	1.1	1.7	0.86	0.68	1.5	0.01
April	1.9	0.18	1.7	0.14	1.8	0.16	1.8	0.36	1.4	1.8	0.59	0.80	1.7	0.04
May	1.8	0.29	1.7	0.04	1.7	0.45	1.7	0.70	1.6	1.7	1.4	0.87	1.7	0.04
June	1.8	0.22	1.7	0.09	1.6	0.04	1.7	1.4	1.7	1.7	2.4	0.94	1.6	0.04
July	1.9	0.30	1.9	0.49	1.8	0.15	1.8	0.52	2.0	1.9	0.76	1.2	1.7	0.04
August	2.0	0.14	2.0	0.09	1.8	0.07	1.9	0.44	2.0	1.9	1.2	1.2	1.7	0.00
September	2.0	0.14	1.9	0.25	1.8	0.13	1.8	0.13	1.9	1.9	0.28	1.1	1.7	0.02
October	1.9	0.35	1.8	0.00	1.7	0.12	1.8	0.08	1.8	2.0	0.27	1.1	1.8	0.09
November	1.9	0.02	1.9	0.14	1.7	0.31	1.7	0.12	1.3	2.0	0.25	0.94	1.8	0.00
December	1.9	0.18	2.0	0.35	1.7	0.32	1.7	0.06	1.3	2.0	0.15	0.84	1.9	0.06
Average mR/week	1.9	0.17	1.8	0.19	1.8	0.23	1.8	0.44	1.5	1.9	0.82	0.92	1.7	0.03
Total mR/year	99	8.8	94	9.9	94	12	94	23	78	99	43	48	88	<1.6

Table A-2. 1967 Monthly Average Gross Beta Concentrations, Air Particulate Filters (pCi/m^3)

Month	Gross Beta Conc.	Max	Min	^{7}Be	^{65}Zn	^{95}Zr-Nb	^{103}Ru	^{131}I	^{137}Cs	^{140}Ba-La	^{144}Ce
January	0.55										
February	0.28										
March	0.27										
April	0.23										
May	0.13										
June	0.097			Isotopic data not located							
July	0.055										
August	0.047										
September	0.079										
October	0.12										
November	0.056										
December	0.86										
Yearly Average	0.23										

Table A-3. 1967 Monthly Average Gross Beta Concentration and Total Gross Beta Activity in Precipitation

Month	Amount Inches	Gross Beta Conc. pCi/l	Gross Beta Activity nCi/m^2	Nuclide Activity (nCi/m^2)									
				^{7}Be	^{89}Sr	^{90}Sr	^{95}Zr-Nb	^{103}Ru	^{131}I	^{137}Cs	^{140}Ba-La	^{141}Ce	^{144}Ce
January	1.7	260[a]	270[a]										
February	4.0	6.4	9.6										
March	8.2	9.6	14										
April	4.1	6.6	7.2										
May	8.0	3.9	5.6										
June	5.3	1.2	1.5										
July	6.0	2.2	2.5										
August	5.4	0.82	1.2										
September	2.2	0.37	0.6										
October	2.1	0.51	0.93										
November	4.0	3.0	2.4										
December	7.6	1,600[a]	1,800[a]										
Total	58.6		2,100										
Weighted Average[b]		210											

Isotopic data not located

[a]See text, section 2.3.1.

[b]Weighted by inches of rainfall.

Table A-4. 1967 BGRR-HFBR Stack Emission

Month	BGRR (MWd)	HFBR (MWd)	Air volume, m^3	Tritiated Water Vapor Ci	Tritiated Water Vapor pCi/m^3	^{131}I mCi	^{131}I pCi/m^3	^{41}Ar Ci	^{41}Ar pCi/m^3	Particulate Gross Beta Activity Ci	Particulate Gross Beta Activity pCi/m^3
January	358	854	1.8E+08	5.4	3.0E+04	92	5.1E+02	3.6E+05	2.0E+09	24	1.3E+05
February	295	802	1.5E+08	12	8.0E+04	70	4.7E+02	3.0E+05	2.0E+09	21	1.4E+05
March	333	790	1.7E+08	14	8.2E+04	75	4.4E+02	3.4E+05	2.0E+09	23	1.4E+05
April	284	788	1.4E+08	18	1.3E+05	50	3.6E+02	2.8E+05	2.0E+09	19	1.4E+05
May	301	917	1.4E+08	37	2.6E+05	65	4.6E+02	2.9E+05	2.1E+09	18	1.3E+05
June	323	1035	1.6E+08	14	8.8E+04	70	4.4E+02	3.2E+05	2.0E+09	19	1.2E+05
July	196	762	1.0E+08	24	2.4E+05	32	3.2E+02	1.8E+05	1.8E+09	12	1.2E+05
August	168	901	8.5E+07	15	1.8E+05	26	3.1E+02	1.6E+05	1.9E+09	9.7	1.1E+05
September	149	855	7.3E+07	16	2.2E+05	19	2.6E+02	1.5E+05	2.1E+09	8.6	1.2E+05
October	156	767	9.3E+07	14	1.5E+05	19	2.0E+02	1.5E+05	1.6E+09	9.2	9.9E+04
November	150	551	9.3E+07	27	2.9E+05	23	2.5E+02	1.4E+05	1.5E+09	8.8	9.5E+04
December	179	581	1.1E+08	17	1.5E+05	31	2.8E+02	1.6E+05	1.5E+09	11	1.0E+05
Annual total	2,892	9,603	1.5E+09	210		570		2.8E+06		180	
Average					1.6E+05		3.6E+02		1.9E+09		1.2E+05

Table A-5. 1967 Imhoff/Clarifier Tank. Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

Month	Flow 10^9 l	Gross Beta[a] Conc. pCi/l	Gross Beta[a] Amount mCi	Tritiated Water Conc. pCi/l	Tritiated Water Amount mCi	^{90}Sr[b] Conc. pCi/l	^{90}Sr[b] Amount mCi	^{137}Cs[b] Conc. pCi/l	^{137}Cs[b] Amount mCi
January	0.087	23	2.0	18,000	1,600	1.2	0.10	2.3	0.20
February	0.083	25	2.1	13,000	1,100	1.3	0.11	2.5	0.21
March	0.089	490[d]	44	6,200	550	1.4	0.12	2.8	0.25
April	0.13	52	6.8	7,100	920	1.0	0.13	2.0	0.26
May	0.1	28	2.9	4,000	400	1.4	0.14	2.8	0.29
June	0.12	23	2.7	4,000	480	1.2	0.14	2.3	0.27
July	0.13	41	5.2	3,200	420	2.1	0.27	4.1	0.52
August	0.12	23	2.8	4,200	500	1.2	0.15	2.3	0.28
September	0.11	15	1.6	3,100	340	0.8	0.09	1.5	0.16
October	0.1	48	4.9	7,300	730	2.4	0.25	4.8	0.49
November	0.089	24	2.1	9,000	800	1.2	0.11	2.4	0.21
December	0.082	45	3.7	60,000[d]	4,900	2.3	0.19	4.5	0.37
Total	1.2		81		13,000		1.8		3.5
Weighted Average[c]		68		11,000		1.5		2.9	

[a] Includes gamma-only emitters; does not include tritiated water.

[b] ^{90}Sr and ^{137}Cs reconstructed based on the 1966 ratio to gross beta (^{90}Sr = 5%, ^{137}Cs = 10%), except for the unusual gross beta concentration events of March and April, which were known to be Tungsten-185 (see section 4.1.1). For these two months, the ^{90}Sr and ^{137}Cs values were based on those in the preceding and following months.

[c] Weighted average concentration = total amount (mCi)/total flow (10^9 l).

[d] See section 4.1.1.

Table A-6. 1967 Chlorinating Plant. Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

		Gross Beta[a]		Tritiated Water		^{90}Sr[b]		^{137}Cs[b]	
Month	Flow 10^9 l	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi
January	0.062	20	1.2	18,000	1,100	2.0	0.12	10.0	0.62
February	0.054	25	1.4	13,000	700	2.5	0.14	13.0	0.71
March	0.076	280[d]	21.4	6,200	470	3.3	0.25	17.0	1.30
April	0.12	60	7.0	7,100	850	2.1	0.25	11.0	1.29
May	0.074	38	2.8	4,000	300	3.8	0.28	19.0	1.40
June	0.11	26	2.8	4,000	440	2.6	0.28	13.0	1.42
July	0.12	26	3.2	3,200	380	2.6	0.32	13.0	1.60
August	0.12	29	3.4	4,200	500	2.9	0.34	15.0	1.78
September	0.087	19	1.7	3,100	270	1.9	0.17	9.5	0.83
October	0.092	13	1.2	7,300	670	1.3	0.12	6.5	0.60
November	0.09	19	1.7	9,000	810	1.9	0.17	9.5	0.86
December	0.07	22	1.5	60,000[d]	4,200	2.2	0.15	11.0	0.77
Total	1.1		49		11,000		2.6		13
Weighted Average[c]		46		10,000		2.4		12	

[a] Includes gamma-only emitters; does not include tritiated water.

[b] ^{90}Sr and ^{137}Cs reconstructed based on average of 1966-1968 ratio to gross beta (^{90}Sr 10%, ^{137}Cs 50%), except for the unusual gross beta concentration events of March and April, which were known to be Tungsten-185 (see section 4.1.1). For these two months, the ^{90}Sr and ^{137}Cs values were based on those in the preceding and following months.

[c] Weighted average concentration = total amount (mCi)/total flow (10^9 l).

[d] See section 4.1.1.

Table A-7. 1967 "M" (Former Perimeter). Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

		Gross Beta[a]		Tritiated Water		^{90}Sr[b]		^{137}Cs[b]	
Month	Flow 10^9 l	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi
January	0.065	20	1.3	17,000	1,100	2.0	0.13	10	0.65
February	0.058	26	1.5	12,000	700	2.6	0.15	13	0.76
March	0.087	260[d]	23	5,400	470	2.8	0.24	14	1.3
April	0.12	55	6.6	7,100	850	2.1	0.25	10	1.3
May	0.10	31	3.2	3,000	300	3.1	0.32	16	1.6
June	0.11	21	2.4	4,000	440	2.1	0.24	11	1.2
July	0.12	24	2.8	3,200	380	2.4	0.28	12	1.4
August	0.10	24	2.5	3,500	350	2.4	0.25	12	1.3
September	0.076	15	1.1	2,700	210	1.5	0.11	7.5	0.57
October	0.085	10	0.9	6,700	570	1.0	0.09	5	0.43
November	0.076	16	1.2	7,700	590	1.6	0.12	8.0	0.61
December	0.078	39	3.1	54,000[d]	4,200	3.9	0.31	20	1.5
Total	1.1		50		10,000		2.5		13
Weighted Average[c]		45		9,100		2.3		12	

[a] Includes gamma-only emitters; does not include tritiated water.

[b] ^{90}Sr and ^{137}Cs reconstructed based on average of 1966-1968 ratio to gross beta (^{90}Sr 10%, ^{137}Cs 50%) except for the unusual gross beta concentration events of March and April, which were known to be Tungsten-185 (see section 4.1.1). For these two months, the ^{90}Sr and ^{137}Cs values were based on those in the preceding and following months.

[c] Weighted average concentration = total amount (mCi)/total flow (10^9 l).

[d] See section 4.1.1.

Table A-8. 1967 "Q" (Current Perimeter).[a] Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

Month	Flow 10^9 l	Gross Beta[b] Conc.[d] pCi/l	Gross Beta[b] Amount mCi	Tritiated Water Conc.[d] pCi/l	Tritiated Water Amount mCi	^{90}Sr[c] Conc.[d] pCi/l	^{90}Sr[c] Amount mCi	^{137}Cs[c] Conc.[d] pCi/l	^{137}Cs[c] Amount mCi	Riverhead Flow 10^9 l
January	0.045	20	0.90	17,000	770	2.0	0.09	10	0.45	1.1
February	0.045	26	1.2	12,000	540	2.5	0.11	13	0.59	1.1
March	0.08	260[e]	21	5,400	430	2.8	0.22	14	1.1	2.0
April	0.087	55	4.8	7,100	620	2.1	0.18	10	0.87	2.2
May	0.10	31	3.1	3,000	300	3.1	0.31	16	1.6	2.6
June	0.099	28	2.8	4,000	400	2.1	0.21	11	1.1	2.5
July	0.096	24	2.3	3,200	310	2.4	0.23	12	1.2	2.4
August	0.085	24	2.0	3,500	300	2.4	0.20	12	1.0	2.1
September	0.064	15	0.96	2,700	170	1.5	0.10	7.5	0.48	1.6
October	0.06	10	0.60	6,700	400	1.0	0.06	5	0.30	1.5
November	0.061	16	0.97	7,700	470	1.6	0.10	8	0.49	1.5
December	0.077	39	3.0	54,000[e]	4,200	3.9	0.30	20	1.5	1.9
Total	0.9		44		8,900		2.1		11	22
Average		49		9,900		2.3		12		

[a] Flow inferred from 1/25 of USGS measured flow at Riverhead. The weir not installed at station "Q" until 1969.

[b] Includes gamma-only emitters; does not include tritiated water.

[c] ^{90}Sr and ^{137}Cs reconstructed based on the 1966 ratio to gross beta (^{90}Sr = 5%, ^{137}Cs = 10%), except for the unusual gross beta concentration events of March and April, which were known to be Tungsten-185 (see section 4.1.1). For these two months, the ^{90}Sr and ^{137}Cs values were based on those in the preceding and following months.

[d] Concentrations measured at "M" assumed for "Q."

[e] See section 4.1.1.

Table A-9. 1967 Monthly Downstream and Control Location Water Grab Samples. Gross Beta and Tritiated Water Concentration

	Downstream Locations								Control Locations				
Month	A	B	C	D	K	L	M[a]	Q	E	F	H	I	J
Gross Beta (pCi/l)													
January	15	7.1	6.9	14	19	20	22	18	-	330	9.7	99	4.9
February	14	8.6	8.2	18	26	25	18	24	5.1	16	3.4	22	7.0
March	20	10	7.6	8.5	74	35	17	67	7.9	100	6.3	17	7.2
April	16	13	11	7.5	58	39	50	47	7.4	23	4.2	18	8.1
May	13	9.8	5.0	6.3	47	40	43	27	5.4	-	8.2	28	9.3
June	21	14	7.6	4.4	35	36	23	48	3.6	27	<1.0	15	6.5
July	9.7	6.4	9.5	6.2	23	30	17	17	4.0	11	1	6.4	6.7
August	1.6	1.7	4.3	2.7	32	27	33	33	2.2	6.2	<1.1	7.7	4.1
September	2.5	1.0	3.3	4.3	15	13	16	20	-	6.4	1.4	6.1	4.7
October	4.1	2.1	3.7	5.5	24	20	28	24	-	5.2	1.8	8.3	4.9
November	3.5	2.3	3.9	5.9	16	12	18	15	-	4.2	1.9	6	4.1
December	3.6	3.7	2.1	2.7	12	14	22	14	-	7.3	1.3	4.3	3.5
Yearly Average	10	6.7	6.1	7.2	32	26	26	30	5.1	48	<28	20	5.9
Tritiated Water (pCi/l)													
January	<1,000	<1,000	<1,000	<1,000	7,600	6,400	16,000	4,800	-	1,100	-	<1,000	<1,000
February	<1,000	<1,000	-	-	-	-	16,000	-	-	<1,000	-	-	-
March	<1,000	<1,000	1,600	<1,000	3,200	2,300	5,800	3,400	<1,000	1,000	<1,000	<1,000	1,100
April	<1,000	<1,000	<1,000	<1,000	3,000	2,600	2,600	2,900	<1,000	-	<1,000	<1,000	<1,000
May	2,200	<1,000	1,400	<1,000	1,000	<1,000	-	1,700	1,200	<1,000	<1,000	<1,000	<1,000
June	4,100	<1,000	<1,000	<1,000	6,400	6,000	-	4,100	<1,000	<1,000	<1,000	1,400	<1,000
July	<1,000	<1,000	<1,000	<1,000	4,300	3,800	-	2,300	<1,000	<1,000	<1,000	<1,000	<1,000
August	<1,000	<1,000	2,400	<1,000	<1,000	<1,000	-	2,100	1,800	<1,000	<1,000	<1,000	<1,000
September	<1,000	<1,000	<1,000	<1,000	2,500	3,300	-	3,100	-	<1,000	<1,000	1,300	<1,000
October	<1,000	<1,000	<1,000	<1,000	7,200	7,600	-	8,400	-	<1,000	<1,000	<1,000	<1,000
November	<1,000	<1,200	1,500	<1,200	3,400	18,000	-	2,500	-	<1,200	1,800	<1,200	1,600
December	<1,000	<1,000	<1,000	<1,000	7,200	12,000	-	12,000	-	-	<1,000	<1,000	<1,000
Yearly Average	<1,400	<1,100	<1,300	<1,100	<4,300	<5,900	-	4,300	-	<1,100	<1,100	<1,100	<1,200

[a] Continuous sample

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table A-10. 1967 Gross Beta and Tritiated Water Concentrations in Potable and Cooling Water Supply Wells

Month	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 101	Well 102	Well 103	Well 104	Well 105
Gross Beta (pCi/l)												
January	<1.0	<1.0	<0.9	<1.0	1.5	1.3	<1.0	1.4	1.1	<1.0	-	1.0
February	<1.0	2.1	<0.9	1.4	2.9	<1.0	1.4	4.8	3.0	2.4	<1.2	1.4
March	<1.0	<0.9	<0.9	1.2	1.4	1.2	1.6	4.9	<0.6	1.0	-	1.7
April	1.3	1.3	1.1	1.2	<1.0	1.3	<1.0	-	-	-	-	-
May	<1.0	1.4	1.0	2.2	<0.9	<0.9	2.1	<0.9	2.2	0.9	2.0	<0.9
June	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	1.6	<0.9	1.0	1.3	<1.1	1.1
July	<0.7	<0.6	<0.6	1.0	<0.7	<0.5	<0.6	<0.4	<0.5	<0.6	<0.6	0.8
August	1.7	<0.9	1.4	<1.0	2.4	<1.0	-	14.1	<1.0	<0.9	1.1	<1.0
September	<0.9	1.2	<0.9	1.2	1.4	-	1.4	9.0	-	1.3	1.3	1.9
October	1.7	<0.9	<0.9	1.7	-	1.3	<0.9	<0.9	<0.9	<0.9	<1.0	1.4
November	<0.9	-	2.4	2.0	<0.9	2.2	2.1	1.2	1.5	1.4	1.2	<1.0
December	1.3	<1.0	1.2	1.7	2.3	<1.0	<1.0	<1.0	1.6	2.7	2.2	2.5
Yearly Average	<1.1	<1.1	<1.1	<1.4	<1.5	<1.1	<1.3	<3.6	<1.3	<1.3	<1.3	<1.3
Tritiated Water (pCi/l)												
January	-	-	-	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-	-	-	-
March	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-
April	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-	-	<1,000	-	-
May	<1,000	<1,000	1,300	<1,000	1,700	1,100	<1,000	<1,000	<1,000	1,600	1,600	<1,000
June	1,400	<1,000	<1,000	1,200	<1,000	1,700	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
July	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
August	1,200	<1,000	<1,000	<1,000	<1,000	<1,000	<1,100	<1,000	<1,000	<1,000	<1,000	<1,000
September	<1,100	<1,000	<1,000	1,100	<1,000	<1,000	<1,000	<1,000	-	<1,100	<1,200	<1,100
October	1,400	1,400	<1,000	<1,000	-	-	1,400	<1,000	1,400	<1,000	1,200	1,200
November	1,700	-	<1,000	<1,000	<1,000	1,300	1,300	1,500	1,900	<1,400	<1,000	<1,400
December	<1,000	2,200	1,700	1,500	<1,000	<1,000	<1,000	<1,000	<1,000	1,500	<1,000	<1,000
Yearly Average	<1,200	<1,200	<1,100	<1,100	<1,100	<1,100	<1,200	<1,100	<1,200	<1,200	<1,200	<1,100

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

APPENDIX B

1968 TABLES

Table B-1. 1968 Background and Source Radiation Levels at the Laboratory Perimeter (mR/week)

Station:	P-2		P-4		P-7		P-9			S-13			O-6	
	Northwest Perimeter		Southwest Perimeter		Southeast Perimeter		Northeast Perimeter			On-site			Off-site	
Month	Background	^{41}Ar	Background	^{41}Ar	Background	^{41}Ar	Background	^{41}Ar	Ecology Source	Background	^{41}Ar	Ecology Source	Background	^{41}Ar
January	2.1	0.04	2.8	0.06	2.3	0.35	2.0	0.26	1.2	2.6	0.47	0.72	2.3	0.01
February	1.7	0.01	1.9	0.12	1.8	0.34	1.7	0.04	1.2	1.9	0.11	0.73	1.7	0.01
March	1.6	0.02	1.7	0.11	1.7	0.17	1.6	0.26	1.3	1.7	0.5	0.81	1.6	0.0
April	1.7	0.23	1.9	0.06	1.9	0.09	1.7	0.27	1.5	1.8	0.54	0.92	1.6	0.04
May	1.7	0.05	1.9	0.16	1.9	0.07	1.7	0.54	1.6	1.8	0.87	0.98	1.6	0.01
June	1.7	0.1	1.9	0.02	1.8	0.15	1.7	0.45	1.8	1.7	0.65	1.1	1.6	0.02
July	1.7	0.0	1.9	0.0	1.7	0.0	1.6	0.0	1.9	1.8	0.0	1.1	1.6	0.0
August	1.9	0.0	2.1	0.0	1.9	0.0	1.8	0.0	2.1	2.0	0.0	1.2	1.7	0.0
September	1.9	0.0	2.0	0.0	1.9	0.0	1.9	0.0	2.0	2.0	0.0	1.2	1.7	0.0
October	1.7	0.0	1.9	0.0	1.8	0.0	1.7	0.0	1.7	1.8	0.0	0.98	1.7	0.0
November	1.7	0.02	1.9	0.0	1.9	0.0	1.7	0.02	1.5	1.8	0.03	0.9	1.7	0.01
December	1.7	0.0	1.7	0.0	1.8	0.0	1.6	0.0	1.3	1.7	0.0	0.72	1.6	0.0
Average mR/week	1.8	0.04	2.0	0.04	1.9	0.1	1.7	0.2	1.6	1.9	0.26	0.95	1.7	0.01
Total mR/year	94	2.1	100	2.1	99	5.2	88	10.0	83	99	14	49	88	0.52

Table B-2. 1968 Monthly Average Gross Beta Concentrations, Air Particulate Filters (pCi/m^3)

Month	Average Gross Beta	^{7}Be	^{65}Zn	^{95}Zr-Nb	^{103}Ru	^{131}I	^{137}Cs	^{140}Ba-La	^{144}Ce
January	0.35	0.2	<0.001	0.13	0.012	0.056	<0.005	0.047	0.024
February	0.31	0.29	<0.001	0.08	0.012	0.004	<0.005	0.015	0.02
March	0.27	0.2	<0.001	0.075	0.009	<0.001	<0.005	0.001	0.012
April	0.36	0.25	<0.001	0.12	0.015	<0.001	<0.005	0.001	0.016
May	0.27	0.13	<0.001	0.11	0.020	<0.001	0.013	<0.001	0.014
June	0.24	0.15	<0.001	0.044	<0.010	<0.001	0.009	<0.001	0.05
July	0.32	0.21	<0.001	0.04	<0.010	<0.001	0.013	<0.001	0.033
August	0.20	0.15	<0.001	0.024	<0.010	<0.001	0.008	<0.001	0.048
September	0.22	0.15	0.002	0.015	<0.010	0.001	0.008	<0.001	0.043
October	0.20	0.13	0.002	0.01	<0.010	<0.001	0.005	<0.001	0.023
November	0.086	0.078	0.001	0.005	<0.010	<0.001	0.003	<0.001	0.018
December	0.089	0.089	0.001	0.004	<0.010	<0.001	0.003	<0.001	0.017
Yearly Average	0.24	0.17	<.0012	0.055	<0.012	<0.006	<0.007	<0.006	0.027

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table B-3. 1968 Monthly Average Gross Beta Concentrations and Total Gross Beta Activity in Precipitation

Month	Amount Inches	Gross Beta Conc. pCi/l	Gross Beta Activity nCi/m^2	Nuclide Activity (nCi/m^2)									
				^{7}Be	^{89}Sr	^{90}Sr	^{95}Zr-Nb	^{103}Ru	^{131}I	^{137}Cs	^{140}Ba-La	^{141}Ce	^{144}Ce
January	2.4	480	29	5.2	0.51	0.09	2.1	0.81	1.90	<0.20	3.50	1.9	<1.0
February	2.3	98	6	7.1	0.30	0.20	1.9	0.20	0.50	<0.20	0.50	0.50	<1.0
March	7.2	61	11	9.9	0.30	0.30	3.3	0.30	0.40	0.30	<0.50	0.40	<1.0
April	1.9	88	4.3	3.7	0.30	0.07	1.3	0.20	<0.10	0.20	<0.50	0.20	<1.0
May	4.1	100	11	1.8	0.14	0.24	2.1	0.30	<0.10	0.20	<0.50	<0.30	<1.0
June	4.5	68	8.1	12	0.11	0.13	2.2	<0.10	<0.10	0.70	<0.50	<0.30	2.5
July	0.42	98	1.2	1.5	<0.05	0.043	1.4	<0.10	<0.10	0.10	<0.50	<0.30	0.3
August	2.8	45	3.1	3.7	<0.05	0.07	0.30	<0.10	<0.10	0.10	<0.50	<0.30	0.6
September	1.6	32	1.8	2.4	<0.05	0.08	0.20	<0.10	0.10	<0.05	<0.50	<0.30	1.2
October	2.5	26	1.6	2.7	<0.05	0.08	0.19	<0.10	0.15	0.11	<0.50	<0.30	1.1
November	6.9	19	3.3	5.8	0.02	0.16	0.30	<0.10	<0.10	0.10	<0.50	<0.30	1.3
December	7.3	15	3.4	6.1	0.05	0.10	0.37	<0.10	<0.10	0.14	<0.50	<0.30	-
Total	44		84	62	<1.9	1.6	16	<2.5	<3.8	<2.4	<9.0	<5.4	<12
Weighted Average[a]		72											

[a]Weighted by inches of rainfall.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table B-4. 1968 BGRR-HFBR Stack Emission

Month	BGRR (MWd)	HFBR (MWd)	Air volume, m^3	Tritiated Water Amount Ci	Tritiated Water Conc. pCi/m^3	^{131}I mCi	^{131}I pCi/m^3	^{41}Ar Ci	^{41}Ar pCi/m^3	Particulate Gross Beta Activity Ci	Particulate Gross Beta Activity pCi/m^3
January	156	863	1.0E+08	13	1.3E+05	31	3.1E+02	1.7E+05	1.7E+09	9.9	9.9E+04
February	139	1,052	8.5E+07	13	1.5E+05	22	2.6E+02	1.3E+05	1.5E+09	7.8	9.2E+04
March	169	608	1.0E+08	20	2.0E+05	21	2.1E+02	1.7E+05	1.7E+09	9.6	9.6E+04
April	127	956	8.5E+07	15	1.8E+05	17	2.0E+02	1.3E+05	1.5E+09	7.6	8.9E+04
May	157	868	1.3E+08	19	1.5E+05	16	1.2E+02	1.5E+05	1.2E+09	9.2	7.1E+04
June	103	948	7.6E+07	24	3.2E+05	11	1.4E+02	9.0E+04	1.2E+09	5.8	7.6E+04
July	0	765	1.9E+07	38	2.0E+06	0.069	3.7E+00	0.0E+00	0.0E+00	0.1	5.3E+03
August	0	1,048	1.9E+07	47	2.5E+06	<0.01	5.3E-01	0.0E+00	0.0E+00	0.1	5.3E+03
September	0	802	1.8E+07	44	2.4E+06	<0.01	5.6E-01	0.0E+00	0.0E+00	0.1	5.6E+03
October	0	678	1.9E+07	62	3.3E+06	<0.01	5.3E-01	0.0E+00	0.0E+00	0.1	5.3E+03
November	8	951	1.9E+07	52	2.7E+06	0.17	8.9E+00	5.5E+03	2.9E+08	0.5	2.6E+04
December	0	794	1.9E+07	37	1.9E+06	<0.01	5.3E-01	0.0E+00	0.0E+00	0.1	5.3E+03
Annual total	859	10,333	6.9E+08	380		<120		8.5E+05		51	
Average					1.3E+06		8.5E+05		7.6E+08		4.8E+04

Table B-5. 1968 Clarifier. Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

Month	Flow 10^9 l	Gross Beta[a] Conc. pCi/l	Gross Beta[a] Amount mCi	Tritiated Water Conc. pCi/l	Tritiated Water Amount mCi	^{90}Sr Conc. pCi/l	^{90}Sr Amount mCi	^{137}Cs Conc. pCi/l	^{137}Cs Amount mCi
January	0.087	27	2.3	14,000	1,200	7.0	0.61	6.0	0.52
February	0.097	17	1.7	7,500	730	4.0	0.39	1.0	0.10
March	0.12	24	2.9	2,300	280	2.0	0.24	<1.0	0.12
April	0.12	14	1.7	22,000	2,700	1.0	0.12	<1.0	0.12
May	0.13	19	2.5	23,000	3,000	1.3	0.17	1.0	0.13
June	0.18	11	2.0	2,700	490	0.5	0.10	1.0	0.18
July	0.15	15	2.3	3,200	480	0.5	0.07	3.0	0.45
August	0.15	12	1.8	6,700	1,000	0.5	0.08	1.0	0.15
September	0.15	11	1.6	3,200	470	0.6	0.09	1.0	0.15
October	0.12	9.0	1.1	57,000	6,700	0.45	0.05	1.0	0.12
November	0.10	15	1.5	48,000	4,900	2.3	0.23	1.0	0.10
December	0.095	8.0	0.8	8,600	820	0.2	0.02	0.6	0.06
Total	1.5		22		23,000		2.2		2.2
Weighted Average[b]		15		15,000		1.5		<1.5	

[a] Includes gamma-only emitters; does not include tritiated water.

[b] Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table B-6. 1968 Chlorinating Plant. Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

		Gross Beta[a]		Tritiated Water		^{90}Sr		^{137}Cs	
Month	Flow 10^9 l	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi
January	0.067	21	1.4	16,000	1,100	2.0	0.13	9.0	0.6
February	0.057	17	0.97	8,200	470	3.0	0.17	9.0	0.51
March	0.07	29	2.0	2,800	200	4.0	0.28	7.0	0.49
April	0.1	17	1.7	19,000	1,900	2.0	0.20	5.0	0.50
May	0.11	19	2.1	15,000	1,700	1.8	0.20	8.0	0.88
June	0.15	14	2.1	2,500	380	0.95	0.14	9.0	1.4
July	0.079	17	1.3	2,000	160	0.8	0.06	6.0	0.47
August	0.13	15	2.0	6,700	870	0.6	0.08	8.0	1.0
September	0.13	15	2.0	3,800	490	1.3	0.17	8.0	1.0
October	0.11	10	1.1	32,000	3,500	0.86	0.95	5.0	0.55
November	0.087	11	0.96	35,000	3,000	4.6	0.40	5.0	0.44
December	0.051	8	0.41	14,000	710	0.3	0.02	5.0	0.26
Total	1.1		18		14,000		2.0		8.1
Weighted Average[b]		16		13,000		1.8		7.4	

[a] Includes gamma-only emitters; does not include tritiated water.

[b] Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table B-7. 1968 "M" (Former Perimeter). Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

		Gross Beta[a]		Tritiated Water		^{90}Sr		^{137}Cs	
Month	Flow 10^9 l	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi
January	0.083	21	1.7	14,000	1,200	2.0	0.16	8.0	0.64
February	0.074	17	1.2	8,000	590	3.0	0.21	7.0	0.49
March	0.11	20	2.2	2,500	280	2.0	0.22	4.0	0.44
April	0.12	15	1.8	19,000	2,200	2.0	0.24	4.0	0.48
May	0.12	17	2.0	15,000	1,800	1.8	0.22	7.0	0.84
June	0.15	16	2.4	2,500	380	1.2	0.18	9.0	1.4
July	0.10	15	1.5	2,200	220	1.2	0.12	6.0	0.60
August	0.12	15	1.8	7,600	910	0.89	0.11	8.0	0.96
September	0.082	12	0.96	4,000	320	1.0	0.08	7.0	0.56
October	0.10	10	1.0	37,000	3,700	1.0	0.10	5.0	0.50
November	0.10	15	1.5	35,000	3,500	4.1	0.41	5.2	0.52
December	0.10	9	0.90	12,000	1,200	0.8	0.08	4.0	0.40
Total	1.3		19		16,000		2.1		7.8
Weighted Average[b]		15		12,000		1.6		6.0	

[a] Includes gamma-only emitters; does not include tritiated water.

[b] Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table B-8. 1968 "Q" (Current Perimeter). Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations[a]

Month	Flow 10^9 l	Gross Beta[b] Conc. pCi/l	Gross Beta[b] Amount mCi	Tritiated Water Conc. pCi/l	Tritiated Water Amount mCi	^{90}Sr Conc. pCi/l	^{90}Sr Amount mCi	^{137}Cs Conc. pCi/l	^{137}Cs Amount mCi
January	0.083	21	1.7	14,000	1,200	2.0	0.17	8.0	0.66
February	0.074	17	1.3	8,000	590	3.0	0.22	7.0	0.52
March	0.11	20	2.2	2,500	280	2.0	0.22	4.0	0.44
April	0.12	15	1.8	19,000	2,300	2.0	0.24	4.0	0.48
May	0.12	17	2.0	15,000	1,800	1.8	0.22	7.0	0.84
June	0.15	16	2.4	2,500	380	1.2	0.18	9.0	1.40
July	0.049	15	0.7	2,200	110	1.2	0.06	6.0	0.29
August	0.12	15	1.8	7,600	910	0.89	0.11	8.0	0.96
September	0.082	12	1.0	4,000	330	1.0	0.08	7.0	0.57
October	0.10	10	1.0	37,000	3,700	1.0	0.10	5.0	0.50
November	0.0001	11[c]	0.0011	47,000[c]	4.7	-	-	-	-
December	0.029	8[c]	0.2	13,000[c]	380	1.0[c]	0.03	5.0[c]	0.15
Total	1.0		16.0		12,000		1.6		6.8
Weighted Average[d]		16		12,000		1.6		6.8	

[a]Concentrations measured at "M" assumed for "Q."

[a] Includes gamma-only emitters; does not include tritiated water.

[c]Actual measurements at new weir used at "Q" for November and December.

[d]Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table B-9. 1968 Monthly Downstream and Control Location Water Grab Samples. Gross Beta and Tritiated Water Concentrations

	Downstream Locations								Control Locations				
Month	A	B	C	D	K	L	M[a]	Q	E	F	H	I	J
Gross Beta (pCi/l)													
January	11	12	21	14	19	13	23	52	-	26	12	46	20
February	9.0	8.0	6.0	6.0	43	23	16	18	5.0	9.0	3.0	26	17
March	15	9.0	6.0	42	11	10	14	9.0	-	11	3.0	2.0	9.0
April	8.0	7.0	4.0	5.0	14	14	14	22	4.0	7.0	2.0	12	7.0
May	9	6.0	7.0	8.0	12	11	17	12	6.0	4.0	4.0	8.0	6.0
June	10	9.0	13	5.0	14	12	20	17	-	10	3.0	40	7.0
July	-	-	-	-	-	-	-	-	-	-	-	-	-
August	6.0	3.0	4.0	39	16	11	10	20	-	9.0	2.0	9.0	16
September	7.0	7.0	4.0	11	10	14	12	21	-	150	5.0	7.0	7.0
October	6.0	2.0	4.0	4.0	4.0	12	9	10	-	5.0	1.0	15	18
November	8.0	8.0	5.0	4.0	13	15	10	11[a]	7.0	10	3.0	<1.0	6.0
December	5.0	4.0	6.0	3.0	11	15	9	9[a]	5.0	9.0	2.0	7.0	5.0
Yearly Average	8.5	7.0	7.0	13	15	14	14	18	5.4	23	4.0	<16	11
Tritiated Water (pCi/l)													
January	b	b	b	b	b	b	b	b	b	b	b	b	b
February	<1,000	1,000	<1,000	<1,000	8,000	6,000	7,000	6,000	1,000	<1,000	<1,000	<1,000	1,000
March	<1,000	1,400	<1,000	<1,000	<1,000	1,600	3,000	<1,000	-	<1,000	<1,000	<1,000	<1,000
April	3,800	1,800	1,600	<1,000	17,000	22,200	26,000	8,500	<1,000	1,400	<1,000	<1,000	<1,000
May	<1,000	<1,000	1,300	<1,000	13,000	13,000	37,000	2,000	-	<1,000	<1,000	<1,000	<1,000
June	<1,000	<1,000	<1,000	1,200	3,800	2,000	2,000	2,200	<1,000	<1,000	1,800	<1,000	1,400
July	-	-	-	-	-	-	-	-	-	-	-	-	-
August	<1,000	<1,000	<1,000	<1,000	7,200	7,900	20,000	15,000	-	1,000	<1,000	<1,000	<1,000
September	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	1,000	<1,000	-	<1,000	<1,000	1,000	<1,000
October	<1,000	<1,000	<1,000	<1,000	4,000	5,000	4,000	5,700	-	<1,000	1,100	<1,000	<1,000
November	<1,000	<1,000	<1,000	<1,000	8,000	<1,000	12,000	14,000[a]	<1,000	<1,000	<1,000	<1,000	<1,000
December	2,000	1,000	<1,000	<1,000	4,000	4,000	7,000	20,000[a]	<1,000	<1,000	<1,000	<1,000	<1,000
Yearly Average	<1,400	<1,100	<1,100	<1,000	<6,700	<6,400	12,000	<7,600	<1,000	<1,100	<1,100	<1,000	<1,000

[a]Continuous sample.

[b]Tritium data were all over 100,000 pCi/l and were not reported since they were believed to be due to a counting artifact.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table B-10. 1968 Bottom Sediment Sample Concentrations

Month	Peconic Location	^{60}Co pCi/g (dry)	^{65}Zn pCi/g (dry)	^{95}Zr-Nb pCi/g (dry)	^{137}Cs pCi/g (dry)	^{144}Ce pCi/g (dry)
March	K	0.3	0.1	<0.1	1.5	1.0
	L	2.3	0.7	<0.1	5.8	0.2
	M	24	1.5	<0.1	13	11
	Q	3.7	0.4	0.9	3.3	2.2
	A	<0.1	<0.1	0.2	0.7	0.6
	B	<0.1	<0.1	0.1	0.5	0.2
	C	0.2	0.1	0.1	0.9	1.0
	D	<0.1	<0.1	<0.1	0.3	0.3
Controls	F	<0.1	<0.1	<0.1	0.9	<0.1
	H	<0.1	<0.1	1.4	<0.1	0.5
	I	<0.1	<0.1	0.9	0.5	0.4
	J	<0.1	<0.1	0.4	<0.1	0.1
Sumps	N	<0.1	<0.1	1.6	2.1	0.5
	O	0.2	<0.1	0.3	0.3	<0.1
July	M	11	-	-	8.3	-

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table B-11. 1968 Concentrations of Gamma-emitting Nuclides in Animals and Vegetation Obtained from the Peconic River

Month	Sample	Station	^{60}Co pCi/g (wet)	^{137}Cs pCi/g (wet)
July	turtles	L	<1.0	3.9
	fish	M	<1.0	7.9
		Q	<1.0	4.7
		A	<1.0	5.4
		B	<1.0	2.0
	frogs	M	<1.0	14
		A	<1.0	1.8
		B	<1.0	3.5
		Q	<1.0	3.0
	tadpoles	M	2.7	1.8
	vegetation	L	-	1.6
		M	1.4	-

< means that the value is less than or equal to the detection limit ˝ or a summation or average value in which one of the components was a < value.

Table B-12. 1968 Gross Beta and Tritiated Water Concentrations in Potable and Cooling Water Supply Wells

Month	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 101	Well 102	Well 103	Well 104	Well 105
Gross Beta (pCi/l)												
January	1.0	<1.0	<1.0	1.5[a]	1.7	1.1	-	5.4	<1.0	1.2	-	-
February	1.3	1.1	<1.0	2.2	1.2	2.4	-	<1.0	<1.0	<1.0	-	-
March	<1.0	2.1	1.2	3.8	7.3	2.7	-	1.8	2.0	4.2	-	8.8
April	2.6	15	1.9	3.6	1.9	-	-	1.7	1.4	2.2	-	-
May	<1.0	4.2	<1.0	3.0	1.8	2.9	1.6	6.3	<1.0	<1.0	-	8.5
June	1.5	1.3	2.0	1.1	2.4	1.4	<1.0	<1.0	1.0	1.5	1.2	3.2
July	-	-	-	-	-	-	-	-	-	-	-	-
August	1.3	-	<1.0	1.2	3.8	1.0	<1.0	<1.0	<1.0	1.6	3.6	4.6
September	1.5	1.2	2.2	1.6	1.3	3.1[b]	6.5	1.1	<1.0	1.6	1.8	1.9
October	2.9	3.9	<1.0	-	1.2	6.6	2.1	-	-	-	1.1	3.6
November	3.1	1.5	11	4.7	3.9	2.7	1.6	2.7	1.6	1.8	-	1.2
December	1.1	2.0	4.3	1.5	<1.0	1.4	<1.0	<1.0	<1.0	1.9	1.8	1.0
Yearly Average	<1.7	<3.3	<2.5	2.4	<2.5	2.5	<2.1	<2.3	<1.2	<1.8	1.9	4.1
Tritiated Water (pCi/l)												
January	c	c	c	c	c	c	c	c	c	c	c	c
February	<1,000	1000	<1,000	<1,000	<1,000	<1,000	-	<1,000	<1,000	<1,000	-	-
March	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-	<1,000	<1,000	<1,000	-	1,100
April	<1,000	<1,000	<1,000	<1,000	<1,000	-	-	<1,000	<1,000	<1,000	-	-
May	<1,000	<1,000	<1,000	<1,000	1,100	<1,000	<1,000	<1,000	1,100	<1,000	-	<1,000
June	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
July	-	-	-	-	-	-	-	-	-	-	-	-
August	1,000	-	1,300	<1,000	1,100	<1,000	<1,000	<1,000	<1,000	<1,000	1,100	<1,000
September	<1,000	<1,000	<1,000	<1,000	7,400	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
October	<1,000	<1,000	<1,000	-	<1,000	<1,000	<1,000	-	-	<1,000	<1,000	<1,000
November	<1,000	<1,000	<1,000	<1,000	1,200	<1,000	<1,000	<1,000	1,100	<1,000	-	<1,000
December	<1,000	<1,000	<1,000	<1,000	1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
Yearly Average	<1,000	<1,000	<1,100	<1,100	<1,700	<1,000	<1,000	<1,000	<1,100	<1,000	<1,100	<1,100

[a]Resampled; original value was 26 pCi/l.

[b]Resampled; orginal value was 220 pCi/l.

[c]Tritium data were all over 100,000 pCi/l and were not reported since they were believed to be due to a counting artifact.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table B-13. 1968 Monthly On-site Sump Samples. Gross Beta and Tritiated Water Concentrations

Month	N North of AGS	O East of HFBR	P Medical
Beta (pCi/l)			
January	4.3	1.4	2.3
February	3.4	1.1	-
March	4.0	2.0	a
April	4.7	6.3	15
May	2.0	2.0	12[b]
June	4.9	3.9	2.5
July	-	-	-
August	3.1	1.2	1.2
September	3.6	2.3	<1.0
October	3.9	<1.0	1.8
November	3.0	3.0	3.0
December	4.0	2.0	2.0
Yearly Average	3.7	<2.4	<4.5
Tritiated Water (pCi/l)			
January	c	c	c
February	<1,000	<1,000	-
March	<1,000	<1,000	-
April	<1,000	<1,000	1,400
May	<1,000	<1,000	<1,000
June	<1,000	<1,000	<1,000
July	-	-	-
August	1,000	<1,000	<1,000
September	<1,000	<1,000	<1,000
October	<1,000	<1,000	1,200
November	<1,000	<1,000	<1,000
December	<1,000	<1,000	<1,000
Yearly Average	<1,000	<1,000	<1,100

[a]Dry

[b]Resampled; original value was 47 pCi/l.

[c]Tritium data were all over 100,000 pCi/l and were not reported since they were believed to be due to a counting artifact.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table B-14. Concentrations in 1968 Milk Samples from Off-site Dairies

	Farm B' (8 km SW)			Farm C (10 km SE)			Farm D (15 km NW)		
Month	^{65}Zn pCi/l	^{131}I pCi/l	^{137}Cs pCi/l	^{65}Zn pCi/l	^{131}I pCi/l	^{137}Cs pCi/l	^{65}Zn pCi/l	^{131}I pCi/l	^{137}Cs pCi/l
January	<10	4.0	8.0	<10	3.0	8.0	<10	5.0	14
February	<10	<1.0	8.0	<10	<1.0	<5.0	<10	3.0	11
March	<10	2.0	12	<10	2.0	19	<10	2.0	8.0
April	<10	1.0	7.0	<10	1.0	13	<10	3.0	8.0
May	<10	1.0	9.0	<10	1.0	9.0	<10	1.0	5.0
June	<10	1.0	9.0	<10	1.0	18	<10	1.0	15
July	<10	1.0	15	<10	2.0	4.0	<10	2.0	9.0
August	29[a]	1.0	11	23[a]	3.0	20	<10	2.0	14
September	<10	1.0	15	<10	1.0	9.0	<10	2.0	13
October	33[a]	2.0	17	35[a]	2.0	11	42[a]	2.0	17
November[b]	-	-	-	-	-	-	-	-	-
December[b]	-	-	-	-	-	-	-	-	-
Yearly Average	<14	<4.5	11	<14	<1.7	<12	<13	2.3	11

[a]See section 5.2.

[b]Next quarterly sampling in January 1969.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table B-15. Concentrations in 1968 Vegetation Sampled from Off-site Farms

Location	Month	^{7}Be	^{95}Zr-Nb	^{137}Cs	^{144}Ce
		pCi/kg (wet)			
Farm A (3 km NW)	July	500	<200	100	600
	October	1,900	400	1,300	800
Farm B' (8 km SW)	July	1,200	300	100	1,100
	October	1,000	100	100	100
Farm C (10 km SE)	July	2,300	500	300	1,000
	October	1,000	200	200	<100
Farm D (15 km NW)	July	800	200	<100	2,100
	October	900	100	<100	300
Farm H (6 km NE)	July	<500	400	100	3,100
	October	1,700	100	100	100

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table B-16. Concentrations in 1968 Soil Sampled from Off-site Farms

Location	Month	^{7}Be	^{95}Zr-Nb	^{137}Cs	^{144}Ce	^{238}U	^{232}Th
		pCi/kg (dry)					
Farm A (3 km NW)	July	<500	300	600	<100	900	700
	October	<500	300	2,000	200	<500	200
Farm B (6 km SW)	July	<500	300	700	<100	1,200	1,600
Farm B' (8 km SW)	July	<500	100	200	<100	2,700	2,200
	October	<500	100	1,000	<100	400	1,100
Farm C (10 km SE)	July	<500	900	800	<100	1,200	1,900
	October	<500	800	1,600	<100	-	600
Farm D (15 km NW)	July	<500	500	1,900	<100	1,500	2,600
	October	<500	200	1,800	<100	<500	200
Farm H (6 km NE)	July	<500	900	800	<100	1,400	1,300
	October	<500	200	800	<100	800	1,400

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

APPENDIX C

1969 TABLES

Table C-1. 1969 Background and Source Radiation Levels at the Laboratory Perimeter (mR/week)

Station:	P-2		P-4		P-7		P-9			S-13			O-6	
	Northwest Perimeter		Southwest Perimeter		Southeast Perimeter		Northeast Perimeter			On-site			Off-site	
Month	Background	Ar-41	Background	Ar-41	Background	Ar-41	Background	Ar-41	Ecology Source	Background	Ar-41	Ecology Source	Background	Ar-41
January	1.7	0.05	1.7	0.01	1.7	0.04	1.6	0.05	1.2	1.7	0.08	0.68	1.5	0.01
February	1.6	0.04	1.5	-	1.6	0.14	1.5	0.05	1.3	1.6	0.11	0.70	1.4	-
March	1.6	0.00	1.5	0.0	1.6	0.20	1.4	0.00	1.4	1.5	0.00	0.76	1.4	0.00
April	1.5	-	1.6	-	1.7	-	1.5	-	1.5	1.6	-	0.82	1.5	-
May	1.6	-	1.6	-	1.7	0.01	1.5	0.03	1.6	1.6	0.05	0.91	1.5	-
June	1.8	0.43	1.9	0.0	1.7	0.09	1.6	0.12	1.9	1.9	0.29	1.2	1.7	0.07
July	1.6	0.00	1.9	0.0	1.8	0.00	1.7	0.00	2.0	1.9	0.00	1.2	1.8	0.00
August	1.7	0.00	1.9	0.0	1.8	0.00	1.7	0.00	2.1	1.9	0.00	1.2	1.7	0.00
September	1.8	0.00	2.0	0.0	1.9	0.00	1.8	0.00	1.9	1.9	0.00	1.1	1.8	0.00
October	1.7	0.00	1.9	0.0	1.9	0.00	1.8	0.00	1.6	1.9	0.00	0.95	1.8	0.00
November	1.7	0.00	1.9	0.0	1.9	0.00	1.8	0.00	1.6	2.0	0.00	0.92	1.8	0.00
December	1.6	0.00	1.8	0.0	1.7	0.00	1.6	0.00	1.3	1.7	0.00	0.73	1.6	0.00
Average mR/week	1.7	0.05	1.8	0.001	1.8	0.04	1.6	0.02	1.6	1.8	0.05	0.93	1.6	0.01
Total mR/year	89	2.6	94	0.05	94	2.1	83	1.0	84	92	2.6	48	83	0.52

[a]With the creation of a new perimeter on both the east and north of the site, the yearly average for the new northeast perimeter would have been about .32 mrem/wk and 17 mrem/yr.

Table C-2. 1969 Monthly Average Gross Beta-emitting Isotope Concentrations, Air Particulate Filters (pCi/m^3)

Month	Gross Beta	^{7}Be	^{65}Zn	^{95}Zr-Nb	^{131}I [a]	^{137}Cs	^{140}Ba-La	^{144}Ce
January	0.078	0.11	0.001	0.007	0.002	0.004	0.003	0.004
February	0.066	0.12	0.002	0.012	<0.001	0.004	0.002	0.006
March	0.11	0.19	0.002	0.022	<0.001	0.005	0.002	0.012
April	0.20	0.33	0.002	0.056	<0.001	0.008	<0.002	0.059
May	0.32	0.49	0.004	0.15	<0.001	0.010	<0.002	0.096
June	0.37	0.48	0.004	0.17	<0.001	0.009	<0.002	0.070
July	0.36	0.32	0.004	0.15	<0.001	<0.005	<0.002	0.076
August	0.52	0.39	0.004	0.16	<0.001	0.011	<0.002	0.086
September	0.26	0.28	0.003	0.097	<0.001	0.008	<0.002	0.072
October	0.15	0.17	0.003	0.048	0.001	0.0056	0.0022	0.048
November	0.090	0.11	0.002	0.022	0.0015	0.0025	-	0.027
December	0.090	0.098	0.001	0.014	0.001	0.0024	-	0.02
Yearly Average	0.22	0.26	0.003	0.076	<0.001	<0.006	<0.002	0.048

[a]Particulate filter samples only.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table C-3. 1969 Monthly Average Gross Beta Concentrations and Total Gross Beta Activity in Precipitation

Month	Amount Inches	Gross Beta Conc. pCi/l	Gross Beta Activity nCi/m^2	Nuclide Activity (nCi/m^2)							
				^{7}Be	^{65}Zn	^{89}Sr	^{90}Sr	^{95}Zr-Nb	^{131}I	^{137}Cs	^{144}Ce
January	0.9	45	0.98	1.7	<0.1	0.07	0.05	0.1	<0.1	<0.1	0.4
February	2.9	27	2.2	5.4	0.17	0.18	0.06	0.45	<0.1	0.1	0.5
March	3.5	86	7.1	15	0.15	0.42	0.15	1.9	1.7	0.35	-
April	4.6	77	9.6	18	0.08	1.10	0.15	3.0	<0.1	0.21	1.8
May	2.0	210	11	14	<0.1	0.80	0.06	2.9	0.9	0.16	2.0
June	1.7	150	8.7	16	<0.1	-	-	5.1	<0.1	0.4	-
July	7.7	68	13	25	0.3	-	-	9.0	<0.1	<0.5	3.8
August	4.3	37	7.1	9.8	0.1	0.32	0.12	3.1	<0.1	0.2	1.6
September	3.5	36	3.6	3.9	<0.1	-	-	1.3	<0.1	0.1	3.3
October	3.8	100	11	7.3	0.32	-	-	1.6	0.39	0.18	1.1
November	4.4	35	3.9	13	0.23	-	-	1.6	0.36	0.24	2.6
December	5.1	26	5.1	30	0.3	<0.10	-	3.6	1.1	0.6	3.9
Total	44		83	160	<1.4	<3.0	0.59	34	<5.2	<3.1	21
Weighted Average[a]		66									

[a]Weighted by inches of rainfall.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table C-4. 1969 BGRR-HFBR Stack Emission

Month	BGRR (MWd)	HFBR (MWd)	Air volume, m^3	Tritiated Water Vapor Amount Ci	Tritiated Water Vapor Conc. pCi/m^3	^{131}I mCi	^{131}I pCi/m^3	^{41}Ar Ci	^{41}Ar pCi/m^3	Particulate Gross Beta Activity Ci	Particulate Gross Beta Activity pCi/m^3
January	59	857	5.2E+07	32	6.2E+05	2.40	4.6E+01	5.2E+04	1.0E+09	2.3	4.4E+04
February	39	857	4.0E+07	28	7.0E+05	1.20	3.0E+01	3.5E+04	8.8E+08	2.3	5.8E+04
March	48	898	4.4E+07	30	6.8E+05	0.90	2.0E+01	4.1E+04	9.3E+08	2.5	5.7E+04
April	0	887	1.8E+07	32	1.8E+06	<0.1	<5.6E+00	0.0E+00	0.0E+00	0.1	5.6E+03
May	12	878	2.1E+07	33	1.6E+06	0.25	1.2E+01	1.1E+04	5.2E+08	1.1	5.2E+04
June[a]	61	775	5.4E+07	36	6.7E+05	2.0	3.7E+01	5.3E+04	9.8E+08	3.8	7.0E+04
July	0	896	1.9E+07	33	1.7E+06	<0.10	<5.3E+00	0.0E+00	0.0E+00	0.1	5.3E+03
August	0	845	1.9E+07	26	1.4E+06	<0.10	<5.3E+00	0.0E+00	0.0E+00	0.1	5.3E+03
September	0	826	1.8E+07	24	1.3E+06	<0.10	<5.6E+00	0.0E+00	0.0E+00	0.1	5.6E+03
October	0	813	1.9E+07	37	1.9E+06	<0.10	<5.3E+00	0.0E+00	0.0E+00	0.1	5.3E+03
November	0	878	1.8E+07	34	1.9E+06	<0.10	<5.6E+00	0.0E+00	0.0E+00	0.1	5.6E+03
December	0	738	1.9E+07	32	1.7E+06	<0.10	5.3E+00	0.0E+00	0.0E+00	0.1	5.3E+03
Annual total	219	10,148	3.4E+08	380		<7.6		1.9E+05		13	
Average					1.3E+06		<1.5E+01		3.6E+08		2.7E+04

[a] Final month of BGRR operation at measurable power levels.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table C-5. 1969 Clarifier. Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

		Gross Beta[a]		Tritiated Water		^{90}Sr		^{137}Cs	
Month	Flow 10^9 l	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi
January	0.095	9	0.86	1,200	110	0.30	0.03	0.9	0.09
February	0.083	23	1.9	1,500	130	0.50	0.04	2.0	0.17
March	0.088	31	2.7	5,200	460	0.60	0.05	1.2	0.10
April	0.097	25	2.4	2,900	280	0.30	0.03	0.7	0.07
May	0.12	17	2.0	12,000	1,400	0.29	0.03	1.0	0.12
June	0.13	23	3.0	4,700	610	-	-	0.4	0.05
July	0.16	10	1.6	17,000	2,700	0.34	0.05	1.0	0.16
August	0.19	17	3.2	8,200	1,600	0.54	0.10	0.4	0.08
September	0.16	8	1.3	2,700	430	0.40	0.06	1.0	0.16
October	0.15	6.6	1.0	34,000	5,100	0.35	0.05	0.3	0.05
November	0.18	12	2.2	20,000	3,600	1.0	0.18	0.8	0.14
December	0.13	12	1.6	7,300	950	0.38	0.05	0.4	0.05
Total	1.6		24		17,000		0.67		1.2
Weighted Average[b]		15		11,000		0.42		0.75	

[a] Includes gamma-only emitters and does not include tritiated water.

[b]Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table C-6. 1969 Chlorinating Plant. Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

		Gross Beta[a]		Tritiated Water		^{90}Sr		^{137}Cs	
Month	Flow 10^9 l	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi
January	0.082	12	0.98	1,600	130	0.5	0.04	5.0	0.41
February	0.077	15	1.2	1,800	140	0.5	0.04	7.0	0.54
March	0.076	24	1.8	5,500	420	1.0	0.076	9.0	0.68
April	0.074	13	0.96	2,500	190	0.8	0.067	5.0	0.37
May	0.099	17	1.7	14,000	1,400	0.7	0.069	6.0	0.59
June	0.12	13	1.6	4,500	540	-	-	3.0	0.36
July	0.13	16	2.1	22,000	2,900	0.6	0.078	4.0	0.52
August	0.14	10	1.4	9,200	1,300	0.71	0.098	2.0	0.28
September	0.13	12	1.6	2,400	310	0.9	0.120	4.0	0.52
October	0.13	10	1.3	33,000	4,300	0.48	0.065	2.4	0.31
November	0.14	9.3	1.3	19,000	2,700	0.7	0.098	3.1	0.42
December	0.092	11	1.0	9,100	840	0.8	0.074	4.0	0.37
Total	1.3		17		15,000		0.83		5.4
Weighted Average[b]		13		12,000		0.64		4.1	

[a] Includes gamma-only emitters and does not include tritiated water.

[b]Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table C-7. 1969 "M" (Former Perimeter). Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

		Gross Beta[a]		Tritiated Water		^{90}Sr		^{137}Cs	
Month	Flow 10^9 l	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi
January	0.097	9	0.87	1,800	170	0.8	0.078	6.0	0.58
February	0.09	12	1.1	1,800	160	0.6	0.054	6.0	0.54
March	0.095	20	1.9	5,300	500	0.8	0.076	7.0	0.67
April	0.097	11	1.1	2,200	210	0.9	0.087	5.0	0.49
May	0.11	14	1.5	12,000	1,300	0.66	0.073	5.0	0.55
June	0.13	13	1.7	4,600	600	1.1	0.14	3.0	0.39
July	0.11	9	0.99	18,000	200	0.92	0.10	5.0	0.55
August	0.14	12	1.7	8,400	1,200	0.93	0.13	3.0	0.42
September	0.12	11	1.3	2,700	3,200	1.0	0.12	4.0	0.48
October	0.12	9.8	1.2	38,000	4,400	0.62	0.074	3.1	0.37
November	0.14	11	1.5	19,000	2,700	0.86	0.12	3.1	0.43
December	0.12	11	1.3	8,000	960	0.84	0.10	3.6	0.43
Total	1.4		16		15,000		1.2		5.9
Weighted Average[b]		12		11,000		0.86		4.2	

[a] Includes gamma-only emitters and does not include tritiated water.

[b]Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table C-8. 1969 "Q" (Current Perimeter). Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

Month	Flow 10^9 l	Gross Beta[a] Conc. pCi/l	Gross Beta[a] Amount mCi	Tritiated Water Conc. pCi/l	Tritiated Water Amount mCi	^{90}Sr Conc. pCi/l	^{90}Sr Amount mCi	^{137}Cs Conc. pCi/l	^{137}Cs Amount mCi
January	0.073	11	0.80	1,500	110	0.7	0.05	5.0	0.37
February	0.05	12	2.00	2,200	110	0.4	0.020	7.0	0.35
March	0.054	21	1.10	5,200	280	0.9	0.049	7.0	0.38
April	0.08	13	1.00	1,900	150	0.9	0.072	5.0	0.40
May	0.086	23	2.00	9,600	830	0.66	0.057	7.0	0.60
June	0.046	15	0.69	4,400	200	0.9	0.041	6.0	0.28
July	0.024	13	0.31	16,000	380	0.53	0.013	6.0	0.14
August	0.069	10	0.69	7,000	480	1.0	0.069	4.0	0.28
September	0.045	10	0.45	2,400	110	1.2	0.054	4.0	0.18
October	0.042	8.5	0.36	34,000	1,400	0.79	0.033	6.0	0.25
November	0.061	15	0.92	14,000	850	0.95	0.058	4.0	0.24
December	0.084	11	0.92	5,900	500	1.0	0.084	2.0	0.17
Total	0.7		9.8		5,400		0.56		3.7
Weighted Average[b]		14		7,700		0.80		5.3	

[a] Includes gamma-only emitters and does not include tritiated water.

[b]Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table C-9. 1969 Monthly Downstream and Control Location Water Grab Samples. Gross Beta and Tritiated Water

	Downstream Locations								Control Locations					
Month	A	B	C	D	K	L	M[a]	Q[a]	E	F	H	I	J	R[b]
Gross Beta (pCi/l)														
January	c	c	c	c	c	c	c	c	c	c	c	c	c	-
February	5.0	4.0	4.0	3.0	28	31	9.0	12	6.0	-	3.0	10	3.0	-
March	3.0	4.0	2.0	7.0	16	18	10	16	6.0	-	5.0	9.0	3.0	-
April	6.0	3.0	4.0	3.0	9.0	11	11	8.0	3.0	8.0	1.0	7.0	3.0	-
May	6.0	5.0	6.0	4.0	26	29	25	21	27	-	3.0	7.0	6.0	-
June	8.0	3.0	9.0	5.0	17	12	14	11	8.0	9.0	-	1.0	8.0	-
July	4.0	2.0	6.0	5.0	12	12	15	10	-	10	-	-	6.0	3.0
August	5.0	4.0	8.0	6.0	10	11	11	8.0	6.0	8.0	2.0	5.0	4.0	4.0
September	5.0	2.0	3.0	3.0	10	9.0	10	6.0	9.0	4.0	2.0	4.0	4.0	4.0
October	6.0	4.0	5.0	9.0	14	12	10	9.0	5.0	6.0	2.0	7.0	4.0	5.0
November	5.0	4.0	3.0	4.0	9.0	7.0	11	15	5.0	4.0	2.0	4.0	3.0	5.0
December	7.0	4.0	4.0	6.0	8.0	10	9.0	8.0	6.0	5.0	4.0	8.0	4.0	15
Yearly Average	5.5	4.0	5.0	5.0	14	15	12	11	8.1	6.8	2.7	6.2	4.4	6.0
Tritiated Water (pCi/l)														
January	c	c	c	c	c	c	c	c	c	c	c	c	c	c
February	<1,000	<1,000	<1,000	<1,000	1,000	1,000	2,000	3,000	<1,000	-	<1,000	<1,000	<1,000	-
March	2,000	<1,000	<1,000	<1,000	<1,000	1,000	3,000	2,000	<1,000	-	2,000	<1,000	2,000	-
April	2,000	<1,000	<1,000	<1,000	<1,000	1,000	<1,000	1,000	1,000	<1,000	<1,000	<1,000	<1,000	-
May	3,000	<1,000	<1,000	<1,000	-	-	35,000	220,000	<1,000	-	<1,000	<1,000	<1,000	-
June	2,000	<1,000	<1,000	<1,000	2,000	<1,000	3,000	3,000	1,000	<1,000	-	<1,000	<1,000	-
July	<1,000	<1,000	1,000	<1,000	<1,000	1,000	5,000	9,000	-	<1,000	-	-	<1,000	<1,000
August	3,000	1,000	1,000	<1,000	3,000	3,000	3,000	4,000	<1,000	<1,000	<1,000	<1,000	1,900	<1,000
September	<1,000	<1,000	<1,000	<1,000	2,000	<1,000	2,000	1,000	-	-	-	-	-	<1,000
October	11,000	6,000	<1,000	<1,000	2,600	3,600	38,000	39,000	<1,000	<1,000	<1,000	<1,000	1,900	<1,000
November	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	19,000	14,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
December	4,000	3,000	2,000	1,000	2,000	3,000	8,000	6,000	<1,000	1,000	<1,000	<1,000	<1,000	1,000
Yearly Average	<2,800	<1,600	<1,100	<1,100	<1,800	<1,700	<11,000	27,000	<1,000	<1,000	<1,100	<1,000	<1,300	<1,000

[a]Continuous sample.

[b]Riverhead USGS Gauging Station.

[c]Not collected due to low input concentrations and adverse weather.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table C-10. 1969 Bottom Sediment Sample Concentrations

Month	Peconic Location	^{60}Co pCi/g (dry)	^{65}Zn pCi/g (dry)	^{95}Zr-Nb pCi/g (dry)	^{137}Cs pCi/g (dry)	U pCi/g (dry)	Th pCi/g (dry)
November	K	-	-	-	-	-	-
	L	0.06	0.02	-	0.19	0.40	0.50
	M	0.89	-	-	1.6	-	-
	Q	0.05	0.02	-	0.61	0.29	0.35
	A	-	0.09	0.04	0.46	0.15	0.11
	B	-	0.13	-	0.18	0.39	0.56
	C	-	-	-	-	-	-
	D	-	-	-	-	-	-

Table C-11. 1969 Concentrations of Gamma-emitting Nuclides in Animals and Vegetation Obtained from the Peconic River

Month	Animal	Plant	Number	Location	^{60}Co pCi/g (wet)	^{65}Zn pCi/g (wet)	^{137}Cs pCi/g (wet)
April	Catfish		1	Q	0.023	0.12	1.1
	Bluegill		1		0.036	0.053	1.6
August		Fontinalis	2	K	6.0	-	1.1
		Sporganium	2	On-site	1.0	-	0.3
		Rumex	2	"	0.7	0.2	0.9
		Polygonum	4	"	1.0	0.2	0.7
		Callitriche	2	"	0.75	0.4	0.7
	Turtles		3	"	0.09	0.03	0.3
	Catfish		2	"	-	0.12	1.8
	Bluegill		2	"	0.015	0.035	1.4
	Frogs		2	"	0.70	0.2	1.1
	Snails		1	"	0.75	0.06	0.9

Table C-12. 1969 Gross Beta and Tritiated Water Concentrations in Potable and Cooling Water Supply Wells

Month	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 101	Well 102	Well 103	Well 104	Well 105
Gross Beta (pCi/l)												
January	1.0	1.0	1.2	2.3	1.6	1.5	1.2	1.1	<1.0	2.8	<1.0	-
February	1.3	2.1	<1.0	1.6	<1.0	<1.0	1.1	1.4	<1.0	1.6	<1.0	1.9
March	2.2	<1.0	2.0	1.3	1.1	1.1	-	1.2	1.8	1.1	-	-
April	1.8	<1.0	<1.0	4.5	1.2	1.5	1.3	<1.0	<1.0	2.4	1.4	1.4
May	1.5	<1.0	1.7	2.1	1.1	1.3	<1.0	1.5	2.4	2.6	7.4	4.6
June	1.3	1.1	<1.0	2.0	-	3.7	4.8	-	-	-	1.4	1.7
July	4.7	3.3	1.7	2.9	1.8	4.0	1.6	-	2.1	-	1.4	1.6
August	<1.0	4.2	1.4	1.4	1.9	1.4	<1.0	-	4.0	-	2.3	1.4
September	<1.0	5.4	2.9	1.5	1.1	1.4	1.1	-	-	-	1.1	1.5
October	0.8	0.7	0.4	1.2	1.0	0.5	<0.5	-	<0.5	-	0.53	0.7
November	1.7	2.5	0.87	5.4	2.0	2.1	0.85	1.6	0.64	-	1.6	2.6
December	1.5	1.4	<0.5	1.1	1.6	1.9	1.0	1.2	-	2.0	-	-
Yearly Average	<1.7	<2.1	<1.3	2.3	<1.4	<1.8	<1.4	<1.3	<1.6	2.1	<1.9	1.9
Tritiated Water (pCi/l)												
January	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-
February	<1,000	<1,000	<1,000	<1,000	<1,000	1,400	<1,000	<1,000	1,500	<1,000	<1,000	<1,000
March	<1,000	<1,000	<1,000	<1,000	1,600	<1,000	-	<1,000	<1,000	<1,000	-	-
April	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	1,400	1,500	<1,000
May	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
June	<1,000	<1,000	<1,000	<1,000	-	<1,000	<1,000	-	-	-	1,600	<1,000
July	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-	2,000	-	1,700	<1,000
August	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-	<1,000	-	<1,000	<1,000
September	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-	<1,000	-	<1,000	<1,000
October	-	-	<1,000	<1,000	<1,000	<1,000	<1,000	-	<1,000	-	<1,000	<1,000
November	220[a]	270[a]	210[a]	100[a]	750[a]	280[a]	430[a]	1,100[a]	390[a]	-	1,200[a]	250[a]
December	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-	-	-
Yearly Average	<930	<940	<930	<930	<1,100	<1,000	<1,000	<1,100	<1,100	<1,100	<1,200	<1,000

[a]Analysis following enrichment.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table C-13. 1969 Monthly On-Site Sump Samples. Gross Beta and Tritiated Water Concentrations

Month	N North of AGS	O East of HFBR	P Medical
Gross Beta (pCi/l)			
January	-	-	-
February	5.0	2.0	2.0
March	5.0	6.0	7.0
April	2.0	4.0	<1.0
May	5.0	4.0	6.0
June	4.0	3.1	1.0
July	1.0	2.0	2.0
August	4.0	5.0	4.0
September	2.0	3.0	1.0
October	1.5	<0.5	69.0
November	1.6	0.6	0.95
December	2.0	1.0	<0.5
Yearly Average	3.0	<2.8	<8.6
Tritiated Water (pCi/l)			
January	-	-	-
February	<1,000	<1,000	<1,000
March	<1,000	<1,000	<1,000
April	<1,000	<1,000	<1,000
May	<1,000	<1,000	<1,000
June	<1,000	<1,000	<1,000
July	<1,000	<1,000	1,000
August	<1,000	2,000	1,000
September	<1,000	<1,000	<1,000
October	1,700	1,000	<1000
November	<1,000	<1,000	<1000
December	<1,000	<1,000	<1,000
Yearly Average	<1,100	<1,100	<1,000

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table C-14. Concentrations in 1969 Milk Samples from Off-site Dairies

	Farm B' (8 km SW)			Farm C (10 km SE)			Farm D (15 km NW)		
Month	^{65}Zn pCi/l	^{131}I pCi/l	^{137}Cs pCi/l	^{65}Zn pCi/l	^{131}I pCi/l	^{137}Cs pCi/l	^{65}Zn pCi/l	^{131}I pCi/l	^{137}Cs pCi/l
January	23.0	<1.0	<5.0	53.0	<1.0	19	23.0	<1.0	<5.0
February	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-
April	-	1.7	16	-	1.1	10	-	1.4	6.8
May	-	8.0	22	-	7.0	19	-	3.0	-
June	-	3.0	28	-	1.0	19	-	2.0	16
July	-	4.0	26	-	2.0	8.0	-	1.0	24
August	-	-	9.0	-	3.0	20	-	1.0	17
September	-	1.0	18	-	1.0	10	-	1.0	14
October	-	6.1	13	-	-	5.0	-	3.0	16
November	-	4.0	16	-	8.6	10	-	6.7	23
December	-	-	-	-	-	-	-	-	-
Yearly Average	-	<3.6	<17	-	<3.1	13	-	<2.2	<15

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table C-15. Concentrations in 1969 Vegetation Sampled from Off-site Farms

Location	Month	^{7}Be	^{65}Zn	^{95}Zr-Nb	^{131}I	^{137}Cs	^{140}Ba-La	^{144}Ce
		pCi/kg (wet)						
Farm A (3 km NW)	July	4,200	<50	1,800	-	79	-	-
	October	7,400	-	1,100	-	400	790	-
Farm B' (8 km SW)	July	-	-	-	-	-	-	-
	October	930	95	160	18	37	130	-
Farm C (10 km SE)	July	940	88	520	-	91	-	-
	October	1,800	-	340	32	83	170	-
Farm D (15 km NW)	July	2,300	<50	720	-	<50	-	4,300
	October	1,100	-	230	18	110	190	-
Farm H (6 km NE)	July	5,300	<50	2,300	-	210	-	1,500
	October	4,700	-	93	-	270	520	-

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table C-16. Concentrations in 1969 Soil Sampled from Off-site Farms

Location	Month	^{7}Be	^{65}Zn	^{95}Zr-Nb	^{125}Sb	^{137}Cs	^{144}Ce	^{238}U	^{232}Th
		pCi/kg (dry)							
Farm A (3 km NW)	July	<500	<50	89	74	1,400	<500	360	500
	October	-	-	-	-	1,000	-	-	-
Farm B' (8 km SW)	July	<500	<50	260	<50	1,300	<500	440	1,100
	October	-	-	240	-	1,800	-	-	-
Farm C (10 km SE)	July	<500	<50	130	<50	1,100	<500	440	830
	October	1,200	-	540	-	530	-	-	-
Farm D (15 km NW)	July	<500	<50	370	<50	1,600	<500	1,300	1,800
	October	-	-	-	-	1,300	-	-	-
Farm H (6 km NE)	July	<500	<50	160	<50	1,700	<500	1,300	1,500
	October	-	-	-	-	-	-	-	-

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

APPENDIX D

1970 TABLES

Table D-1. 1970 Background and Source Radiation Levels at the Laboratory Perimeter (mR/week)

Station:	P-2	P-4	P-7	P-9		S-13		O-6
	Northwest Perimeter	Southwest Perimeter	Southeast Perimeter	Northeast Perimeter		On-site		Off-site
Month	Background	Background	Background	Background	Ecology Source	Background	Ecology Source	Background
January	1.6	1.7	1.6	1.6	1.2	1.6	0.61	1.5
February	1.8	1.7	1.7	1.6	1.3	1.6	0.59	1.6
March	1.5	1.8	1.7	1.8	1.3	1.7	0.72	1.6[b]
April	1.5	1.8	1.7	2.0	1.5	1.7	0.79	-
May	1.4	1.8	1.5	2.0	1.7	1.7	0.94	-
June	1.5	1.9	1.7	1.7	1.8	1.7	1.1	-
July	1.7	1.9	1.7	1.7	1.9	1.8	1.1	-
August	2.0	1.9	1.7	1.7	1.9	1.9	1.3	-
September	2.0	1.9	1.8	1.7	1.7	1.9	1.2	-
October	2.1	2.1	1.9	1.9	1.7	2.1	1.0	-
November	2.1	2.1	1.9	1.9	1.6	2.1	0.99	-
December	2.0	2.1	2.0	1.9	1.5	2.0	0.87	-
Average mR/week	1.8	1.9	1.7	1.8	1.6	1.8	0.93	NA
Total mR/year	94	99	88	93	83	94	48	NA

[a]At the new northeast perimeter the yearly average would have been .32 mrem/wk and 17 mrem/yr (20% of 1.6 and 83).

[b]Final data. Station discontinued.

Table D-2. 1970 Monthly Average Gross Beta Concentrations, Air Particulate Filters (pCi/m^3)

Month	Gross Beta	^{7}Be	^{65}Zn	^{90}Sr	^{95}Zr-Nb	^{131}I	^{137}Cs	^{140}Ba-La	^{144}Ce
January	0.098	0.17	0.002	-	0.020	<0.001	0.005	<0.001	0.032
February	0.14	0.19	0.002	-	0.060	<0.001	0.006	<0.001	0.035
March	0.17	0.21	0.002	-	0.045	<0.001	0.005	<0.001	0.026
April	0.24	0.30	0.004	0.003	0.092	<0.001	0.010	<0.001	0.12
May	0.35	0.45	0.006	0.004	0.18	<0.001	0.018	<0.001	0.091
June	0.43	0.51	0.009	0.006	0.21	<0.001	0.035	<0.001	0.15
July	0.33	0.67	0.012	0.006	0.28	<0.001	0.043	<0.001	0.19
August	0.30	0.32	0.062	0.005	0.12	<0.001	0.019	<0.001	0.12
September	0.12	0.17	0.003	0.002	0.042	<0.001	0.009	<0.001	0.046
October	0.10	0.15	0.002	-	0.025	<0.001	0.008	<0.001	0.036
November	0.11	0.17	0.002	0.001	0.042	0.006	0.006	0.008	0.040
December	0.11	0.15	0.002	0.001	0.11	0.022	0.006	<0.001	0.026
Yearly Average	0.21	0.29	0.009	0.004	0.10	0.003	0.014	0.002	0.076

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table D-3. 1970 Monthly Average Gross Beta Concentrations and Total Gross Beta Activity in Precipitation

Month	Amount Inches	Gross Beta Conc. pCi/l	Gross Beta Activity nCi/m^2	Nuclide Activity nCi/m^2							
				^{7}Be	^{65}Zn	^{90}Sr	^{95}Zr-Nb	^{131}I	^{137}Cs	^{140}Ba-La	^{144}Ce
January	0.70	45	0.6	2.5	<0.1	-	0.3	<0.1	0.1	<0.1	0.9
February	4.0	32	2.7	8.6	<0.1	-	1.5	0.3	0.2	<0.1	0.6
March	4.4	86	5.6	23	<0.1	-	6.2	<0.1	0.4	<0.1	9.4
April	4.0	84	6.3	17	0.2	0.18	4.6	<0.1	0.5	<0.1	8.2
May	2.7	160	12	20	0.2	0.21	7.2	<0.1	0.6	<0.1	7.4
June	1.7	230	10	11	0.1	0.18	3.4	<0.1	0.4	<0.1	3.1
July	3.3	220	19	9.0	0.1	0.24	2.4	<0.1	0.4	<0.1	7.3
August	5.0	40	6.8	9.5	0.1	0.17	2.4	<0.1	0.3	<0.1	8.1
September	2.3	24	1.2	3.5	<0.1	0.07	0.4	<0.1	0.1	<0.1	0.8
October	1.7	28	1.2	1.8	<0.1	0.05	0.3	0.2	-	<0.1	1.8
November	6.0	43	6.6	10	0.1	0.11	1.0	<0.1	0.2	0.4	0.8
December	2.8	28	1.9	4.6	<0.1	0.06	0.5	<0.1	0.2	<0.1	0.8
Total	39		74	120	<1.4	1.3	30	<1.5	<3.5	<1.5	49
Weighted Average[a]		79									

[a]Weighted by inches of rainfall.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table D-4. 1970 HFBR Stack Emission

Month	HFBR (MWd)	Air volume, m^3 [a]	Tritiated Water Vapor Amount Ci	Tritiated Water Vapor Conc. pCi/m^3
January	0	1.9E+07	280	1.5E+07
February	780	1.9E+07	33	1.7E+06
March	830	1.9E+07	38	2.0E+06
April	940	1.9E+07	41	2.2E+06
May	670	1.9E+07	28	1.5E+06
June	1,000	1.9E+07	33	1.7E+06
July	570	1.9E+07	13	6.8E+05
August	880	1.9E+07	38	2.0E+06
September	810	1.9E+07	49	2.6E+06
October	860	1.9E+07	63	3.3E+06
November	1,000	1.9E+07	39	2.1E+06
December	650	1.9E+07	32	1.7E+06
Annual total	8,990	2.3E+08	690	
Average				3.0E+06

[a]A value of 1.9×10^7 was used based on the air volume discharged during periods when the BGRR was not operating.

Table D-5. 1970 Clarifier. Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

		Gross Beta[a]		Tritiated Water		^{90}Sr		^{137}Cs	
Month	Flow 10^9 l	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi
January	0.099	68	6.7	2,700	270	1.5	0.15	60.0	5.9
February	0.10	110	11.0	22,000	2,200	1.4	0.14	7.0	0.7
March	0.11	43	4.7	90,000	9,900	1.5	0.17	12.0	1.3
April	0.13	35	4.6	17,000	2,200	4.2	0.55	10.0	1.3
May	0.15	16	2.4	29,000	4,400	1.5	0.23	1.0	0.15
June	0.15	20	3.0	31,000	4,700	1.2	0.18	2.0	0.30
July	0.18	19	3.4	18,000	3,200	1.0	0.18	8.0	1.4
August	0.19	11	1.2	11,000	2,100	0.95	0.18	0.2	0.038
September	0.17	7	1.2	9,500	1,600	0.64	0.11	0.9	0.15
October	0.15	7	1.1	19,000	2,900	0.47	0.071	1.0	0.15
November	0.17	20	3.4	5,100	870	0.60	0.10	0.4	0.068
December	0.11	20	2.2	9,400	1,000	1.3	0.14	5.0	0.55
Total	1.7		45		35,000		2.2		12
Weighted Average[b]		26		21,000		1.3		7.1	

[a] Includes gamma-only emitters; does not include tritiated water.

[b] Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table D-6. 1970 Chlorinating Plant. Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

Month	Flow 10^9 l	Gross Beta[a] Conc. pCi/l	Gross Beta[a] Amount mCi	Tritiated Water Conc. pCi/l	Tritiated Water Amount mCi	^{90}Sr Conc. pCi/l	^{90}Sr Amount mCi	^{137}Cs Conc. pCi/l	^{137}Cs Amount mCi
January	0.085	14	1.2	2,800	240	0.85	0.07	6.0	0.51
February	0.074	15	1.1	19,000	1,400	1.1	0.08	8.0	0.59
March	0.10	19	1.9	85,000	8,500	1.4	0.14	11.0	1.10
April	0.094	27	2.5	18,000	1,700	5.6	0.53	14.0	1.30
May	0.16	19	3.0	29,000	4,600	3.8	0.61	14.0	2.20
June	0.13	25	3.3	32,000	4,200	2.1	0.27	15.0	2.00
July	0.16	34	5.4	19,000	3,000	1.7	0.27	22.0	3.50
August	0.16	15	2.4	12,000	1,900	1.3	0.21	0.9	0.14
September	0.15	7.0	1.1	9,900	1,500	0.91	0.14	4.0	0.60
October	0.13	8.0	1.0	18,000	2,300	0.96	0.12	5.0	0.65
November	0.12	12	1.4	5,000	600	0.80	0.10	4.0	0.48
December	0.077	15	1.2	9,600	740	0.90	0.07	8.0	0.62
Total	1.4		26		31,000		2.6		14
Weighted Average[b]		18		21,000		1.9		10	

[a] Includes gamma-only emitters; does not include tritiated water.

[b] Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table D-7. 1970 "M" (Former Perimeter). Flow, Gross Beta, Tritiated Water, ^{90}Sr, and ^{137}Cs Amounts and Concentrations

Month	Flow 10^9 l	Gross Beta[a] Conc. pCi/l	Gross Beta[a] Amount mCi	Tritiated Water Conc. pCi/l	Tritiated Water Amount mCi	^{90}Sr Conc. pCi/l	^{90}Sr Amount mCi	^{137}Cs Conc. pCi/l	^{137}Cs Amount mCi
January	0.097	14	1.4	2,700	260	0.85	0.08	5.0	0.5
February	0.09	14	1.3	15,000	1,400	1.10	0.10	7.0	0.63
March	0.10	17	1.7	73,000	7,300	1.70	0.17	11.0	1.1
April	0.16	18	2.9	9,700	1,500	3.80	0.61	9.0	1.4
May	0.23	16	3.7	23,000	5,300	3.20	0.74	9.0	2.1
June	0.14	23	3.2	32,000	4,500	1.60	0.22	15.0	2.1
July	0.16	35	5.6	20,000	3,200	1.40	0.22	15.0	2.4
August	0.16	17	2.7	12,000	1,900	1.40	0.22	2.0	0.32
September	0.15	8	1.2	9,700	1,500	1.20	0.28	6.0	0.90
October	0.13	8	1.0	20,000	2,600	0.97	0.13	4.0	0.52
November	0.12	12	1.4	5,400	650	0.90	0.11	3.0	0.36
December	0.087	14	1.2	9,000	780	0.90	0.08	7.0	0.61
Total	1.6		27		31,000		3.0		13
Weighted Average[b]		17		19,000		1.9		8.1	

[a] Includes gamma-only emitters; does not include tritiated water.

[b] Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table D-8. 1970 "Q" (Current Perimeter). [a]Flow, Gross Beta, Tritiated Water, ^{90}Sr and ^{137}Cs Amounts and Concentrations

		Gross Beta[a]		Tritiated Water		^{90}Sr		^{137}Cs	
Month	Flow 10^9 l	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi	Conc. pCi/l	Amount mCi
January	0.11	12	1.3	3,200	350	0.80	0.09	5.0	0.55
February	0.10	11	1.1	12,000	1,200	1.3	0.13	6.0	0.60
March	0.077	15	1.2	75,000	5,800	1.6	0.12	9.0	0.69
April	0.17	13	2.2	11,000	1,900	2.6	0.44	7.0	1.20
May	0.14	16	2.2	22,000	3,100	2.4	0.34	11	1.50
June	0.14	25	3.5	30,000	4,200	1.2	0.17	13	1.80
July	0.12	43	5.2	19,000	2,300	1.1	0.13	16	1.90
August	0.10	18	1.8	14,000	1,400	1.6	0.16	9.0	0.90
September	0.06	10	0.6	8,400	500	1.1	0.07	7.0	0.42
October	0.33	8.0	2.6	18,000	5,900	1.6	0.53	6.0	2.00
November	0.035	14	0.5	3,800	130	1.2	0.04	5.0	0.18
December	0.048	10	0.5	6,600	320	0.7	0.03	8.0	0.38
Total	1.4		23		27,000		2.3		13
Weighted Average[b]		16		19,000		1.6		8.6	

[a] Includes gamma-only emitters; does not include tritiated water.

[b] Weighted average concentration = total amount (mCi)/total flow (10^9 l).

Table D-9. 1970 Monthly Downstream and Control Location Water Grab Samples. Gross Beta and Tritiated Water

	Downstream Locations								Control Locations				
Month	A	B	C	D	K	L	M[a]	Q[a]	E	F	H	I	J
Gross Beta (pCi/l)													
January	5.0	3.0	4.0	3.0	12	12	15	13	4.0	31	1.0	9.0	4.0
February	16	8.0	7.0	7.0	24	6.0	17	14	6.0	6.0	5.0	28	4.0
March	7.0	5.0	5.0	4.0	24	18	48	20	6.0	3.0	3.0	6.0	5.0
April	10	8.0	5.0	5.0	32	25	19	13	5.0	7.0	4.0	9.0	6.0
May	8.0	7.0	10	17	25	21	20	14	5.0	7.0	4.0	9.0	6.0
June	10	7.0	7.0	4.0	17	18	15	25	<1.0	2.0	<1.0	7.0	4.0
July	10	21	7.0	8.0	53	29	35	35	12	18	10	21	25
August	8.0	5.0	4.0	8.0	13	15	22	11	6.0	5.0	1.0	8.0	2.0
September	8.0	3.0	4.0	3.0	7.0	10	7.0	6.0	6.0	4.0	1.0	6.0	10
October	5.0	3.0	4.0	4.0	9.0	9.0	4.0	7.0	8.0	8.0	2.0	5.0	4.0
November	6.0	5.0	6.0	5.0	10	9.0	5.0	19	7.0	5.0	3.0	5.0	4.0
December	9.0	4.0	5.0	7.0	13	12	17	7.0	28	6.0	5.0	5.0	7.0
Yearly Average	8.5	6.6	5.7	6.3	20	15	19	15	<7.8	8.5	<3.3	10	6.8
Tritiated Water (pCi/l)													
January	<1,000	<1,000	<1,000	1,000	<1,000	1,000	1,000	1,000	1,000	<1,000	<1,000	<1,000	<1,000
February	8,000	6,000	2,000	2,000	7,000	7,000	110,000	50,000	<1,000	<1,000	<1,000	1,000	<1,000
March	7,000	6,000	7,000	6,000	88,000	87,000	83,000	78,000	1,000	<1,000	<1,000	<1,000	<1,000
April	16,000	2,000	2,000	2,000	26,000	20,000	13,000	22,000	<1,000	<1,000	<1,000	1,000	<1,000
May	3,000	2,000	3,000	2,000	10,000	5,000	5,000	8,000	<1,000	<1,000	<1,000	1,000	<1,000
June	10,000	4,000	3,000	2,000	10,000	8,000	22,000	17,000	<1,000	1,000	<1,000	<1,000	<1,000
July	2,000	1,000	2,000	3,000	8,000	8,000	7,000	9,000	2,000	<1,000	<1,000	<1,000	2,000
August	4,000	3,000	2,000	2,000	7,000	8,000	2,000	4,000	<1,000	<1,000	<1,000	<1,000	<1,000
September	<1,000	<1,000	<1,000	<1,000	3,000	3,000	5,000	5,000	<1,000	<1,000	<1,000	<1,000	<1,000
October	<1,000	<1,000	<1,000	<1,000	3,000	3,000	5,000	8,000	<1,000	<1,000	<1,000	<1,000	<1,000
November	1,000	<1,000	<1,000	<1,000	9,000	8,000	16,000	4,000	<1,000	<1,000	<1,000	<1,000	<1,000
December	<1,000	<1,000	<1,000	<1,000	18,000	17,000	13,000	10,000	<1,000	<1,000	<1,000	<1,000	<1,000
Yearly Average	<4,600	<2,500	<2,200	<2,000	<16,000	15,000	<24,000	18,000	<1,100	<1,000	<1,000	<1,000	<1,100

[a]Continuous sample.

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table D-10. 1970 Bottom Sediment Sample Concentrations

Month	Peconic Location	^{60}Co pCi/g (dry)	^{137}Cs pCi/g (dry)
August	L	23	8

Table D-11. 1970 Concentrations of Gamma-emitting Nuclides in Vegetation Obtained from the Peconic River

Month	Peconic Location	^{60}Co pCi/g (wet)	^{137}Cs pCi/g (wet)
August	M (Perimeter)	2.3	4.3

Table D-12. 1970 Gross Beta and Tritiated Water Concentrations in Potable and Cooling Water Supply Wells

Month	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 101	Well 102	Well 103	Well 104	Well 105
Gross Beta (pCi/l)												
January	2.9	1.2	<1.0	2.4	<1.0	2.0	<1.0	<1.0	<1.0	-	-	-
February	<1.0	1.0	<1.0	2.0	1.2	1.2	<1.0	<1.0	<1.0	22	-	-
March	1.4	1.4	<1.0	2.3	1.1	<1.0	<1.0	22	<1.0	2.4	-	2.1
April	3.5	8.9	<1.0	<1.0	1.2	1.2	1.7	1.1	<1.0	1.7	-	3.5
May	1.1	2.1	<1.0	4.8	1.6	2.4	1.4	<1.0	<1.0	1.4	1.5	3.3
June	1.5	2.4	1.6	<1.0	<1.0	<1.0	1.2	<1.0	1.4	<1.0	1.9	1.8
July	7.8	9.0	6.2	4.3	1.9	8.3	1.3	<1.0	2.0	-	2.0	2.4
August	1.8	1.4	1.3	2.6	2.2	1.0	<1.0	1.0	<1.0	-	1.9	1.8
September	1.0	<1.0	1.4	1.6	2.3	1.3	<1.0	<1.0	1.1	<1.0	<1.0	1.0
October	<1.0	1.0	<1.0	1.5	8.7	1.6	<1.0	<1.0	<1.0	-	<1.0	1.4
November	3.0	2.1	1.3	2.0	<1.0	1.3	1.0	1.0	<1.0	<1.0	1.2	-
December	1.9	-	<1.0	9.7	1.2	1.9	3.8	<1.0	<1.0	1.0	<1.0	1.9
Yearly Average	<2.3	<2.9	<1.6	<2.9	<2.0	<2.0	<1.4	<2.8	<1.1	<3.9	<1.4	<2.1
Tritiated Water (pCi/l)												
January	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-	<1,000
February	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-	<1,000
March	<1,000	<1,000	<1,000	<1,000	<1,000	-	<1,000	<1,000	<1,000	<1,000	-	<1,000
April	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-	<1,000
May	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
June	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	1,100	<1,000
July	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
August	<1,000	<1,000	<1,000	<1,000	1,500	<1,000	<1,000	<1,000	<1,000	<1,000	1,200	<1,000
September	1,400	<1,000	2,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
October	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
November	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-
December	<1,000	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
Yearly Average	<1,100	<1,000	<1,100	<1,000	<1,100	<1,000	<1,000	<1,000	<1,000	<1,100	<1,100	<1,000

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table D-13. 1970 Monthly On-Site Sump Samples. Gross Beta and Tritiated Water Concentrations

Month	N North of AGS	O East of HFBR	P Medical
Gross Beta (pCi/l)			
January	3.0	1.0	2.0
February	2.0	1.0	<1.0
March	3.0	8.0	2.0
April	6.0	4.0	6.0
May	6.0	4.0	6.0
June	2.0	14.0	1.0
July	<1.0	6.0	8.0
August	2.0	4.0	6.0
September	4.0	7.0	2.0
October	4.0	3.0	2.0
November	2.0	1.0	2.0
December	4.0	3.0	65.0
Yearly Average	<3.3	<4.7	<8.6
Tritiated Water (pCi/l)			
January	<1,000	<1,000	<1,000
February	<1,000	<1,000	<1,000
March	1000	<1,000	<1,000
April	<1,000	<1,000	<1,000
May	<1,000	<1,000	<1,000
June	<1,000	<1,000	<1,000
July	<1,000	<1,000	1000
August	<1,000	1000	<1,000
September	<1,000	2000	<1,000
October	<1,000	<1,000	<1,000
November	<1,000	<1,000	<1,000
December	<1,000	<1,000	<1,000
Yearly Average	<1,000	<1,100	<1,000

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.

Table D-14. Concentrations in 1970 Milk Samples from Off-site Dairies

	Farm B' (8 km SW)			Farm C (10 km SE)		
Month	^{3}H pCi/l	^{131}I pCi/l	^{137}Cs pCi/l	^{3}H pCi/l	^{131}I pCi/l	^{137}Cs pCi/l
May	-	4.0	20	-	2.0	12
June	-	3.0	18	-	1.0	27
July	-	1.0	38	-	1.0	28
August	-	4.0	15	-	1.0	38
September	-	1.0	31	-	1.0	28
October	-	0.2	27	-	-	27
November	920	1.6	24	510	0.7	20
December	<1,000	2.5	19	-	0.5	33
Average	-	2.2	24	-	1.0	27

< means that the value is less than or equal to the detection limit or a summation of average value in which one of the components was a < value.

Table D-15. Concentrations in 1970 Vegetation Sampled from Off-site Farms

Location	Month	^{7}Be	^{65}Zn	^{95}Zr-Nb	^{137}Cs	^{144}Ce	^{238}U	^{232}Th
		pCi/kg (wet)						
Farm A (3 km NW)	July	4,300	140	2,100	370	2,800	<500	<500
	October	1,800	<100	330	260	910	-	-
Farm B' (8 km SW)	July	3,700	170	1,700	210	1,900	<500	<500
	October	840	<100	200	130	520	-	-
Farm C (10 km SE)	July	2,000	100	1,100	220	1,400	<500	<500
	October	1,400	<100	280	220	350	-	-
Farm D (15 km NW)	July	2,000	100	900	150	1,500	<500	<500
	October	550	<100	120	40	70	-	-
Farm H (6 km NE)	July	3,500	80	1,800	630	2,200	<500	<500
	October	5,300	<100	1,300	460	350	-	-

< means that the value is less than or equal to the detection limit or a summation or average value in which on of the components was a < value.

Table D-16. Concentrations in 1970 Soil Sampled from Off-site Farms

Location	Month	^{7}Be	^{65}Zn	^{95}Zr-Nb	^{137}Cs	^{144}Ce	^{238}U	^{232}Th
		pCi/kg (dry)						
Farm A (3 km NW)	July	<500	<250	220	1,900	<500	1,000	1,600
	October	<500	<250	150	1,800	<500	420	770
Farm B' (8 km SW)	July	<500	<250	180	1,200	<500	860	1,300
	October	<500	<250	170	1,800	<500	500	710
Farm C (10 km SE)	July	<500	<250	330	880	<500	770	880
	October	<500	<250	290	1,900	<500	660	1,000
Farm D (15 km NW)	July	<500	<250	290	1,300	<500	640	1,000
	October	<500	<250	300	1,200	<500	1,200	1,200
Farm H (6 km NE)	July	<500	<250	270	520	<500	520	850
	October	<500	<250	160	210	<500	510	650

< means that the value is less than or equal to the detection limit or a summation or average value in which one of the components was a < value.