1971 ENVIRONMENTAL MONITORING REPORT

BROOKHAVEN NATIONAL LABORATORY
Upton, New York 11973

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INTRODUCTION

Brookhaven National Laboratory is a scientific research center situated in Suffolk County on Long Island, about 70 miles east of New York City. Its location with regard to surrounding communities is shown in Fig. 1. Except for shoreline communities, much of the land area within ten miles is currently either forested or under cultivation.

The Laboratory site with its principal effluent-producing facilities is shown in Fig. 2. It consists of some 4,500 acres, most of which is wooded, except for a central area of less than 1,000 acres. The site terrain is gently rolling, with elevations varying between 120 and 40 feet above sea level. The land 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.

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

1) Structure and properties of matter.
2) Physical, chemical and biological effects of radiation.
3) Radioisotopes and other nuclear tools.
4) Nuclear technology.

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

1) The High Flux Beam Reactor (HFBR) is enriched uranium fueled, heavy water moderated and cooled, and has a routine power level of 40 MW.

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

3) The Alternating Gradient Synchrotron (AGS) operates at energies up to 33 BeV.

4) The 200 MeV Proton Linac serves as an injector for the AGS, but will also supply continuous currents of protons for isotope production by spallation reactions.

5) The Tandem Van de Graaff, 60-inch Cyclotron, Research Van de Graaff, Vertical Accelerator and Chemistry Van de Graaff are used in medium energy investigations, as well as for special isotope production.

6) The High Intensity Radiation Development Laboratory (HIRDL) contains million-curie range ^{60}Co and ^{137}Cs sources.

Additional programs involving irradiations and/or the use of radionuclides for scientific investigations are carried on at other Laboratory facilities, including the Medical Research Center, the Biology Department (including two multi-curie field irradiation sources), the Chemistry Department, and the Department of Applied Science. The latter includes the Hot Laboratory, where special purpose radioisotopes are developed and processed for on and off-site use.

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

SUMMARY

Natural background and radiation levels in the vicinity of Brookhaven National Laboratory attributable to its operations during 1971 are summarized in this report. Among the data reported are external radiation levels, air particulate, tritium and radioiodine concentrations, precipitation, liquid effluent-related concentrations in stream, ground water and surveillance wells, milk, grass and soil samples.

External radiation levels at the north boundary of the Laboratory, attributable to an ecology forest irradiation source, were 16 mR/year, or 3% of the

applicable radiation protection standard(1). Other than tritium, there was no indication of BNL effluents in environmental air and precipitation samples. In air, the largest BNL effluent-related tritium concentration was 8 pCi/m^3, which is 0.004% of the applicable standard. In precipitation it was 300 nCi/l, which is 0.01% of the standard for drinking water.

About 75% of the volume of liquid effluent released onto the sand filter beds at the BNL sewage treatment plant is recovered and flows into the headwaters of the Peconic River, while about 25% of it flows into the ground water underlying the beds. The gross concentration of beta and gamma-emitters in it was 4% of the applicable radiation standard. Tritium, which is measured separately, was 0.3% of its standard.

Of the input from the sand filter beds to the Peconic River, 65% permeated into the ground water underlying the stream bed between the point of release and the Laboratory perimeter, while 35% flowed over the measuring weir at the boundary. The gross beta and gamma-emitter concentration at the site boundary was 2% of the applicable radiation protection standard, while that of tritium was 0.3% of its standard.

At downstream locations, the largest yearly average gross beta concentration in monthly grab samples was 0.7% of the applicable radiation protection standard, while that of tritium was 0.1% of its standard. The downstream gross beta concentrations were not significantly different from those measured at remote "control" stream locations.

Seasonal sampling of Peconic River bottom sediments, stream vegetation and of miscellaneous aquatic fauna indicated that small concentrations of ^{60}Co (< 1,000 pCi/kg), and a slight excess (< 10,000 pCi/kg) of ^{137}Cs above prevailing fallout background, were present in some samples obtained in the upper reaches of the Peconic, on-site and a few miles downstream. These concentrations are insignificant (< 1%) relative to calculated concentration guides.

Routine grab samples from the Laboratory's potable and cooling water supply wells disclosed no consistent differences between those upstream in ground water flow and those downstream from the principal Laboratory facilities. The gross beta concentration of the large volume of cooling water released to on-site sumps was only very slightly above that of the supply wells.

Ground water surveillance was conducted adjacent to identified areas from which there is a potential for the migration of radioactivity. Immediately adjacent to the sand filter beds and the Peconic River on-site, gross alpha, gross beta, strontium and tritium concentrations up to a few percent of the applicable radiation protection standards were found.

On-site in wells adjacent to a decontamination facility drain sump, and adjacent to the Solid Waste Disposal Area, a few gross beta, ^{90}Sr and ^{137}Cs concentrations were found in excess of off-site radiation protection standards. However, these appear to be very local, and concentrations in perimeter wells were generally only a few percent of the standards.

Monthly milk samples were obtained from two nearby dairy farms. No significant differences between these and those generally prevailing in the northeast United States were apparent. Two sets of grass and soil samples were also collected from these and three other farms, as well as from perimeter and on-site locations. There was no significant difference between off-site samples generally downwind and those generally upwind of Brookhaven. A possible small excess of ^{137}Cs was apparent at the BNL northeast perimeter and adjacent to the Solid Waste Disposal Area, compared to other samples.

MONITORING DATA COLLECTION, ANALYSIS AND EVALUATION

External Exposure Monitoring

External radiation levels, including natural background (as influenced by fallout) and increments attributable to BNL activities were measured continuously at the four perimeter stations shown on Fig. 2. Included in each station's equipment was an ion chamber and dynamic condensor electrometer. Those units are capable of accurately measuring < 10 μR/hr and of detecting changes of the order of 1 μR/hr.

The observed monthly average radiation levels are set forth in Table I. There was no increment to the natural background attributable to BNL activities, except at the northeast perimeter station. At this location, the Ecology Forest irradiation source, which contained about 7,000 curies of ^{137}Cs, produced a measurable radiation level. Since the station was located about 250 feet south of the present BNL north boundary, the observed readings have been adjusted on the basis of spot comparisons, which indicate an average ratio of 0.2 between the station and the actual north perimeter radiation levels.

Ground-Level Air Particulate, Tritium and Radioiodine

During 1971, "high volume" (20 ft^3/min) positive displacement air pumps (Gast 3040) were operated at a monitoring station immediately east of the Solid Waste Disposal Area, and at the southeast and southwest perimeter monitoring stations (Fig. 2). The air sampling media consisted of a 3 inch diameter air particulate filter (Gelman Type G) followed by a 3" x 1" bed of petroleum-based charcoal (Columbia Grade LC 12/28 x mesh) for sampling of radiohalogens. The Solid Waste Disposal Area air particulate filter was changed and counted on a daily (5 times per week) basis. The remaining samples were changed and counted on a two-week basis through September, and weekly thereafter.

After allowing several days for the decay of short-lived natural radioactivity, gross alpha counts of the one-day air particulate samples (from the Solid Waste Disposal Area stations) were made using a 5" diameter Zn-S coated photomultiplier. After a similar delay, gross beta counts were made of all the particulate samples, using a 5" beta scintillator. These data are shown in

Table II. No consistent differences between sampling locations were apparent and there was no indication of BNL effluent radionuclides in air particulate samples at any location.

Continuous tritium vapor collections, using thermo-electric coolers, were made at the southeast and northeast perimeter stations which are most frequently downwind from the High Flux Beam Reactor stack. These collections were composited on a monthly basis, and after enrichment by electrolysis, were assayed for tritium. Net concentrations of tritium vapor in air at the BNL perimeter, which are assumed to be principally attributable to HFBR stack effluent tritium vapor, were arrived at by subtracting the tritium concentration from the perimeter sampled concentrations found in an off-site precipitation collection. The result was converted to an air concentration by assuming that 1 pCi/ml in vapor corresponds on the average to 10 pCi/cm^3 in air. This is only strictly so at 59^{o}F and 50% R.H. These air concentration data are shown in Table III.

In addition to the gross beta counts indicated above, analyses for gamma-emitting nuclides were performed on a consolidated monthly composite of all individual air particulate samples shortly after the end of each month. Additional air particulate analyses were also scheduled at six-month and one-year post-collection to facilitate the resolution of short- and long-lived nuclides with photopeaks too close to be resolved by the NaI detection system employed. The charcoal samples were reanalyzed at one month post-collection to determine ^{131}I by decay in its photopeak region during this time. Available data are reported herein in Table IV. In the absence of any recent fission products during most of the year, all transactions in its energy region have been attributed to 285-day ^{144}Ce. These data do not disclose any indication of BNL effluents.

Precipitation

Two pot-type rain collectors, each with a surface area of 0.33 m^2, were situated adjacent to the BNL filter beds. Two routine collections were made from these, one whenever precipitation was observed during a previous 24-hour (or weekend) period, and the other once a week whether or not precipitation had occurred. Part of each collection was evaporated for gross beta counting, a small fraction composited for monthly tritium analysis, and the balance put through ion exchange columns for subsequent monthly ^{89}Sr-^{90}Sr and gamma analyses. The data are reported in Table V.

With the exception of tritium, there is no indication in the on-site precipitation collection of the washout of BNL released airborne radioactivity. As indicated in Table VI, the ^3H concentration in the collector located at the filter beds (which are in a predominant downwind direction) appears to have been about twice that of the off-site collection. The total deposition of ^3H on the BNL site (about 4,000 acres) during 1971 was between 5-10 curies. The lower estimate is based on the concentration in the off-site collection, and the upper on that in the on-site downwind sample.

Liquid Effluent Monitoring

Within established administrative limits, microcurie amounts of low-level radioactive liquid effluents are routinely disposed of by release into the Laboratory's sanitary waste system. This affords considerable dilution by a large volume ($\sim 10^6$ gal/day) of uncontaminated water. Primary treatment to remove suspended solids from the liquid effluents discharged to this system is provided by a 250,000 gallon Clarifier. The liquid effluent then flows onto sand filter beds, from which most of it is recovered by an underlying tile field. It is then chlorinated and released into a small stream that forms one of the headwaters of the Peconic River.

A schematic illustration of the sewage treatment plant, including the related monitoring arrangements, are shown in Fig. 3. 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), are installed at the Chlorine House, at the former site boundary 0.5 miles downstream on the Peconic, and at the site boundary (1.6 miles downstream).

The monthly average flow and the monthly totals of gross beta and principal nuclide activities at the Clarifier (input to the filter beds) and at the Chlorine House (output from the beds) are shown in Table VII. Yearly totals and average concentrations are also indicated. It is apparent that not all of the liquid effluent flow into the sand filter beds appears in the output from them. The balance presumably mixes with the ground water flow under the beds. Estimates of the amounts of radioactivity released to the ground water in this fashion during 1971 are also shown in Table VII. These were calculated on the assumption that the average concentrations of the contained nuclides corresponded to those in the observed output from the beds.

Flow, activity and concentration information at the former site boundary and at the present site boundary are shown in Table VIII. A greater stream flow was observed at the former site boundary than at the Chlorine House, reflecting some upstream addition to the BNL stream effluent. There is a negligible change in the total activity in the stream between these two locations. However, there was a considerable reduction in stream flow between the former perimeter and the present site boundary. Upper limit estimates of the total activity so released to ground water, based on the concentrations observed at the boundary, are also shown in Table VIII.

Monthly "grab" water samples were obtained at on and off-site locations along the upper tributary of the Peconic River, into which the Laboratory routinely discharges low-level radioactive wastes. Reference "grab" samples were also obtained from other nearby streams and bodies of water outside the Laboratory's drainage area. The sampling locations as shown in Fig. 4 were as follows:

Off-Site (Peconic River, proceeding downstream)

A - Peconic River at Schultz Rd. 15,900 ft. downstream

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

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

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

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

Controls (Not in BNL Drainage)

E - Peconic River, upstream from BNL effluent outfall

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

H - Carman's River - outfall of Yaphank Lake

I - Artist Lake (maintained by water table, no surface outfall)

J - Lake Panamoka (maintained by water table, no surface outfall)

The individual monthly and yearly average gross beta and tritium concentrations at the downstream and control locations are shown in Table IX. A comparison suggests that the BNL effluents have little effect on the prevailing concentrations in the Peconic.

During the summer of 1971, additional sampling of the stream bottom sediment, of immersed and emergent vegetation, and of small stream fauna was conducted along the length of the Peconic. Control samples were obtained from the Carman's

River. Sampling locations corresponded to those used for monthly water samples. In addition, samples were obtained on-site at the following locations:

On-Site (proceeding downstream)

K - Peconic River at effluent outfall.

L - Peconic River, 1300 ft. below effluent outfall.

L′ - Peconic River, 2000 ft. below effluent outfall.

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

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

Off-Site

V - Peconic River (54,600 ft. downstream)

W - Peconic River (59,600 ft. downstream)

The sediment data are shown in Table X. Small concentrations of ^{60}Co and ^{65}Zn, as well as small increments in the ^{137}Cs, U and Th backgrounds are apparent in most samples obtained on-site and in the upper reaches of the Peconic. The corresponding vegetation data are shown in Table XI. These show considerable scatter. Small concentrations of ^{60}Co and a slight excess of ^{137}Cs over prevailing backgrounds may have been present in vegetation in the upper reaches of the Peconic, at the BNL boundary and immediately downstream. A few samples of fish, turtles and one of clams were also obtained along the upper reaches of the Peconic. These data, which are shown in Table XII, appear compatable to those found in vegetation. When the concentrations found in these samples are compared with radiation concentration guides, calculated on the basis of an assumed intake of 50 grams/day, the potential exposures from aquatic animals obtained from the upper reaches of the Peconic appear to be quite insignificant.

Potable Water Supply Wells

The Laboratory's potable water supply wells and cooling water supply wells are about 100 feet deep, or about 50 feet below the water table in the Long

Island surface layer of glacial outwash, sand and gravel. As apparent from Fig. 5, most of these wells are located generally west to northwest, and therefore upstream in the local ground water flow pattern[2], of the Laboratory's principal facilities. The exceptions are main well Nos. 1 and 3, and the small well No. 5 adjacent to the sand filter beds. A total of about 5×10^6 gal/day is obtained from these wells.

Monthly grab samples were scheduled for these wells. These were analyzed for gross alpha, gross beta and tritium. All gross alpha concentrations were less than 1 pCi/l, and all tritium concentrations were less than 1 nCi/l. The gross beta results are set forth in Table XIII. There are no differences in the gross beta concentrations in these wells which might be attributed to BNL effluents.

Recharge Basins

About 4×10^6 gal/day of the total water pumped from the ground water supply under the BNL site, is returned to this supply in three large open recharge sumps located about 1 km north of the Liquid Waste Evaporator Facility, about 1 km east of the HFBR, and about 1 km south of the MRR. These are monitored by routine monthly grab sampling. Their average gross beta and tritium concentrations, shown in Table XIV, were only very slightly in excess of those in the BNL supply wells.

Ground Water Surveillance

Several areas from which there is a potential for the migration of radioactivity downward from the surface into the saturated zone of ground water, have been identified. Ground water sampling was routinely conducted in shallow wells located adjacent to and downstream from these areas. These areas include the Sand Filter Beds and downstream along the Peconic River, the Solid Waste Disposal Area, the former open-pit dump and the sanitary landfill which replaced it in 1967, and the Decontamination Facility Sump. Their locations and those of the related ground water surveillance wells are shown in Fig. 6. Detailed locations of the several wells installed at the Solid Waste Disposal Area are shown in Fig. 6-A.

For convenience in assessing the data, the wells have been divided into several groups. Yearly average gross alpha, gross beta and tritium concentrations of the wells generally in the proximity of the Sand Filter Beds and downstream on the Peconic River are summarized in Table XV. At least one sample from most of these locations was also analyzed from ^{90}Sr and ^{137}Cs (by gamma analysis) during the year. This data is also indicated as available. Corresponding information for the wells generally in the proximity or downstream of the Solid Waste Disposal Area, the landfill and dump zones, and of the Decontamination Facility Sump (about 1 km east of the HFBR) is summarized in Table XVI.

From these data, it appears that the spread of contamination in the ground water, if any, is limited to within a few hundred feet of the identified foci and that this is limited to a small percentage of the applicable Radiation Protection Standards.

Milk Sampling

Monthly samples of milk were obtained from the two nearest dairy farms located 10 km south-southwest and 10 km south-southeast of Brookhaven. These samples were analyzed for gamma-emitters and then processed through an ion exchange column to improve the lower detection capability for ^{131}I. The data are indicated in Table XVII. There is no significant difference between these and the average 1971 concentrations reported[5] for milk samples in the northeast region of the United States by the Environmental Protection Agency.

Grass and Soil Sampling

Two sets of samples, one early in the growing season and one toward its end, were collected adjacent to most of the BNL perimeter monitoring stations and from a number of off-site farms. A few on-site samples were also obtained. These were analyzed for gamma-emitting nuclides. The data for soil are shown in Table XVIII and those for grass in Table XIX. Comparison of off-site downwind samples (6 km northeast and 10 km southeast) with other samples discloses no consistent differences. Comparison of off-site samples with on-site samples suggests the possible presence of a slight excess of ^{137}Cs in samples obtained at the northeast perimeter and adjacent to the Solid Waste Disposal Area.

REFERENCES

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2. M.A. Warren, W. deLaguna and N.J. Lusczynski, Hydrology of Brookhaven National Laboratory and Vicinity, Geo. Survey Bull. 1156-C (1968).

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5. ----------, Radiation Data and Reports, 13:4, U.S. Env. Protn. Agency, (April 1972).

1971 BNL ENVIRONMENTAL MONITORING
BACKGROUND AND SOURCE RADIATION LEVELS
AT THE LABORATORY PERIMETER (MILLIROENTGENS/WEEK)

Month	Northwest Perimeter (Background)	Southwest Perimeter (Background)	Southeast Perimeter (Background)	Northeast Perimeter (Background)	Northeast Perimeter (Source)	All Stations (Background)
Jan.	1.74	1.81	1.72	1.68	0.24	1.73
Feb.	1.62	1.65	1.64	1.63	0.25	1.64
March	1.64	1.67	1.67	1.59	0.26	1.64
April	1.66	1.62	1.62	1.60	0.26	1.63
May	1.74	1.73	1.83	1.61	0.31	1.73
June	1.76	1.77	1.86	1.59	0.32	1.74
July	1.77	1.79	1.85	1.63	0.35	1.76
Aug.	1.73	1.92	1.90	1.76	0.38	1.83
Sept.	1.72	1.90	1.90	1.72	0.37	1.81
Oct.	1.75	1.92	1.98	1.76	0.35	1.85
Nov.	1.80	1.97	2.06	1.82	0.30	~~1.86~~ 1.91
Dec.	1.78	1.92	2.05	1.79	0.28	1.89
Average	1.73	1.81	1.84	1.68	0.31	~~1.76~~ 1.76
Yearly Total	90	94	95	87	16*	92
Radiation Protection Standard (1)	-	-	-	-	500	-

Estimated Error ± 0.10 mR/wk.

*Measured 250 feet from North Perimeter and adjusted on the basis of spot comparisons between levels at this location and the perimeter.

TABLE II

1972 BNL ENVIRONMENTAL MONITORING MONTHLY AVERAGE GROSS ALPHA AND GROSS BETA CONCENTRATIONS, AIR PARTICULATE FILTERS (pCi/m³)

		Gross Alpha				Gross Beta			
...th	Location	No.	Average	Maximum	Minimum	No.	Average	Maximum	[illegible]
...n.	Waste Disposal	22	0.0012	0.0039	< 0.0001	22	0.1115	0.4650	0.0174
	S.W. Perimeter	-	-	-	-	5	0.1122	0.1840	0.0338
	N.E. Perimeter	-	-	-	-	5	0.0998	0.1760	0.0532
...eb.	Waste Disposal	21	0.0010	0.0024	< 0.0001	21	0.0783	0.1680	0.0523
	S.W. Perimeter	-	-	-	-	5	0.0716	0.1270	0.0523
	N.E. Perimeter	-	-	-	-	3	0.0828	0.1140	0.0451
...rch	Waste Disposal	23	0.0010	0.0019	< 0.0001	23	0.0869	0.2460	0.0170
	S.W. Perimeter	-	-	-	-	4	0.0898	0.1170	0.0554
	N.E. Perimeter	-	-	-	-	4	0.0808	0.1080	0.0763
...pril	Waste Disposal	21	0.0010	0.0021	0.0003	21	0.0965	0.2940	0.0222
	S.W. Perimeter	-	-	-	-	5	0.1142	0.2030	0.0465
	N.E. Perimeter	-	-	-	-	5	0.1011	0.1450	0.0465
...ay	Waste Disposal	21	0.0009	0.0025	0.0005	21	0.1430	0.2830	0.0609
	S.W. Perimeter	-	-	-	-	4	0.1246	0.1850	0.0736
	N.E. Perimeter	-	-	-	-	4	0.1202	0.1570	0.0558
...une	Waste Disposal	22	0.0006	0.0018	< 0.0001	22	0.1734	0.3690	0.0837
	S.W. Perimeter	-	-	-	-	5	0.2040	0.2570	0.1130
	N.E. Perimeter	-	-	-	-	5	0.1720	0.2580	0.0612
July	Waste Disposal	20	0.0013	0.0026	0.0006	20	0.2005	0.3700	0.068...
	S.W. Perimeter	-	-	-	-	5	0.1754	0.3030	0.088...
	N.E. Perimeter	-	-	-	-	5	0.1696	0.3120	0.0[illegible]
Aug.	Waste Disposal	22	0.0016	0.0036	0.0009	22	0.1233	0.1630	0.069...
	S.W. Perimeter	-	-	-	-	4	0.1232	0.1670	0.083...
	N.E. Perimeter	-	-	-	-	4	0.1056	0.1300	0.092...
Sept.	Waste Disposal	21	0.0012	0.0034	0.0003	21	0.0927	0.1350	0.030
	S.W. Perimeter	-	-	-	-	4	0.0997	0.1270	0.057
	N.E. Perimeter	-	-	-	-	4	0.0838	0.1100	0.038
Oct.	Waste Disposal	22	0.0009	0.0020	0.0002	22	0.0643	0.1620	0.030
	S.W. Perimeter	-	-	-	-	5	0.0525	0.0897	0.031
	N.E. Perimeter	-	-	-	-	5	0.0409	0.0475	0.035
Nov.	Waste Disposal	19	0.0007	0.0014	0.0003	19	0.0529	0.1060	0.01...
	S.W. Perimeter	-	-	-	-	4	0.0431	0.0513	0.02...
	N.E. Perimeter	-	-	-	-	4	0.0358	0.0430	0.02...
Dec.	Waste Disposal	20	0.0009	0.0027	0.0002	20	0.0428	0.0848	0.01...
	S.W. Perimeter	-	-	-	-	5	0.0482	0.0708	0.02...
	N.E. Perimeter	-	-	-	-	5	0.0375	0.0508	0.02
Average	Waste Disposal	254	0.0010	0.0039	< 0.0001	254	0.1006	0.4650	0.01
	S.W. Perimeter	-	-	-	-	55	0.0879	0.3030	0.02
	N.E. Perimeter	-	-	-	-	54	0.0938	0.3120	0.02
Est. % Error of Individual Sample				± 25				± 10	
Radiation Protection Standard				0.100				100	

1971 BNL ENVIRONMENTAL MONITORING [illegible]
AND GROSS BETA CONCENTRATIONS, AIR PARTICULATE FILTERS (pCi/m^3)

		Gross Alpha				Gross Beta			
Month	Location	No.	Average	Maximum	Minimum	No.	Average	Maximum	Minimum
Jan.	Waste Disposal	15	0.0007	0.0029	0.0005	21	0.075	0.116	0.045
	S.W. Perimeter	-	-	-	-	2	0.096	0.112	0.080
	S.E. Perimeter	-	-	-	-	-	-	-	-
Feb.	Waste Disposal	15	0.0012	0.0021	< 0.0001	20	0.087	0.153	0.021
	S.W. Perimeter	-	-	-	-	2	0.081	0.102	0.059
	S.E. Perimeter	-	-	-	-	2	0.112	0.142	0.083
March	Waste Disposal	19	0.0011	0.0019	0.0001	23	0.177	0.338	0.058
	S.W. Perimeter	-	-	-	-	2	0.152	0.164	0.140
	S.E. Perimeter	-	-	-	-	2	0.172	0.199	0.143
April	Waste Disposal	17	0.0009	0.0022	< 0.0001	22	0.230	0.395	0.043
	S.W. Perimeter	-	-	-	-	2	0.213	0.214	0.212
	S.E. Perimeter	-	-	-	-	2	0.255	0.255	0.255
May	Waste Disposal	14	0.0014	0.0070	0.0001	24	0.428	0.910	0.072
	S.W. Perimeter	-	-	-	-	2	0.352	0.445	0.258
	S.E. Perimeter	-	-	-	-	2	0.289	0.450	0.128
June	Waste Disposal	17	0.0012	0.0033	< 0.0001	22	0.458	0.760	0.08
	S.W. Perimeter	-	-	-	-	2	0.396	0.406	0.38
	S.E. Perimeter	-	-	-	-	2	0.435	0.472	0.39
July	Waste Disposal	15	0.0009	0.0018	0.0001	23	0.420	0.660	0.12
	S.W. Perimeter	-	-	-	-	2	0.352	0.461	0.28
	S.E. Perimeter	-	-	-	-	2	0.443	0.544	0.34
August	Waste Disposal	18	0.0011	0.0032	< 0.0001	23	0.263	0.905	0.07
	S.W. Perimeter	-	-	-	-	2	0.235	0.245	0.22
	S.E. Perimeter	-	-	-	-	2	0.263	0.287	0.23
Sept.	Waste Disposal	17	0.0008	0.0016	0.0001	23	0.118	0.195	0.06
	S.W. Perimeter	-	-	-	-	3	0.123	0.143	0.08
	S.E. Perimeter	-	-	-	-	3	0.120	0.148	0.07
Oct.	Waste Disposal	16	0.0008	0.0031	< 0.0001	23	0.077	0.144	0.02
	S.W. Perimeter	-	-	-	-	4	0.093	0.171	0.02
	S.E. Perimeter	-	-	-	-	4	0.104	0.182	0.04
Nov.	Waste Disposal	21	0.0009	0.0021	0.0004	21	0.080	0.165	0.0
	S.W. Perimeter	-	-	-	-	4	0.057	0.067	0.0
	S.E. Perimeter	-	-	-	-	4	0.084	0.090	0.0
Dec.	Waste Disposal	22	0.0008	0.0018	0.0005	22	0.074	0.128	0.0
	S.W. Perimeter	-	-	-	-	4	0.043	0.086	0.0
	S.E. Perimeter	-	-	-	-	4	0.086	0.096	0.0
1971	Waste Disposal	206	0.0010	0.0070	< 0.0001	267	0.207	0.905	0.0
	S.W. Perimeter	-	-	-	-	33	0.179	0.461	0.0
	S.E. Perimeter	-	-	-	-	31	0.215	0.544	0.0

Estimated Error (at 95% confidence limits): Gross Alpha ± 0.0001 or ± 25%; Gross Beta ± 10%.
Radiation Protection Standard(1) 0.1000* 10.00**
*For unidentified alpha-emitters **For unidentified beta-emitters

TABLE III

1971 BNL ENVIRONMENTAL MONITORING MONTHLY AVERAGE TRITIUM CONCENTRATION IN AIR (pCi/m^3)

Month	No. of Samples	S.W. Perimeter	No. of Samples	N.E. Perimeter
Jan.	1*	11	0	-
Feb.	1*	10	0	-
March	1*	5	0	-
April	1*	4	1*	10
May	1*	3	1*	9
June	1*	15	1*	12
July	1*	0	1*	15
August	1*	1	1*	3
Sept.	1*	0	1*	4
Oct.	1*	2	1*	3
Nov.	0	-	0	-
Dec.	1*	3	0	-
Average		5		8
Radiation Protection Standard[(1)]		2×10^5		2×10^5

*Tritium analysis made of monthly composite samples of water vapor. The net tritium concentration in this, arrived at by subtracting that in an off-site precipitation sample, is converted to air concentration on the assumption that on the average 1 pCi/ml in vapor corresponds to 10 pCi/m^3 in air, which is strictly so at 59°F. and 50° R.H.

Estimated Error (at 95% confidence limits): ± 1 pCi/m^3, or ± 50%.

TABLE IV

1971 BNL ENVIRONMENTAL MONITORING
MONTHLY AVERAGE OF γ-EMITTING NUCLIDES IN MONTHLY COMPOSITE
AIR PARTICULATE AND CHARCOAL FILTERS (pCi/m^3)

Month	^{7}Be	^{65}Zn	^{90}Sr	^{95}Zr-Nb	^{106}Ru	^{125}Sb	^{131}I**	^{137}Cs	^{140}Ba-La	^{144}Ce
January	0.094	0.001		0.012	0.007	0.001	< 0.001	0.004	< 0.001	0.022
February	0.103	0.003		0.019	0.007	0.003	< 0.001	0.005	< 0.001	0.028
March	0.243	0.003		0.070	0.018	0.003	< 0.001	0.010	< 0.001	0.077
April	0.374	0.003		0.142	0.013	0.004	< 0.001	0.012	< 0.001	0.118
May	0.476	0.007		0.227	0.043	0.007	< 0.001	0.017	< 0.001	0.188
June	0.453	0.010	0.003	0.274	0.051	0.008	< 0.001	0.026	< 0.001	0.235
July	Pending	0.009		0.192	Pending	0.008	< 0.001	0.023	< 0.001	0.202
August	Pending	0.007		0.104	Pending	0.005	0.001	0.017	< 0.001	0.111
September	Pending	0.003		0.042	Pending	0.003	< 0.001	0.017	< 0.001	0.054
October	Pending	0.002		0.013	Pending	0.002	< 0.001	0.003	< 0.001	0.025
November	Pending	0.001		0.009	Pending	0.001	0.001	0.003	0.004	0.021
December	Pending	0.001		0.005	Pending	0.001	0.002	0.002	0.003	0.016
Average	0.291*	0.004	0.002	0.092	0.024*	0.003	< 0.001	0.012	< 0.001	0.091
Est. % Error of Individual Sample	± 25	± 50		± 25	± 33	± 33	± 50	± 25	± 50	± 25
Radiation(1) Protection Standard	$4x10^4$	$2x10^3$		$1x10^3$	200	900	100	500	1,000	200

*Based on partial data.

**[illegible] all other nuclides collected on air particulate filter.

TABLE V

1971 BNL ENVIRONMENTAL MONITORING
MONTHLY AVERAGE GROSS BETA CONCENTRATION, TOTAL GROSS BETA ACTIVITY, AND PRINCIPAL NUCLIDE ACTIVITY IN PRECIPITATION

Month	Amount Inches	Gross Beta Conc. (pCi/l)	Gross Beta Activity (nCi/m²)	Nuclide Activity (nCi/m²)							
				^{7}Be	^{65}Zn	^{90}Sr	^{95}Zr-Nb	^{131}I	^{137}Cs	^{140}Ba-La	14
Jan.	1.97	31	1.57	5.2	< 0.1	0.04	0.4	0.1	0.1	< 0.1	1
Feb.	4.62	42	2.34	14.4	< 0.1	0.12	2.7	< 0.1	0.2	< 0.1	1
March	2.37	81	4.95	9.6	< 0.1	0.17	3.5	< 0.1	0.2	< 0.1	1
April	1.70	122	4.59	4.6	< 0.1	0.05	1.2	< 0.1	0.2	< 0.1	1
May	3.12	169	14.03	26.6	0.1	0.30	7.6	< 0.1	1.0	< 0.1	3
June	0.74	219	4.39 }	10.3	< 0.1	0.27	3.4	< 0.1	0.5	< 0.1	1
July	3.37	36	2.72 }								
Aug.	5.57	19	2.53	6.7	< 0.1	0.13	1.1	< 0.1	0.2	< 0.1	
Sept.	1.98	9	0.38	1.4	< 0.1	0.05	0.2	< 0.1	0.1	< 0.1	
Oct.	3.11	16	1.25	5.9	< 0.1	0.14	0.4	< 0.1	0.1	< 0.1	
Nov.	3.45	39	4.75	1.7	< 0.1	0.11	0.1	< 0.1	< 0.1	< 0.1	
Dec.	3.23	58	4.77	4.8	0.1	0.05	0.4	0.3	0.1	0.6	
Total	35.23	56*	~~47.67~~ [illegible]	~~95.2~~ 41	< 1.0	1.43	21.0	< 1.0	~~2.1~~ 2	< 1.0	[illegible]

* Average

Est.Error	0.25	± 6	± 2.39	± 19.0	-	± 0.14	± 2.1	-	± 0.8	-	±
Radiation Protection Standard**(1)		3 x 10^3									

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

TABLE VI

1971 BNL ENVIRONMENTAL MONITORING
MONTHLY AVERAGE TRITIUM CONCENTRATION AND ACTIVITY IN PRECIPITATION

Month	BNL Concentration (pCi/l)	BNL Activity (nCi/m^2)	OFF-SITE Concentration (pCi/l)
January	661	33	300
February	300	17	210
March	1,570	96	459
April	1,470	55	605
May	972	81	705
June, July	1,186	136	523
August	460	61	306
September, October	325	41	82
November	273	16	104
December	248	20	148
Total	650*	556	320*
*Average			
Estimated Error	± 65	± 57	± 32
Radiation Protection Standard** (1)	3×10^6		3×10^6

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

1971 BNL ENVIRONMENTAL MONITORING
LIQUID EFFLUENT FLOW, TOTAL ACTIVITY AND CONCENTRATION OF PRINCIPAL β AND γ EMITTERS AT CLARIFIER AND CHLORINE HOUSE

CLARIFIER

(mCi)

Month	Flow $\times 10^{11} cm^3$	GS*	^{3}H	^{7}Be	^{60}Co	^{65}Zn	^{90}Sr	^{95}Zr-Nb	^{131}I	^{137}Cs	^{144}Ce
Jan.	1.142	1.62	1,122	< 0.10	0.13	0.07	0.19	< 0.01	0.18	0.40	0.34
Feb.	0.919	3.05	588	0.40	0.14	< 0.01	0.15	< 0.01	2.04	0.35	0.30
March	0.933	1.35	489	0.24	0.07	< 0.01	0.12	0.02	1.01	0.19	0.30
April	0.924	2.54	532	0.22	0.09	0.05	0.12	0.04	1.62	0.26	0.57
May	1.477	3.24	1,333	< 0.10	0.11	< 0.01	0.27	0.62	0.72	0.66	0.40
June	1.209	1.60	4,291	0.26	0.05	< 0.01	0.21	0.04	0.87	0.22	0.26
July	1.304	2.51	626	0.51	0.09	< 0.01	0.20	< 0.10	0.58	0.30	0.40
Aug.	1.701	13.48	704	< 0.10	0.26	< 0.01	6.36	< 0.10	2.63	5.11	1.72
Sept.	1.339	5.77	407	0.56	0.09	< 0.01	2.77	< 0.10	1.17	1.15	0.64
Oct.	1.627	3.34	564	0.29	0.06	< 0.01	1.09	< 0.10	0.66	0.53	0.43
Nov.	1.003	1.55	148	0.13	< 0.05	< 0.01	0.46	< 0.10	0.10	0.41	0.17
Dec.	1.001	3.98	158	0.28	0.04	0.02	0.38	< 0.10	0.70	0.38	0.91
Total	14.579	44.03	10,962	~~2.93~~ [illegible]	1.16	0.19	12.32	1.03	12.28	9.96	6.44
Avg. Conc. (pCi/l)		30.2	7,510	2.0	0.8	0.1	8.5	0.7	8.4	6.8	4.4
% of Total		100	-	7	3	< 1	28	2	28	23	14

CHLORINE HOUSE

(mCi)

Month	Flow $\times 10^{11} cm^3$	GS*	^{3}H	^{7}Be	^{60}Co	^{65}Zn	^{90}Sr	^{95}Zr-Nb	^{131}I	^{137}Cs	^{144}Ce
Jan.	0.870	1.15	1,150	< 0.10	0.02	< 0.01	0.10	< 0.01	0.07	0.90	0.22
Feb.	0.697	1.67	466	0.35	0.01	< 0.01	0.10	< 0.01	0.39	0.78	0.23
March	0.784	1.23	432	0.18	0.03	< 0.01	0.11	< 0.01	0.23	0.68	0.34
April	0.760	1.34	439	0.12	0.02	< 0.01	0.13	< 0.01	0.16	0.49	0.18
May	1.167	1.72	1,207	< 0.10	0.02	0.03	0.19	0.04	0.09	0.48	0.11
June	0.963	1.24	3,454	< 0.10	0.03	< 0.01	0.15	0.03	0.12	0.55	0.15
July	1.020	1.60	598	0.24	0.02	< 0.01	0.12	-	0.13	0.50	0.24
Aug.	1.347	1.36	546	< 0.10	0.02	< 0.01	0.31	< 0.10	0.19	0.51	0.29
Sept.	0.552	1.04	108	0.24	0.01	< 0.01	0.77	0.01	0.26	0.27	0.17
Oct.	1.293	5.50	463	0.43	0.02	< 0.01	5.18	-	0.28	0.97	0.36

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*Includes γ only emitters; does not include ^{3}H.

CHLORINE HOUSE

(mCi)

Month	Flow x 10^{11} cm^3	Gβ*	^3H	^7Be	^{60}Co	^{65}Zn	^{90}Sr	^{95}Zr-Nb	^{131}I	^{137}Cs	^{144}Ce
Nov.	0.905	2.90	131	0.15	0.01	0.01	1.33	-	< 0.10	0.76	0.40
Dec.	0.871	3.79	122	0.30	0.09	0.02	1.18	-	0.46	0.69	0.49
Total	11.219	24.54	9,116	2.21	0.30	0.10	9.67	0.15	2.44	7.58	3.18
Avg. Conc. (pCi/l)		21.0	8,120	2.0	0.3	0.1	8.6	0.1	2.2	6.8	2.8
% of Total		100	-	9	1	< 1	39	1	10	31	13

GROUND WATER

(mCi)

Total	3.360	7.36	2,730	0.67	0.10	0.03	2.90	0.03	0.74	2.28	0.94
Estimated Error (%)		± 10	± 10	± 25	± 50	± 50	± 10	± 50	± 25	± 10	± 25
Radiation (1) Protection Standard (pCi/l)		600	$3x10^6$	$2x10^6$	$5x10^4$	$1x10^5$	300	$6x10^4$	300	$2x10^4$	1x10[illegible]

*Includes γ only emitters; does not include ^3H.

1971 BNL ENVIRONMENTAL MONITORING

LIQUID EFFLUENT FLOW, TOTAL ACTIVITY AND CONCENTRATION OF PRINCIPAL β AND γ EMITTERS AT FORMER PERIMETER (0.5 MILES DOWNSTREAM)

(mCi)

th	Flow x 10^{11} cm^3	Gβ*	^{3}H	^{7}Be	^{60}Co	^{65}Zn	^{90}Sr	^{95}Zr-Nb	^{131}I	^{137}Cs	[illegible]
n.	0.974	1.27	979	< 0.10	0.02	0.01	0.11	< 0.01	0.06	1.00	0.23
b.	0.953	1.85	658	0.23	0.02	< 0.01	0.14	< 0.01	0.36	0.92	0.51
rch	0.957	1.50	448	0.34	0.02	< 0.01	0.16	0.02	0.20	0.80	0.30
ril	0.923	1.77	482	0.23	0.01	0.01	0.16	0.02	0.22	0.46	0.21
y	1.332	1.73	1,275	< 0.10	0.01	0.02	0.28	0.04	0.12	0.58	0.14
ne	0.978	1.17	3,365	< 0.10	0.02	< 0.01	0.21	0.02	0.07	0.48	0.13
ly	1.004	1.43	584	0.16	0.02	< 0.01	0.12	-	0.12	0.41	0.24
g.	1.262	1.28	532	0.09	0.02	< 0.01	0.27	-	0.13	0.54	0.24
pt.	0.767	1.47	221	0.23	0.02	< 0.01	1.09	0.01	0.33	0.31	0.22
t.	1.136	4.76	397	0.25	0.01	< 0.01	4.39	-	0.19	0.82	0.27
v.	0.890	2.98	110	0.20	< 0.01	0.02	1.44	-	< 0.10	0.78	0.23
c.	0.919	3.77	125	0.30	0.02	< 0.01	1.08	-	0.29	0.74	0.33
tal	12.095	25.00	9,176	2.18	0.20	0.11	9.45	0.12	2.14	7.84	3.05
g. Conc.		20.6	7,560	1.8	0.2	0.1	7.8	0.1	1.8	6.5	2.5
of total		100	-	9	1	< 1	38	< 1	9	31	[illegible]
diation(1) Protection Standards (pCi/l)		600	3x10^{6}	2x10^{6}	5x10^{4}	1x10^{5}	300	6x10^{4}	300	2x10^{4}	[illegible]x10^{4}

LIQUID EFFLUENT FLOW, TOTAL ACTIVITY AND CONCENTRATION OF PRINCIPAL β AND γ EMITTERS AT SITE BOUNDARY (1.6 MILES DOWNSTREAM)

(mCi)

Jan.	0.627	0.72	716	< 0.10	0.01	0.01	0.06	< 0.10	0.03	0.50	0.21
Feb.	0.494	0.85	270	0.25	< 0.01	< 0.01	0.06	0.03	0.21	0.31	0.12
March	0.813	1.35	362	0.39	0.02	< 0.01	0.13	0.05	0.13	0.50	0.24
April	0.728	1.37	367	0.23	0.01	< 0.01	0.12	0.04	0.08	0.36	0.18
May	0.697	1.57	521	0.43	0.01	0.01	0.17	0.08	0.13	0.31	0.10
June	0.263	0.30	746	< 0.10	0.01	< 0.01	0.06	0.01	0.02	0.11	[illegible]
July	0.064	0.09	37	0.01	< 0.01	< 0.01	0.01	< 0.01	0.01	0.03	[illegible]
Aug.	0.061	0.07	27	< 0.01	< 0.01	< 0.01	0.01	-	0.01	0.02	[illegible]
Sept.	0.053	0.09	15	0.02	< 0.01	< 0.01	0.08	< 0.01	0.02	0.02	[illegible]

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*Includes γ only emitters; does not include ^{3}H.

TABLE VIII (Cont'd)

SITE BOUNDARY (1.6 MILES DOWNSTREAM)

(mCi)

th	Flow x 10^{11} cm^3	Gβ*	^3H	^7Be	^{60}Co	^{65}Zn	^{90}Sr	^{95}Zr-Nb	^{131}I	^{137}Cs	^{144}Ce
t.	0.067	0.21	21	0.03	< 0.01	< 0.01	0.26	-	0.01	0.04	0.03
v.	0.067	0.26	10	0.03	< 0.01	< 0.01	0.11	-	< 0.01	0.03	0.02
c.	0.067	0.34	9	0.04	< 0.01	< 0.01	0.08	-	0.01	0.03	0.03
tal	4.001	7.22	3,101	1.54	0.10	~~0.05~~ 0.7	~~1.25~~ 1.[illegible]	~~0.23~~ [illegible]	0.67	2.27	1.00
g. Conc.		18.0	7,800	3.9	0.2	0.1	3.1	0.6	1.7	5.7	2.5
of total		100	-	21	1	1	17	3	9	31	14

GROUND WATER

(mCi)

tal	8.094	14.59	6,075	3.15	0.16	0.08	2.52	0.49	1.37	4.61	2.02
timated rror (%)		± 10	± 10	± 25	± 50	± 50	± 10	± 50	± 25	± 10	± 25
diation(1) otection tandards (pCi/l)		1000	$3x10^6$	$2x10^6$	$5x10^4$	$1x10^5$	300	$6x10^4$	300	$2x10^4$	$1x10^4$

Includes γ only emitters; does not include ^3H.

1971 BNL ENVIRONMENTAL MONITORING
MONTHLY DOWNSTREAM AND CONTROL WATER SAMPLES
GROSS BETA (pCi/l) AND ^3H (nCi/l)

GROSS BETA (pCi/l)

	Downstream Locations					Control Locations				
Month	A	B	C	D	R	E	F	H	I	J
Jan.	5	3	4	3	-	3	3	1	15	6
Feb.	6	4	3	4	-	3	3	1	4	4
March	7	4	4	4	-	4	2	3	5	5
April	6	4	5	4	6	5	4	3	7	5
May	28	6	10	15	9	7	17	7	12	8
June	6	4	5	4	8	7	4	3	6	6
July	3	3	4	4	6	16	4	2	6	3
Aug.	3	2	4	3	6	8	3	2	6	3
Sept.	4	3	3	2	3	8	4	2	3	3
Oct.	2	3	2	3	4	7	3	2	3	2
Nov.	< 1	1	5	2	4	7	5	< 1	5	2
Dec.	10	9	9	9	-	7	12	6	11	7
Average	7	4	5	5	6*	7	5	3	6	5

^3H (nCi/l)

Month	A	B	C	D	R	E	F	H	I	J
Jan.	4	3	< 1	< 1	-	< 1	< 1	< 1	< 1	< 1
Feb.	< 1	< 1	< 1	< 1	-	3	< 1	< 1	< 1	< 1
March	< 1	1	< 1	< 1	-	< 1	< 1	< 1	< 1	< 1
April	< 1	3	< 1	< 1	< 1	< 1	< 1	< 1	1	< 1
May	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
June	6	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
July	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Aug.	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sept.	< 1	< 1	< 1	< 1	< 1	1	< 1	< 1	< 1	< 1
Oct.	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Nov.	< 1	< 1	< 1	< 1	< 1	1	< 1	< 1	< 1	< 1
Dec.	< 1	< 1	< 1	< 1	-	< 1	< 1	< 1	< 1	< 1
Average	1	1	< 1	< 1	< 1*	< 1	< 1	< 1	< 1	< 1

*Partial Year

Radiation Protection Standard:[1] Gross Beta - 1,000 pCi/l; ^3H - 3×10^3 nCi/l.

TABLE X

1971 BNL ENVIRONMENTAL MONITORING
CONCENTRATIONS OF γ-EMITTING NUCLIDES
IN PECONIC RIVER AND CARMAN'S RIVER SEDIMENTS

Peconic River

Station	^{60}Co (pCi/kg)	^{65}Zn (pCi/kg)	^{137}Cs (pCi/kg)	Th (pCi/kg)	U (pCi/kg)	K (gm/kg)
O*	93	95	409	737	484	3.17
K	-	-	846	1,300	-	1.19
L	190	41	1,230	1,330	1,060	4.17
L′	1,030	150	3,330	1,650	-	3.91
M	172	63	1,590	4,890	-	3.68
Q	-	-	718	645	642	2.02
A	31	47	1,170	669	522	1.61
B	44	81	-	841	839	3.93
C	-	-	727	925	646	3.12
D	26	7	277	357	524	1.74
V	66	32	228	369	527	2.63
W	31	6	84	407	436	2.13
R	-	-	88	290	116	0.88
Y	-	64	-	509	-	2.44

Reference (Carman's River)

Average (2)	-	-	187	607	427	2.69

*Sewage Outlet

[illegible]

1971 BNL ENVIRONMENTAL MONITORING CONCENTRATIONS OF γ-EMITTING NUCLIDES IN PECONIC RIVER AND CARMAN'S RIVER VEGETATION

Station	^{7}Be (pCi/kg)	^{60}Co (pCi/kg)	^{95}Zr-Nb (pCi/kg)	^{137}Cs (pCi/kg)	Th (pCi/kg)	U (pCi/kg)	K (gm/kg)
Carex (sedge)							
K	1,450	-	861	1,370	284	160	1.84
L	-	-	1,050	1,440	378	-	-
L'	1,920	-	1,164	1,100	278	283	1.00
M	1,680	-	686	514	173	204	-
Q	2,340	-	488	2,990	252	349	0.13
A	-	-	666	5,050	-	388	0.64
B	1,580	-	740	1,420	251	189	1.11
C	895	-	551	1,130	138	94	-
D	-	-	-	-	-	-	-
V	3,230	-	1,330	1,800	396	194	6.70
W	-	811	1,030	381	1,500	-	3.05
Y	1,130	-	750	415	953	836	4.20
Potedaria (pickerel weed)							
C	265	-	924	-	39	496	1.27
D	238	-	71	100	62	41	1.10
V	645	-	222	-	63	52	1.96
W	451	-	116	106	67	63	0.69
R	43	-	96	-	26	44	1.47
Y	109	-	186	-	36	28	0.88
Vallisneria (wild celery)							
M	-	249	-	380	208	-	0.62
C	289	-	126	68	79	-	1.28
D	217	30	88	57	57	53	0.91
Reference Vegetation (Carman's River)							
Carex	273	-	696	223	74	67	4.70
Misc.	668	-	315	272	124	93	5.61

1971 BNL ENVIRONMENTAL MONITORING
CONCENTRATIONS OF γ-EMITTING NUCLIDES
IN ANIMALS OBTAINED FROM THE PECONIC RIVER

No.	Station	^{7}Be (pCi/kg)	^{60}Co (pCi/kg)	^{137}Cs (pCi/kg)	Th (pCi/kg)	U (pCi/kg)	K (gm/kg)
2	Snapping Turtles						
	L	220	-	478	-	82	0.52
	M	7,176	-	1,270	1,586	1,372	4.82
1	Box Turtle						
	L'	-	-	13,520	2,500	-	-
4	Eastern Painted Turtles						
	M	348	-	1,290	422	173	-
	M	-	-	672	144	161	1.18
	M	7,860	-	889	215	130	-
	C	190	-	205	-	58	1.62
5	Pickerels						
	M	-	-	795	352	864	-
	M	1,120	-	805	-	416	-
	Q	-	-	1,480	263	169	-
	A	-	445	247	109	170	-
	A	815	-	464	401	204	-
3	Catfish						
	Q	1,000	-	605	443	436	-
	B	335	-	580	164	129	-
	C	454	-	654	205	134	1.78
2	Perch						
	Q	-	-	647	201	218	-
	Q	689	-	1,280	793	869	-
1	Clams (several counted together)						
	C	129	-	89	210	228	0.31
Radiation Protection Standard*		(1) 9×10^{7}	2×10^{6}	9×10^{5}	9×10^{4}	9×10^{5}	-

*Assumed intake of 50 gms/day.

TABLE XIII

1971 BNL ENVIRONMENTAL MONITORING
GROSS BETA AND TRITIUM† CONCENTRATIONS
IN POTABLE WATER SUPPLY WELLS

GROSS BETA (pCi/l)

Well #	1	2	3	4	5	6	7	101	102	103	104	105
Jan.	1.0	< 1.0	< 1.0	1.2	< 1.0	1.2	< 1.0	1.0	< 1.0	1.6	< 1.0	2.1
Feb.	< 1.0	< 1.0	< 1.0	1.6	< 1.0	1.4	< 1.0	< 1.0	< 1.0	2.1	-	-
Mar.	2.6	4.2	1.3	2.9	3.1	5.5	1.5	1.6	4.0	1.5	-	-
Apr.	2.1	2.4	2.3	3.2	2.8	2.2	2.7	1.5	1.6	2.2	2.3	1.9
May	3.5	4.1	2.8	2.7	3.1	4.0	2.7	-	-	-	2.8	2.9
June	1.4	1.8	2.9	1.2	1.4	1.4	1.1	1.2	-	-	1.6	1.6
July				N O T	S A M P L E D							
Aug.				N O T	S A M P L E D							
Sept.				N O T	S A M P L E D							
Oct.	< 1.0	< 1.0	< 1.0	-	1.2	1.3	< 1.0	< 1.0	< 1.0	1.3	< 1.0	2.1
Nov.	< 1.0	< 1.0	< 1.0	2.2	< 1.0	2.8	2.2	1.5	1.4	1.9	< 1.0	< 1.0
Dec.	0.9	2.6	1.6	2.2	1.7	4.7	1.5	0.9	1.3	2.4	< 1.0	< 1.0
Average	1.5	~~2.1~~ 1.9	1.4	2.2	1.7	2.8	1.5	1.0	1.4	~~2.2~~ 1.9	1.2	1.7

Radiation Protection Standard[1]: 100 pCi/l (for unidentified nuclides, in the absence of ^{226}Ra or ^{228}Ra.)

† All tritium concentrations < 1.0 nCi/l.

TABLE XIV

1971 BNL ENVIRONMENTAL MONITORING
MONTHLY SUMP SAMPLES
GROSS BETA (pCi/l) AND ^{3}H (nCi/l) CONCENTRATIONS

GROSS BETA (pCi/l)

Month	N North of Evaporator	O East of HIRDL	P Medical
Jan.	19	1	2
Feb.	3	2	1
March	7	8	2
April	3	3	2
May	11	3	3
June	1	5	1
July	2	1	1
Aug.	2	2	1
Sept.	6	1	2
Oct.	1	1	1
Nov.	2	< 1	< 1
Dec.	6	3	-
Average	5	3	2

^{3}H (nCi/l)

Jan.	< 1	< 1	1
Feb.	< 1	< 1	< 1
March	< 1	< 1	< 1
April	2	< 1	< 1
May	< 1	< 1	< 1
June	< 1	5	1
July	< 1	1	< 1
Aug.	< 1	< 1	< 1
Sept.	< 1	< 1	< 1
Oct.	< 1	< 1	< 1
Nov.	< 1	< 1	< 1
Dec.	-	< 1	-
Average	< 1	1	< 1

Radiation Protection Standard:[1] Gross Beta - 1,000 pCi/l; ^{3}H - 3×10^{3} nCi/l.

TABLE XV

1971 BNL ENVIRONMENTAL MONITORING
SAND FILTER BEDS AND PECONIC RIVER AREA GROUND WATER SURVEILLANCE WELLS
GROSS ALPHA, GROSS BETA, TRITIUM, ^{90}SR AND ^{137}CS CONCENTRATIONS

Well	Gross α No.	Gross α Avg. Conc. (pCi/l)	Gross β No.	Gross β Avg. Conc. (pCi/l)	^{3}H No.	^{3}H Avg. Conc. (nCi/l)	^{90}Sr No.	^{90}Sr Avg. Conc. (pCi/l)	^{137}Cs No.	^{137}Cs Avg. Conc. (pCi/l)
SA	13	1.0	13	5.9	12	< 1.0	2	0.2	2	< 0.5
SB	11	< 0.5	11	1.8	10	< 1.0	2	0.2	2	< 0.5
SC	8	< 0.5	8	2.8	8	< 1.0	-	-	-	-
SD	13	< 0.5	13	1.5	13	< 1.0	-	-	-	-
XA	12	< 0.5	13	10.6	13	6.9	1	5.0	1	< 0.5
XB	4	1.2	4	7.5	2	0.5	1	0.2	1	< 0.5
XC	7	1.3	8	8.4	2	0.5	1	3.2	1	< 0.5
XD	12	< 0.5	12	1.1	2	0.4	1	< 0.2	1	< 0.5
XE	12	0.7	12	2.5	12	11.0	1	0.2	1	< 0.5
XF	7	< 0.5	7	2.0	1	0.2	-	-	-	-
XG	7	< 0.5	7	6.0	7	4.8	1	3.1	1	0.6
XH	11	< 0.5	11	1.7	2	0.6	1	0.5	1	< 0.5
XI	7	< 0.5	7	1.7	2	0.2	1	0.4	1	< 0.5
XJ	7	< 0.5	7	3.1	3	0.3	1	1.8	1	< 0.5
XK	7	< 0.5	7	10.8	7	7.7	1	2.1	1	< 0.5
XL	13	1.1	13	19.9	13	10.5	1	13.0	1	< 0.5
XM	13	< 0.5	13	9.0	13	5.7	1	5.0	1	1.2
XN	7	2.2	7	6.8	3	0.4	1	0.8	1	< 0.5
XO	7	0.9	7	7.1	3	0.2	1	2.3	1	< 0.5
XQ	12	< 0.5	12	4.8	12	8.6	-	-	-	-
XR	2	0.7	2	5.6	2	< 1.0	-	-	-	-
XS	12	1.0	12	7.1	2	0.3	-	-	-	-
XT	13	< 0.5	13	2.4	2	0.4	-	-	-	-
XU	13	< 0.5	13	2.3	1	0.4	-	-	-	-
XV	13	< 0.5	13	36.3	2	0.6	-	-	-	-
XW	13	< 0.5	13	3.2	2	0.6	-	-	-	-
Radiation Protection Standard (1)		100*		300**		300		300		2×10^{4}

* If ^{129}I, ^{226}Ra and ^{220}Ra not present.

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

TABLE XVI

1971 BNL ENVIRONMENTAL MONITORING
SOLID WASTE DISPOSAL AREA, LANDFILL AND DUMP AREA, AND 650 SUMP
GROSS ALPHA, GROSS BETA, TRITIUM, ^{90}SR AND ^{137}CS CONCENTRATIONS

Well	Gross α No.	Gross α Avg. Conc. (pCi/l)	Gross β No.	Gross β Avg. Conc. (pCi/l)	^{3}H No.	^{3}H Avg. Conc. (nCi/l)	^{90}Sr No.	^{90}Sr Avg. Conc. (pCi/l)	^{137}Cs No.	^{137}Cs Avg. Conc. (pCi/l)
WA	6	2.7	8	69,800	-	-	1	326	6	68,300
WB	11	< 0.5	11	64	2	0.70	1	31	1	0.9
WC	12	< 0.5	11	17	2	0.68	-	-	-	-
WD	12	< 0.5	12	19	13	3.3	-	-	-	-
WE	11	< 0.5	11	24	1	0.7	1	11	1	< 0.5
WF	7	< 0.5	7	427	1	0.6	1	453	1	1.4
WG	9	< 0.5	9	26	1	0.5	1	7	1	< 0.5
WH	7	< 0.5	7	7.5	1	0.5	1	3	1	2
WI	2	< 0.5	2	2.3	1	0.4	1	4	1	0.5
WJ	2	< 0.5	2	18	1	0.5	1	7	1	< 0.5
WK	9	< 0.5	9	19	9	1.0	1	10	1	< 0.5
WL	9	< 0.5	9	130	9	0.8	1	99	1	< 0.5
WM	9	< 0.5	9	8.9	9	7.8	1	0.4	1	< 0.5
WN	10	< 0.5	10	3.1	3	0.7	1	0.2	1	< 0.5
WO	5	< 0.5	5	< 1.5	1	0.4	-	-	-	-
WP	6	< 0.5	6	4.0	6	2.6	-	-	-	-
WQ	7	< 0.5	7	5.3	7	2.5	-	-	-	-
WR	2	3.5	2	42	2	23	-	-	-	-
WS	6	< 0.5	6	1.7	2	0.8	-	-	-	-
WT	8	< 0.5	8	1.6	2	0.4	1	< 0.2	1	< 0.5
WU				NOT	SAMPLED					
WV				NOT	SAMPLED					
WW	2	< 0.5	2	3.4	2	< 1.0	-	-	-	-
WX	2	< 0.5	2	3.4	2	< 1.0	-	-	-	-
WZ	10	< 0.5	10	2.9	1	0.6	-	-	-	-
W-1	1	< 0.5	1	93	1	0.5	-	-	-	-
W-2	1	< 0.5	1	103	1	0.8	-	-	-	-
W-3	1	< 0.5	1	3.9	1	< 1.0	-	-	-	-
W-4	1	< 0.5	1	4.6	1	< 1.0	-	-	-	-
W-5	1	< 0.5	1	1.1	1	< 1.0	-	-	-	-
Radiation Protection Standard(1)		100*		300**		300		300		2×10^4

* If ^{129}I, ^{226}Ra and ^{220}Ra not present.

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

waste

waste

TABLE XVII

1971 BNL ENVIRONMENTAL MONITORING

CONCENTRATIONS OF ^{90}SR, ^{131}I, ^{137}CS AND K IN MILK

	Farm B - 10 Km SSW				Farm C - 10 Km SE			
Month	^{90}Sr** (pCi/l)	^{131}I (pCi/l)	^{137}Cs (pCi/l)	K (gm/l)	^{90}Sr** (pCi/l)	^{131}I (pCi/l)	^{137}Cs (pCi/l)	K (gm/l)
Jan.		< 5	16	1.42		< 5	18	1.33
Feb.		< 5	22	1.41		< 5	24	1.48
March	5	< 5	24	1.41	10	< 5	14	1.16
April		< 5	12	1.35		< 5	10	1.21
May		< 5	23	1.47		< 5	20	1.15
June	6	< 5	27	1.44	5	< 5	20	1.35
July		< 5	16	1.32		< 5	15	1.21
August		< 5	23	1.61		< 5	22	1.29
Sept.	6	< 5	20	1.00	11	< 5	20	1.93
Oct.		< 5	15	1.34		< 5	22	1.49
Nov.		< 5	15	1.15		< 5	14	1.4[illegible]
Dec.	< 3	< 5	13	1.50	10	< 5	11	1.2[illegible]
Average	5	< 5	19	1.37	9	< 5	18	1.3[illegible]
Radiation[1] Protection Standard	200*	100*	4×10^4	-	200*	100	4×10^4	

* Based on FRC Radiation Protection Guide[3] and an assumed intake of one liter/day.

**Quarterly Data of New York State Health Department[4].

TABLE XVIII

1971 BNL ENVIRONMENTAL MONITORING
CONCENTRATION OF γ-EMITTING NUCLIDES IN SOIL

Off-Site Location	Month	^{95}Zr-Nb (pCi/kg)	^{137}Cs (pCi/kg)	^{144}Ce (pCi/kg)	U (pCi/kg)	Th (pCi/kg)	K (gm/kg)
Farm A	June	810	4,250	4,710	1,260	2,460	7.90
3 km NW	Sept.	232	484	4,490	1,630	1,760	11.50
Farm B	June	580	< 500	2,080	710	527	5.75
10 km SSW	Sept.	311	521	2,820	833	930	7.09
Farm C	June	525	2,060	2,670	955	634	4.40
10 km SE	Sept.	184	1,560	2,340	865	950	4.35
Farm D	June	453	1,800	4,320	1,115	1,255	9.70
15 km NW	Sept.	240	1,760	4,360	1,800	2,110	11.50
Farm H	June	505	735	1,735	730	550	5.14
6 km NE	Sept.	314	820	2,220	582	650	4.85
On-Site Location							
Northwest	June	191	443	< 1,000	975	1,050	7.70
Perimeter	August	304	413	2,260	1,295	1,760	8.10
Southwest	June	335	2,220	< 1,000	961	1,410	7.81
Perimeter	August	268	515	2,390	1,570	1,590	10.00
Southeast	June	587	1,350	< 1,000	712	1,155	9.90
Perimeter	August	1,020	725	3,060	1,070	1,380	9.01
Northeast	June	510	4,700	< 1,000	3,470	3,880	17.30
Perimeter	August	396	3,140	3,620	2,470	2,660	14.00
Solid Waste Disp. Area	Sept.	-	3,620	N/A	1,290	1,750	8.27
SW Ecology Forest	Sept.	297	546	1,630	707	808	5.07
Est. Error %		± 25	± 25	± 25	± 25	± 25	± 25

TABLE [illegible]

1971 BNL ENVIRONMENTAL MONITORING
CONCENTRATIONS OF γ-EMITTING NUCLIDES IN GRASS

Off-Site Location	Month	^{7}Be (pCi/kg)	^{65}Zn (pCi/kg)	^{95}Zr-Nb (pCi/kg)	^{137}Cs (pCi/kg)	^{144}Ce (pCi/kg)	U (pCi/kg)	Th (pCi/kg)	K (gm/kg)
Farm A	June	970	68	391	195	425	-	-	4.10
3 km NW	Sept.	1,470	96	306	107	1,075	177	324	6.10
Farm B	June	985	61	440	69	535	-	-	4.28
10 km SSW	Sept.	732	95	111	75	471	< 100	131	5.68
Farm C	June	705	75	316	196	< 500	-	-	4.55
10 km SSE	Sept.	1,590	121	303	199	1,020	< 100	258	5.07
Farm D	June	823	89	440	118	559	-	-	5.22
15 km NW	Sept.	580	104	132	125	715	199	230	5.25
Farm H	June	1,620	95	825	218	1,190	-	-	5.30
6 km NE	Sept.	1,760	79	442	145	1,170	< 100	< 100	5.22
On-Site Location									
Northwest	June				NOT SAMPLED				
Perimeter	August	2,430	130	1,020	289	2,460	-	-	3.92
Southwest	June	1,560	< 50	795	204	438	-	-	4.41
Perimeter	August	1,160	119	352	87	759	-	-	5.55
Southeast	June				NOT SAMPLED				
Perimeter	August	1,035	106	410	177	292	-	-	4.70
Northeast	June	2,070	133	1,115	233	1,680	-	-	6.00
Perimeter	August	1,720	88	727	381	1,260	-	-	3.94
Solid Waste Disp. Area	Sept.	1,650	111	306	403	396	-	-	6.96
SW Ecology Forest	Sept.	2,260	96	426	220	469	-	-	3.92
Est. Error %		± 25	± 50	± 25	± 25	± 25			± 25