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Environmental Monitoring Report:

Calendar Year

1959 — 1977

MOUND FACILITY
Miamisburg, Ohio

operated by
MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company

Monsanto

for the
U. S. DEPARTMENT OF ENERGY

84-19

1977

MLM-2515

Annual Environmental Monitoring Report: Calendar Year 1977

Billy M. Farmer and Daniel G. Carfagno

April 25, 1978

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Foreword

This report was prepared by the Environmental Assessment and Planning Section of the Safety and Environmental Technology Function in the Administrative Services Department at Mound Facility. Sample analyses and data reduction were performed by the Environmental Evaluation and Environmental Laboratory groups of the Environmental Assessment and Planning Section. Particulate samples offsite are collected by the Air Pollution Control Section of the Montgomery County Combined General Health District which acts as the Regional Air Pollution Control Agency in this area for the Ohio Environmental Protection Agency.

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Introduction

Mound Facility is situated on 180 acres of land in Miamisburg, Ohio. This location is approximately 16 km (10 mi) southwest of Dayton. The predominant geographical feature in the five-county region surrounding the Facility is the Great Miami River which flows from northeast to southwest through Miamisburg. This river valley area is generally highly industrialized. The remainder of the region is predominantly agricultural with some light industry and scattered residential communities. The location and population of these communities are shown in Figure 1. Figure 2 shows the population distribution around Mound Facility. Drinking water for the area is obtained from a buried valley aquifer which generally follows the Great Miami River. The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately 10% of the land area in agricultural use is devoted to pasturing livestock [1]. Weather conditions in the area are moderate. The average annual precipitation is approximately 91 cm (36 in.) and is evenly distributed throughout the year. Winds are predominantly from the south or west except during the summer months when a higher frequency is recorded from out of the southwest. The wind speed averages about 16 km/hr (10 mi/hr) annually [2]. Figure 3 shows the wind rose compiled at Wright Patterson AFB which is located approximately 13 miles northeast from Mound.

Mound Facility began operations in 1949. Its mission currently includes research, development, engineering, production and surveillance of components for the Department of Energy (DOE) weapon programs; separation, purification, and sale of stable isotopes of the noble gases; the fabrication of radioisotopic heat sources fueled with plutonium-238 for thermoelectric generators. The radionuclides of primary concern currently being handled include plutonium-238 and tritium.

Radionuclides in particulate form are removed from process air effluents from nuclear operations facilities by high efficiency particulate air (HEPA) filters. The air effluents are filtered first at the points of origin, i.e., glove boxes, and just prior to the release point, i.e., the stack. The filtering system at the stack consists of two banks of HEPA filters in series, each bank with a collection efficiency of 99.9%. Radionuclides are removed from liquid effluents such as process waste liquids by chemical processing. Solid radioactive wastes are packaged and shipped offsite for burial at approved burial sites. Airborne and liquid wastes generated in the processing of explosive materials are collected and disposed of according to the Army Materiel Command Regulation 385-100.

An onsite sanitary waste treatment plant provides secondary treatment in accordance with U. S. Environmental Protection Agency (EPA) requirements [3] using an activated sludge process operating in the extended aeration mode. All domestic sewage generated onsite is treated in this facility. The influent and effluent at the sewage treatment plant are also monitored for radioactivity to ensure no undetected release can occur to the environment via the sanitary sewage plant. The digested sludge from the sewage plant is shipped offsite for burial at an approved burial site. Nonradioactive solid wastes are

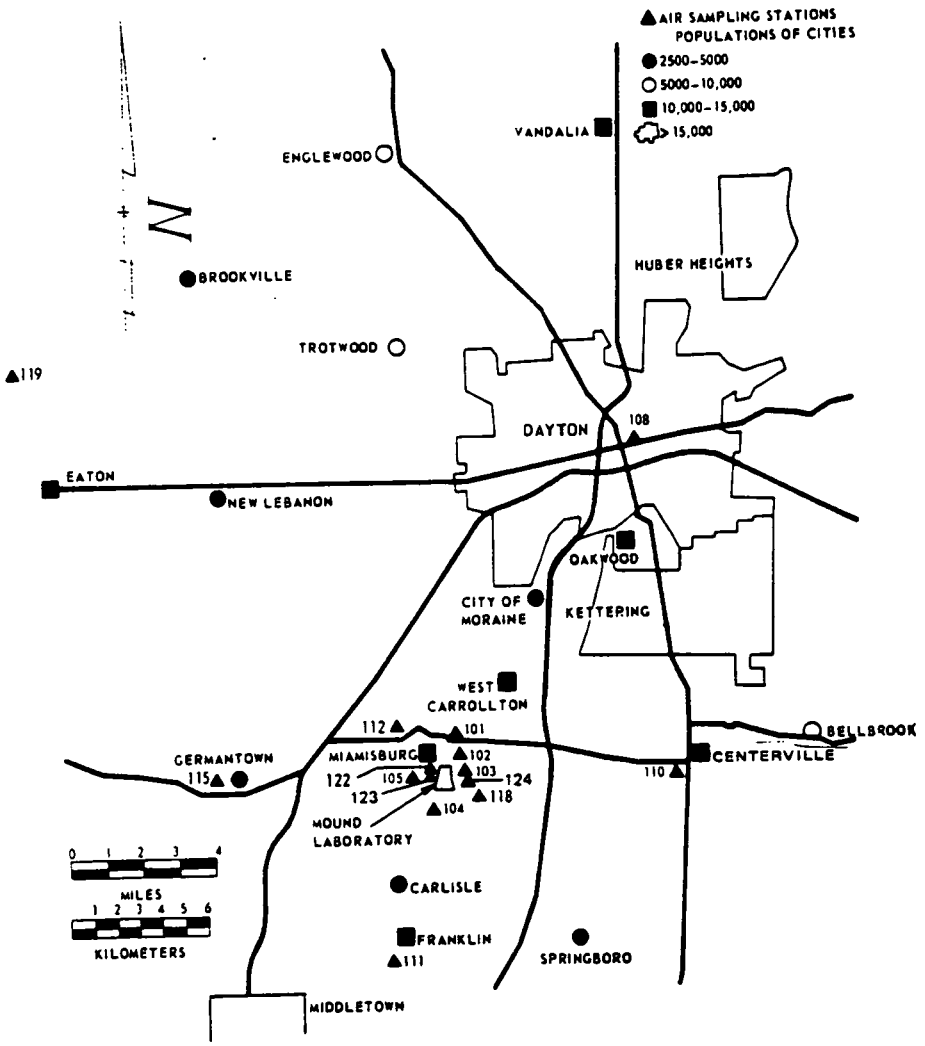

FIGURE 1 - Offsite air sampling locations.

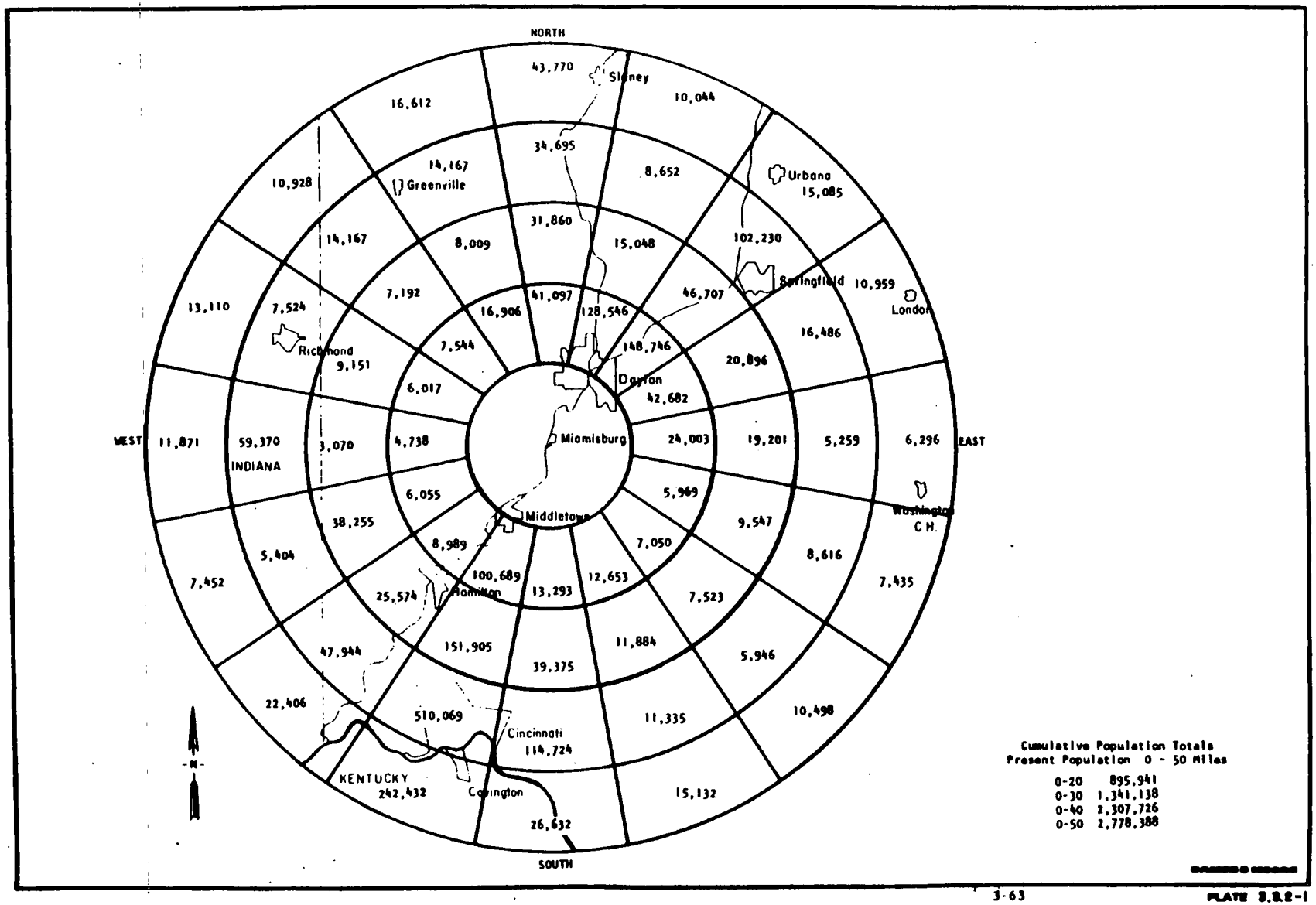

FIGURE 2 - 1970 population within 50 miles of Mound Facility.

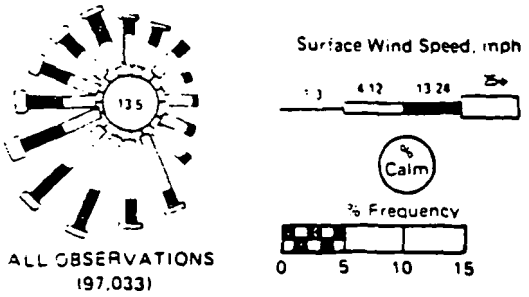

FIGURE 3 - The relative frequency and strength of winds from different directions for Wright-Patterson Air Force Base.

disposed of according to a recycling and reclamation program.

White paper, scrap metal and wood are sold for reclamation. General refuse was transported during 1977 to the Franklin Reclamation Center, Franklin, Ohio, for processing and eventual use in recycled products. Waste solvents and chemicals are removed offsite by a commercial industrial-waste-disposal firm.

Conformance to regulations prescribed by DOE pertaining to the safety of employees and the public has been demonstrated during the history of Mound Facility. The fundamental objective of the Mound Facility Environmental Control Program, which has been in existence throughout the history of the Facility, is the containment of radioactive effluents to levels well within the existing standards. As part of this function, effluents are monitored and controlled at each operating step resulting in only low-level releases of airborne or liquid wastes to the environment. Because of early detection, control techniques can be taken thus ensuring that concentrations are well within existing standards.

As part of the Mound Environmental Program monitoring functions, air, water, foodstuff, and soil samples are collected from the environment at distances up to 45 km (28 mi) from the Facility boundaries. These samples are analyzed for the specific radionuclides handled at the Facility.

A quality control program for environmental analytical procedures has been in effect for several years. There are two parts to the program: internal and external. The internal portion consists of blank and duplicate analyses for each group of samples. The blank values have been consistently small in comparison with sample values indicating good control during analytical procedures. The duplicate results for 1977 were in the range expected. Chemical recoveries were greater than 50%. The external portion of the program consists of sending duplicate samples to an independent laboratory. These results for 1977 were also satisfactory. Mound Facility participated in DOE's Quality Assurance Program conducted by the Environmental Measurements Laboratory (EML) during CY-1977. Sample media such as air, water, soil, vegetation, and tissue were analyzed for various radionuclides such as plutonium-238, plutonium-239, uranium-234, uranium-235, uranium-238, and tritium. In this program, Mound along with other facilities received and analyzed samples of various media and submitted data for comparison with EML values. Overall, the ratio of Mound to EML values averaged 0.85 $\pm$ 0.24 with a range of 0.40 to 1.14 which indicates good agreement with the Environmental Measurements Laboratory.

The results of the environmental analyses for calendar year 1977 are provided in

this report. Error limits, when given, reflect standard deviations in the data from counting statistics at the 95% conficence level. A lower detection limit (LDL) is provided for each set of data. This LDL is composed of the average blank for the set of analyses plus 2σ of the average of the blanks for those analyses involving chemical processes. The LDL for data consisting of analyses by counting procedures only is equal to 2σ of the counting error of the blank. In some special instances, where an inadequate number of blanks exist, the average blank plus 2σ of the counting error is used for those analyses involving chemical procedures.

Summary

The local environment surrounding Mound Facility was monitored for tritium and plutonium-238. The results are reported for calendar year 1977. The environmental parameters analyzed included air, water, foodstuffs, soil and silt. The average concentrations of plutonium-238 and tritium were within the applicable stringent standards for radioactive species adopted by the U. S. DOE. Mound Facility drinking water has been brought into compliance with the new EPA standard for tritium in community drinking water systems, and Mound has undertaken a program to achieve compliance for nine private wells adjacent to the Facility site. The program has partially achieved its objective by bringing Mound wells and some of the nine affected private wells in the vicinity of Mound Facility into compliance with the U. S. EPA standard and significantly reducing tritium concentration in the remaining wells. Data concerning nonradioactive species in air and water are also presented and compared to federal, state, and local standards, where applicable.

The average concentrations of plutonium-238 and tritium oxide in air measured at all offsite locations during CY-1977 were $<0.75 \times 10^{-17}$ and $<0.63 \times 10^{-11}$ μCi/ml, respectively. These correspond to <0.037% and <0.009% of their respective Radioactivity Concentration Guides (RCG). Details of the applicable standards are given in the Appendix.

The average concentrations of plutonium-238 and tritium measured at all locations in the Great Miami River during CY-1977 were $<0.27 \times 10^{-10}$ and $<1.4 \times 10^{-6}$ μCi/ml, respectively. These correspond to <0.0014% and <0.14% of the respective RCG.

The average concentrations of plutonium-238 and tritium found during CY-1977 in surface water and the drinking water of the area municipalities were also a fraction of each respective DOE RCG and EPA standard.

Although there are no specific standards (RCG) for plutonium-238 and tritium in foodstuffs, the concentrations found, if compared to the water standard, are also a small fraction of the RCG. In addition, there is no evidence of other than minimal uptake of plutonium-238 from soil. [4]

Mound Facility has been granted a National Pollutant Discharge Elimination System permit. Analyses during 1977 indicate compliance with permit conditions except for two minor exceptions involving suspended solids during July. All results indicated that Mound effluent streams have no significant effect on the Great Miami River and certainly do not cause Ohio Stream Standards to be exceeded.

The effluent data are summarized in Table 1. In addition, the person-rem calculated out to 80 km for CY-1977 was 12.2 person-rem.

These data demonstrate the status of compliance with various current regulatory agency standards.

Table 1 - EFFLUENT DATA FOR CY-1977

Radionuclide	Media	Quantity	
Tritium	air	4896	Ci
Tritium	water	56.7	Ci
Plutonium-238	air	0.012	mCi
Plutonium-238	water	2.8	mCi
Uranium-233	water	3.3	mCi

Environmental surveillance

Air - radioactive

An offsite air sampling network consisting of 14 continuously operating air-sampling stations which are used for sampling both tritium oxide and plutonium and a fifteenth sampler used for sampling plutonium only were used during CY-1977. Ten sampling stations are located approximately within a 1.6 km (1 mi) radius of the Facility and four samplers are located in or near population centers. The remaining sampler (#119) is approximately 44.8 kg (28 mi) from the Facility in the least prevailing wind direction. This site receives no measurable contribution from Mound operations and serves as a baseline sample for comparison purposes. The samplers currently in operation are located at critical distances and directions based on a diffusion model developed for Mound Facility. The locations of the sampling stations are shown in Figure 1.

Two types of samples are collected at each sampling station. One is a particulate air sample for plutonium-238 analysis and the other is a bubbler type sample for tritium oxide analysis. The particulate sample is collected on a 200-mm diameter Microsorban disk by a continuously operating (24 hr/day, 7 days/week) high-volume air sampler. The air is sampled at an average rate of 1.3×10^6 cm^3/min (~45 ft^3/min). The Microsorban disk is changed weekly and represents a sample of approximately 13,000 m^3 of air. Plutonium-238 analyses were performed on a monthly composite for three sampling locations, 122, 123 and 124, and on quarterly composites for the other offsite locations.

The analytical scheme for plutonium-238 incorporates the following basic steps: addition of a known amount of plutonium-242 tracer, ignition to 600°C, dissolution with nitric acid, separation of plutonium with anion exchange resin, electrodeposition of plutonium, and finally alpha spectrometry. The results reported represent total concentrations of the analyzed radionuclides including contribution from atmospheric fallout.

The average offsite plutonium-238 air concentration for all locations was $<0.75 \times 10^{-17}$ µCi/ml which is <0.037% of the DOE RCG. The RCG used for comparison is the guide for the soluble form of the isotope and for the general population. This is the most restrictive RCG for plutonium-238 and is applied since the solubility of the measured particles in the human body is unknown. The analytical results are summarized in Table 2. Samples reported as less than (<) the Lower Detection Limit (LDL) are, for averaging purposes, considered to be the value of LDL. This provides a conservative approach to low level environmental data.

Also included in Table 2 are ratios of plutonium-238 to plutonium-239 for each sampling location.

Table 2 - CONCENTRATIONS OF PLUTONIUM IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1977

Location	Number of Samples	^{238}Pu Range (10^{-17} µCi/ml)	^{238}Pu Average[a,d] (10^{-17} µCi/ml)	Percent of RCG[b]	^{239}Pu Average[c,d] (10^{-17} µCi/ml)	$^{238}Pu/^{239}Pu$
101	51	0.15 - 3.2	1.0 ± 0.05	0.05	2.4 ± 0.13	0.42
102	52	0.52 - 1.3	0.81 ± 0.08	0.04	2.2 ± 0.13	0.39
103	51	0.42 - 0.88	0.62 ± 0.07	0.03	2.1 ± 0.13	0.30
104	52	0.22 - 0.50	0.37 ± 0.06	0.02	2.2 ± 0.13	0.17
105	52	<0.076 - 0.23	<0.15 ± 0.04	<0.01	2.0 ± 0.12	<0.08
108	48	<0.076 - 0.29	<0.15 ± 0.04	<0.01	2.7 ± 0.14	<0.06
110	51	<0.076 - 0.15	<0.09 ± 0.04	<0.01	2.3 ± 0.13	<0.04
111	52	<0.076 - 0.32	<0.21 ± 0.05	<0.01	2.5 ± 0.14	<0.08
112	48	<0.076 - 0.21	<0.16 ± 0.04	<0.01	2.1 ± 0.13	<0.08
115	51	<0.076 - 0.21	<0.13 ± 0.04	<0.01	2.5 ± 0.14	<0.05
118	51	0.25 - 1.2	0.75 ± 0.08	0.04	2.5 ± 0.14	0.30
119	51	<0.076 - 0.11	<0.10 ± 0.04	<0.01	2.1 ± 0.13	<0.05
122	47	0.61 - 6.3	2.1 ± 0.22	0.11	1.6 ± 0.19	1.3
123	52	0.54 - 9.6	2.9 ± 0.26	0.15	2.1 ± 0.22	1.4
124	52	0.35 - 4.2	1.7 ± 0.20	0.09	2.4 ± 0.23	0.71

[a]Lower Detection Limit (LDL) for ^{238}Pu in air for samplers 101 through 119 is 0.076×10^{-17} µCi/ml and the LDL for samplers 122 through 124 is 0.258×10^{-17} µCi/ml. This is 0.004% and 0.013%, respectively of the RCG.

[b]Radioactivity Concentration Guide (RCG) = 2000×10^{-17} µCi/ml for the soluble form of ^{238}Pu for the general population.

[c]The LDL for ^{239}Pu in air for samplers 101 through 119 is 0.033×10^{-17} µCi/ml and the LDL for samplers 122 through 124 is 0.121×10^{-17} µCi/ml.

[d]Error limits include only counting statistics at 95% confidence level.

The gas bubbler sample is also collected on a continuous basis by bubbling air at approximately 3×10^3 cm^3/min through 200 ml of ethylene glycol. Ethylene glycol is used because this material eliminates evaporation and freezing problems associated with sample collection [5]. Any tritium (oxide) in the air is collected in the solution. Tritium oxide rather than elemental tritium is sampled and analyzed because the RCG for the oxide is 200 times more restrictive than it is for elemental tritium [6]. A sample representing ~30 m^3 of air is collected and an

aliquot representing 1.5 m^3 is counted in a liquid scintillation spectrometer. The average concentration of tritium oxide measured during CY-1977 for all offsite locations was <0.63 x 10^{-11} µCi/ml which is <0.009% of RCG. The RCG used for comparison is the most restrictive RCG for tritium for the general population. The results are summarized in Table 3. Table 4 shows background values for plutonium-238 and tritium in air and water.

An onsite perimeter network consisting of five continuous, high-volume air samplers is used to further assess the effectiveness of stack emission control systems. The onsite sampling locations are shown in Figure 4. Particulate samples are collected by the onsite samplers at approximately the same flow rate as the offsite samplers, i.e., 1.3 x 10^6 cm^3/min, and are analyzed in the same manner. The tritium samplers operate at slightly less air flow, i.e., approximately 2 x 10^3 cm^3/min, and are analyzed in the same manner as offsite samplers.

Table 3 - CONCENTRATIONS OF TRITIUM OXIDE IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1977

Location	Number of Samples	Tritium Oxide Range (10^{-11} µCi/ml)	Tritium Oxide Average[a,c] (10^{-11} µCi/ml)	Percent of RCG[b]
101	52	<0.29 - 2.16	<0.64 ± 0.43	<0.009
102	52	<0.29 - 9.73	<1.24 ± 0.44	<0.018
103	52	<0.29 - 2.77	<0.72 ± 0.43	<0.010
104	52	<0.29 - 1.27	<0.44 ± 0.42	<0.006
105	52	<0.29 - 1.45	<0.40 ± 0.42	<0.006
108	52	<0.29 - 0.94	<0.37 ± 0.42	<0.005
110	52	<0.29 - 1.22	<0.40 ± 0.42	<0.006
111	52	<0.29 - 7.53	<0.62 ± 0.43	<0.009
112	52	<0.29 - 2.10	<0.59 ± 0.43	<0.008
115	52	<0.29 - 2.66	<0.56 ± 0.42	<0.008
118	52	<0.29 - 2.37	<0.57 ± 0.42	<0.008
119	51	<0.29 - 2.33	<0.44 ± 0.42	<0.006
123	52	<0.29 - 4.36	<0.88 ± 0.43	<0.013
124	52	<0.29 - 5.98	<0.94 ± 0.43	<0.013

[a]Lower Detection Limit (LDL) for tritium oxide in air is 0.29 x 10^{-11} µCi/ml which is 0.004% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = 7000 x 10^{-11} µCi/ml for the general population and for soluble form of tritium.

[c]Error limits include only counting statistics at 95% confidence level.

Table 4 - CONCENTRATIONS OF BACKGROUND LEVELS OF TRITIUM AND PLUTONIUM-238

Plutonium-238 in Air[a]	0.3 ± 0.1 x 10^{-17} µCi/ml
Plutonium-238 in Surface Water[b]	7 x 10^{-13} µCi/ml
Tritium Oxide in Air[c]	0.2 x 10^{-11} µCi/ml
Tritium in Surface and Ground Water[d]	0.9 x 10^{-6} µCi/ml

[a]References 7, 8
[b]Reference 9
[c]Reference 10
[d]Reference 11

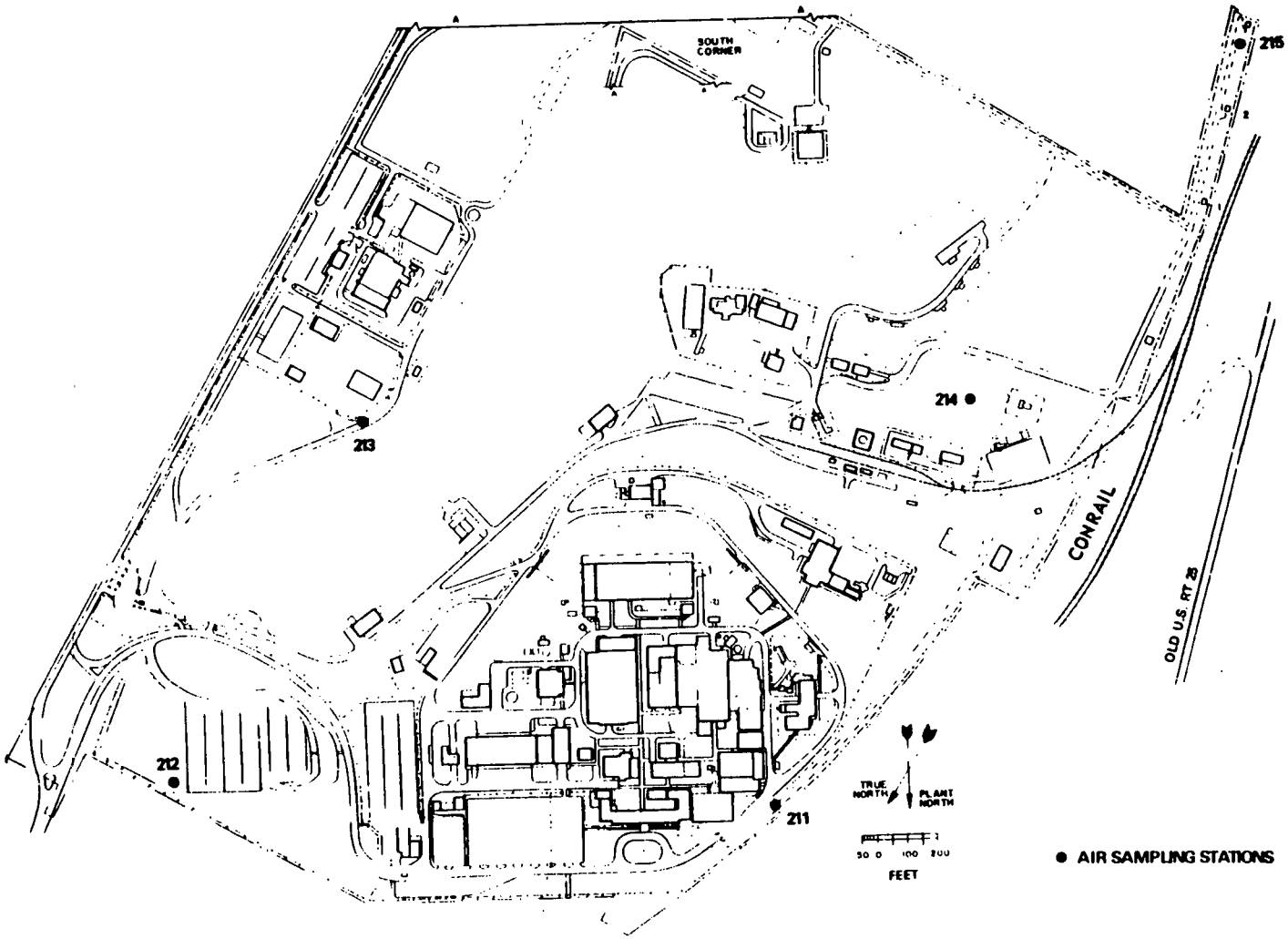

FIGURE 4 - Onsite air sampling locations.

The average plutonium-238 concentration measured for all locations onsite was 4.02×10^{-17} µCi/ml which is 0.057% of the RCG. The results are summarized in Table 5.

The average onsite tritium oxide concentration for all locations was $<2.0 \times 10^{-11}$ µCi/ml which is <0.01% of the RCG. The results are summarized in Table 6.

Table 5 - CONCENTRATION OF ^{238}Pu IN AIR AT ONSITE SAMPLING LOCATIONS IN 1977

Location	Number of Samples	^{238}Pu Range (10^{-17} µCi/ml)	^{238}Pu Average[a,d] (10^{-17} µCi/ml)	Percent of RCG[b]	^{239}Pu Average[c] (10^{-17} µCi/ml)
211	43	2.4 - 10.1	5.1 ± 0.34	0.07	2.0 ± 0.22
212	43	0.98 - 11.7	2.5 ± 0.24	0.04	1.9 ± 0.21
213	43	4.2 - 14.8	8.1 ± 0.42	0.12	3.1 ± 0.27
214	43	0.98 - 8.5	3.1 ± 0.27	0.04	1.9 ± 0.21
215	43	0.37 - 2.9	1.3 ± 0.18	0.02	<1.7 ± 0.20

[a]Lower Detection Limit (LDL) for ^{238}Pu in air is 0.258×10^{-17} µCi/ml which is 0.004% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = 7000×10^{-17} µCi/ml for the soluble form of plutonium-238 for individuals in the population.

[c]Lower Detection Limit (LDL) for ^{239}Pu in air is 0.121×10^{-17} µCi/ml.

[d]Error limits include only counting statistics at 95% confidence level.

Table 6 - CONCENTRATION OF TRITIUM OXIDE IN AIR AT ONSITE SAMPLING LOCATIONS IN 1977

Location	Number of Samples	Tritium in Oxide Range (10^{-11} µCi/ml)	Tritium in Oxide Average[a,c] (10^{-11} µCi/ml)	Percent of RCG[b]
211	51	<0.73 - 27.8	<1.8 ± 1.1	<0.009
212	40	<0.73 - 14.3	<3.0 ± 1.1	<0.015
213	35	<0.73 - 6.7	<2.0 ± 1.1	<0.010
214	52	<0.73 - 6.8	<1.6 ± 1.1	<0.008
215	52	<0.73 - 6.4	<1.6 ± 1.1	<0.008

[a]Lower Detection Limit (LDL) for tritium oxide in air is 0.73×10^{-11} µCi/ml which is 0.004% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = $20,000 \times 10^{-11}$ µCi/ml for individuals in the population and soluble form of tritium.

[c]Error limits include only counting statistics at 95% confidence level.

The RCGs used for onsite comparisons are those applicable for exposed individuals in the population. The total amounts of plutonium-238 and tritium discharged to the atmosphere were 0.012 mCi and 4896 Ci respectively. Comparison of these quantities to the RCG is not valid.

Air - nonradioactive

The Mound steam power supply has been converted from fuel oil to natural gas (on an interruptable basis). During unusually cold weather, natural gas supply to Mound is interrupted, and fuel oil with <1% sulfur content is burned. The average sulfur content of the fuel oil burned was approximately 0.4%. During 1977 Mound steam supply was fired almost equally by fuel oil and natural gas. Approximately 990,000 gal of No. 2 fuel oil were burned.

Additional sources of airborne emissions are as follows. A water-wash, paint spray booth is operated intermittently in the Mound paint shop. Wastes from operations involving explosives are disposed of by open burning. A shipping container fire test facility for testing shipping containers for radioactive wastes is used on the average of once per month. A maintenance grinding operation and a carpenter shop are also operated on an intermittent basis. Firefighter training excercises are held at an open outdoor facility.

Emissions from sources registered with the Regional Air Pollution Control Agency (RAPCA) and the Ohio EPA which have applicable emission standards are summarized in Table 7. The emissions were estimated from emission factors established by the USEPA or from material balances [12]. The emission from the shipping container fire test facility is controlled with a forced air supply and water spray nozzles at the fuel-flame interface to an average opacity of <20%. The particulates from the grinding and carpenter shop operations are captured by cyclone air cleaners rated at 95% efficiency. Nonradioactive airborne emissions at Mound Facility were all within applicable standards and had minimal impact on ambient air quality. This is further demonstrated by the particulate concentration data summarized in Table 8. The data presented are weekly particulate concentrations measured at Mound's offsite air sampling sites. The particulate concentration appears to be independent of distance from Mound which demonstrates no influence from Mound operations. For comparison purposes, the State of Ohio - Ambient Air Quality Standard for airborne particulates is 60 $\mu g/m^3$.

Water - Radioactive

Water sampling locations along the bank of the Great Miami River were selected according to guidelines recommended by the U. S. EPA [13]. The locations, shown in Figure 5, provide samples which are representative of river water after suitable mixing of the effluent from Mound has occurred. Water samples are normally collected at these locations five days per week and are subjected to specific analyses for plutonium-238 and tritium.

The plutonium-238 river water analyses have been improved by a procedure developed at Mound Facility to maximize the sensitivity in detection of plutonium-238 in water. Large volume water samples are analyzed by compositing daily samples for a semiannual

Table 7 - NONRADIOACTIVE AIRBORNE EMISSIONS 1977

Emission Source	Pollutant	Emission	Emission Standard[a]	% of Standard
Power House	Particulates	0.12 lb/10^6 Btu Input	0.25 lb/10^6 Btu Input	48
Power House	Sulfur Oxides	0.39 lb/10^6 Btu Input	1.6 lb/10^6 Btu Input	24
Paint Shop	Organics	0.32 lb/day	40 lb/day	0.8
Explosives Burning Area	Particulates	∿ 10 lb/yr	NA	NA
Firefighter Training	Particulates	∿ 330 lb	NA	NA

[a]Ohio EPA Air Pollution Regulations 3745-1701 through 3745-17-13 and 3745-21-01 through 3745-21-08.

NA - not applicable.

Table 8 - 1977 WEEKLY PARTICULATE CONCENTRATION DATA[a]

Location	Range (μg/m^3)	Average (μg/m^3)
101	13-189	72
102	19-123	56
103	16- 84	40
104	16-131	56
105	24- 91	45
108	16-143	72
110	15- 88	44
111	21-123	63
112	17- 98	45
115	22-110	50
118	13-113	52
119	2- 94	33
122	21-123	43
123	31-108	51
124	5-100	47

[a]Ohio Ambient Air Quality Standard = 60 ug/m^3

These data are obtained by Mound's air monitoring program and are indicative only of the particulate air loading in the Dayton metropolitan area. Mound's particulate discharges presented in Table 7 make a negligible contribution to the surrounding area.

analysis. The average concentration of plutonium-238 measured for all locations in the Great Miami River was <0.27 x 10^{-10} μCi/ml which is <0.0014% of the RCG for the general population and the most restrictive standard for plutonium-238. These results are summarized in Table 9.

Tritium analyses are performed on a weekly composite of daily samples. The average concentration of tritium measured at all locations in the Great Miami River was <1.4 x 10^{-6} μCi/ml which is <0.14% of the RCG for the general population and the most restrictive standard for tritium. These results are summarized in Table 10.

Results of plutonium-238 and tritium analysis for three offsite sampling locations on the abandoned Miami-Erie Canal and adjacent ponds shown in Figure 6 are reported in Tables 11 and 12, respectively. However, two of these locations, 6 and 7, went dry during the early part of the year which

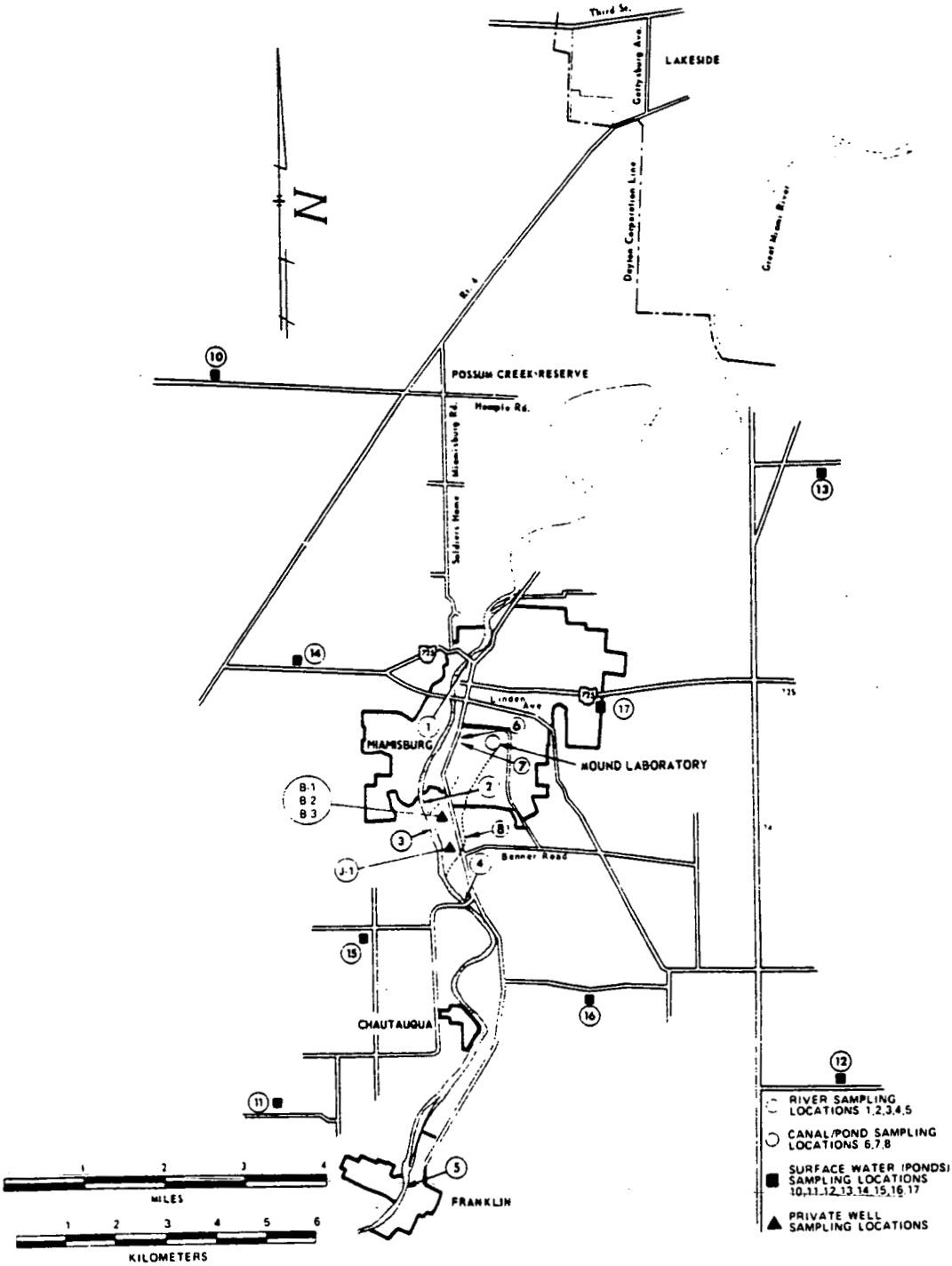

FIGURE 5 - Offsite water sampling locations.

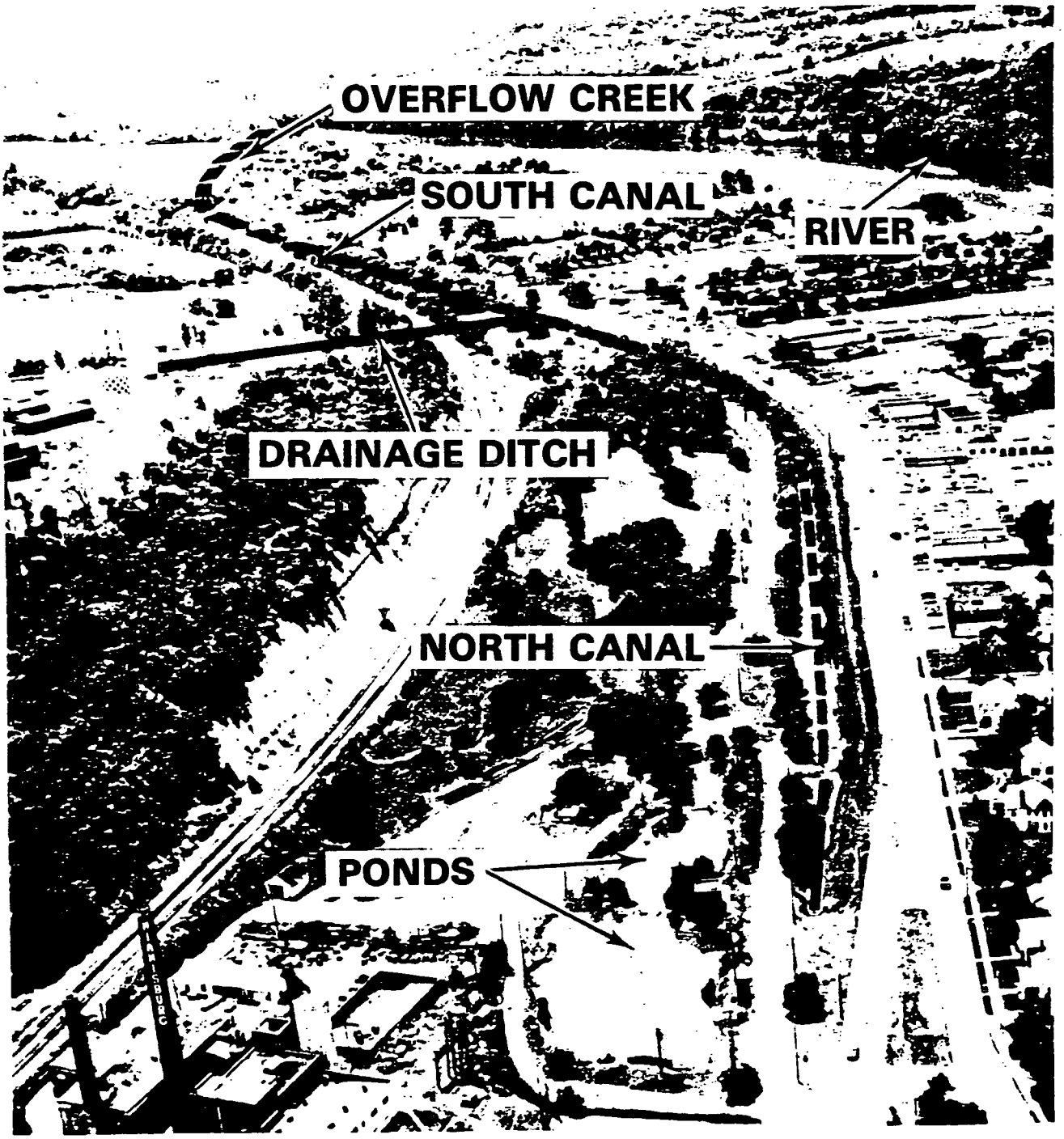

FIGURE 6 - Aerial view (from the north) of offsite abandoned canal and pond system.

Table 9 - CONCENTRATION OF ^{238}Pu IN THE GREAT MIAMI RIVER IN 1977

Location	Number of Samples[a]	^{238}Pu Range (10^{-10} µCi/ml)	^{238}Pu Average[b,d] (10^{-10} µCi/ml)	Percent of RCG[c]
1	210	-	<0.10 ± 0.01	<0.0005
2	210	<0.1 - 0.21	<0.16 ± 0.02	<0.0008
3	210	0.16 - 0.23	0.20 ± 0.01	0.0010
4	210	<0.1 - 1.5	<0.80 ± 0.05	<0.0040
5	210	-	<0.10 ± 0.03	<0.0005

[a]Two composite large volume water samples for each location from water collected during CY-1977.

[b]Lower Detedtion Limit (LDL) for ^{238}Pu in water is 0.1×10^{-10} µCi/ml which is 0.0005% of the RCG.

[c]Radioactivity Concentration Guide (RCG) = $20{,}000 \times 10^{-10}$ µCi/ml for the general population and the soluble form of plutonium-238.

[d]Error limits include only counting statistics at 95% confidence level.

Table 10 - CONCENTRATION OF TRITIUM IN THE GREAT MIAMI RIVER IN 1977

Location	Number of Samples	Tritium Range (10^{-6} µCi/ml)	Tritium Average[a,c] (10^{-6} µCi/ml)	Percent of RCG[b]
1	210	<0.20 - 4.3	<1.0 ± 0.35	<0.10
2	210	<0.20 - 16.8	<1.5 ± 0.36	<0.15
3	210	<0.20 - 8.3	<1.9 ± 0.36	<0.19
4	210	<0.20 - 23.4	<1.6 ± 0.36	<0.16
5	210	<0.20 - 4.5	<1.0 ± 0.35	<0.10

[a]Lower Detection Limit (LDL) for tritium in water is 0.20×10^{-6} µCi/ml which is 0.02% of the RCG.

[b]DOE Radioactivity Concentration Guide (RCG) which is compared to tritium concentration in water not used for drinking purposes = 1000×10^{-6} µCi/ml for the general population and the soluble form of tritium.

[c]Error limits include only counting statistics at 95% confidence level.

Table 11 - CONCENTRATION OF ^{238}Pu IN WATER FROM CANAL/POND AREA IN 1977

Location[a]	Number of Samples[b]	^{238}Pu Range (10^{-10} µCi/ml)	^{238}Pu Average[c,e] (10^{-10} µCi/ml)	Percent of RCG[d]
8 (South Canal)	210	26.0 - 45.0	35.5 ± 0.20	0.18

[a]Locations are shown in Figure 5.

[b]Two composite large volume water sample for each location from water collected during CY-1977.

[c]Lower Detection Limit (LDL) for ^{238}Pu in Water is 0.1×10^{-10} µCi/ml which is 0.0005% of the RCG.

[d]Radioactivity Concentration Guide (RCG) = $20,000 \times 10^{-10}$ µCi/ml for the general population and soluble form of plutonium-238.

[e]Error limits include only counting statistics at 95% confidence level.

Table 12 - CONCENTRATION OF TRITIUM IN WATER FROM CANAL/POND AREA IN 1977

Location[a]	Number of Samples	Tritium Range (10^{-6} µCi/ml)	Tritium Average[b,d] (10^{-6} µCi/ml)	Percent of RCG[c]
6 (North Pond)	20	6.8 - 11	8.9 ± 0.46	0.89
7 (North Canal)	12	0.6 - 7.7	5.2 ± 0.41	0.52
8 (South Canal)	200	4.7 - 44	24 ± 0.63	2.4

[a]Locations are shown in Figure 5.

[b]Lower Detection Limit (LDL) for tritium in water is 0.2×10^{-6} µCi/ml which is 0.02% of the RCG.

[c]DOE Radioactivity Concentration Guide (RCG) which is compared to tritium concentration in water not used for drinking purposes = 1000×10^{-6} µCi/ml for the general population and soluble form of tritium.

[d]Error limits include only counting statistics at 95% confidence level.

prevented samples from being taken. Total annual data on sample location 8, however, is shown. These values represent levels from the site drainage ditch which discharges into the offsite canal-pond system prior to mixing with the Great Miami River. These values, as expected, are higher than those concentrations found in the Great Miami River where mixing and dilution occur. The total amounts of plutonium-238, tritium and uranium-233 discharged to the Great Miami River were 2.8 mCi, 56.7 Ci, and 3.3 mCi, respectively. The concentrations were 0.09%, 2.3%, and 0.01% of the most restrictive RCG for individuals in the population. From the uranium-233 concentrations found in the effluent streams, estimated concentrations offsite from Mound operations would be undistinguishable from any background. This can be readily seen by comparing plutonium-238 quantities found in the effluent streams with concentrations found offsite.

Eight additional surface water locations such as ponds in all quadrants surrounding Mound Facility are sampled annually. These samples, used for plutonium-238 determination, are large volume water samples of approximately 40 liters each. The large volume of sample increases the sensitivity of the analysis. A smaller aliquot (10 ml) was taken for the tritium analysis. The average concentrations of plutonium-238 and tritium for all locations were $<0.1 \times 10^{-10}$ and $<1.01 \times 10^{-6}$ µCi/ml, respectively, which are <0.0005% and <0.10% of the respective RCG for the general population. The results of the surface water samples are summarized in Tables 13 and 14. Background levels of plutonium-238 and tritium for the surface water are shown in Table 5.

Drinking water from communities in the surrounding area is sampled and analyzed annually for tritium with the exception of drinking water from Miamisburg which is sampled and analyzed quarterly. These communities and their relative locations are shown in Figure 1. The average concentration of tritium for all locations was 1.1×10^{-6} µCi/ml which is 5.5% of the new standard which was adopted by the U. S. EPA in 1977 for community drinking water systems. Data from the analyses of community drinking water samples are summarized in Table 15.

Several private wells in the vicinity of Mound Facility were analyzed semi-monthly for for tritium. The average concentration in these wells was 35.3×10^{-6} µCi/ml. Although these wells were always well within the prevailing AEC and ERDA standard for tritium effluent and drinking water, the U. S. EPA's new drinking water standards for radiological, biological, and chemical elements in water, which became effective in June 1977, placed some of the wells in a noncompliance status because the new standard for radioactivity is 50 times less than the old standard. The average concentration for 1977 exceeds the new standard by a factor of 1.8.

Private well analyses results are summarized in Table 16. As shown by the data, concentrations in these wells are higher than in municipal wells in the area. This situation resulted from Mound Facility releasing tritiated waste water to the Great Miami River via the site drainage ditch and Miami-Erie Canal over a period of years prior to 1970. Some of the water migrated into the aquifer adjacent to Mound Facility and increased the concentration of tritium in the aquifer.

Table 13 - SUMMARY OF SURFACE WATER MONITORING FOR PLUTONIUM-238 in 1977

Location	Number of Samples[a]	^{238}Pu Range (10^{-10} µCi/ml)	^{238}Pu Average[b,d] (10^{-10} µCi/ml)	Percent of RCG[c]
10	210	<0.1 - 0.13	<0.12 ± 0.02	<0.0006
11	210	-	<0.1 ± 0.01	<0.0005
12	210	-	<0.1 ± 0.01	<0.0005
13	210	-	<0.1 ± 0.01	<0.0005
14	210	-	<0.1 ± 0.01	<0.0005
15	210	-	<0.1 ± 0.01	<0.0005
16	210	-	<0.1 ± 0.01	<0.0005
17	210	-	<0.1 ± 0.01	<0.0005

[a]Two composite large volume water samples were used for each location.

[b]Lower Detection Limit (LDL) for ^{238}Pu in water is 0.1 x 10^{-10} µCi/ml which is 0.0005% of the RCG.

[c]Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = 20,000 x 10^{-10} µCi/ml for the general population and soluble form of plutonium-238.

[d]Error limits include only counting statistics at 95% confidence level.

Table 14 - SUMMARY OF SURFACE WATER MONITORING FOR TRITIUM IN 1977

Location	Number of Samples	Tritium Range (10^{-6} µCi/ml)	Tritium Average[a,c] (10^{-6} µCi/ml)	Percent of RCG[b]
10	3	<0.4 - 1.4	<0.8 ± 0.6	<0.08
11	4	<0.4 - 0.9	<0.6 ± 0.6	<0.06
12	4	<0.4 - 0.7	<0.5 ± 0.6	<0.05
13	4	1.0 - 1.3	1.1 ± 0.6	0.11
14	4	<0.4 - 1.4	<1.1 ± 0.6	<0.11
15	4	0.8 - 1.5	1.3 ± 0.6	0.13
16	4	0.6 - 1.0	0.8 ± 0.6	0.08
17	3	1.5 - 2.3	1.9 ± 0.6	0.19

[a]Lower Detection Limit (LDL) for tritium in water is 0.4 x 10^{-6} µCi/ml which is 0.04% of the RCG.

[b]DOE Radioactivity Concentration Guide (RCG) which is compared to tritium concentration in water not used for drinking purposes = 1000 x 10^{-6} µCi/ml for the general population and soluble form of tritium.

[c]Error limits include only counting statistics at 95% confidence level.

Table 15 - SUMMARY OF TRITIUM LEVELS IN COMMUNITY DRINKING WATER IN 1977

Location	Number of Samples	Tritium Range (10^{-6} µCi/ml)	Tritium Average[a,c] (10^{-6} µCi/ml)	Percent of RCG[b]
Bellbrook	1	-	0.5 ± 0.4	2.5
Centerville	1	-	1.1 ± 0.4	5.5
Dayton	1	-	0.5 ± 0.4	2.5
Franklin	1	-	1.3 ± 0.4	6.5
Germantown	1	-	0.8 ± 0.4	4.0
Kettering	1	-	0.8 ± 0.4	4.0
Miamisburg	3	1.9 - 4.6	2.8 ± 0.6	14.0
Middletown	1	-	0.9 ± 0.4	4.5
Moraine	1	-	0.7 ± 0.4	3.5
Springboro	1	-	1.3 ± 0.4	6.5
Waynesville	1	-	0.6 ± 0.4	3.0
West Carrollton	1	-	2.0 ± 0.4	10.0

[a]Lower Detection Limit (LDL) for tritium oxide is 0.25 x 10^{-6} µCi/ml which is 1.2% of the EPA Standard for community drinking water.

[b]EPA Drinking Water Standard for tritium = 20 x 10^{-6} µCi/ml for community drinking water systems.

[c]Error limits include only counting statistics at 95% confidence level.

Table 16 - TRITIUM IN PRIVATE WELLS IN 1977

Location	Number of Samples	Tritium Range (10^{-6} µCi/ml)	Tritium Average[a, b,d] (10^{-6} µCi/ml)	Percent Standard[c]
B-1	25	33.0 - 59.0	46.7 ± 1.4	233
B-2	25	23.6 - 35.7	29.9 ± 1.1	149
B-3	25	22.4 - 37.3	31.1 ± 1.2	155
J-1	24	19.4 - 49.3	33.3 ± 1.2	165

[a]These concentrations are the average levels for 1977. The latest data obtained in March 1978 show that these levels have been reduced considerably as follows: B-1 = 22.6, B-2 = 22.3, B-3 = 20.9, and J-1 = 27.4 (x 10^{-6} µCi/ml). All wells are approaching compliance with the new EPA standard of 20 x 10^{-6} µCi/ml.

[b]Lower Detection Limit (LDL) for tritium in water is 0.4 x 10^{-6} µCi/ml which is 0.04% of the EPA Standard.

[c]EPA Standard for tritium in community drinking water systems = 20 x 10^{-6} µCi/ml. Mound is using the EPA Standard as a guide for the private water supplies.

[d]Error limits include only counting statistics at 95% confidence level.

There is no health problem associated with the levels of tritium in local water supplies although they exceed the new EPA standard. The EPA's very conservative regulations for tritium are essentially a nondegradation standard and are not based on new toxicological or epidemiological evidence of deleterious health effects and do not condemn water supplies that exceed the new standards.

Since 1970, changes in operating procedures reduced the Mound Facility tritium effluent concentration by a factor of almost 50 and resulted in a continuing decrease of tritium in the private wells. In order to accelerate the rate at which tritium was being dissipated from the aquifer and to achieve compliance of the private wells with the new EPA standard at the earliest possible time, Mound initiated a forced water-turnover program for the aquifer using a high-capacity well at the Mound site and an old well no longer used by the City of Miamisburg. These wells pumped continuously from spring of 1977 for the remainder of the year. Increased water infiltration to and discharge from the aquifer have brought some of the wells into compliance with the EPA standard. It is anticipated that the pumping program will result in all private wells achieving compliance during 1978. This program has been approved by the Ohio EPA and U. S. EPA. Mound has a continuing commitment to keep these agencies appraised of the program progress to achieve compliance by the affected wells.

A study to determine the impact of rainout of tritium from airborne emissions of tritium was conducted during 1977. Precipitation samples were collected at various locations around Mound Facility and analyzed for tritium. In addition, on several occasions, rainwater runoff was collected and analyzed.

The total 1977 rainfall was 34.88 in., with an average tritium concentration of 4 nCi/liter. A calculated total of 10.94 Ci of tritium was in the rainfall over an area of 1-km radius around Mound Facility during the year, of which an estimated 2.3 Ci infiltrated the aquifer. This represents less than 0.1% of the total tritium released to the atmosphere from Mound Facility and only 7% of the total amount withdrawn from the aquifer during the aquifer pumping program. Because a large portion of the total collected tritium fell during periods of heavy rain, with a resultant increased runoff, the total contribution to the aquifer could be much lower than 2.8 Ci.

Runoff water exhibited an average tritium concentration of 5 nCi/liter and never exceeded 10 nCi/liter. This concentration is well within the U. S. EPA standard for drinking water and is similar to the measured average tritium concentration in rain water.

Two private wells and Miamisburg city water were sampled and analyzed monthly for plutonium-238. These samples were large volume water samples averaging 40 liters. The average plutonium-238 concentration for these locations was $<0.46 \times 10^{-10}$ μCi/ml which is <0.002% of the applicable DOE RCG for the general population. These results are shown in Table 17.

Water - Nonradioactive

Mound Facility has a discharge permit under the National Pollutant Discharge Elimination System (NPDES) issued by Region V of the U. S. EPA. The permit specifies

Table 17 - PLUTONIUM-238 IN PRIVATE WELLS AND MIAMISBURG MUNICIPAL DRINKING WATER IN 1977

Location	Number of Samples[a]	^{238}Pu Range (10^{-10} µCi/ml)	^{238}Pu Average[b,d] (10^{-10} µCi/ml)	Percent of RCG[c]
Miamisburg	2	-	<0.1 ± 0.01	<0.0005
B-1	2	-	<0.1 ± 0.01	<0.0005
B-2	2	-	<0.1 ± 0.01	<0.0005
B-3	2	0.21 - 2.8	1.5 ± 0.08	0.0075
J-1	2	<0.1 - 0.9	<0.5 ± 0.02	<0.0025

[a]Two composite large volume water samples were analyzed from each location from water collected during CY-1977.

[b]Lower Detection Limit (LDL) for ^{238}Pu is 0.1 x 10^{-10} µCi/ml which is 0.0005% of the RCG.

[c]Applicable DOE Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = 20,000 x 10^{-10} µCi/ml for the general population and soluble form of ^{238}Pu.

[d]Error limits include only counting statistics at 95% confidence level.

limitations for pollutants in the two effluent streams from Mound that discharge to the Great Miami River. The discharge from outfall number 001 includes the discharge from the sanitary waste treatment plant, radioactive waste disposal facility, single-pass cooling water, zeolite softener backwash, and some storm water runoff. The discharge from outfall number 002 consists of single-pass cooling water, cooling-tower blowdown, boiler-plant blowdown, zeolite softener backwash, and most of the storm water runoff. A 24-hr composite sample of each effluent stream is collected automatically. The volume of samples collected is proportional to the flow in the stream. The composite effluent water samples are analyzed for water quality parameters according to standard methods [14]. The results of effluent stream analyses for 1977 are summarized in Tables 18 and 19. Only two exceptions occurred during 1977. The exceptions were slightly elevated suspended solids discharged from outfall 001 during July. These waterborne effluents had no significant effect on the River since the river flow, even under low flow conditions, was approximately 350 times the maximum flow discharge from Mound during 1977. These data show that the Mound releases to the Miami River did not cause the Ohio Stream Standards to be exceeded.

Foodstuffs and vegetation - radioactive

Various locally grown foodstuffs and vegetation samples are collected from the surrounding area. The intent of this portion of the Environmental Monitoring Program is to determine whether there is any uptake and concentration of radionuclides by plant or animal life. Where possible, sampling sites are chosen at maximum deposition locations predicted on the basis of the diffusion model developed for Mound Facility [15]. Field crops and vegetables are collected on the basis of this diffusion model. Milk is collected from individual farms closest to the Facility. Aquatic life is trapped from the Miami River generally

Table 18 - 1977 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT DATA FOR STATION 001[a]

Parameter		No. Samples	Minimum	Maximum	Average
Flow, MGD	Reported	Cont.	0.07	0.34	0.18
	Permit			0.92	0.53
BOD_5	Reported	88	0.3	7.3	2.2
	Permit			45	30.0
Fecal Coliform	Reported	12	ND	52	15
	Permit			400	200
Suspended Solids	Reported	104	1.2	32.5	12
	Permit			45	30
Dissolved Oxygen	Reported	240	5.2	10.9	8.4
	Permit				5
Residual Chlorine	Reported	52	ND	0.6	0.1
	Permit			0.8	
Oil and Grease	Reported	52	ND	8.1	1.3
	Permit			10	
pH	Reported	240	6.2	9.0	
	Permit		6.0	9.0	
Organic Carbon	Reported	52	1	86	30
Ammonia	Reported	20	0.1	0.1	0.1

[a]ND - none detectable.

MGD - million gallons per day.

Values for fecal coliform are number of coliform per 100 ml of water and pH is reported in pH units.

All other values are in milligrams per liter.

Standards are those in effect through June 30, 1977. More restrictive standards went into effect on July 1. These are given in the Appendix.

Table 19 - 1977 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT DATA FOR STATION 002[a]

Parameter		No. Samples	Minimum	Maximum	Average
Flow, MGD	Reported	Cont.	0.18	0.90	0.38
	Permit				0.53
Suspended Solids	Reported	68	3.0	24.6	10.6
	Permit			25.0	20.0
Dissolved Oxygen	Reported	22	5.1	12.0	9.2
	Permit				>5.0
Residual Chlorine	Reported	38	<0.05	0.05	<0.05
	Permit			0.10	
Oil and Grease	Reported	40	ND	7.0	0.8
	Permit			10.0	
pH	Reported	180	6.0	9.0	
	Permit		6.0	9.0	
Dissolved Solids	Reported	65	242	2918	913
	Permit			3000	2000

[a]ND - none detectable.

MGD - million gallons per day.

All other values are in milligrams per liter, except pH.

Standards are those in effect through June 30, 1977. More restrictive standards went into effect on July 1. These are given in the Appendix.

downstream of Miamisburg and from adjacent waterways, depending upon availability of fish. Grass samples are collected in the vicinity of the surface water locations shown in Figure 5. The plutonium-238 content of the foodstuff and vegetation samples including milk is determined by ashing the samples and then proceeding with the same techniques used for plutonium-238 analyses of air samples (see section on Air - Radioactive). Milk samples are analyzed for tritium oxide by distilling the water fraction from an aliquot. The distillate is then analyzed for tritium by liquid scintillation spectrometry in the same manner as the water samples (see section on Water - Radioactive). The results of the foodstuff and vegetation analyses are summarized in Tables 20 and 21. The concentration is given in terms of the sample weight (wet weight) before ashing. The vegetables analyzed were turnips and potatoes. The sample of aquatic life analyzed included only the edible fleshy portions of fish. No evidence has been found that there is any significant uptake or concentration by plant or animal

Table 20 - PLUTONIUM-238 IN FOODSTUFFS AND VEGETATION IN 1977

Type of Sample	Number of Samples	^{238}Pu Range (10^{-10} µCi/g)	Average[a,b,c,d] (10^{-10} µCi/g)
Milk	3	<2.0 - 2.1	<2.0 ± 0.8
Vegetables	4	<7.5 - 11.0	<8.4 ± 2.8
Grass	25	<6.6 - 44.6	13.1 ± 6.2
Aquatic Life	4	<5.3 - 9.6	<6.7 ± 1.4

[a]Lower Detection Limit (LDL) for ^{238}Pu in milk is 2.0×10^{-10} µCi/g

[b]Lower Detection Limit (LDL) for ^{238}Pu in vegetables is 7.5×10^{-10} µCi/g

[c]Lower Detection Limit (LDL) for ^{238}Pu in grass is 6.6×10^{-10} µCi/g

[d]Lower Detection Limit (LDL) for ^{238}Pu in aquatic life is 5.3×10^{-10} µCi/g

[e]Error limits include only counting statistics at 95% confidence level.

Table 21 - TRITIUM IN FOODSTUFFS AND VEGETATION IN 1977

Type of Sample	Number of Samples	Tritium Range (10^{-6} µCi/g)	Average[a,b] (10^{-6} µCi/g)
Milk	4	0.27 - 0.45	0.38 ± 0.23

[a]LDL for tritium in milk = 0.16×10^{-6} µCi/g.

[b]Error limits include only counting statistics at 95% confidence level.

life of the radionuclides handled at Mound Facility.

Silt - radioactive

Silt samples were collected from the surface water sample locations shown in Figure 5. These samples were obtained by filtration of sediment (silt) from the water that was collected from these locations.

The results of the silt sample analyses are found in Tables 22, 23, and 24.

Soil - radioactive

During CY-1977, emphasis was placed on completing Mound's Soil Inventory for plutonium-238. Essentially all the soil samples taken and analyzed during CY-1977 were related to the Soil Inventory Program.

Table 22 - PLUTONIUM-238 IN SILT FROM RIVER MONITORING LOCATIONS IN 1977

Location	Number of Samples	^{238}Pu Range (10^{-6} μCi/g)	^{238}Pu Average[a,b] (10^{-6} μCi/g)
1	2	0.51 - 1.1	0.8 ± 0.05
2	2	0.48 - 14.4	7.4 ± 0.07
3	2	2.6 - 2.8	2.7 ± 0.12
4	2	4.4 - 5.1	4.7 ± 0.15
5	2	<0.3 - 1.6	<0.9 ± 0.04

[a]Lower Detection Limit (LDL) for ^{238}Pu in silt is 0.3 x 10^{-6} μCi/g.

[b]Error limits include only counting statistics at 95% confidence level.

Table 23 - PLUTONIUM-238 IN SILT FROM SURFACE WATER MONITORING LOCATIONS IN 1977

Location	Number of Samples	^{238}Pu Range (10^{-6} μCi/g)	^{238}Pu Average[a,b] (10^{-6} μCi/g)
10	2	-[a]	<0.3 ± 0.02
11	2	-[a]	<0.3 ± 0.01
12	2	-[a]	<0.3 ± 0.01
13	2	-[a]	<0.3 ± 0.03
14	2	-[a]	<0.3 ± 0.02
15	2	-[a]	<0.3 ± 0.001
16	2	-[a]	<0.3 ± 0.05
17	2	<0.3 - 0.55	<0.4 ± 0.05

[a]Lower Detection Limit (LDL) for ^{238}Pu is 0.3 x 10^{-6} μCi/g.

[b]Error limits include only counting statistics at 95% confidence level.

Table 24 - PLUTONIUM-238 IN SILT FROM CANAL/POND AREA SILT IN 1977

Location[a]	Number of Samples	^{238}Pu Range (10^{-6} μCi/g)	^{238}Pu Average[b,c] (10^{-6} μCi/g)
8 (South Canal)	2	61.1 - 263.9	162.5 ± 0.63

[a]Locations are shown in Figure 5.

[b]Lower Detection Limit (LDL) for ^{238}Pu in silt is 0.3 x 10^{-6} μCi/g.

[c]Error limits include only counting statistics at 95% confidence level.

The purpose of the soil inventory was to establish the quantity of plutonium-238 which was deposited in the environment from Mound Facility stack emissions. A preliminary soil inventory was performed in 1975; however, soil sampling was not completed, and additional samples were taken in 1977, to extend the soil isopleths to background concentrations.

Soil core sample values around and within the Facility site boundary were used to arrive at an estimate of deposition of airborne plutonium-238 from Facility operations. The core sample depths in most cases were 30 cm with a core diameter of ~8 cm. Ten cores were collected at each sampling location. The ten cores were composited, dried, crushed, and passed through a quarter-inch mesh screen. The sample was then riffled down to approximately 3 kg and pulverized to pass a 60-mesh sieve. Aliquots of 500 g or 1000 g, depending on soil location, were then taken from this homogenized sample for analysis. The analytical scheme used for these analyses was essentially the HASL (now EML) Procedure No. E-Pu-06 using plutonium-242 as the internal tracer.

A series of soil sampling locations sampled earlier were reinforced by 31 additional locations in 16 different directions and distances from the Facility. A total of 79 soil sampling locations were used in the inventory.

Soil background levels were obtained by collecting four additional samples at 0°, 90°, 180° and 270° at distance ranging from 34 to 51 km (21 to 32 mi). The ratio of plutonium-239 to plutonium-238 ranged from 22 to 27 for these samples which is in good agreement with accepted values for fallout or background plutonium [23]. The plutonium-238 values in these samples averaged 0.1 mCi/km^2 and any value exceeding that level was assumed to be the result of past emissions from Mound facilities.

The soil sampling values along each of 16 equally spaced radials originating in the center of Mound Facility were fit to power function curves by a least squares program. The concentration along each of the 16 radials is represented by the equation:

$$y = ax^b$$

where y = concentration, mCi/km^2
a = constant
x = distance, km
b = exponent, <0

Table 25 shows the values a, b, and the correlation coefficient for each of the 16 radials. The distances between each radial were obtained by a data smoothing technique. The isopleths were then completed and the area between isopleths was measured by planimetry. The concentration calculated at the midpoint distance between each isopleth was used as the average concentration for the area between the isopleths. The isopleth plot is shown in Figure 7.

The total quantity of plutonium-238 in the offsite environment due to airborne emissions from Mound operations is estimated by this technique to be 360 mCi. The error associated with this value is estimated to be ±35% which includes errors due to chemical analysis, counting, area measurement, and sampling. Radiation dose to the public due to resuspended plutonium, even from the areas of maximum concentration, is well within the proposed EPA standard for transuranium elements in soil.

Table 25 - CONSTANTS FOR THE EQUATION: $y = ax^b$ AND CORRELATION COEFFICIENTS SHOWING GOODNESS OF FIT

Direction Radial (degrees)	Constant a	Exponent b	Correlation Coefficient
0	10.59	-1.96	-0.98
22.5	16.33	-1.98	-0.98
45	6.57	-1.65	-0.98
67.5	11.08	-1.93	-0.97
90	14.16	-1.97	-0.97
112.5	6.41	-1.89	-0.99
135	4.07	-1.55	-0.98
157.5	1.32	-1.49	-0.99
180	0.83	-0.90	-0.98
202.5	1.11	-1.03	-0.99
225	3.30	-1.58	-0.93
247.5	13.53	-2.06	-0.91
270	5.30	-1.66	-0.96
292.5	6.67	-2.24	-0.99
315	6.08	-2.43	-0.99
337.5	2.02	-1.92	-0.99

Evaluation of potential dose to the public

A dose assessment was performed for radionuclides in the environment from Mound Facility operations. These radionuclides are plutonium-238 and tritium. Tritium (oxide) is the only radionuclide at Mound Facility for which the critical organ is the whole body. The critical organs for plutonium-238 are asssumed to be the lung for insoluble material and the bone for soluble material. The solubility of plutonium-238 in the receptor is unknown; therefore each dose evaluation for both lung and bone were based on total concentration of plutonium-238 found in the environment. This approach gives a very conservative estimate of dose equivalents.

Plutonium-238 assumptions and methodology

The dose equivalent estimates for plutonium-238 were based on environmental monitoring data for CY-1977. The estimates for maximum dose equivalent to the lung at the site boundary and maximum dose equivalent to the lung in individuals were based on the maximum onsite average concentration of plutonium-238 in air from onsite samplers (sampler 213) since the samplers are in close proximity to the site boundary. The maximum dose equivalent to the lung in population group(s) was based on the maximum offsite average concentration of plutonium-238 in air (sampler 123).

The estimates for maximum dose equivalent to the bone at the site boundary and in

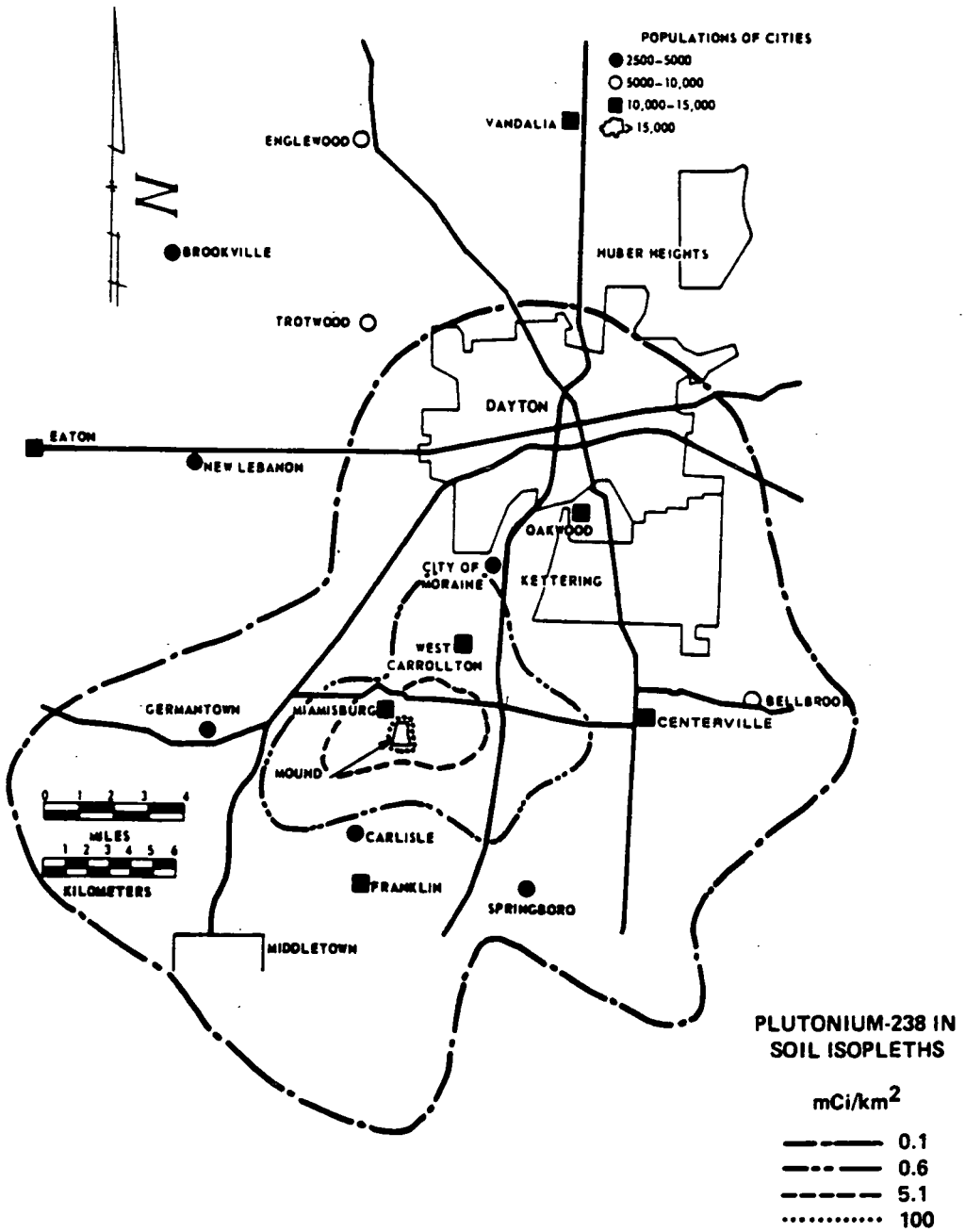

FIGURE 7 - Plutonium-238 in soil isopleths (mCi/km^2).

individuals were also based on the maximum onsite average concentration of plutonium-238 in air and the maximum offsite average concentration of plutonium-238 in drinking water (average of B-1, B-2, B-3). The maximum dose equivalent to the bone for individuals in population group(s) was based on the maximum offsite average concentrations of plutonium-238 in air and water (Miamisburg drinking water). The total dose equivalent for bone was obtained by the addition of the dose equivalent of plutonium in air and the dose equivalent of plutonium in water.

The term "maximum dose equivalent at the site boundary" and "maximum dose equivalent to individuals" refer to the maximum dose equivalent possible for individuals to receive assuming they remain at the site boundary 24 hr/day and 365 days/yr. The term "maximum dose equivalent for individuals in population group(s)," refer to those individuals who reside in a location adjacent to Mound Facility who receives the maximum dose equivalent values found in the offsite environment.

The calculational methods can be found in the Appendix.

Tritium (oxide) assumptions and methodology

The dose equivalent estimates for tritium (oxide) were also based on environmental monitoring data for CY-1977. The concentrations used for dose equivalent estimates for tritium (oxide) were arrived at by the same method as that used for plutonium. The maximum average onsite air concentration was measured at sampler 212, and the maximum drinking water concentration was the average of B-1, B-2, and B-3. The maximum average offsite air concentration was measured at sampler 102, and the maximum concentration of drinking water for individuals in a population group was Miamisburg drinking water. The total dose equivalent for the whole body was obtained by addition of the dose equivalent of tritium (oxide) in air and the dose equivalent of tritium (oxide) in water. The calculational methods can be found in the Appendix. The results of the dose estimate calculations are shown in Table 26.

The 80-km (50-mi) person-rem (whole body) dose equivalent estimates were based on average tritium (oxide) data from environmental air sampling stations, average tritium (oxide) data in community drinking water, and atmospheric dispersion estimates.

Two ranges of dose equivalent estimates based on distance from Mound Facility, were considered to obtain the 80-km (50-mi) person-rem dose estimate. The first range was from 0 to 3.2 km (2 mi). The second range was from 3.2 to 80 km (50 mi).

The 0 to 3.2 km (2 mi) range dose estimate for airborne tritium oxide was obtained from the average concentration (less background) of nine offsite tritium (oxide) samplers with a 3.2 km (2 mi) radius of Mound Facility. The dose in this distance range from tritium (oxide) in water was obtained from a weighted average of drinking water concentrations. These dose equivalents from tritium (oxide) in air and in water were summed.

The 3.2 to 80 km (50 mi) range dose estimate was obtained by finding the midpoint distance where the average tritium (oxide) concentration of the remaining offsite samplers would be located. This value is

Table 26 - DOSE EQUIVALENT ESTIMATES

	Plutonium-238 (mrem/yr)		Tritium Oxide (mrem/yr)
	Lung	Bone	Whole Body
Maximum dose equivalent at the site boundary	0.11	0.047	3.47
Maximum dose equivalent to an individual	0.11	0.047	3.47
Maximum dose equivalent to an individual in the population group(s)	0.036	0.016	0.21

estimated at 6.3 km (4 mi) [21]. From this distance and average concentrations of tritium (oxide) at sampling locations from 3.2 to 32 km (20 mi), it was determined that the maximum distance of influence from Mound Facility is ~32 km. Beyond 32 km the levels are calculated to be background concentrations.

The dose equivalent for tritium (oxide) from 3.2 to 32 km (20 mi) was based on the average of the remaining tritium (oxide) air sample concentrations and the average of the remaining community drinking water concentrations. The calculations are shown in the Appendix.

These calculated doses were then weighted by the population in each range. The total person-rem from 0 to 32 km is equal to 12.2 person-rem in addition to background. Based on diffusion model calculations, the remaining population from 32 to 80 km (50 mi) is not receiving dose from tritium (oxide) emissions from Mound Facility; therefore, the total person-rem from 0 to 80 km from tritium (oxide) emissions from Mound Facility is equal to 12.2 person-rem.

For comparison, the person-rem values from natural radiation, including cosmic rays and terrestrial radiation, would be approximately 320,000 person-rem for the 0 to 80 km (50 mi) range [22]. The dose commitment due to natural background tritium alone is 80 person-rem for the 0 to 80 km range.

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Appendix

Applicable standards

RADIOACTIVE STANDARDS

In conformance with DOE Manual Chapter 0524, "Standards for Radiation Protection," offsite sample results are compared with RCG's established for the general population. These RCG's are derived by dividing the RCG's for an uncontrolled area by three.

Onsite sample results are compared with the uncontrolled area RCG's which are applicable for individuals in the population.

The RCG values (in microcuries per milliliter - μCi/ml) used for comparison purposes for the various types of samples in this report are listed below. In all cases, these are the most restrictive RCG's

Plutonium-238 (Soluble Form)

Air

General Population	$2x10^{-14}$	μCi/ml
Uncontrolled Area (Individuals in the Population)	$7x10^{-14}$	μCi/ml

Water

General Population	$2x10^{-6}$	μCi/ml
Uncontrolled Area (Individuals in the Population)	$5x10^{-6}$	μCi/ml

Tritium (Soluble Form)

Air

General Population	$7x10^{-8}$	μCi/ml
Uncontrolled Area (Individuals in the Population)	$2x10^{-7}$	μCi/ml

Water (DOE RCG is compared to water not used for drinking purposes)

General Population	$1x10^{-3}$	μCi/ml
Uncontrolled Area (Individuals in the Population)	$3x10^{-3}$	μCi/ml

As of June 24, 1977, community drinking water quality is regulated by the EPA National Interim Primary Drinking Water Regulations for Radionuclides. The new standard = 20×10^{-6} μCi/ml (20,000 pCi/l).

Foodstuffs

There are no RCG values specified for foodstuffs.

Soil

There are no guidelines established for radioactive species in soil. (The U. S. EPA has guidelines under consideration.)

NONRADIOACTIVE STANDARDS

Water

Region V of the USEPA has issued a discharge permit under NPDES regulations covering both Mound Facility liquid effluent streams. The discharge limitations for each effluent stream through June 30, 1977, are as follows:

Outfall Number 001	Daily Average	Daily Maximum
Flow (10^6 gal/day)	0.53	0.92
BOD-5 Day (mg/liter)	30	45
Suspended Solids (mg/liter)	30	45
Dissolved Oxygen (mg/liter)	5	-
Residual Chlorine (mg/liter)		0.8
Oil and Grease (mg/liter)		10
Fecal Coliform (No./100 ml)	200	400
pH	6-9	

Outfall Number 002	Daily Average	Daily Maximum
Flow (10^6 gal/day)	0.53	-
Suspended Solids (mg/liter)	20	25
Dissolved Oxygen October-April (mg/liter)	>8	-
May-September (mg/liter)	>5	-
Residual Chlorine (mg/liter)		0.1
Dissolved Solids (mg/liter)	2000	3000
Oil and Grease (mg/liter)		10
pH	6-9	

The discharge limitations for each effluent stream as of July 1, 1977, became more restrictive and are as follows:

Outfall Number 001		
Flow (10^6 gal/day)	0.53	0.92
BOD-5 Day (mg/liter)	10	15
Suspended Solids (mg/liter)	10	15
Dissolved Oxygen (mg/liter)	5	-
Residual Chlorine (mg/liter)	-	0.5
Oil and Grease (mg/liter)	-	10
pH	6-9	-

Outfall Number 002	Daily Average	Daily Maximum
Flow (10^6 gal/day)	0.53	-
Suspended Solids (mg/liter)	15	20
Dissolved Oxygen (mg/liter October-April (mg/liter)	8	-
May-September (mg/liter)	5	-
Residual Chlorine (mg/liter)	-	0.05
Oil and Grease (mg/liter)		10
Dissolved Solids (mg/liter)	1500	2000
pH	6-9	

The Ohio EPA has established Water Quality Standards (3745-1-01-3745-1-09). The standards listed below are excerpted from these regulations. These standards are stream standards and apply to a stream beyond a suitable mixing zone permitted for discharges. They should not be compared with effluent concentrations.

Constituent	Average Concentration (mg/liter)
Dissolved Oxygen	5.0
pH	6-9
Fecal Coliform	200 per 100 ml
Dissolved Solids	1500
Ammonia	1.5
Arsenic	0.05
Barium	0.8
Cadmium	0.005
Chloride	250
Chromium (Hexavalent)	0.05
Cyanide (Free)	0.005
Fluoride	1.3
Foaming Agents (MBAS)	0.5
Iron	1
Lead	0.04
Manganese	1
Mercury	0.0005
Oil & Grease	5
Phenols	0.01
Selenium	0.005
Silver	0.001
Copper	0.005 - 0.075*
Zinc	0.075 - 0.5*

*Dependent on $CaCo_3$ hardness

Dose equivalent calculations

PLUTONIUM-238 CALCULATIONAL METHODS

The dose equivalent to the lung resulting from continuous inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1 C I_a t f_a f_r \; \Sigma EF(RBE)\eta}{\lambda m}\left(1-\frac{1-e^{-\lambda t}}{\lambda t}\right)$$

where D(t) = dose equivalent delivered to the lung in 365 days of continuous exposure to plutonium-238 in air, rem/yr.

C = average airborne concentration, μCi/ml

I_a = average air intake = 2×10^7 ml/day (Ref. 16)

t = time exposed, 365 days

f_a = fraction of inhaled material reaching organ of interest = 0.7 (max.) for the pulmonary region (Ref. 17)

f_r = fraction of pulmonary deposition undergoing long-term retention = 0.6 for actinide (class Y) (Ref. 17)

$\Sigma EF(RBE)\eta$ = effective energy deposition per disintegration = 57 (Ref. 16)

λ = effective decay rate, 0.0014 day^{-1} for actinides (class Y) from the pulmonary region (Ref. 18)

m = lung mass, 1000 g (Ref. 16)

The dose equivalent to bone resulting from continuous inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1 C I_a f_a t \; \Sigma EF(RBE)\eta}{\lambda m}\left(1-\frac{1-e^{-\lambda t}}{\lambda t}\right)$$

where f_a = 0.2 (Ref. 16)

$\Sigma EF(RBE)\eta$ = 284 (Ref. 16)

m = 7×10^3 g (Ref. 16)

λ = 3×10^{-5} day^{-1} (Ref. 16)

The dose equivalent to bone resulting from continuous ingestion of plutonium-238 in water was calculated by:

$$D(t) = \frac{51.1 C I_w f_a t \; \Sigma EF(RBE)}{\lambda m}\left(1-\frac{1-e^{-\lambda t}}{\lambda t}\right)$$

where I_w = average quantity of water intake, 2200 cm^3 (Ref. 16)

f_a = 2.4×10^{-5} (Ref. 16)

TRITIUM OXIDE CALCULATIONAL METHODS

The dose equivalent to the whole body resulting from continuous exposures to tritium (oxide) in air was calculated by:

$$D(t)a = \frac{\bar{C}a}{Ra} \times S$$

where D(t)a = dose equivalent, mrem/yr

$\bar{C}a$ = average concentration of tritium (oxide) in air

Ra = RCG for tritium (oxide) in air (Ref. 6)

S = Radiation protection standard in mrem/yr (Ref. 6)

The dose equivalent to the whole body resulting from continuous uptake of tritium (oxide) in water was calculated by:

$$D(t)w = \frac{\bar{C}w}{Rw} \times S$$

where D(t)w = dose equivalent in mrem/yr

$\bar{C}w$ = average concentration

Rw = RCG for tritium (oxide) in water (Ref. 6)

S = radiation protection standard in mrem/yr (Ref. 6)

Those dose equivalent values were divided by 1.7 in order to reflect the quality factor of one as recommended by the International Commission on Radiological Protection [19] and the National Council on Radiation Protection and Measurements [20].

Person-rem calculations

The equations used for this calculation in the 0-3.2 km range were:

$$\bar{D}(t)a_{0-3.2} = \frac{\bar{C}a}{Ra} \times S$$

where $\bar{D}(t)a_{0-3.2}$ = dose equivalent from 0 to 3.2 km from tritium (oxide) in air

Ca = average tritium (oxide) concentration in air from 0 to 3.2 km

Ra = RCG for tritium (oxide) in air (Ref. 6)

S = radiation protection standard for tritium (oxide) in air in mrem/yr (Ref. 6)

$$\bar{D}(t)w_{0-3.2} = \frac{\bar{C}w}{Rw} \times S$$

where $\bar{D}(t)w_{0-3.2}$ = dose equivalent from 0 to 3.2 km from tritium (oxide) in water

$\bar{C}w$ = average tritium (oxide) concentration in water from 0 to 3.2 km

Rw = RCG for tritium (oxide) in water (Ref. 6)

S = radiation protection standard for tritium (oxide) in water, mrem/yr (Ref. 6)

The equations for these calculations in the 3.2 to 32 km range are:

$$\bar{D}(t)a_{3.2-32} = \frac{\bar{C}a}{Ra} \times S$$

where $\bar{D}(t)a_{3.2-32}$ = dose equivalent from 3.2 to 32 km from tritium (oxide) in air

$\bar{C}a$ = average tritium (oxide) concentrations in air from 3.2 to 32 km

Ra = RCG for tritium (oxide) in air (Ref. 6)

S = Radiation Protection Standard for tritium (oxide) in air, mrem/yr (Ref. 6)

$$\bar{D}(t)w_{3.2-32} = \frac{\bar{C}w}{Rw} \times S$$

where $\bar{D}(t)w_{3.2-32}$ = dose equivalent from 3.2 to 32 km from tritium (oxide) in water

$\bar{C}w$ = average tritium (oxide) concentration in water from 3.2 to 32 km

Rw = RCG for tritium (oxide) in water (Ref. 6)

S = Radiation Protection Standard for tritium (oxide) in water, mrem/yr (Ref. 6)

The total person-rem from 0 to 32 km is obtained by:

$$\sum_{0}^{32} R = \left(\bar{D}(t)a_{0-3.2} + \bar{D}(t)w_{0-3.2}\right) \sum_{0}^{3.2} P + \left(\bar{D}(t)a_{3.2-32} + \bar{D}(t)w_{3.2-32}\right) \sum_{3.2}^{32} P$$

where $\sum_{0}^{32} R$ = person-rem within 32 km

$\sum_{0}^{3.2} P$ = population from 0 to 3.2 km = 14,700

$\sum_{3.2}^{32} P$ = population from 3.2 to 32 km = 881,241

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Billy M. Farmer, Bob Robinson,

and Daniel G. Carfagno

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MOUND LABORATORY
Miamisburg, Ohio 45342
operated for

UNITED STATES ENERGY RESEARCH
AND DEVELOPMENT ADMINISTRATION

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Foreword

This report was prepared by the Environmental Assessment and Planning Section of the Safety and Environmental Technology Function in the Administrative Services Department at Mound Laboratory. Sample analyses and data reduction were performed by the Environmental Evaluation and Environmental Laboratory groups of the Environmental Assessment and Planning Section. Particulate samples offsite are collected by the Air Pollution Control Section of the Montgomery County Combined General Health District which acts as the Regional Air Pollution Control Agency in this area for the Ohio Environmental Protection Agency.

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Introduction

Mound Laboratory is situated on 180 acres of land in Miamisburg, Ohio. This location is approximately 16 km (10 mi) southwest of Dayton. The predominant geographical feature in the five-county region surrounding the Laboratory is the Great Miami River which flows from the northeast to the southwest through Miamisburg. This river valley area is generally highly industrialized. The remainder of the region is predominantly agricultural with some light industry and scattered residential communities. The location and population of these communities are shown in Figure 1. The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately 10% of the land area in agricultural use is devoted to pasturing livestock [1]. Weather conditions in the area are described as moderate. The average annual precipitation is approximately 91 cm (36 in.) and is evenly distributed throughout the year. Winds are predominantly from the south or west except during the summer months when a higher frequency is recorded from out of the southwest. The wind speed averages about 16 km/hr (10 mi/hr) annually [2].

Mound Laboratory began operations in 1949. Its mission currently includes research, development, engineering, and production of components for the ERDA weapon programs; research, development, and production of explosive components; separation, purification, and sale of stable isotopes of the noble gases; the fabrication of radioisotopic heat sources fueled with plutonium-238 for space, terrestrial, and military applications. The radionuclides of primary concern currently being handled include plutonium-238 and tritium.

Radionuclides in particulate form are removed from process air effluents by high efficiency particulate air filters (HEPA). The air effluents are filtered first at the points of origin, i.e. glove boxes, and just prior to the release point, i.e. the stack. The filtering system at the stack consists of two banks of HEPA filters in series, each bank with a collection efficiency of 99.9%. Radionuclides are removed from liquid effluents such as process waste liquids by chemical processing. Solid radioactive wastes are packaged and shipped offsite for burial at approved burial sites. Airborne and liquid wastes generated in the processing of explosive materials are collected and disposed of according to the Army Materiel Command Regulation 385-100.

An onsite sanitary waste treatment plant provides secondary treatment in accordance with EPA requirements [3] using an activated sludge process operating in the extended aeration mode. All domestic sewage generated onsite is treated in this facility. The influent and effluent at the sewage treatment plant are also monitored for radioactivity to ensure no undetected release can occur to the environment via the sanitary sewage plant. The digested sludge from the sewage plant is shipped offsite for burial at an approved burial site to ensure that no contaminated sludge is released to the environment. Nonradioactive solid wastes are disposed of according to a recycling and reclamation program.

White paper, scrap metal and wood are sold for reclamation. General refuse is transported to the Franklin Reclamation Center, Franklin, Ohio, for processing and eventual use in recycled products. Waste solvents and chemicals are removed offsite by a commercial industrial-waste-disposal firm.

Conformance to regulations prescribed by ERDA pertaining to the safety of employees and the public has been demonstrated during the history of Mound Laboratory. The fundamental objective of the Mound Laboratory Environmental Control Program, which has been in existence throughout the history of the Laboratory, is the containment of radioactive effluents to levels well within the existing standards. As part of this function, effluents are monitored and controlled at each operating step resulting in only low-level releases of airborne or liquid wastes to the environment. Because of early detection, control techniques can be taken thus ensuring that concentrations are well within existing standards.

As part of the Environmental Program monitoring functions, air, water, foodstuff, and soil samples are collected from the environment at distances up to 45 km (28 mi) from the Laboratory boundaries. These samples are analyzed for the specific radionuclides handled at the Laboratory.

A quality control program for environmental analytical procedures has been in effect for several years. There are two parts to the program: internal and external. The internal portion consists of blank and duplicate analyses for each group of

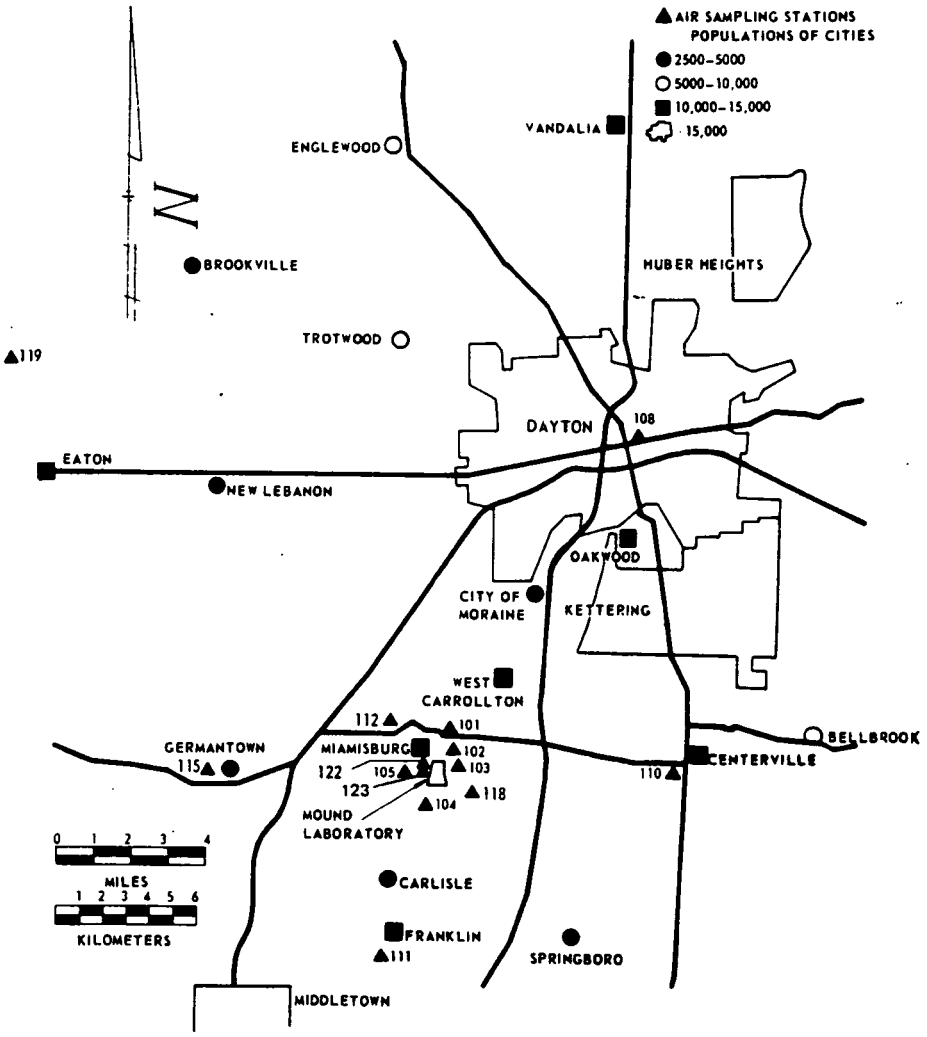

FIGURE 1 - Offsite air sampling locations

samples. The blank values have been consistently small in comparison with sample values indicating good control during analytical procedures. The duplicate results for 1976 were in the range expected. Chemical recoveries were greater than 50%. The external portion of the program consists of sending duplicate samples to an independent laboratory. These results for 1976 were also satisfactory. In addition, counting times or sampling volumes were increased during the second half of the year to provide lower detection limits. Mound Laboratory also, very successfully, participated in the International Atomic Energy Agency (IAEA) Laboratory Intercomparison for plutonium analyses in air and plutonium and tritium analyses in water.

The results of the environmental analyses for calendar year 1976 are provided in this report. Error limits, when given, reflect standard deviations in the data from counting statistics at the 95% confidence level.

Summary

The local environment surrounding Mound Laboratory was monitored for tritium and plutonium-238 released by Mound Laboratory. The results are reported for calendar year 1976. The environmental parameters analyzed included air, water, foodstuffs, and silt. The average concentrations of plutonium-238 and tritium were within the stringent standards for radioactive species adopted by the U. S. Energy Research and Development Administration. Data concerning nonradioactive species in air and water are also presented and compared to federal, state, and local standards, where applicable.

The average concentrations of plutonium-238 and tritium oxide measured at all locations in air during CY-1976 were $<2.3 \times 10^{-17}$ and $<1.0 \times 10^{-11}$ µCi/ml, respectively. These correspond to <0.12% and <0.014% of their respective Radioactivity Concentration Guides (RCG). Details of the applicable standards are given in the Appendix.

The average concentrations of plutonium-238 and tritium measured at all locations in the Great Miami River during CY-1976 were $<0.09 \times 10^{-10}$ and $<1.0 \times 10^{-6}$ µCi/ml, respectively. These correspond to <0.0005% and <0.10% of the respective RCG.

The average concentrations of plutonium-238 and tritium found during CY-1976 in surface water, community drinking water, and private wells were also a small fraction of each respective RCG.

Although there are no specific standards (RCG) for plutonium-238 and tritium in foodstuffs, the concentrations found, if compared to the water standard, are also a small fraction of the RCG. In addition, there is no evidence of other than minimal reentrainment of radioactive species from silt.

Mound Laboratory has undertaken a comprehensive program to bring water supplies into compliance with new U. S. EPA drinking water standards which will be effective June 24, 1977.

Mound Laboratory has been granted a National Pollutant Discharge Elimination System permit. Analyses during 1976 indicate compliance with permit conditions. All results indicated that Mound effluent streams have no significant effect on the Great Miami River and certainly do not cause Ohio Stream Standards to be exceeded.

These data demonstrate compliance with various current regulatory agency standards and that the operation of Mound Laboratory has a negligible effect on the environment.

Environmental Surveillance

AIR - RADIOACTIVE

An offsite air sampling network consisting of 12 continuously operating air-sampling stations which are used for sampling both tritium oxide and plutonium and a thirteenth sampler used for sampling plutonium only were used for the first six months of CY-1976. One additional sampler was added during the second half of the year in the abandoned Miami-Erie canal area to provide additional monitoring capabilities. During the first half of the year, seven sampling stations were located within a 1.6-km (1-mi) radius of the Laboratory (eight during the last half), and four samplers were located in or near population centers. The remaining sampler (#119) is still used and is approximately 44.8 km (28 mi) from the Laboratory in the least prevailing wind direction. This site should receive no measurable contribution from Mound operations and serves as a baseline sample for comparison purposes. The samplers currently in operation sample critical distances and directions based on the diffusion model developed for Mound Laboratory. The locations of the sampling stations are shown in Figure 1.

Two types of samples are collected at each sampling station, a particulate air sample for plutonium-238 analysis and a bubbler sample for tritium oxide analysis. The particulate sample is collected on a 200-mm diameter Microsorban disk by a

continuously operating (24 hr/day, 7 days/week) high-volume air sampler. The air is sampled at the average rate of 1.3×10^6 cm^3/min (~45 ft^3/min). The Microsorban disk is changed weekly which represents a sample of approximately 13,000 m^3 of air. Plutonium-238 analyses were performed on a monthly composite during the first half of the year and quarterly during the last half.

The analytical scheme for plutonium-238 incorporates the following basic steps: addition of a known amount of plutonium-242 tracer, ignition to 600°C, dissolution with nitric acid, separation of plutonium with anion exchange resin, electrodeposition of plutonium, and finally alpha spectrometry. The results reported represent total concentrations of the analyzed radionuclides including contribution from atmospheric fallout.

The average offsite plutonium-238 air concentration for all locations was $<2.3 \times 10^{-17}$ µCi/ml which is <0.12% of the RCG. The RCG used for comparison is the guide for the soluble form of the isotope and for the general population. This is the most restrictive RCG for plutonium-238 and is applied since the solubility of the measured particles in the human body is unknown. The analytical results are summarized in Table 1. Samples reported as less than (<) the Minimum Detection Limit (MDL) are, for averaging purposes, considered to be the value of MDL. Actually, the true value lies somewhere between natural background and MDL.

Also included in Table 1 are ratios of plutonium-238 to plutonium-239 for each sampling location.

The gas bubbler sample is also collected on a continuous basis by bubbling air at approximately 3×10^3 cm^3/min through 200 ml of ethylene glycol. Ethylene glycol is used because this material eliminates evaporation and freezing problems associted with sample collection [4]. Any tritium (oxide) in the air is collected in the solution. Tritium oxide rather than elemental tritium is sampled and analyzed because the RCG for the oxide is 200 times more restrictive than it is for elemental tritium [5]. A sample representing ~30 m^3 of air is collected and an aliquot representing 1.5 m^3 is counted in a liquid scintillation spectrometer. The average concentration of tritium oxide measured during CY-1976 for all locations was $<1.0 \times 10^{-11}$ µCi/ml which is <0.014% of RCG. The RCG used for comparison is the most restrictive RCG for tritium for the general population. The results are summarized in Table 2. Table 3 shows background values for plutonium-238 and tritium in air and water.

An onsite perimeter network consisting of five continuous, high-volume air samplers is used to further assess the effectiveness of control systems. The onsite sampling locations are shown in Figure 2. Particulate samples are collected by the onsite samplers at approximately the same flow rate as the offsite samplers, i.e. 1.3×10^6 cm^3/min, and are analyzed in the same manner. The tritium samplers operate at slightly less air flow, i.e. approximately 2×10^3 cm^3/min, and are analyzed in the same manner as offsite samplers.

The average plutonium-238 concentration measured for all locations onsite was 10×10^{-17} µCi/ml which is 0.14% of the RCG. The results are summarized in Table 4.

The average onsite tritium oxide concentration for all locations was $<2.2 \times 10^{-11}$ µCi/ml which is <0.01% of the RCG. The results are summarized in Table 5.

The RCGs used for onsite comparisons are those applicable for incidently exposed individuals in the population. The total amounts of plutonium-238 and tritium discharged to the atmosphere were 0.015 mCi and 6206 Ci respectively. Comparison of these quantities to the RCG is not valid.

AIR - NONRADIOACTIVE

The Mound steam power supply has been converted from fuel oil to natural gas (on an interruptable basis). During unusually cold weather, natural gas supply to Mound is interrupted, and fuel oil with <1% sulfur content is burned. Natural gas was burned during most of 1976 until late November when natural gas supply to Mound was halted. Fuel oil was burned for the remainder of the year, and the use of fuel oil is forecast for all of 1977. The average sulfur content of the fuel oil burned was approximately 0.4%. Approximately 340,000 gal of No. 2 fuel oil were burned during 1976. Additional sources of airborne emissions are as follows. A water-wash, paint spray booth is operated intermittently in the Mound paint shop. Wastes from operations involving explosives are disposed of by open burning. A shipping container fire test facility for testing shipping containers for radioactive wastes is used on the average of once per month. A maintenance grinding operation and a carpenter shop are also operated on an intermittent basis. Firefighter training excercises are held at an open outdoor facility.

Table 1

CONCENTRATIONS OF PLUTONIUM IN
AIR AT OFFSITE SAMPLING LOCATIONS IN 1976

Location	Number of Samples	^{238}Pu Range (10^{-17} µCi/ml)	^{238}Pu Average[a,d] (10^{-17} µCi/ml)	Percent of RCG[b]	^{239}Pu Average[c,d] (10^{-17} µCi/ml)	$^{238}Pu/^{239}Pu$
101	52	0.26 - 14.4	3.9 ±0.18	0.20	0.67 ±0.10	5.8
102	52	0.76 - 7.4	2.6 ±0.17	0.13	0.52 ±0.09	5.0
103	52	0.59 - 7.5	2.9 ±0.19	0.15	0.85 ±0.11	3.4
104	52	<0.077 - 1.9	<0.79 ±0.10	<0.04	0.52 ±0.09	<1.5
105	52	<0.077 - 0.47	<0.21 ±0.07	<0.01	0.48 ±0.09	<0.44
108	44	0.08 - 0.71	0.39 ±0.08	0.02	0.44 ±0.09	0.89
110	52	<0.077 - 0.42	<0.17 ±0.06	<0.01	0.46 ±0.09	<0.40
111	52	0.16 - 1.0	0.41 ±0.08	0.02	0.59 ±0.10	0.69
112	51	0.12 - 0.43	0.26 ±0.07	0.01	0.51 ±0.09	0.51
115	52	0.04 - 1.4	0.21 ±0.07	0.01	0.55 ±0.09	0.38
118	51	0.35 - 1.7	0.65 ±0.10	0.03	0.56 ±0.09	1.2
119	52	<0.027 - 0.06	<0.05 ±0.03	<0.01	0.38 ±0.06	<0.13
122	51	0.55 - 10.7	3.8 ±0.20	0.19	0.60 ±0.10	6.3
123	25	3.1 - 29.4	16.0 ±0.35	0.80	0.51 ±0.06	31.4

[a] Minimum Detection Limit (MDL) for ^{238}Pu in air is 0.077×10^{-17} µCi/ml for the first half of the year and 0.027×10^{-17} µCi/ml for the second half of the year. This is 0.004% and 0.001%, respectively, of the RCG.

[b] Radioactivity Concentration Guide (RCG) = 2000×10^{-17} µCi/ml for the soluble form of ^{238}Pu and the general population.

[c] Minimum Detection Limit (MDL) for ^{239}Pu in air is 0.043×10^{-17} µCi/ml for the first half of the year and 0.015×10^{-17} µCi/ml for the second half of the year.

[d] Error limits are counting statistics only at 95% confidence level.

Table 2

CONCENTRATIONS OF TRITIUM OXIDE IN AIR
AT OFFSITE SAMPLING LOCATIONS IN 1976

Location	Number of Samples	Tritium Oxide Range (10^{-11} µCi/ml)	Tritium Oxide Average[a,c] (10^{-11} µCi-ml)	Percent of RCG[b]
101	51	<0.45 - 13.6	<1.3 ±0.72	<0.02
102	51	<0.45 - 19.2	<1.5 ±0.85	<0.02
103	51	<0.45 - 7.5	<1.1 ±0.72	<0.02
104	49	<0.45 - 3.8	<0.94 ±0.70	<0.01
105	51	<0.45 - 5.3	<0.89 ±0.70	<0.01
108	50	<0.45 - 4.1	<0.89 ±0.70	<0.01
110	51	<0.45 - 5.4	<0.90 ±0.70	<0.01
111	51	<0.45 - 1.8	<0.81 ±0.70	<0.01
112	51	<0.45 - 3.1	<0.92 ±0.70	<0.01
115	51	<0.45 - 3.5	<0.85 ±0.70	<0.01
118	50	<0.45 - 1.9	<0.90 ±0.70	<0.01
119	51	<0.45 - 3.5	<0.88 ±0.70	<0.01
123	25	<0.45 - 3.1	<1.1 ±0.44	<0.02

[a] Minimum Detection Limit (MDL) for tritium oxide in air during the first half of the year was 0.99 x 10^{-11} µCi/ml and 0.45 x 10^{-11} µCi/ml for the second half. This is 0.014% and 0.006%, respectively, of the RCG.

[b] Radioactivity Concentration Guide (RCG) = 7000 x 10^{-11} µCi/ml for the general population and for soluble form of tritium.

[c] Error limits are counting statistics only at 95% confidence level.

Table 3

CONCENTRATIONS OF BACKGROUND LEVELS
OF TRITIUM AND PLUTONIUM-238

Plutonium-238 in Air[a]	0.3 ±0.1 x 10^{-17} µCi/ml
Plutonium-238 in Surface Water[b]	7 x 10^{-13} µCi/ml
Tritium Oxide in Air[c]	0.2 x 10^{-11} µCi/ml
Tritium in Surface Water[d]	0.5 ±0.2 x 10^{-6} µCi/ml

[a] References 6, 7
[b] Reference 8
[c] Reference 9
[d] Reference 10

Table 4

CONCENTRATION OF ^{238}Pu IN
AIR AT ONSITE SAMPLING LOCATIONS IN 1976

Location	Number of Samples	^{238}Pu Range (10^{-17} µCi/ml)	^{238}Pu Average[a,d] (10^{-17} µCi/ml)	Percent of RCG[b]	^{239}Pu Average[c] (10^{-17} µCi/ml)
211	52	0.26 - 37.3	8.7 ±0.36	0.1	0.59 ±0.10
212	52	1.4 - 11.0	3.5 ±0.23	0.05	0.54 ±0.09
213	52	7.2 - 77.6	26.7 ±0.59	0.4	1.3 ±0.14
214	47	1.7 - 37.9	9.1 ±0.36	0.1	0.81 ±0.11
215	50	0.75 - 6.8	3.3 ±0.21	0.05	0.60 ±0.10

[a] Minimum Detection Limit (MDL) for ^{238}Pu in air is 0.081×10^{-17} µCi/ml during the first half of the year and 0.027×10^{-17} µCi/ml for the second half. This is 0.0012% and 0.0004%, respectively, of the RCG.

[b] Radioactivity Concentration Guide (RCG) = 7000×10^{-17} µCi/ml for the soluble form of plutonium-238 for individuals in the population.

[c] Minimum Detection Limit (MDL) for ^{239}Pu is 0.045×10^{-17} µCi/ml during the first half of the year and 0.015×10^{-17} µCi/ml for the second half of the year.

[d] Error limits are counting statistics only at 95% confidence level.

Table 5

CONCENTRATION OF TRITIUM OXIDE IN
AIR AT ONSITE SAMPLING LOCATIONS IN 1976

Location	Number of Samples	Tritium Oxide Range (10^{-11} µCi/ml)	Tritium Oxide Average[a,c] (10^{-11} µCi/ml)	Percent of RCG[b]
211	49	<0.74 - 8.6	<1.8 ±1.2	<0.01
212	48	<0.74 - 5.2	<2.0 ±1.2	<0.01
213	51	<0.74 - 20.0	<2.8 ±1.2	<0.01
214	50	<0.74 - 10.2	<2.2 ±1.2	<0.01
215	50	<0.74 - 33.9	<2.4 ±1.2	<0.01

[a] Minimum Detection Limit (MDL) for tritium oxide in air was 1.65×10^{-11} µCi/ml during the first half of the year and 0.74×10^{-11} µCi/ml during the last half. This is 0.008% and 0.004%, respectively, of the RCG.

[b] Radioactivity Concentration Guide (RCG) = $20,000 \times 10^{-11}$ µCi/ml for individuals in the population and soluble form of tritium.

[c] Error limits are counting statistics only at 95% confidence level.

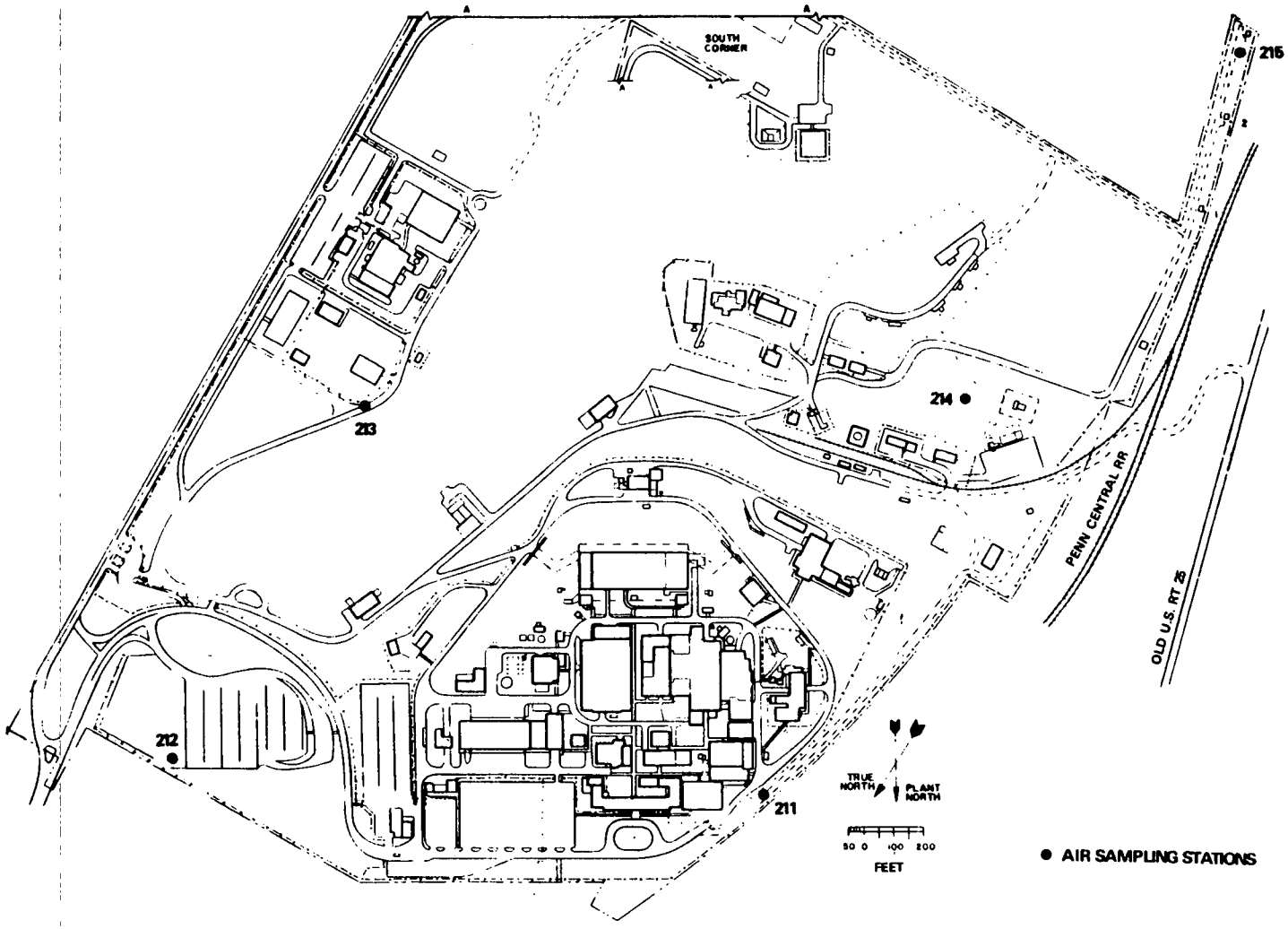

FIGURE 2 - Onsite air sampling locations

Emissions from sources registered with the Regional Air Pollution Control Agency (RAPCA) and the Ohio EPA which have applicable emission standards are summarized in Table 6. The emissions were estimated from emission factors established by the USEPA or from material balances [11]. The emission from the shipping container fire test facility is controlled with a forced air supply and water spray nozzles at the fuel-flame interface to an average opacity of <20%. The particulates from the grinding and carpenter shop operations are captured by cyclone air cleaners rated at 95% efficiency. No fire fighter training exercises were held during 1976. Non-radioactive airborne emissions at Mound Laboratory were all within applicable standards and had minimal impact on ambient air quality.

WATER - RADIOACTIVE

Water sampling locations along the bank of the Great Miami River were selected according to guidelines recommended by the U. S. EPA [2]. The locations, shown in Figure 3, provide samples which are representative of river water after suitable mixing of the effluent from Mound has occurred. Water samples are normally collected at these locations five days per week and are subjected to specific analyses for plutonium-238 and tritium.

The plutonium-238 river water analyses have been upgraded from a procedure developed at Mound Laboratory to allow lower detection of plutonium-238 in water. Large volume water samples are analyzed by compositing daily samples for a semiannual analysis. The average concentration of plutonium-238 measured for all locations in the Great Miami River was $<0.09 \times 10^{-10}$ µCi/ml which is <0.0005% of the RCG for the general population and the most restrictive standard for plutonium-238. These results are summarized in Table 7.

Tritium analyses are performed on a weekly composite of daily samples. The average concentration of tritium measured at all locations in the Great Miami River was $<1.0 \times 10^{-6}$ µCi/ml which is <0.1% of the RCG for the general population and the most restrictive standard for tritium. These results are summarized in Table 8.

Results of plutonium-238 and tritium analyses for three offsite sampling locations on the abandoned Miami-Erie Canal and adjacent ponds shown in Figure 4 are reported in Tables 9 and 10, respectively. These values represent levels from the site drainage ditch which discharges into the offsite canal-pond system prior to mixing with the Great Miami River. These values, as expected, are higher than those concentrations found in the Great Miami River where mixing and dilution occur. The total amounts of plutonium-238, tritium, and uranium-233 discharged to the Great Miami River were 3 mCi, 46 Ci, and 2.5 mCi, respectively. The concentrations were 0.7%, 1.8% and 0.01% of the most restrictive RCG for individuals in the population. From the uranium-233 concentrations found in the effluent streams, estimated concentrations offsite from Mound operations would be undistinguishable from any background. This can be readily seen by comparing plutonium-238 quantities found in the effluent streams with concentrations found offsite.

Eight additional surface water locations such as ponds in all quadrants surrounding Mound Laboratory are sampled annually. These samples, used for plutonium-238 determination, are large volume water samples of approximately 25 liters each. The large volume of sample increases the sensitivity of the analysis. A smaller aliquot (10 ml) was taken for the tritium analysis. The average concentrations of plutonium-238 and tritium for all locations were 0.08×10^{-10} and $<0.63 \times 10^{-6}$ µCi/ml, respectively, which are 0.0004% and 0.06% of the respective RCG for the general population. The results of the surface water samples are summarized in Tables 11 and 12. Background levels of plutonium-238 and tritium for the surface water are shown in Table 3.

Drinking water from communities in the surrounding area is sampled and analyzed annually for tritium with the exception of drinking water from Miamisburg which is sampled and analyzed quarterly for tritium. These communities and their relative locations are shown in Figure 1. The average concentration of tritium for all locations was $<0.9 \times 10^{-6}$ µCi/ml which is <0.09% of the RCG for the general population. The results of the analyses of the community drinking water samples are summarized in Table 13.

Several private wells in the vicinity of Mound Laboratory were also sampled and analyzed monthly for tritium. The average concentration of tritium in these wells was 43.5×10^{-6} µCi/ml which is 4.4% of the RCG for the general population. The private well analyses results

Table 6

NONRADIOACTIVE AIRBORNE EMISSIONS

1976

Emission Source	Pollutant	Emission	Emission Standard[a]	% of Standard
Power House	Particulates	0.03 lb/10^6 Btu Input	0.25 lb/10^6 Btu Input	12
Power House	Sulfur Oxides	0.066 lb/10^6 Btu Input	1.6 lb/10^6 Btu Input	4
Paint Shop	Organics	0.22 lb/day	40 lb/day	0.6
Explosives Burning Area	Particulates	∿3 lb/yr	NA	NA

[a] Ohio EPA Air Pollution Regulations AP-3-01 through AP-3-14 and AP-5-01 through AP-5-08

NA - not applicable

Table 7

CONCENTRATION OF ^{238}Pu IN THE GREAT MIAMI RIVER IN 1976

Location	Number of Samples[a]	^{238}Pu Average[b,d] (10^{-11} μCi/ml)	Percent of RCG[c]
1	105	0.06 ±0.02	0.0003
2	105	0.19 ±0.03	0.0010
3	105	<0.04 ±0.02	<0.0002
4	105	0.10 ±0.02	0.0005
5	105	0.05 ±0.02	0.0003

[a] One composite large volume water sample for each location from water collected during a six-month period.

[b] Minimum Detection Limit (MDL) for ^{238}Pu in water is 0.01 x 10^{-10} μCi/ml which is 0.00005% of the RCG.

[c] Radioactivity Concentration Guide (RCG) = 20,000 x 10^{-10} μCi/ml the general population and the soluble form of plutonium-238.

[d] Error limits are counting statistics only at 95% confidence level.

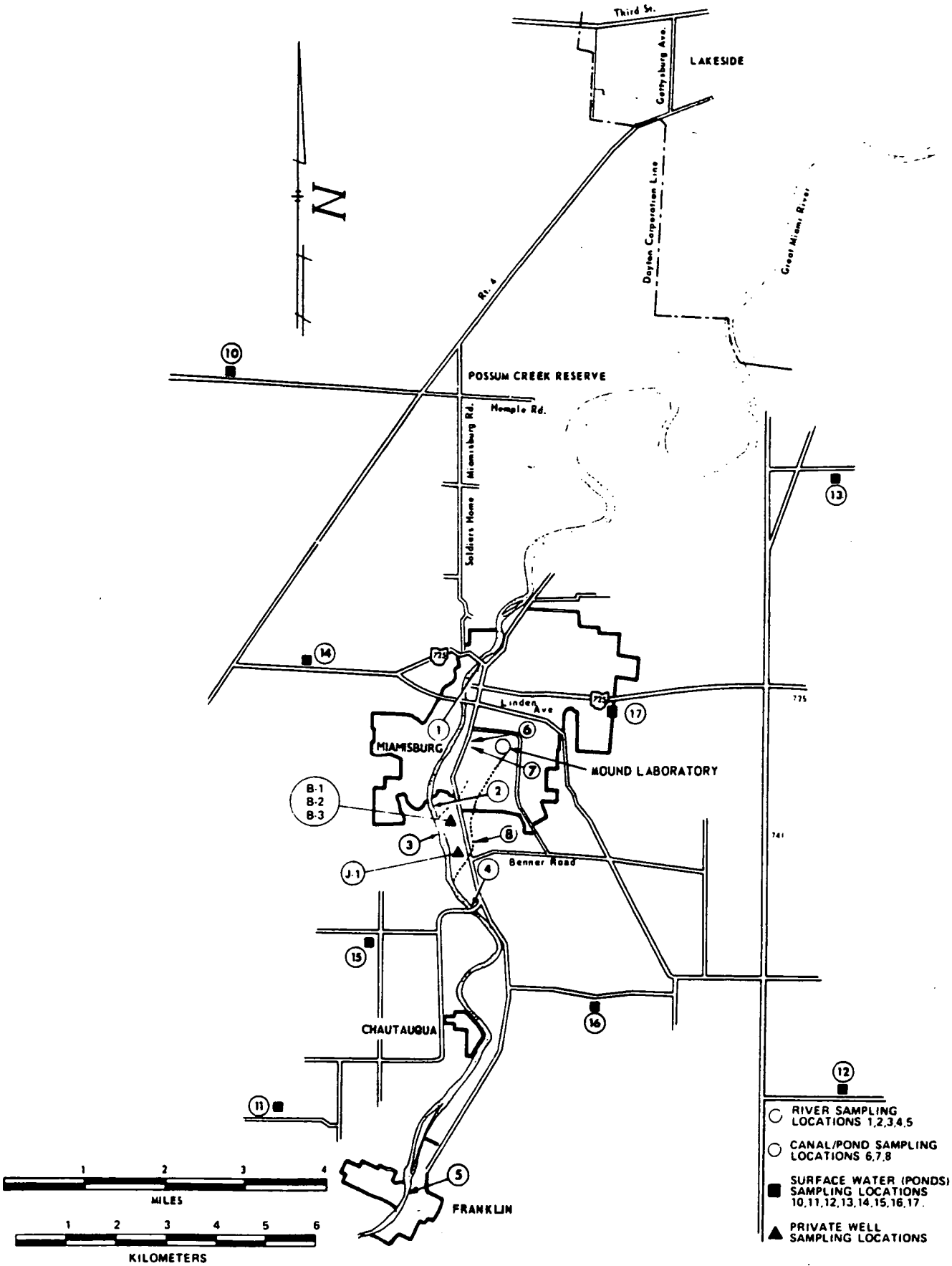

FIGURE 3 - Offsite water sampling locations

Table 8

CONCENTRATION OF TRITIUM IN
THE GREAT MIAMI RIVER IN 1976

Location	Number of Samples	Tritium Range (10^{-6} μCi/ml)	Tritium Average[a,c] (10^{-6} μCi/ml)	Percent of RCG[b]
1	210	<0.34 - 2.1	<0.89 ±0.42	<0.09
2	210	<0.51 - 3.7	<1.30 ±0.43	<0.13
3	210	<0.34 - 1.9	<0.93 ±0.42	<0.09
4	210	<0.34 - 2.4	<0.90 ±0.42	<0.09
5	210	<0.34 - 2.6	<0.90 ±0.43	<0.09

[a] Minimum Detection Limit (MDL) for tritium in water is 0.51 x 10^{-6} μCi/ml for the first half of the year and 0.34 x 10^{-6} μCi/ml for the second half. This is 0.051% and 0.034%, respectively, of the RCG.

[b] Radioactivity Concentration Guide (RCG) = 1000 x 10^{-6} μCi/ml for the general population and the soluble form of tritium.

[c] Error limits are counting statistics only at 95% confidence level.

Table 9

CONCENTRATION OF ^{238}Pu IN
CANAL/POND AREA IN 1976

Location[a]	Number of Samples[b]	^{238}Pu Average[c,e] (10^{-10} μCi/ml)	Percent of RCG[d]
6 (North Pond)	105	0.35 ±0.03	0.002
7 (North Canal)	105	0.96 ±0.06	0.005
8 (South Canal)	105	32.2 ±0.30	0.16

[a] Locations are shown in Figure 3.

[b] One composite large volume water sample for each location from water collected during a six-month period.

[c] Minimum Detection Limit (MDL) for ^{238}Pu in water is 0.01 x 10^{-10} μCi/ml which is 0.00005% of the RCG.

[d] Radioactivity Concentration Guide (RCG) = 20,000 x 10^{-10} μCi/ml for the general population and soluble form of plutonium-238.

[e] Error limits are counting statistics only at 95% confidence level.

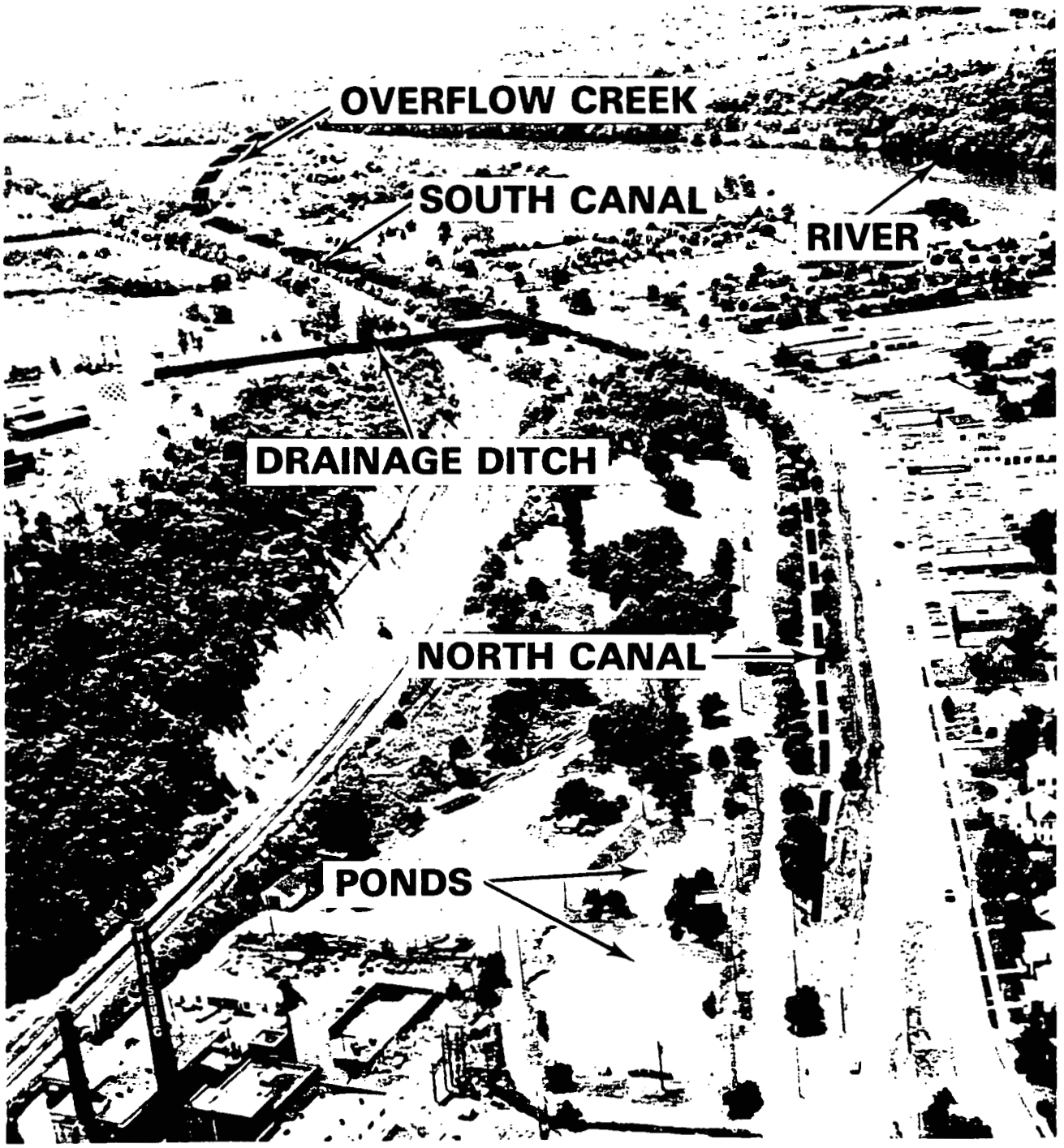

FIGURE 4 - Aerial view (from the north) of offsite abandoned canal and pond system.

Table 10

CONCENTRATION OF TRITIUM IN
CANAL/POND AREA IN 1976

Location[a]	Number of Samples	Tritium Range (10^{-6} µCi/ml)	Tritium Average[b,d] (10^{-6} µCi/ml)	Percent of RCG[c]
6 (North Pond)	210	13 - 37	24 ±0.8	2.4
7 (North Canal)	210	17 - 41	30 ±0.9	3.0
8 (South Canal)	210	19 - 59	41 ±0.9	4.1

[a] Locations are shown in Figure 3.

[b] Minimum Detection Limit (MDL) for tritium in water is 0.52 x 10^{-6} µCi/ml for the first half of the year and 0.35 x 10^{-6} µCi/ml for the second half. This is 0.052% and 0.035%, respectively, of the RCG.

[c] Radioactivity Concentration Guide (RCG) = 1000 x 10^{-6} µCi/ml for the general population and soluble form of tritium.

[d] Error limits are counting statistics only at 95% confidence level.

Table 11

SUMMARY OF SURFACE WATER MONITORING
FOR PLUTONIUM-238 IN 1976

Location	Number of Samples[a]	^{238}Pu Range (10^{-10} µCi/ml)	^{238}Pu Average[b,d] (10^{-10} µCi/ml)	Percent of RCG[c]
10	2	0.06 - 0.15	0.10 ± 0.02	0.0005
11	2	0.07 - 0.20	0.12 ± 0.02	0.0006
12	2	0.03 - 0.15	0.07 ± 0.02	0.0004
13	2	0.03 - 0.10	0.06 ± 0.01	0.0003
14	2	0.08 - 0.14	0.11 ± 0.02	0.0006
15	2	0.04 - 0.08	0.05 ± 0.01	0.0003
16	2	0.06 - 0.09	0.08 ± 0.02	0.0004
17	2	0.03 - 0.06	0.04 ± 0.01	0.0002

[a] Two composite large volume water samples were used for each location.

[b] Minimum Detection Limit (MDL) for ^{238}Pu in water for the first half of the year was 0.007 x 10^{-10} µCi/ml and 0.012 x 10^{-10} µCi/ml for the second half. This is 0.000035% and 0.00006%, respectively, of the RCG.

[c] Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = 20,000 x 10^{-10} µCi/ml for the general population and soluble form of plutonium-238.

[d] Error limits are counting statistics only at 95% confidence level.

Table 12

SUMMARY OF SURFACE WATER MONITORING
FOR TRITIUM IN 1976

Location	Number of Samples	Tritium Average[a,c] (10^{-6} µCi/ml)	Percent of RCG[b]
10	1	0.59 ± 0.3	0.059
11	1	<0.34 ± 0.3	<0.034
12	1	<0.34 ± 0.3	<0.034
13	1	0.38 ± 0.3	0.038
14	1	0.48 ± 0.3	0.048
15	1	0.63 ± 0.3	0.063
16	1	<0.34 ± 0.3	<0.034
17	1	1.9 ± 0.4	0.19

[a] Minimum Detection Limit (MDL) for tritium in water is 0.34 x 10^{-6} µCi/ml. The MDL is 0.034% of the RCG.

[b] Radioactivity Concentration Guide (RCG) for tritium oxide in water = 1000 x 10^{-6} µCi/ml for the general population and soluble form of tritium.

[c] Error limits are counting statistics only at 95% confidence level.

Table 13

SUMMARY OF TRITIUM LEVELS
IN COMMUNITY DRINKING WATER IN 1976

Location	Number of Samples	Tritium Range (10^{-6} µCi/ml)	Tritium Average[a,c] (10^{-6} µCi/ml)	Percent of RCG[b]
Bellbrook	1		<0.54 ±0.5	<0.05
Centerville	1		<0.54 ±0.5	<0.05
Franklin	1		<0.54 ±0.5	<0.05
Germantown	1		<0.54 ±0.5	<0.05
Kettering	1		<0.54 ±0.5	<0.05
Miamisburg	4	1.6 - 6.0	3.7 ±0.6	0.37
Middletown	1		<0.54 ±0.5	<0.05
Moraine	1		<0.54 ±0.5	<0.05
Springboro	1		<0.54 ±0.5	<0.05
Waynesville	1		<0.54 ±0.5	<0.05
West Carrollton	1		1.3 ±0.6	0.13

[a] Minimum Detection Limit (MDL) for tritium oxide is 0.54 x 10^{-6} µCi/ml. The MDL is 0.054% of the RCG.

[b] Radioactivity Concentration Guide (RCG) for tritium oxide in water = 1000 x 10^{-6} µCi/ml for the general population and soluble form of tritium.

[c] Error limits are counting statistics only at 95% confidence level.

are summarized in Table 14. The concentrations of tritium in these wells have been minutely influenced by past Mound Laboratory tritium effluent releases. As shown by the data, concentrations in these wells are higher than in other wells in the area, but are much less than the RCG and show a steady decrease over the past 7 yr. This situation has developed primarily from years of releasing quantities of water effluents at a small fraction of the RCG. Part of this water effluent has migrated into the aquifer adjacent to Mound Laboratory. Changes in operating procedures have reduced Mound Laboratory tritium releases by a factor of 50 since 1969. As mentioned earlier, these levels are well within the ERDA standard; however, the U.S. EPA has formulated new drinking water standards for radiological, biological, and chemical elements in water, which will be effective in June 1977. Although they are not based on new toxicological or epidemiological information, these standards will reduce the current federal standard by a factor of approximately 50.

There is no health problem associated with the very low levels of tritium in local water supplies; in fact, the EPA's very conservative regulations do not condemn water supplies that exceed the new standards as being unsafe to drink. However, as a result of Mound's influence upon local water supplies, a comprehensive program has been undertaken to bring the affected water supplies into compliance. This program has been approved by the Ohio EPA.

Two private wells and Miamisburg city water were sampled and analyzed monthly for plutonium-238. These samples also were large volume water samples averaging 40 liters. The average plutonium-238 concentration for these locations was 0.03 x 10^{-10} μCi/ml which is 0.00015% of the RCG for the general population. These results are shown in Table 15.

WATER - NONRADIOACTIVE

Mound Laboratory has been granted a discharge permit under the National Pollutant Discharge Elimination System (NPDES) by Region V of the U. S. EPA. The permit specifies limitations for the pollutants for the two effluent streams from Mound that discharge to the Great Miami River. The discharge from outfall number 001 includes the discharge from the sanitary waste treatment plant, radioactive waste disposal facility, single-pass cooling water, zeolite softener backwash, and some storm water runoff. The discharge from outfall number 002 consists of single-pass cooling water, cooling-tower blowdown, boiler-plant blowdown, zeolite softener backwash, and most of the storm water runoff. A 24-hr composite sample of each effluent stream is automatically collected daily. The volume of samples collected is proportional to the flow in the stream. The composite effluent water samples are analyzed for water quality parameters according to standard methods [13]. The results of effluent stream analyses for 1976 are summarized in Tables 16 and 17. All discharges for 1976 are within permit limitations and these waterborne effluents had no significant effect on the River since the river flow, even under low flow conditions, was approximately 350 times the maximum flow discharge from Mound during 1976. These data show that the Mound releases to the Miami River did not cause the Ohio Stream Standards to be exceeded.

FOODSTUFFS AND VEGETATION - RADIOACTIVE

Various locally grown foodstuffs and vegetation samples are collected from the surrounding area. The intent of this portion of the Environmental Monitoring Program is to determine whether there is any uptake and concentration of radionuclides by plant or animal life. Where possible, sampling sites are chosen at maximum deposition locations predicted on the basis of the diffusion model developed for Mound Laboratory [14]. Field crops and vegetables are collected on the basis of this diffusion model. Milk is collected from individual farms closest to the Laboratory. Aquatic life is trapped from the Miami River generally downstream of Miamisburg and from adjacent waterways, depending upon availability of fish. Grass samples are collected in the vicinity of the surface water locations shown in Figure 3. The plutonium-238 content of the foodstuff and vegetation samples is determined by ashing the samples and then proceeding with the same techniques used for plutonium-238 analyses of air samples (see section on Air - Radioactive). Milk samples are analyzed for tritium oxide by distilling the water fraction from an aliquot. The distillate is then analyzed for tritium by liquid scintillation spectrometry in the same manner as the water samples (see section on Water - Radioactive). The field crop samples are analyzed for tritium by oxidizing the samples in a controlled air stream and collecting the combustion products. The tritium content of the combustion products is then determined by liquid scintillation spectrometry. This technique allows analysis for total tritium in the samples rather than for tritium oxide only. The results of the foodstuff and vegetation analyses are summarized

Table 14

TRITIUM IN PRIVATE WELLS
IN 1976

Location	Number of Samples	Tritium Range (10^{-6} µCi/ml)	Tritium Average[a,c] (10^{-6} µCi/ml)	Percent of RCG[b]
B-1	28	43.3 - 69.5	59.8 ±1.2	6.0
B-2	28	20.3 - 37.8	31.0 ±0.8	3.1
B-3	26	31.8 - 49.7	42.3 ±0.9	4.2
J-1	25	32.3 - 47.6	40.8 ±0.9	4.1

[a] Minimum Detection Limit (MDL) for tritium oxide is 0.54 x 10^{-6} µCi/ml. The MDL is 0.54% of the RCG.

[b] Radioactivity Concentration Guide (RCG) for tritium oxide in water = 1000 x 10^{-6} µCi/ml for general population and soluble form of tritium.

[c] Error limits are counting statistics only at 95% confidence level.

Table 15

PLUTONIUM-238 IN PRIVATE WELLS AND MIAMISBURG
MUNICIPAL DRINKING WATER IN 1976

Location	Number of Samples[a]	^{238}Pu Average[b,d] (10^{-10} µCi/ml)	Percent of RCG[c]
Miamisburg	6	0.033 ±0.008	0.00017
B#1	6	0.038 ±0.009	0.00019
B#2	6	0.033 ±0.008	0.00017
B#3	6	0.022 ±0.008	0.00011
J	6	0.036 ±0.009	0.00018

[a] One composite large volume water. Sample was analyzed for each location from water collected during a six-month period.

[b] Minimum Detection Limit (MDL) for ^{238}Pu is 0.005 x 10^{-10} µCi/ml. The MDL is 0.00003% of the RCG.

[c] Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = 20,000 x 10^{-10} µCi/ml for the general population and soluble form of ^{238}Pu.

[d] Error limits are counting statistics only at 95% confidence level.

Table 16

1976 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT DATA FOR STATION 001[a]

Parameter		No. Samples	Minimum	Maximum	Average
Flow	Reported	Cont.	0.09 MGD	0.44 MGD	0.18 MGD
	Permit			0.92	0.53
BOD_5	Reported	104	0.2	12	4.1
	Permit			45.0	30.0
Fecal Coliform	Reported	64	ND	52	13
	Permit			400.0	200.0
Suspended Solids	Reported	104	ND	45	16.0
				45.0	30.0
Dissolved Oxygen	Reported	260	5.0	10.2	7.8
	Permit				5.0
Residual Chlorine	Reported	64	ND	0.8	0.3
	Permit			0.8	
Oil and Grease	Reported	52	ND	6.5	1.0
	Permit			10.0	
pH	Reported	260	6.2	8.9	
	Permit		6.0	9.0	
Carbon	Reported	104	74	134	88
Ammonia	Reported	52	0.1	0.1	0.1

[a] ND - none detectable.

MGD - million gallons per day.

Values for fecal coliform are number of coliform per 100 ml of water.

All other values are in milligrams per liter.

Table 17

1976 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT DATA FOR STATION 002[a]

Parameter		No. Samples	Minimum	Maximum	Average
Flow	Reported	Cont.	0.20 MGD	0.90 MGD	0.43 MGD
	Permit				0.53
Suspended Solids	Reported	104	ND	24	14.1
	Permit			25.0	20.0
Dissolved Oxygen	Reported	154	6.7	11.8	8.7
	Permit				5.0
Residual Chlorine	Reported	52	<0.05	0.05	<0.05
	Permit			0.10	
Oil and Grease	Reported	52	ND	7.0	0.6
	Permit			10.0	
pH	Reported	260	6.7	8.6	
	Permit		6.0	9.0	
Dissolved Solids	Reported	104	160	2179	967
	Permit			3000.0	2000.0

[a] ND - none detectable

MGD - million gallons per day

All values are in milligrams per liter.

in Tables 18 and 19. The concentration is given in terms of the sample weight (wet weight) before ashing. The vegetables analyzed were turnips and the field crop analyzed was the edible portions of corn. The sample of aquatic life analyzed included only the edible fleshy portions of the fish. No evidence has been found that there is any significant uptake and concentration by plant or animal life of the radionuclides handled at Mound Laboratory.

SOIL AND SILT - RADIOACTIVE

During CY-1976, emphasis was placed on the relocation of soil sampling, and soil samples were collected throughout the year to provide better inventory data. However, because of the time involved in the collection of the samples and the time involved in other critical projects, no CY-1976 data were obtained. Therefore, there will be no soil data reported for CY-1976.

Silt samples from the Great Miami River (See Figure 3) and from the surface water monitoring locations (ponds) were analyzed, however. These samples were obtained by filtration of sediment (silt) from the water that was collected from these locations for that water analyses shown in Tables 7 and 11. The results of the silt sample analyses are found in Tables 20 and 21.

Evaluation of Potential Dose Equivalent to the Public

A dose assessment was performed for radionuclides in the environment from Mound Laboratory operations. These radionuclides are plutonium-238 and tritium. Tritium (oxide) is the only radionuclide at Mound Laboratory for which the critical is the whole body. The critical organs for plutonium-238 are assumed to be the lung for insoluble material and the bone for soluble material since the solubility in the receptor is unknown. In order to resolve the uncertainty of the solubility of plutonium, each dose evaluation for the lung and the bone included the concentration found in the environment, which gives a very conservative estimate of dose equivalence.

PLUTONIUM-238

Assumptions and Methodology The dose equivalent estimates for plutonium-238 were based on environmental monitoring data for CY-1976. The estimates for maximum dose equivalent to the lung at the site boundary and maximum dose equivalent to the lung in individuals were based on the maximum onsite average concentration of plutonium-238 in air from onsite samplers since the samplers are in close proximity to the site boundary. The maximum dose equivalent to the lung in population group(s) were based on the maximum offsite average concentration of plutonium-238 in air.

The estimates for maximum dose equivalent to the bone at the site boundary and in individuals were also based on the maximum onsite average concentration of plutonium-238 in air and the maximum offsite average concentration of plutonium-238 in drinking water. The maximum dose equivalent to the bone for population group(s) was based on the maximum offsite average concentrations of plutonium-238 in air and water. The total dose equivalent for bone was obtained by the addition of the dose equivalent of plutonium in air and the dose equivalent of plutonium in water.

Calculational Methods The dose equivalent to the lung resulting from continuous inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1 C I_a t f_a f_r \; EF(RBE)_\alpha}{\lambda m}\left(1 - \frac{1 - e^{-\lambda}}{\lambda t}\right)$$

where D(t) = dose equivalent delivered to the lung in 365 days of continuous exposure to plutonium-238 in air, rem/yr

C = average airborne concentration, μCi/ml

I_a = average air intake = 2 x 10^7 ml/day (Ref. 15)

t = time exposed, 365 days

f_a = fraction of inhaled material reaching organ of interest = 0.7 (max.) for the pulmonary region (Ref. 16)

f_r = fraction of pulmonary deposition undergoing long-term retention = 0.6 for actinide (class Y) (Ref. 16)

$\Sigma EF(RBE)_\alpha$ = effective energy deposition per disintegration = 57 (Ref. 15)

λ = effective decay rate, 0.0014 day^{-1} for actinides (class

Table 18

PLUTONIUM-238 IN FOODSTUFFS
AND VEGETATION IN 1976

Type of Sample	Number of Samples	^{238}Pu Range (10^{-8} μCi/g)	Average[a,b,c,d] (10^{-8} μCi/g)
Milk	2	-	<0.009 ±0.01
Vegetables	2	<0.022 - 0.036	<0.029 ±0.02
Grass	9	<0.052 - 6.32	<2.03 ±0.17
Field crop	2	<0.022 - 0.028	<0.024 ±0.02
Aquatic Life	2	0.024 - 0.047	0.036 ±0.03

[a] Minimum Detection Limit (MDL) for ^{238}Pu in fruits and vegetables, field crops, and aquatic life is 0.022 x 10^{-8} μCi/g.

[b] Minimum Detection Limit (MDL) for ^{238}Pu in milk is 0.009 x 10^{-8} μCi/g.

[c] Minimum Detection Limit (MDL) for ^{238}Pu in grass is 0.052 x 10^{-8} μCi/g.

[d] Error limits are counting statistics only at 95% confidence level.

Table 19

TRITIUM IN FOODSTUFFS AND VEGETATION
IN 1976

Type Sample	Number of Samples	Tritium Range (10^{-6} μCi/g)	Average[a,b] (10^{-6} μCi/g)
Milk	2	0.72 - 0.75	0.73 ±0.29
Field crops	2	-	< 3.0 ±3.0

[a] MDL for tritium in milk = 0.29 x 10^{-6} μCi/g. MDL for tritium in field crops = 3.0 x 10^{-6} μCi/g. MDL for tritium in aquatic life = 1.8 x 10^{-6} μCi/g.

[b] Error limits are counting statistics only at 95% confidence level.

Table 20

^{238}Pu IN SILT FROM RIVER MONITORING LOCATIONS IN 1976

Location	Number of Samples	^{238}Pu Average[b,c] (10^{-6} µCi/g)
1	1	1.19 ±0.11
2	1	15.22 ±0.36
3[a]	-	-
4	1	5.12 ±0.44
5	1	0.47 ±0.04

[a] No data reported

[b] Minimum Detection Limit (MDL) for Pu^{238} is 0.018 x 10^{-6} µCi/g.

[c] Error Limits are counting statistics at 95% confidence level.

Table 21

^{238}Pu IN SILT FROM SURFACE WATER MONITORING LOCATIONS IN 1976

Location	Number of Samples	^{238}Pu Range (10^{-6} µCi/g)	Average[a,b] (10^{-6} µCi/g)
10	2	0.03 - 0.05	0.04 ± 0.01
11	2	0.10 - 10	5.1 ± 0.28
12	2	0.07 - 0.39	0.23 ± 0.06
13	2	2.8 - 47	25.1 ±15.1
14	2	0.1 - 7.1	3.6 ± 0.33
15	2	0.01 - 0.23	0.12 ± 0.01
16	2	2.2 - 224	113 ± 8
17	2	0.4 - 2.4	1.4 ± 0.23

[a] Minimum Detection Limit (MDL) for ^{238}Pu is 0.003 x 10^{-6} µCi/g.

[b] Error Limits are counting statistics at 95% confidence level.

Y) from the pulmonary region (Ref. 17)

m = lung mass, 1000 g (Ref. 15)

The dose equivalent to bone resulting from continuous inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1 CI_a f_a t \; EF(RBE)_x}{\lambda m} \; 1 - \left(\frac{1 - e^{-\lambda t}}{\lambda t}\right)$$

where f_a = 0.2 (Ref. 15)

$\Sigma EF(RBE)_x$ = 284 (Ref. 15)

m = 7×10^3 g (Ref. 15)

$\lambda = 3 \times 10^{-5}$ day^{-1} (Ref. 15)

The dose equivalent to bone resulting from continuous ingestion of plutonium-238 in water was calculated by:

$$D(t) = \frac{51.1 CI_w f_a t \; \Sigma EF(RBE)}{\lambda m} \left(1 - \frac{1 - e^{-\lambda t}}{\lambda t}\right)$$

where I_w = average quantity of water intake, 2200 cm^3 (Ref. 15)

$f_a = 2.4 \times 10^{-5}$ (Ref. 15)

The results of the calculations are:

Maximum dose equivalent to the lung at the site boundary - 0.37 mrem/yr

Maximum dose equivalent to the lung in individuals - 0.37 mrem/yr

Maximum dose equivalent to the lung in population group(s) - 0.22 mrem/yr

Maximum dose equivalent to the bone at the site boundary - 0.15 mrem/yr

Maximum dose equivalent to the bone at the site boundary - 0.15 mrem/yr

Maximum dose equivalent to the bone in individuals - 0.15 mrem/yr

Maximum dose equivalent to the bone in population group(s) - 0.09 mrem/yr

TRITIUM (OXIDE)

Assumptions and Methodology The dose equivalent estimates for tritium (oxide) were also based on environmental monitoring data for CY-1976. The concentrations used for dose equivalent estimates for tritium (oxide) were calculated by the same method as that used for plutonium. The total dose equivalent for the whole body was obtained by addition of the dose equivalent of tritium (oxide) in air and the dose equivalent of tritium (oxide) in water.

Calculational Methods The dose equivalent to the whole body resulting from continuous exposures to tritium (oxide) in air was calculated by:

$$D(t) = \frac{\bar{C}_a}{R_a} \times S$$

where $D(t)_a$ = dose equivalent, mrem/yr

$\bar{C}_a$ = average concentration of tritium (oxide) in air

R_a = RCG for tritium (oxide) in air (Ref. 5)

S = Radiation protection standard in mrem/yr (Ref. 5)

The dose equivalent to the whole body resulting from continuous uptake of tritium (oxide) in water was calculated by:

$$D(t)_w = \frac{\bar{C}_w}{R_w} \times S$$

where $D(t)_w$ = dose equivalent in mrem/yr

$\bar{C}_w$ = average concentration

R_w = RCG for tritium (oxide) in water (Ref. 5)

S = radiation protection standard in mrem/yr (Ref. 5)

Those dose equivalent values were divided by 1.7 in order to reflect the quality factor of one as recommended by the International Commission on Radiological Protection [18] and the National Council on Radiation Protection and Measurements [19].

The results of the calculations are:

Maximum dose equivalent at the site boundary - 4.43 mrem/yr

Maximum dose equivalent to an individual - 4.43 mrem/yr

Maximum dose equivalent to population group(s) - 0.37 mrem/yr

The 50-mi (80-km) person-rem (whole body) dose equivalent estimates were based on average tritium (oxide) data from environmental air sampling stations, average tritium (oxide) data in community drinking water, and atmospheric dispersion estimates.

Two ranges of dose equivalent estimates based on distance from Mound Laboratory,

were considered to obtain the 80-km (50-mi) person-rem dose estimate. The first range was from 0 to 3.2 km (2 mi). The second range was from 3.2 to 80 km. This distance breakdown was used because of the placement of samplers in the Mound diffusion model.

The 0 to 3.2 km range dose estimate for airborne tritium oxide was obtained from the average concentration (less background) of eight offsite tritium (oxide) samplers within a 3.2 km radius of Mound Laboratory. This distance range dose from tritium (oxide) in water was obtained from a weighted average of drinking water concentrations. These dose equivalents from tritium (oxide) in air and in water were summed.

The equations used for this calculation were:

$$\bar{D}(t)_{a\,0-2} = \frac{\bar{C}_a}{R_a} \times S$$

where $\bar{D}(t)_{a\,0-2}$ = dose equivalent from 0 to 3.2 km from tritium (oxide) in air

$\bar{C}_a$ = average tritium (oxide) concentration in air from 0 to 3.2 km

R_a = RCG for tritium (oxide) in air (Ref. 5)

S = radiation protection standard for tritium (oxide) in air in mrem/yr (Ref. 5)

$$\bar{D}(t)_{w\,0-2} = \frac{\bar{C}_w}{R_w} \times S$$

where $\bar{D}(t)_{w\,0-2}$ = dose equivalent from 0 to 3.2 km from tritium (oxide) in water

$\bar{C}_w$ = average tritium (oxide) concentration in water from 0 to 3.2 km

R_w = RCG for tritium (oxide) in water (Ref. 5)

S = radiation protection standard for tritium (oxide) in water, mrem/yr (Ref. 5)

The 3.2 to 80 km range dose estimate was obtained by finding the midpoint distance where the average tritium (oxide) concentration of the remaining offsite samplers would be located. This value is estimated at 6.3 km [20]. From this distance and average concentrations of tritium (oxide) at sampling locations from 3.2 to 32 km, it was determined that the maximum distance of influence from Mound Laboratory is ∿32 km. Beyond 32 km the levels are calculated to be background concentrations.

The dose equivalent for tritium (oxide) from 3.2 to 32 km was based on the average of the remaining tritium (oxide) air sample concentrations and the average of the remaining community drinking water concentrations.

The equations for these calculations are:

$$\bar{D}(t)_{a\,2-0} = \frac{\bar{C}_a}{R_a} \times S$$

where $\bar{D}(t)_{a\,2-20}$ = dose equivalent from 3.2 to 32 km from tritium (oxide) in air

$\bar{C}_a$ = average tritium (oxide) concentrations in air from 3.2 to 32 km

R_a = RCG for tritium (oxide) in air (Ref. 5)

S = Radiation Protection Standard for tritium (oxide) in air, mrem/yr (Ref. 5)

$$\bar{D}(t)_{w\,2-20} = \frac{\bar{C}_w}{R_w} \times S$$

where $\bar{D}(t)_{w\,2-20}$ = dose equivalent from 3.2 to 32 km from tritium (oxide) in water

$\bar{C}_w$ = average tritium (oxide) concentration in water from 3.2 to 32 km

R_w = RCG for tritium (oxide) in water (Ref. 5)

S = Radiation Protection Standard for tritium (oxide) in water, mrem/yr (Ref. 5)

The total person-rem from 0 to 32 km is obtained by:

$$\sum_0^{20} R = \left(\bar{D}(t)_{a\,0-2} + \bar{D}(t)_{w\,0-2}\right) \sum_0^{2} P + \left(\bar{D}(t)_{a\,2-20} + \bar{D}(t)_{w\,2-20}\right) \sum_2^{22} P$$

where $\sum_0^{20} R$ = person-rem within 32 km

$\sum_0^{2} P$ = population from 0 to 3.2 km = 14,700

$\sum_2^{20} P$ = population from 3.2 to 32 km = 881,241

Note: The total person-rem from 0 to 3.2 km is equal to 25 person-rem in addition to background. Based on diffusion model calculations, the remaining population from 32 to 80 km is not receiving dose from tritium (oxide) releases from Mound Laboratory; therefore, the total person-rem from 0 to 80 km from tritium (oxide) releases from Mound Laboratory is equal to 25 person-rem.

For comparison, the person-rem values from natural radiation, including cosmic rays and terrestrial radiation, would be approximately 320,000 person-rem for the 0 to 80 km range [21]. The dose commitment due to natural background tritium alone is 80 person-rem for the 0 to 80 km range.

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Appendix

APPLICABLE STANDARDS

RADIOACTIVE STANDARDS

In conformance with ERDA Manual Chapter 0524, "Standards for Radiation Protection," offsite sample results are compared with RCG's established for the general population. These RCG's are derived by dividing the RCG's for an uncontrolled area by 3.

Onsite sample results are compared with the uncontrolled area RCG's which are applicable for individuals in the population.

The RCG values (in microcuries per milliliter - μCi/ml) used for comparison purposes for the various types of samples in this report are listed below. In all cases, these are the most restrictive RCG's.

Plutonium-238 (Soluble Form)

Air

General Population	2×10^{-14} μCi/ml
Uncontrolled Area (Individuals in the Population)	7×10^{-14} μCi/ml

Water

General Population	2×10^{-6} μCi/ml
Uncontrolled Area (Individuals in the Population)	5×10^{-6} μCi/ml

Tritium (Soluble Form)

Air

General Population	7×10^{-8} μCi/ml
Uncontrolled Area (Individuals in the Population)	2×10^{-7} μCi/ml

Water

General Population	1×10^{-3} μCi/ml
Uncontrolled Area (Individuals in the Population)	3×10^{-3} μCi/ml

Foodstuffs

There are no RCG values specified for foodstuffs.

Soil

There are no guidelines established for radioactive species in soil.

NONRADIOACTIVE STANDARDS

Water - Region V of the USEPA has issued a discharge permit under NPDES regulations covering both Mound Laboratory liquid effluent streams. The discharge limitations for each effluent stream are as follows:

Outfall Number 001

	Daily Average	Daily Maximum
Flow (10^6 gal/day)	0.53	0.92
BOD-5 Day (mg/l)	30	45
Suspended Solids (mg/l)	30	45
Dissolved Oxygen (mg/l)	5	-
Residual Chlorine (mg/l)		0.8
Oil and Grease (mg/l)		10
Fecal Coliform (No./100 ml)	200	400
pH	6-9	

Outfall Number 002

Flow (10^6 gal/day)	0.53	-
Suspended Solids (mg/l)	20	25
Dissolved Oxygen		
October-April (mg/l)	>8	-
May-September (mg/l)	>5	-
Residual Chlorine (mg/l)		0.1
Dissolved Solids (mg/l)	2000	3000
Oil and Grease (mg/l)		10
pH	6-9	

The Ohio EPA has established Water Quality Standards (EP-1-EP-9). The standards listed below are excerpted from these regulations. These standards are stream standards and apply to a stream beyond a suitable mixing zone permitted for discharges. They should not be compared with effluent concentrations.

Constituent	Average Concentration (mg/l)
Dissolved Oxygen	5.0
pH	6-9
Fecal Coliform	200 per 100 ml
Dissolved Solids	1500
Ammonia	1.5
Arsenic	0.05
Barium	0.8
Cadmium	0.005
Chloride	250
Chromium (Hexavalent)	0.05
Cyanide (Free)	0.005
Fluoride	1.3
Foaming Agents (MBAS)	0.5
Iron	1
Lead	0.04
Manganese	1
Mercury	0.0005
Oil & Grease	5
Phenols	0.01
Selenium	0.005
Silver	0.001
Copper	0.005 - 0.075[a]
Zinc	0.075 - 0.5[a]

[a] Dependent on $CaCO_3$ hardness.

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Annual Environmental Monitoring Report: Calendar Year 1975

Billy M. Farmer, Bobby Robinson,

and Daniel G. Carfagno

April 26, 1976

Research and Development Report

MOUND LABORATORY
Miamisburg, Ohio
operated by

MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company
for the
UNITED STATES ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
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Billy M. Farmer, Bobby Robinson, and Daniel G. Carfagno

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U. S. Government Contract No. E-33-1-GEN-53

Foreword

This report was prepared by the Environmental Control Section of the Personnel Safety, Waste Management, and Environmental Control Function in the Administrative Services Department at Mound Laboratory. Sample analyses and data reduction were performed by the Radiological Surveillance group of the Environmental Control Section. Particulate samples off-site are collected by the Air Pollution Control Section of the Montgomery County Combined General Health District which acts as the Regional Air Pollution Control Agency in this region for the Ohio Environmental Protection Agency.

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Introduction

Mound Laboratory is situated on 180 acres of land in Miamisburg, Ohio. This location is approximately 16 km (10 mi) southwest of Dayton. The predominant geographical feature in the five-county region surrounding the Laboratory is the Great Miami River which flows from the northeast to the southwest through Miamisburg. This river valley area is generally highly industrialized. The remainder of the region is predominantly agricultural with some light industry and scattered residential communities. The location and population of these communities are shown in Figure 1. The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately 10% of the land area in agricultural use is devoted to pasturing livestock.[1]

Weather conditions in the area are described as moderate. The average annual precipitation is approximately 91 cm (36 in.) and is evenly distributed throughout the year. Winds are predominately from the south or west except during the summer months when a higher frequency is recorded from out of the southwest. The wind speed averages about 16 km/hr (10 mi/hr) annually.[2]

Mound Laboratory began operations in 1949. Its mission currently includes research, development, engineering, and production of components for the ERDA weapons program; research, development, and production of explosive materials; separation, purification, and sale of stable isotopes of the noble gases; and development, design, and fabrication of radioisotopic heat sources for medical application and space exploration. The radionuclides of primary concern currently being handled include plutonium-238 and tritium.

Conformance to regulations prescribed by ERDA pertaining to the safety of employees and the public have been demonstrated during the history of Mound Laboratory. The fundamental objectives of the Mound Laboratory Environmental Control Program, which has been in existence throughout the history of the Laboratory, is the containment of radioactive effluents to levels well within the existing standards. As part of this control function, effluents are monitored and controlled at each operating step resulting in detection of low-level releases of airborne or liquid wastes to the environment. Because of this early detection, control techniques can be taken thus ensuring that concentrations are well within existing standards.

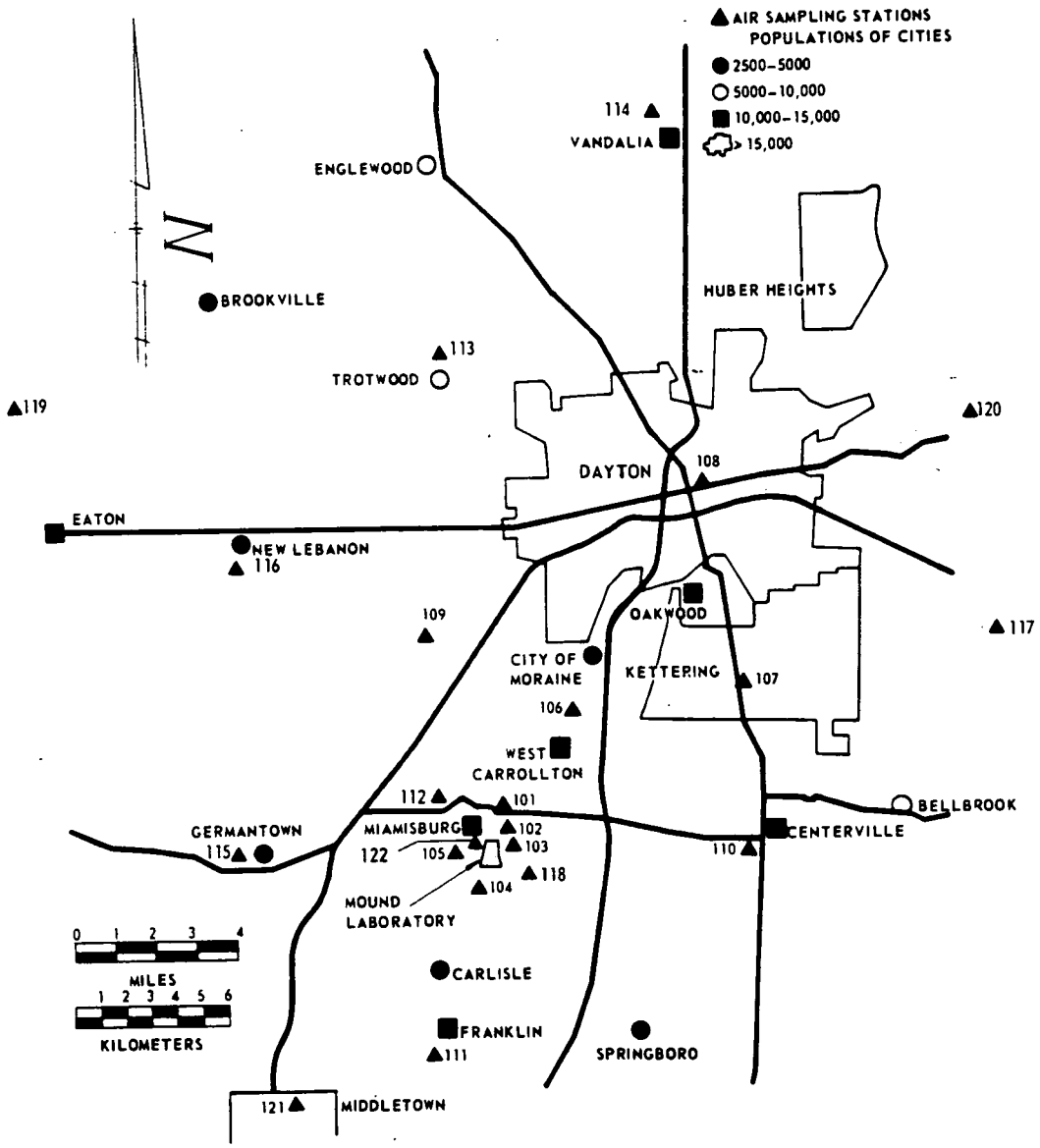

FIGURE 1 - Off-site air sampling locations

As part of the Environmental Program monitoring functions, air, water, foodstuff, and soil samples are collected from the environment at distances up to 45 km (28 mi) from the Laboratory boundaries. These samples are analyzed for the specific radionuclides handled at the Laboratory.

Radionuclides in particulate form are removed from air effluents by high efficiency particulate air filters (HEPA). The air effluents are filtered first at the points of origin, i.e. glove boxes, and just prior to the release point, i.e. the stack. The filtering system at the stack consists of two banks of HEPA filters in series, each with a collection efficiency of 99.9%. Radionuclides are removed from liquid effluents such as process waste liquids by chemical processing. Solid radioactive wastes are packaged and shipped off-site for burial at ERDA-approved burial sites. Airborne and liquid wastes generated in the processing of explosive materials are collected and disposed of according to the Army Materiel Command Regulation 385-100.

A new sanitary waste treatment plant was placed in operation during 1975. The plant provides secondary treatment in accordance with EPA requirements[3] using an activated sludge process operating in the extended aeration mode. All domestic sewage generated on-site is treated in this facility. The influent and effluent at the sewage treatment plant are also monitored for radioactivity to ensure no undetected release can occur to the environment via the sanitary sewage plant. The digested sludge from the sewage plant is shipped off-site for burial to an ERDA-approved burial site to ensure that no contaminated sludge is released to the environment. Nonradioactive solid wastes are disposed of according to a recycling and reclamation program implemented during the first quarter of 1974. White paper, scrap metal, and wood are sold for reclamation. General refuse is transported to the Franklin Reclamation Center, Franklin, Ohio, for processing and eventual use in recycled products. Waste solvents and chemicals are removed off-site by a commercial industrial-waste-disposal firm.

A quality control program for environmental analytical procedures has been in effect for several years. There are two parts to the program: internal and external. The internal portion consists of blank and duplicate analyses for each group of samples. The blank results have been consistently small and insignificant in comparison with sample results. The duplicate results for 1975 were also satisfactory. The external portion of the program consists of sending duplicate samples to an independent laboratory. These results for 1975 were also satisfactory. In summary, results indicate good analytical control.

The results of the analyses for calendar year 1975 are provided in this report. Error limits, when given, reflect uncertainties in the data due to counting statistics at the 95% confidence level.

Summary

The local environment surrounding Mound Laboratory was monitored for tritium and plutonium-238 released by Mound Laboratory. The results are reported for calendar year 1975. The environmental parameters analyzed included air, water, foodstuffs, soil, and silt. For radioactive species, the average concentrations of plutonium-238 and tritium were within the stringent standards adopted by the U.S. Energy Research and Development Administration. Data concerning nonradioactive species in air and water are also presented and compared to federal, state, and local standards, where applicable.

The average concentrations of plutonium-238 and tritium measured in air during CY-1975 were $<0.64 \times 10^{-17}$ μCi/ml and $<0.89 \times 10^{-11}$ μCi/ml, respectively. These correspond to <0.03% and <0.01% of their respective Radioactivity Concentration Guides (RCG's). The RCG's and their explanation are given in the Appendix.

The average concentrations of plutonium-238 and tritium in the Great Miami River during CY-1975 were 0.3×10^{-10} μCi/ml and $<1.9 \times 10^{-6}$ μCi/ml, respectively. These correspond to 0.002% and <0.19% of their respective RCG's.

Additionally, data concerning tritium and plutonium-238 in surface water, community drinking water, foodstuffs, soil, and silt are presented. From the analyzed data, there is no evidence of other than negligible uptakes of radioactive species from air, water, soil, or silt by plant or animal life.[4] There is also no evidence of other than negligible reentrainment of radioactive species from soil or silt.

Also included is a plutonium-238 deposition inventory in waterways and a preliminary soil inventory of plutonium-238 based on soil core sampling around Mound Laboratory.[5] This study gives a preliminary evaluation in quantities of plutonium-238 in the environment from Laboratory operations.

Mound Laboratory has been issued a National Pollutant Discharge Elimination System discharge permit. Analyses indicate general compliance with permit conditions with the exception of three oil and grease values. These values are reported, but are suspect because of analytical problems. All results indicate that Mound effluent streams have no significant effect on the Great Miami River and certainly do not

cause Ohio Stream Standards to be exceeded.

These data demonstrate our compliance with various regulatory agency standards and that the operation of Mound Laboratory has a negligible effect on the environment.

Environmental Surveillance

AIR - RADIOACTIVE

An off-site air sampling network consisting of 21 continuously operating air-sampling stations (22 for plutonium-238) was used for the first six months of CY-1975. Because of funding reductions, however, this number was reduced to 12 (13 for plutonium-238) during the last six months of CY-1975. During the first half of the year, eight sampling stations were located within a 1.6-km (1-mi) radius of the Laboratory. The original 13 samplers located in or near population centers were reduced to four during the last half of the year. The remaining sampler (#119) is still used and is approximately 44.8 km (28 mi) from the Laboratory in the least prevailing wind direction. This site should receive no measurable contribution from Mound operations and serves as a baseline sample for comparison purposes. The samplers currently in operation sample critical distances and directions based on the diffusion model developed for Mound Laboratory. The sampling sites are shown in Figure 1.

Two types of samples are collected at each sampling station, a particulate air sample for plutonium-238 analysis and a bubbler sample for tritium oxide analysis. The particulate sample is collected on a 200-mm diameter Microsorban disk by a continuously operating (24 hr, 7 days per week) high-volume air sampler. The air is sampled at the average rate of 1.3×10^6 cm^3/min (~45 ft^3/min). The Microsorban disk is changed weekly thus represents a sample of approximately 13,000 m^3 of air. Plutonium-238 analyses are performed on a monthly composite.

The analytical scheme for plutonium-238 incorporates the following basic steps: addition of a known amount of plutonium-242 tracer, ignition to 600°C, dissolution with nitric acid, separation of plutonium with anion exchange resin, electrodeposition of plutonium, and finally alpha spectrometry. The results reported represent total concentrations of the analyzed radionuclides including contribution from atmospheric fallout.

The average off-site plutonium-238 air concentration was $<0.64 \times 10^{-17}$ μCi/ml which is <0.03% of the RCG. The RCG used for comparison is the guide for the soluble form of the isotope and for the general population. This is the most restrictive RCG for plutonium-238 and is applied since

the solubility of the measured particles in the human body is unknown. The results are summarized in Table 1. Samples reported as less than (<) the Minimum Detection Limit (MDL) are, for averaging purposes, considered to be the value of MDL. Actually, the true value lies somewhere between natural background and MDL.

Also included in Table 1 are ratios of plutonium-238 to plutonium-239 for each sampling location. A ratio greater than ~0.2 would indicate a concentration of plutonium-238 greater than that from atmospheric fallout and thus would indicate influence from Laboratory operations.[6]

The gas bubbler sample is also collected on a continuous basis by bubbling air at approximately 3×10^3 cm^3/min through 200 ml of ethylene glycol. Ethylene glycol is used because this material eliminates evaporation and freezing problems associated with sample collection.[7] Any tritium (oxide) in the air is collected in the solution. The sampling and analysis are directed to tritium oxide since the RCG for the oxide is 200 times more restrictive than for elemental tritium.[8] A sample representing ~30 m^3 of air is collected and an aliquot representing 1.5 m^3 is counted in a liquid scintillation spectrometer. The average concentration of tritium oxide measured during CY-1975 was less than 0.89×10^{-11} μCi/ml which is less than 0.01% of RCG. The RCG used for comparison is the guide for the general population and for soluble form, which is the most restrictive RCG for tritium. The results are summarized in Table 2.

Table 3 shows values of background for plutonium-238 and tritium in air.

An on-site perimeter network consisting of five continuous, high-volume air samplers is used to further assess the effectiveness of control systems. The on-site sampling locations are shown in Figure 2. Particulate samples are collected by the on-site samplers at approximately the same flow rate as the off-site samplers, i.e. 1.3×10^6 cm^3/min, and are analyzed in the same manner. The tritium samplers operate at slightly less air flow, i.e. approximately 2×10^3 cm^3/min, and are analyzed in the same manner as off-site samplers.

The average plutonium-238 concentration measured on-site was 28×10^{-17} μCi/ml which is 0.4% of the RCG. The results are summarized in Table 4.

The average on-site tritium oxide concentration was $<3.0 \times 10^{-11}$ μCi/ml which is <0.02% of the RCG. The results are summarized in Table 5.

The RCG's used for on-site comparisons are those applicable for incidently exposed individuals in the population. The total amounts of plutonium-238 and tritium discharged to the atmosphere were 0.022 mCi and 8,859 Ci, respectively. Comparison of these quantities to the RCG is not valid.

Table 1

CONCENTRATIONS OF PLUTONIUM IN
AIR AT OFF-SITE SAMPLING LOCATIONS IN 1975

Location	Number of Samples	^{238}Pu Range (10^{-17} $\mu Ci/ml$)	^{238}Pu Average[a,d] (10^{-17} $\mu Ci/ml$)	Percent of RCG[b]	^{239}Pu Average[c,d] (10^{-17} $\mu Ci/ml$)	$^{238}Pu/^{239}Pu$
101	52	0.37 - 5.6	2.3 ±0.22	0.12	2.9 ±0.25	0.79
102	52	0.58 - 3.0	1.4 ±0.17	0.07	2.9 ±0.25	0.48
103	52	0.45 - 3.1	1.3 ±0.17	0.07	2.3 ±0.22	0.57
104	52	0.23 - 9.4	1.4 ±0.17	0.07	2.2 ±0.22	0.64
105	41	0.08 - 5.4	0.94 ±0.14	0.05	1.9 ±0.20	0.49
106	13	0.27 - 0.35	0.32 ±0.08	0.02	3.8 ±0.29	0.08
107	25	0.16 - 1.6	0.62 ±0.12	0.03	3.6 ±0.28	0.17
108	52	0.11 - 1.6	0.75 ±0.13	0.04	1.9 ±0.20	0.39
109	25	0.08 - 0.86	0.33 ±0.08	0.02	3.7 ±0.28	0.09
110	52	<0.079 - 0.47	<0.23 ±0.07	<0.01	1.9 ±0.20	<0.12
111	52	<0.079 - 0.53	<0.33 ±0.08	<0.02	2.2 ±0.22	<0.15
112	52	0.12 - 0.49	0.35 ±0.15	0.02	3.1 ±0.26	0.11
113	25	0.14 - 0.18	0.16 ±0.06	0.01	4.0 ±0.29	0.04
114	22	0.15 - 0.21	0.18 ±0.06	0.01	4.0 ±0.29	0.05
115	52	<0.079 - 0.38	<0.17 ±0.06	<0.01	2.6 ±0.24	<0.07
116	25	0.10 - 0.13	0.12 ±0.05	0.01	3.5 ±0.28	0.03
117	21	0.15 - 0.74	0.48 ±0.10	0.02	3.4 ±0.27	0.14
118	52	0.14 - 0.76	0.44 ±0.10	0.02	1.8 ±0.20	0.24
119	50	<0.079 - 0.20	<0.14 ±0.06	<0.01	1.9 ±0.20	<0.07
120	25	0.17 - 0.18	0.18 ±0.06	0.01	3.5 ±0.28	0.05
121	25	0.14 - 0.18	0.16 ±0.06	0.01	3.7 ±0.28	0.04
122	44	0.64 - 7.4	1.7 ±0.19	0.09	1.6 ±0.19	1.1

[a] Minimum Detection Limit (MDL) for ^{238}Pu in air is 0.079×10^{-17} $\mu Ci/ml$ which is 0.004% of the RCG.

[b] Radioactivity Concentration Guide (RCG) = 2000×10^{-17} $\mu Ci/ml$ for the soluble form of ^{238}Pu and the general population.

[c] Minimum Detection Limit (MDL) for ^{239}Pu in air is 0.046×10^{-17} $\mu Ci/ml$.

[d] Error limits are counting statistics only at 95% C.L.

Table 2

CONCENTRATIONS OF TRITIUM OXIDE IN AIR
AT OFF-SITE SAMPLING LOCATIONS IN 1975

Location	Number of Samples	Range (10^{-11} μCi/ml)	Average[a,c] (10^{-11} μCi/ml)	Percent of RCG[b]
101	52	<0.72 - 4.2	<1.3 ±0.27	<0.02
102	52	<0.72 - 4.9	<1.6 ±0.30	<0.02
103	52	<0.72 - 5.2	<1.4 ±0.28	<0.02
104	52	<0.72 - 2.7	<0.9 ±0.23	<0.01
105	52	<0.72 - 6.8	<1.1 ±0.25	<0.02
106	27	<0.72 - 1.1	<0.73 ±0.20	<0.01
107	27	<0.72 - 1.4	<0.79 ±0.21	<0.01
108	52	<0.72 - 2.1	<0.78 ±0.21	<0.01
109	27	<0.72 - 1.8	<0.80 ±0.21	<0.01
110	52	<0.72 - 1.6	<0.74 ±0.21	<0.01
111	52	<0.72 - 1.3	<0.74 ±0.21	<0.01
112	52	<0.72 - 4.6	<1.0 ±0.21	<0.01
113	27	<0.72 - 1.3	<0.76 ±0.21	<0.01
114	23	<0.72 - 1.4	<0.77 ±0.21	<0.01
115	52	<0.72 - 1.7	<0.75 ±0.21	<0.01
116	27	<0.72 - 1.2	<0.74 ±0.21	<0.01
117	23	<0.72 - 1.3	<0.77 ±0.21	<0.01
118	52	<0.72 - 1.8	<0.89 ±0.23	<0.01
119	51	<0.72 - 1.3	<0.74 ±0.21	<0.01
120	27	<0.72 - 0.87	<0.72 ±0.20	<0.01
121	27	<0.72 - 1.0	<0.73 ±0.20	<0.01

[a] Minimum Detection Limit (MDL) for tritium oxide in air is 0.72×10^{-11} μCi/ml, which is 0.01% of the RCG.

[b] Radioactivity Concentration Guide (RCG) = 7000×10^{-11} μCi/ml for the general population and for soluble form of tritium.

[c] Error limits are counting statistics only at 95% C.L.

Table 3

CONCENTRATIONS OF BACKGROUND LEVELS
OF TRITIUM AND PLUTONIUM-238 IN 1975

Plutonium-238 in Air[a]	$0.3 \pm 0.1 \times 10^{-17}$ μCi/ml
Plutonium-238 in Surface Water[b]	7×10^{-13} μCi/ml
Tritium-Oxide in Air[c]	0.2×10^{-11} μCi/ml
Tritium-Oxide in Surface Water[d]	$0.5 \pm 0.2 \times 10^{-6}$ μCi/ml

[a] References 12, 13
[b] Reference 14
[c] Reference 15
[d] Reference 16

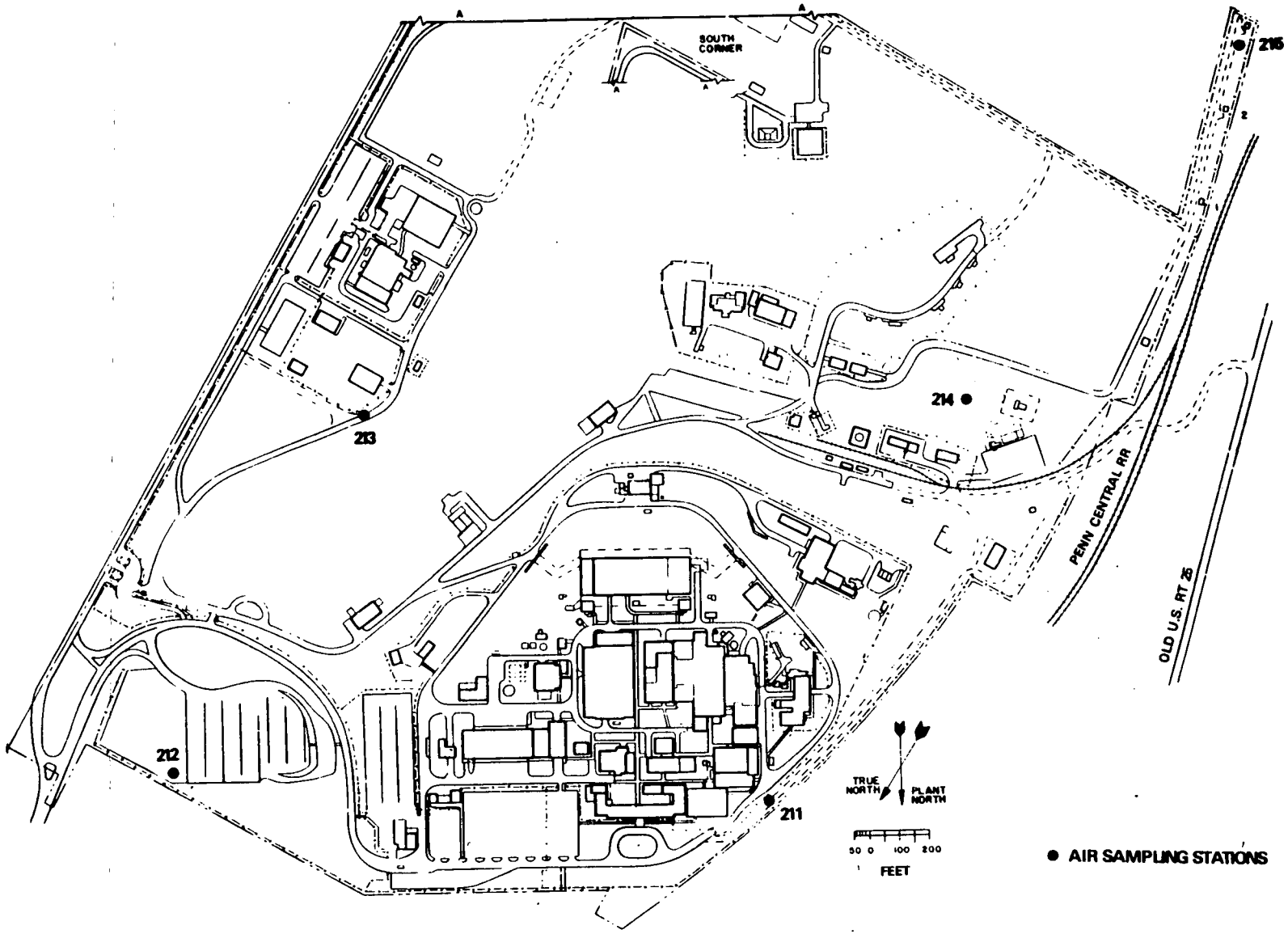

FIGURE 2 - On-site air sampling locations

Table 4

CONCENTRATION OF ^{238}Pu IN
AIR AT ON-SITE SAMPLING LOCATIONS IN 1975

Location	Number of Samples	^{238}Pu Range (10^{-17} μCi/ml)	^{238}Pu Average[a,d] (10^{-17} μCi/ml)	Percent of RCG[b]	^{239}Pu Average[c] (10^{-17} μCi/ml)	$^{238}Pu/^{239}Pu$
211	52	6.8 - 72.9	21.2 ±0.72	0.3	2.2 ±0.23	9.6
212	49	2.3 - 14.2	5.2 ±0.36	0.07	2.1 ±0.23	2.5
213	52	8.7 - 1095.9	103.3 ±1.6	1.5	4.1 ±0.32	25.2
214	44	1.3 - 17.3	6.7 ±0.41	0.1	2.5 ±0.25	2.7
215	51	1.7 - 9.1	3.8 ±0.31	0.05	2.2 ±0.23	1.7

[a] Minimum Detection Limit (MDL) for ^{238}Pu in air is 0.089×10^{-17} μCi/ml which is 0.0012% of the RCG.

[b] Radioactivity Concentration Guide (RCG) = 7000×10^{-17} μCi/ml for the soluble form of plutonium-238 for individuals in the population.

[c] Minimum Detection Limit (MDL) for ^{239}Pu is 0.052×10^{-17} μCi/ml.

[d] Error limits are counting statistics only at 95% C.L.

Table 5

CONCENTRATION OF TRITIUM OXIDE IN
AIR AT ON-SITE SAMPLING LOCATIONS IN 1975

Location	Number of Samples	Range (10^{-11} μCi/ml)	Average[a,c] (10^{-11} μCi/ml)	Percent of RCG[b]
211	52	<1.2 - 10.0	<3.1 ±0.55	<0.02
212	50	<1.2 - 9.0	<3.3 ±0.56	<0.02
213	52	<1.2 - 11.7	<3.1 ±0.55	<0.02
214	52	<1.2 - 29.0	<3.4 ±0.58	<0.02
215	51	<1.2 - 8.3	<2.0 ±0.44	<0.01

[a] Minimum Detection Limit (MDL) for tritium oxide in air is 1.22 x 10^{-11} μCi/ml which is 0.006% of the RCG.

[b] Radioactivity Concentration Guide (RCG) = 20,000 x 10^{-11} μCi/ml for individuals in the population and soluble form of tritium.

[c] Error limits are counting statistics only at 95% C.L.

AIR - NONRADIOACTIVE

The Mound steam power supply has been converted from fuel oil to natural gas on an interruptable basis. During unusually cold weather, natural gas supply to Mound is interrupted and fuel oil with much less than 1% sulfur content is burned. Except for these occasions, virtually all sulfur dioxide emissions have been eliminated. None of the present operations at Mound Laboratory involve amounts of material which would lead to significant particulate, carbon monoxide, photochemical oxidant, or hydrocarbon emissions from stationary sources. Therefore, no sampling for these nonradioactive pollutants is done at this time.

WATER - RADIOACTIVE

Water sampling locations along the bank of the Great Miami River were selected according to guidelines proposed by the U.S. EPA.[9] The locations, shown in Figure 3, provide samples which are representative of river water after suitable mixing of the effluent from Mound has occurred. Water samples are collected at these locations five days per week and are subjected to specific analyses for plutonium-238 and tritium oxide.

The plutonium-238 river water analyses have been upgraded to allow lower detection of plutonium-238 in water. Large volume water samples are analyzed by compositing daily samples for a semiannual analysis. The average volume of water analyzed was 19 liters. The average concentration of plutonium-238 measured in the Great Miami River was 0.3×10^{-10} μCi/ml which is 0.002% of the RCG for the general population and the most restrictive form (soluble) of plutonium-238. These results are summarized in Table 6.

Tritium oxide analyses are performed on a weekly composite of daily samples. The average concentration of tritium oxide measured in the Great Miami River was $<1.9 \times 10^{-6}$ μCi/ml which is <0.2% of the RCG for the general population and for the most restrictive form of tritium. The results are summarized in Table 7.

Results of plutonium-238 and tritium analyses for three off-site sampling locations on the abandoned Miami-Erie Canal and adjacent ponds are reported in Tables 8 and 9, respectively. These values represent levels from the site drainage ditch which discharges into the off-site canal-pond system prior to mixing with the Great Miami River. These values, as expected, are higher than those concentrations found in the Great Miami River where mixing and dilution occur.

The total amounts of plutonium-238, tritium, and uranium-233 discharged to the Great Miami River were 18 mCi, 58 Ci, and 17 mCi, respectively. These values in terms of RCG's are 0.3%, 1.8% and 0.05% of the most restrictive RCG for individuals in the population. From the uranium-233 concentrations found in the effluent streams, estimated concentrations off-site from Mound operations would be negligible. This can be

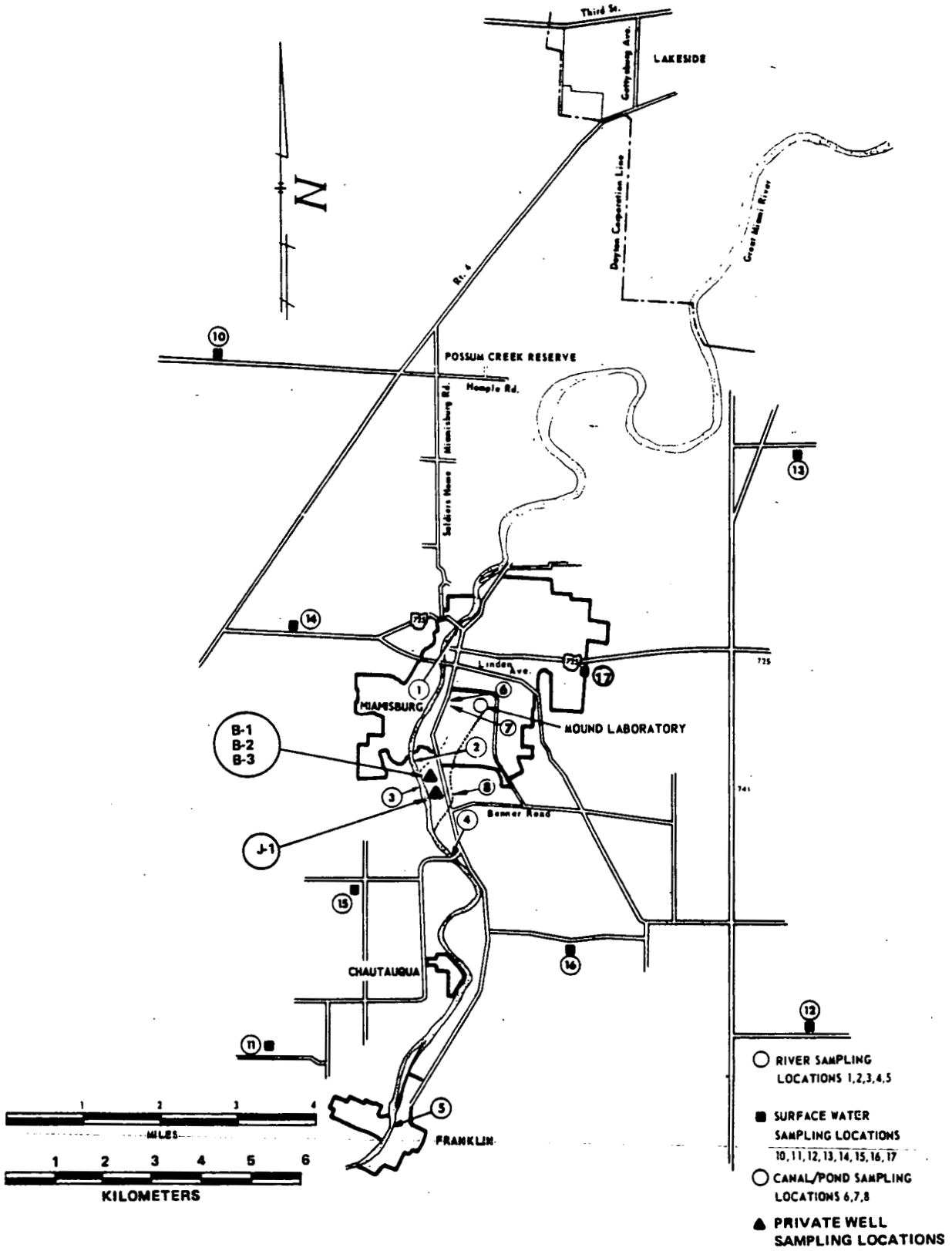

FIGURE 3 - Off-site water sampling locations

Table 6

CONCENTRATION OF ^{238}Pu IN
THE GREAT MIAMI RIVER IN 1975

Location	Number of Samples	Range (10^{-10} μCi/ml)	Average[b,d] (10^{-10} μCi/ml)	Percent of RCG[c]
1	210	0.15 - 0.23	0.19 ±0.02	0.0010
2	210	0.32 - 0.35	0.34 ±0.03	0.0017
3[a]	210	(0.23)	0.23 ±0.03	0.0012
4	210	0.25 - 0.79	0.52 ±0.04	0.0026
5	210	0.06 - 0.43	0.24 ±0.03	0.0012

[a] Only one composite.

[b] Minimum Detection Limit (MDL) for ^{238}Pu in water is 0.01×10^{-10} μCi/ml which is 0.00005% of the RCG.

[c] Radioactivity Concentration Guide (RCG) = $20,000 \times 10^{-10}$ μCi/ml for the general population and the soluble form of plutonium-238.

[d] Error limits are counting statistics only at 95% C.L.

Table 7

CONCENTRATION OF TRITIUM IN
THE GREAT MIAMI RIVER IN 1975

Location	Number of Samples	Range (10^{-6} μCi/ml)	Average[a,c] (10^{-6} μCi/ml)	Percent of RCG[b]
1	210	<0.5 - 7.7	<1.5 ±0.19	<0.15
2	210	<0.5 - 17.5	<2.1 ±0.23	<0.21
3	210	<0.5 - 13.9	<1.9 ±0.22	<0.19
4	210	<0.5 - 19.8	<2.1 ±0.23	<0.21
5	210	<0.5 - 14.5	≤1.7 ±0.20	<0.17

[a] Minimum Detection Limit (MDL) for tritium in water is 0.5×10^{-6} μCi/ml which is 0.05% of the RCG.

[b] Radioactivity Concentration Guide (RCG) = 1000×10^{-6} μCi/ml for the general population and the soluble form of tritium.

[c] Error limits are counting statistics only at 95% C.L.

Table 8

CONCENTRATION OF ^{238}Pu IN
CANAL/POND AREA IN 1975

Location[a]	Number of Samples	Range (10^{-10} μCi/ml)	Average[b,d] (10^{-10} μCi/ml)	Percent of RCG[c]
6 (North Pond)	210	0.63 - 3.8	2.2 ±0.08	0.01
7 (North Canal)	210	0.83 - 5.9	3.4 ±0.10	0.02
8 (South Canal)	210	8.1 - 19.9	14.0 ±0.20	0.07

[a]Locations are shown in Figure 3.

[b]Minimum Detection Limit (MDL) for ^{238}Pu in water is 0.01 x 10^{-10} μCi/ml which is 0.00005% of the RCG.

[c]Radioactivity Concentration Guide (RCG) = 20,000 x 10^{-10} μCi/ml for the general population and soluble form of plutonium-238.

[d]Error limits are counting statistics only at 95% C.L.

Table 9

CONCENTRATION OF TRITIUM IN
CANAL/POND AREA IN 1975

Location[a]	Number of Samples	Range (10^{-6} μCi/ml)	Average[b,d] (10^{-6} μCi/ml)	Percent of RCG[c]
6 (North Pond)	210	19 - 72	37 ±1.0	3.7
7 (North Canal)	210	18 - 87	39 ±1.0	3.9
8 (South Canal)	210	17 - 96	43 ±1.0	4.3

[a]Locations are shown in Figure 3.

[b]Mimimum Detection Limit (MDL) for tritium in water is 0.5 x 10^{-6} μCi/ml which is 0.05% of the RCG.

[c]Radioactivity Concentration Guide (RCG) = 1000 x 10^{-6} μCi/ml for the general population and soluble form of tritium.

[d]Error limits are counting statistics only at 95% C.L.

readily seen by comparing plutonium-238 quantities found in the effluent streams with concentrations found off-site.

Eight additional surface water locations such as ponds are sampled annually. These samples, used for plutonium-238 determination, are large volume water samples of approximately 40 liters each. The large volume of sample increases the sensitivity of the analysis. A smaller aliquot (10 ml) was taken for the tritium oxide analysis. The average concentrations of plutonium-238 and tritium oxide at these locations were 0.65×10^{-10} μCi/ml and $<1.2 \times 10^{-6}$ μCi/ml, respectively, which are 0.003% and 0.12% of their respective RCG's for the general population. The results of the surface water monitoring program are summarized in Tables 10 and 11.

Table 10

SUMMARY OF SURFACE WATER MONITORING
FOR PLUTONIUM-238 IN 1975

Location	Number of Samples	Average[a,c] (10^{-10} μCi/ml)	Percent of RCG[b]
10	1	1.4 ±0.02	0.007
11	1	1.5 ±0.02	0.008
12	1	0.67 ±0.02	0.003
13	1	0.34 ±0.01	0.002
14	1	0.41 ±0.01	0.002
15	1	0.66 ±0.02	0.003
16	1	0.09 ±0.01	0.0006
17	1	0.14 ±0.01	0.0007

[a] Minimum Detection Limit (MDL) for ^{238}Pu in water is 0.003×10^{-10} μCi/ml. The MDL = 0.000015% of the RCG.

[b] Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = $20,000 \times 10^{-10}$ μCi/ml for the general population and soluble form of plutonium-238.

[c] Error limits are counting statistics only at 95% C.L.

In addition, background levels of plutonium-238 and tritium oxide for surface water are shown in Table 3.

Drinking water from communities in the surrounding area is sampled and analyzed semiannually for tritium oxide with the exception of drinking water from Miamisburg which was sampled and analyzed monthly for tritium oxide. These communities are shown in Figure 1.

Table 11

SUMMARY OF SURFACE WATER MONITORING
FOR TRITIUM IN 1975

Location	Number of Samples	Average[a,c] (10^{-6} μCi/ml)	Percent of RCG[b]
10	1	0.9 ±0.1	0.09
11	1	3.1 ±0.2	0.31
12	1	<0.3 ±0.1	<0.03
13	1	0.8 ±0.1	0.08
14	1	1.5 ±0.1	0.15
15	1	0.6 ±0.1	0.06
16	1	0.4 ±0.1	0.04
17	1	2.1 ±0.2	0.21

[a] Minimum Detection Limit (MDL) for tritium in water is 0.3×10^{-6} μCi/ml. The MDL is 0.03% of the RCG.

[b] Radioactivity Concentration Guide (RCG) for tritium oxide in water = 1000×10^{-6} μCi/ml for the general population and soluble form of tritium.

[c] Error limits are counting statistics only at 95% C.L.

The average concentration of tritium oxide was $<1.4 \times 10^{-6}$ μCi/ml which is <0.14% of the RCG for the general population. The results of the community drinking water sampling program are summarized in Table 12.

Several private wells in the vicinity of Mound Laboratory were also sampled and analyzed monthly for tritium oxide. The average concentration of tritium oxide in these wells was 50.0×10^{-6} μCi/ml which is 5.0% of the RCG for the general population. The well results are summarized in Table 13. These wells apparently have been minutely influenced by Mound Laboratory tritium effluent releases in water. As shown by the data, concentrations in these wells are higher than in other wells in the area, but much less than the RCG. This situation has apparently developed from years of releasing quantities of water effluents at a small fraction of the RCG. Part of this water effluent has migrated into the aquifer at short distances from Mound Laboratory.

Two private wells and Miamisburg city water were sampled and analyzed monthly for plutonium-238. These samples also were large volume water samples averaging 40 liters. The average plutonium-238 concentration of these samples was 0.06×10^{-10} μCi/ml which is 0.0003% of the RCG for the general population. These results are shown in Table 14.

Table 12

SUMMARY OF TRITIUM OXIDE LEVELS
IN COMMUNITY DRINKING WATER IN 1975

Location	Number of Samples	Range (10^{-6} μCi/ml)	Average[a,c] (10^{-6} μCi/ml)	Percent of RCG[b]
Bellbrook	2	<0.5 - 1.1	<0.8 ±0.14	<0.08
Centerville	2	<0.5 - 1.7	<1.1 ±0.16	<0.11
Dayton	2	<0.5 - 0.9	<0.7 ±0.13	<0.07
Franklin	2	<0.5 - 1.4	<1.0 ±0.15	<0.10
Germantown	2	1.0 - 1.3	1.2 ±0.17	0.12
Kettering	2	<0.5 - 1.2	<0.9 ±0.15	<0.09
Miamisburg	11	5.5 - 8.9	7.1 ±0.45	0.71
Middletown	2	<0.5 - 0.7	<0.6 ±0.12	<0.06
Moraine	2	<0.5 - 1.2	<0.9 ±0.15	<0.09
South Lebanon	2	<0.5 - 0.7	<0.6 ±0.12	<0.06
Springboro	2	<0.5 - 1.4	<1.0 ±0.15	<0.10
Waynesville	2	<0.5 - <0.5	<0.5 ±0.11	<0.05
West Carrollton	2	1.6 - 1.7	1.7 ±0.20	0.17

[a]Minimum Detection Limit (MDL) for tritium oxide is 0.5 x 10^{-6} μCi/ml. The MDL is 0.05% of the RCG.

[b]Radioactivity Concentration Guide (RCG) for tritium oxide in water = 1000 x 10^{-6} μCi/ml for the general population and soluble form of tritium.

[c]Error limits are counting statistics only at 95% C.L.

Table 13

TRITIUM-OXIDE IN PRIVATE WELLS
IN 1975

Location	Number of Samples	Range (10^{-6} μCi/ml)	Average[a,c] (10^{-6} μCi/ml)	Percent of RCG[b]
B-1	11	65.3 - 89.9	74.9 ±1.5	7.5
B-2	11	32.7 - 40.0	35.7 ±1.0	3.6
B-3	11	34.6 - 42.9	37.7 ±1.0	3.8
J-1	11	44.0 - 63.5	51.5 ±1.2	5.2

[a]Minimum Detection Limit (MDL) for tritium oxide is 0.6 x 10^{-6} μCi/ml. The MDL is 0.06% of the RCG.

[b]Radioactivity Concentration Guide (RCG) for tritium oxide in water = 1000 x 10^{-6} μCi/ml for general population and soluble form of tritium.

[c]Error limits are counting statistics only at 95% C.L.

Table 14

PLUTONIUM-238 IN PRIVATE WELLS AND
MIAMISBURG MUNICIPAL DRINKING WATER IN 1975

Location	Number of Samples	Range (10^{-10} μCi/ml)	Average[a,c] (10^{-10} μCi/ml)	Percent of RCG[b]
Miamisburg	11	0.07 - 0.80	0.43 ±0.03	0.002
J	11	0.08 - 0.33	0.20 ±0.02	0.001
B	11	0.04 - 0.08	0.06 ±0.01	0.0003

[a] Minimum Detection Limit (MDL) for ^{238}Pu is 0.006 x 10^{-10} μCi/ml. The MDL is 0.00003% of the RCG.

[b] Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = 20,000 x 10^{-10} μCi/ml for the general population and soluble form of plutonium-238.

[c] Error limits are counting statistics only at 95% C.L.

WATER - NONRADIOACTIVE

Mound Laboratory was issued a discharge permit under the National Pollutant Discharge Elimination System (NPDES). The permit was issued by Region V of the USEPA effective July 1, 1975. Each of the two effluent streams from Mound which discharge to the Great Miami River has limitations specified by the discharge permit. The discharge from outfall number 001 includes the discharge from the sanitary waste treatment plant, radioactive waste disposal facility, single-pass cooling water, zeolite softener backwash, and some storm water runoff. The discharge from outfall number 002 consists of single-pass cooling water, cooling-tower blowdown, boiler-plant blowdown, zeolite softener backwash, and most of the storm water runoff. A 24-hr composite sample of each effluent stream is automatically collected daily. The volume of samples collected is proportional to the flow in the stream. The composite effluent water samples are analyzed for the water quality parameters listed in Tables 10 and 11 according to standard methods.[10] The results of effluent stream analyses for 1975 are summarized in Tables 15 and 16. All results are within permit limitations with the exception of oil and grease. The limitation was exceeded once for outfall 001 and twice for outfall 002. A contaminated sample or an analytical error is suspected since no discharge of oil, either intentional or accidental, was reported or observed. However, since the flow of the Great Miami River, even under low-flow conditions, was approximately 400 times the maximum flow discharge from Mound during 1975[11], these limitation exceptions had no significant effect on the River and certainly did not cause the Ohio Stream Standards to be exceeded.

Table 15

1975 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
PERMIT DATA FOR STATION 001

Parameter		No. Samples	Minimum	Maximum	Average
Flow	Reported	Cont.	0.12 MGD	0.33 MGD	0.19 MGD
	Permit			0.92	0.53
BOD_5	Reported	52	3.2	23.6	8.9
	Permit			45.0	30.0
Fecal Coliform	Reported	26	ND	15.0	5.4
	Permit			400.0	200.0
Suspended Solids	Reported	52	ND	44.0	16.9
	Permit			45.0	30.0
Dissolved Oxygen	Reported	182	5.4	9.6	7.4
	Permit				5.0
Residual Chlorine	Reported	52	0.25	0.8	0.61
	Permit			0.8	
Oil and Grease	Reported	26	ND	22.3	2.7
	Permit			10.0	
pH	Reported	182	6.2	8.3	
	Permit		6.0	9.0	
Carbon	Reported	52	53.0	110.0	85.0
	Permit		-	-	-
Ammonia	Reported	26	0.1	0.1	0.1
	Permit		-	-	-

NOTES:

ND - none detectable.

MGD - million gallons per day.

Values for fecal coliform are number of coliform per 100 ml of water.

All other values are in milligrams per liter.

FOODSTUFFS AND VEGETATION - RADIOACTIVE

Various locally grown foodstuffs and vegetation samples are collected from the surrounding area. The intent of this portion of the Environmental Monitoring Program is to determine whether there is any uptake and concentration of radionuclides by plant or animal life. Where possible, sampling sites are chosen at maximum deposition locations predicted on the basis of the diffusion model developed for Mound Laboratory. Field crops, fruit, and vegetables are collected on the

Table 16

1975 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
PERMIT DATA FOR STATION 002

Parameter		No. Samples	Minimum	Maximum	Average
Flow	Reported	Cont.	0.33 MGD	0.85 MGD	0.51 MGD
	Permit				0.53
Suspended Solids	Reported	52	ND	23.0	10.6
	Permit			25.0	20.0
Dissolved Oxygen	Reported	182	5.2	9.6	7.3
	Permit				5.0
Residual Chlorine	Reported	26	0.05	0.05	0.05
	Permit			0.10	
Oil and Grease	Reported	26	ND	11.5	3.5
	Permit			10.0	
pH	Reported	182	6.5	8.3	
	Permit		6.0	9.0	
Dissolved Solids	Reported	52	93.0	2295.0	1008.0
	Permit			3000.0	2000.0

NOTES:

ND - none detectable.

MGD - million gallons per day.

All values are in milligrams per liter.

basis of this diffusion model. Milk is collected from individual farms closest to the Laboratory. Aquatic life is trapped from the Miami River generally downstream of Miamisburg and from adjacent waterways, dependent upon availability of fish. Grass samples are collected in the vicinity of the surface water locations listed in Tables 17 and 18. The plutonium-238 content of the foodstuff and vegetation samples is determined by slowly evaporating the samples to dryness and then proceeding with the same techniques used for plutonium-238 analyses of air samples (see section on Air - Radioactive). Milk samples are analyzed for tritium oxide by distilling the water fraction from an aliquot. The distillate is then analyzed for tritium by liquid scintillation spectrometry in the same manner as the water samples previously discussed in this report (see section on Water - Radioactive). The remaining foodstuff samples are analyzed for tritium by oxidizing the samples in a controlled air stream and collecting the combustion products. The tritium content of the combustion products is then determined by liquid scintillation spectrometry as discussed above. This technique allows analysis for total tritium in the samples rather than tritium oxide

only. The results of the foodstuff and vegetation analyses are summarized in Table 17 and 18. The concentration is given in terms of the sample weight (wet weight) before evaporation to dryness. The vegetables and fruits analyzed included potatoes and tomatoes. The field crops analyzed were the edible portions of corn and soybeans. The sample of aquatic life analyzed included only the edible fleshy portions of the fish. No evidence has been found that there is any significant uptake and concentration by plant or animal life of the radionuclides handled at Mound Laboratory.

Table 17

PLUTONIUM-238 IN FOODSTUFFS
AND VEGETATION IN 1975

Type of Sample	Number of Samples	Range (10^{-8} μCi/g)	Average[a-c] (10^{-8} μCi/g)
Milk	6	<0.013 - 0.028	0.024 ±0.01
Fruits & Vegetables	3	<0.022 - 0.086	<0.064 ±0.02
Grass	8	0.50 - 2.18	1.01 ±0.15
Field Crops	1	(0.11)	0.11 ±0.03
Aquatic Life	3	<0.022 - 0.03	<0.026 ±0.01

[a]Minimum Detection Limit (MDL) for ^{238}Pu in milk, fruits and vegetables, field crops, and aquatic life is 0.022 x 10^{-8} μCi/g.

[b]Minimum Detection Limit (MDL) for ^{238}Pu in grass is 0.09 x 10^{-8} μCi/g.

[c]Error limits are counting statistics only at 95% C.L.

SOIL AND SILT - RADIOACTIVE

During CY-1975 emphasis was placed on the evaluation of previously collected soil monitoring data, specifically soil core samples. The program is twofold, evaluation of plutonium-238 deposition from releases via water and evaluation of plutonium-238 deposition from releases via stack.

Preliminary soil and silt samples collected from off-site sediment in the Miami-Erie canal area near Mound Laboratory indicated that plutonium-238 concentrations were substantially above baseline levels. As a result, an extensive sampling and analysis program was performed during 1974 to determine plutonium-238 concentrations as a function of depth and location in the drainage ditch, the canal, two ponds, a runoff hollow, a canal overflow creek, and the Great Miami River. The study

Table 18

TRITIUM IN FOODSTUFFS
AND VEGETATION IN 1975

Type of Sample	Number of Samples	Average[a,b] (10^{-6} μCi/g)
Milk	3	<10.5 ±6.9
Fruits & Vegetables	1	< 4.4 ±2.9
Grass	8	< 4.4 ±2.9
Field Crops	1	< 4.9 ±3.3
Aquatic Life	3	< 4.4 ±2.9

[a]All samples less than Minimum Detection Limit (MDL). MDL for tritium in fruits and vegetables, grass, and aquatic life = 4.4 x 10^{-6} μCi/g. MDL for tritium in field crops = 4.9 x 10^{-6} μCi/g. MDL for tritium in milk = 10.5 x 10^{-6} μCi/g.

[b]Error limits are counting statistics only at 95% C.L.

found that in January, 1969, plutonium-238 had been released when an underground pipeline carrying plutonium-238 waste solution from the Plutonium Processing (PP) Building to the Waste Disposal (WD) Facility ruptured. Acidic waste solution containing plutonium-238 was released to the soil adjacent to the pipe. The plutonium was quickly and strongly sorbed by the soil where it was immobilized. During excavation and repair operations in 1969 when the contaminated soil was most susceptible to erosion, the weather warmed and there was intense rainfall for two days. This heavy rain eroded the exposed surface of the contaminated soil causing the soil particles to be carried off-site. These erosion products, suspended in the moving water, settled according to normal sedimentation processes in the waterways adjacent to Mound Laboratory. From 1974 sampling and analysis data, it was determined that about 5.2 Ci of plutonium-238 were deposited on sediment in these waterways, approximately 1-1/2 miles long, mostly buried under up to 3 ft of sediment.[5]

Soil core sample values around and within the Laboratory site boundary were used to arrive at a preliminary estimate of deposition of airborne plutonium-238 from Laboratory operations. It should be pointed out that this is <u>not</u> a <u>final</u> estimate of the inventory value. More core samples should be taken in order to obtain a statistically valid inventory value. A minimum of 80 additional sampling locations is planned.

The preliminary soil inventory was established within the 1 mCi/km^2 boundary of plutonium-238 concentrations. Additional data, to be collected during 1976, will be required to assess the inventory beyond the 1 mCi/km^2 boundary.

The concentrations were determined by using a planimeter on an enlarged map of the area (see Figure 4). Iso-millicurie lines were determined from soil samples taken in and around the Laboratory vicinity. The area between each isopleth was measured by the planimeter. The millicurie concentration between each contour line was calculated by taking the product of the area and the average value of the two boundary contour lines.

Equations were developed for each of 16 directions from Mound Laboratory of the form: $y = ax^b$

where y = concentration
a = constant
x = distance
b = exponent

These equations were used to plot additional isopleths to fill gaps in the data where no soil core samples had been taken. These additional contours were then used to determine a revised estimate of the total millicurie value in the vicinity of Mound Laboratory.

The estimate of deposited plutonium-238 is 464 mCi outside Mound Laboratory within the 1 mCi/km^2 boundary. It should be pointed out again that this estimate is only a preliminary estimate. More core sampling data are needed to arrive at a final estimate.

In summary, a preliminary evaluation indicates that airborne releases of plutonium-238 have contributed roughly 0.5 Ci to the off-site environment as deposition on soil. Water releases of plutonium-238 are responsible for an additional 5.2 Ci deposited in the off-site adjacent waterways.

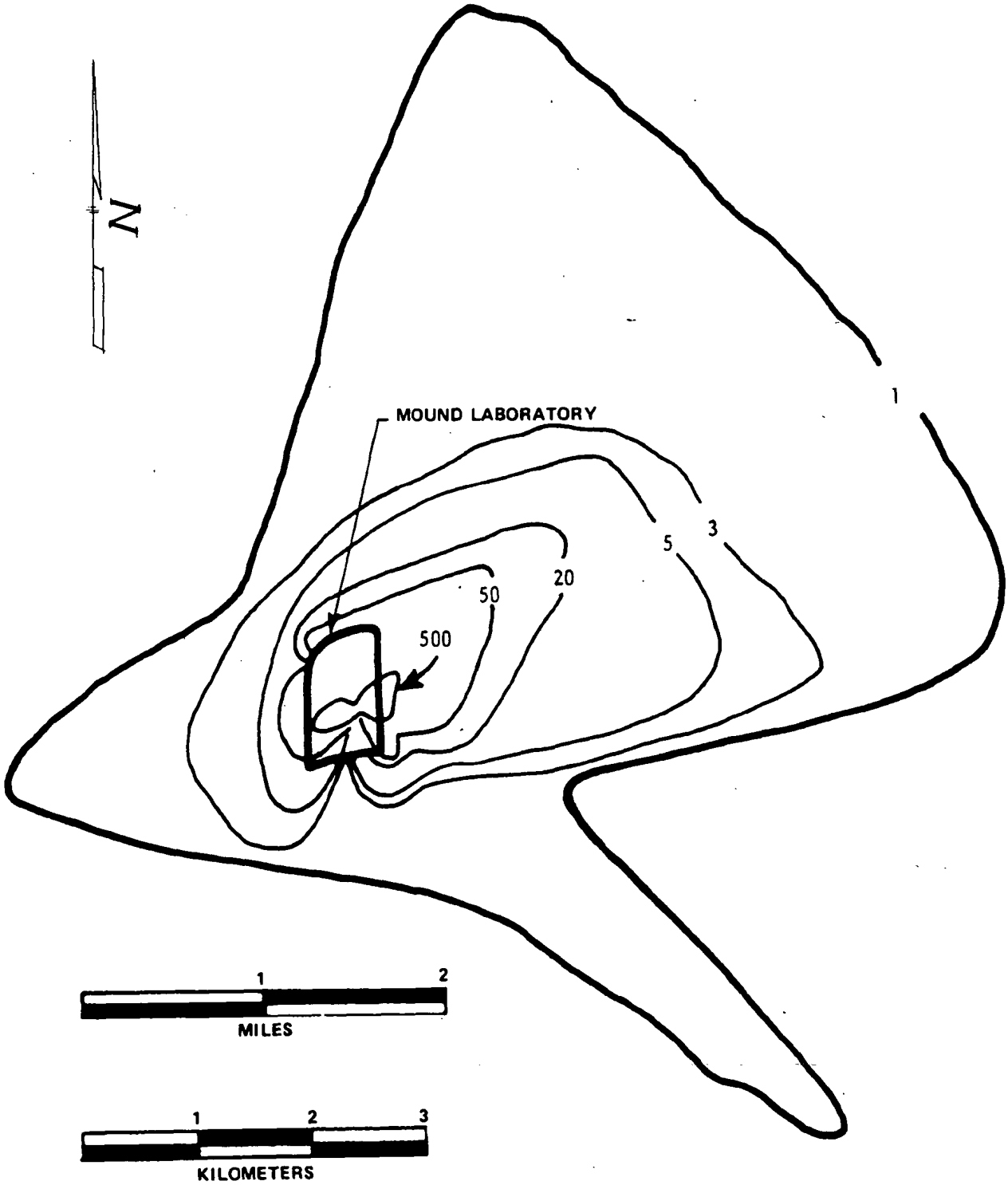

FIGURE 4 - Millicurie per square kilometer isopleths

Evaluation of Potential Dose to the Public

A dose assessment was performed for each radionuclide measureable in the environment from Mound Laboratory operations. These radionuclides are plutonium-238 and tritium. Tritium (oxide) is the only radionuclide at Mound Laboratory for which the critical organ is the whole body. The critical organs for plutonium-238 are assumed to be the lung for insoluble material and the bone for soluble material since the solubility in the receptor is unknown. In order to resolve the uncertainty of the solubility of plutonium, each dose evaluation for the lung or the bone included 100% of the concentration found in the environment, which gives a very conservative estimate.

PLUTONIUM-238

Assumptions and Methodology The dose estimates for plutonium-238 were based on environmental monitoring data for CY-1975. The estimates for maximum dose to the lung at the site boundary and maximum dose to the lung in individuals were based on the maximum on-site average concentration of plutonium-238 in air from our on-site samplers since the samplers are in close proximity to the site boundary. The maximum dose to the lung in population group(s) was based on the maximum off-site average concentration of plutonium-238 in air.

The estimates for maximum dose to the bone at the site boundary and in individuals were also based on the maximum on-site average concentration of plutonium-238 in air and the maximum off-site average concentration of plutonium-238 in drinking water. The maximum dose to the bone for population group(s) was based on the maximum off-site average concentration of plutonium-238 in air and water. The total dose equivalent for bone was obtained by the addition of the dose equivalent of plutonium in air and the dose equivalent of plutonium in water.

Calculational Methods The dose equivalent to the lung resulting from continuous inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1\ C\ I_a\ t\ f_a\ f_r\ \Sigma EF(RBE)_x}{\lambda m} \left(1 - \frac{1 - e^{-\lambda t}}{\lambda t}\right)$$

where D(t) = dose equivalent delivered to the lung in 365 days of continuous exposure to plutonium-238 in air, rem/yr

C = average airborne concentration, μCi/ml

I_a = average air intake = 2×10^7 ml/day (Ref. 17)

t = time exposed, 365 days

f_a = fraction of inhaled material reaching organ of interest = 0.7 (max.) for the pulmonary region (Ref. 22)

f_r = fraction of pulmonary deposition undergoing long-term retention = 0.6 for actinide (class Y) (Ref. 22)

$\Sigma EF(RBE)_\alpha$ = effective energy deposition per disintegration = 57

λ = effective decay rate, 0.0014 day^{-1} for actinides (class Y) from the pulmonary region (Ref. 23)

m = lung mass, 1000 g (Ref. 17)

The dose equivalent to bone resulting from continuous inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1\ C\ I_a\ f_a\ t\ \Sigma EF(RBE)_\alpha}{\lambda m} \left(1 - \frac{1 - e^{-\lambda t}}{\lambda t}\right)$$

where f_a = 0.2 (Ref. 17)

$\Sigma EF(RBE)_\alpha$ = 284 (Ref. 17)

$m = 7 \times 10^3$ g (Ref. 17)

$\lambda = 3 \times 10^{-5}\ day^{-1}$ (Ref. 17)

The dose equivalent to bone resulting from continuous ingestion of plutonium-238 in water was calculated by:

$$D(t) = \frac{51.1\ C\ I_w\ f_a\ t\ \Sigma EF(RBE)_\alpha}{\lambda m} \left(1 - \frac{1 - e^{-\lambda t}}{\lambda t}\right)$$

where I_w = average quantity of water intake, 2200 cm^3 (Ref. 17)

$f_a = 2.4 \times 10^{-5}$ (Ref. 17)

The results of the calculations are:

Maximum dose to the lung at the site boundary -	1.43 mrem/yr
Maximum dose to the lung in individuals -	1.43 mrem/yr
Maximum dose to the lung in population group(s) -	0.028 mrem/yr
Maximum dose to the bone at the site boundary -	0.572 mrem/yr
Maximum dose to the bone in individuals -	0.572 mrem/yr
Maximum dose to the bone in population group(s) -	0.011 mrem/yr

TRITIUM (OXIDE)

Assumptions and Methodology The dose estimates for tritium (oxide) were also based on environmental monitoring data for CY-1975. The concentrations used for dose estimates for tritium (oxide) were produced by the same method as that used for plutonium. The total dose equivalent for the whole body was obtained by addition of the dose equivalent of tritium (oxide) in air and the dose equivalent of tritium (oxide) in air and the dose equivalent of tritium (oxide) in water.

Calculational Methods The dose equivalent to the whole body resulting from continuous exposure to tritium (oxide) in air was calculated by:

$$D(t)_a = \frac{\overline{C}_a}{R_a} \times S$$

where $D(t)_a$ = dose equivalent, mrem/yr

$\overline{C}_a$ = average concentration of tritium (oxide) in air

R_a = RCG for tritium (oxide) in air (Ref. 8)

S = Radiation protection standard in mrem/yr (Ref. 8)

The dose equivalent to the whole body resulting from continuous uptake of tritium (oxide) in water was calculated by:

$$D(t)_w = \frac{\overline{C}_w}{R_w} \times S$$

where $D(t)_w$ = dose equivalent in mrem/yr

$\overline{C}_w$ = average concentration

R_w = RCG for tritium (oxide) in water (Ref. 8)

S = radiation protection standard in mrem/yr (Ref. 8)

These dose equivalent values were divided by 1.7 in order to reflect the quality factor of one as recommended by the International Commission on Radiological Protection[18] and the National Council on Radiation Protection and Measurements.[19]

The results of the calculations are:

Maximum dose at the site boundary -	4.84 mrem/yr
Maximum dose to an individual -	4.84 mrem/yr
Maximum dose to population group(s) -	4.81 mrem/yr

The 50-mi (80-km) person-rem (whole body) dose estimates were based on average tritium (oxide) data from environmental air sampling stations, average tritium (oxide) data in community drinking water, and atmospheric dispersion estimates.

Two ranges of dose estimates were considered to obtain the 50-mi (80-km) person-rem dose estimate. The first range was from 0 to 2 mi (3.2 km). The second range was from 2 to 50 mi. This distance breakdown was used because of the placement of samplers in the Mound diffusion model.

The 0 to 2 mi range dose estimate for airborne tritium oxide was obtained from the average concentration (less background) of seven off-site tritium (oxide) samplers within a 2-mi radius of Mound Laboratory. This distance range dose from tritium (oxide) in water was obtained from a weighted average of drinking water concentrations. These dose equivalents from tritium (oxide) in air and in water were summed.

The equations used for this calculation were:

$$\overline{D}(t)_{a_{0-2}} = \frac{\overline{C}_a}{R_a} \times S$$

where $\overline{D}(t)_{a_{0-2}}$ = dose equivalent from 0-2 mi from tritium (oxide) in air

$\overline{C}_a$ = average tritium (oxide) concentration in air from 0 to 2 mi

R_a = RCG for tritium (oxide) in air (Ref. 8)

S = radiation protection standard for tritium (oxide) in air in mrem/yr (Ref. 8)

$$\overline{D}(t)_{w_{0-2}} = \frac{\overline{C}_w}{R_w} \times S$$

where $\overline{D}(t)_{w_{0-2}}$ = dose equivalent from 0-2 mi from tritium (oxide) in water

$\overline{C}_w$ = average tritium (oxide) concentration in water from 0-2 mi

R_w = RCG for tritium (oxide) in water (Ref. 8)

S = radiation protection standard for tritium (oxide) in water, mrem/yr (Ref. 8)

The 2 to 50-mi range dose estimate was obtained by finding the midpoint distance where the average tritium (oxide) concentration of the remaining off-site samplers would be located. This value is estimated at

4.4 mi.[20] From this distance and average concentrations of tritium (oxide) at sampling locations from 2 to 20 mi, it was determined that the maximum distance of influence from Mound Laboratory is ~22 mi. Beyond 22 mi the levels are calculated to be background concentrations.

The dose equivalent for tritium (oxide) from 2 to 22 mi was based on the average of the remaining tritium (oxide) air sample concentrations and the average of the remaining community drinking water concentrations.

The equations for these calculations are:

$$\overline{D}(t)_{2-22_a} = \frac{\overline{C}_a}{R_a} \times S$$

where $\overline{D}(t)_{2-22_a}$ = dose equivalent from 2-22 mi from tritium (oxide) in air

$\overline{C}_a$ = average tritium (oxide) concentrations in air from 2 to 22 mi

R_a = RCG for tritium (oxide) in air (Ref. 17)

S = Radiation Protection Standard for tritium (oxide) in air, mrem/yr (Ref. 17)

$$\overline{D}(t)_{2-22_w} = \frac{\overline{C}_w}{R_w} \times S$$

where $\overline{D}(t)_{2-22_w}$ = dose equivalent from 2-22 mi from tritium (oxide) in water

$\overline{C}_w$ = average tritium (oxide) concentration in water from 2 to 22 mi

R_w = RCG for tritium (oxide) in water (Ref. 17)

S = Radiation Protection Standard for tritium (oxide) in water, mrem/yr (Ref. 17)

The total person-rem from 0-22 mi is obtained by:

$$\sum_0^{22} R = \left(\overline{D}(t)_{0-2_a} + \overline{D}(t)_{0-2_w} \right) \sum_0^{2} P + \left(\overline{D}(t)_{2-22_a} + \overline{D}(t)_{2-22_w} \right) \sum_2^{22} P$$

where $\sum_0^{22} R$ = person-rem within 22 mi

$\sum_0^{2} P$ = population from 0 to 2 mi = 14,700

$\sum_{2}^{22} P$ = population from 2 to 22 mi = 1,066,302

Note

The total person-rem from 0-22 mi is equal to 64 person-rem in addition to background. Based on diffusion model calculations, the remaining population from 22 to 50 mi is not receiving dose from tritium (oxide) releases from Mound Laboratory; therefore, the total person-rem from 0-50 mi (80 km) from tritium (oxide) releases from Mound Laboratory is equal to 64 person-rem.

For comparison, the person-rem values from natural radiation, including cosmic rays and terrestrial radiation, would be approximately 320,000 person-rem for the 0-50 mi range.[21] The dose commitment due to natural background tritium is 82 person-rem for the 0-50 mi range.

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Appendix

APPLICABLE STANDARDS

RADIOACTIVE STANDARDS

In conformance with ERDA Manual Chapter 0524, "Standards for Radiation Protection," off-site sample results are compared with RCG's established for the general population. These RCG's are derived by dividing the RCG's for an uncontrolled area by 3.

On-site sample results are compared with the uncontrolled area RCG's which are applicable for individuals in the population.

The RCG values (in microcuries per milliliter - μCi/ml) used for comparison purposes for the various types of samples in this report are listed below. In all cases, these are the most restrictive RCG's.

Plutonium-238 (Soluble Form)

Air

General Population	2×10^{-14} μCi/ml
Uncontrolled Area (Individuals in the Population)	7×10^{-14} μCi/ml

Water

General Population	2×10^{-6} μCi/ml
Uncontrolled Area (Individuals in the Population)	5×10^{-6} μCi/ml

Tritium (Soluble Form)

Air

General Population	7×10^{-8} μCi/ml

Uncontrolled Area (Individuals in the Population)	2×10^{-7} μCi/ml

Water

General Population	1×10^{-3} μCi/ml
Uncontrolled Area (Individuals in the Population)	3×10^{-3} μCi/ml

Foodstuffs There are no RCG values specified for foodstuffs.

Soil There are no guidelines established for radioactive species in soil.

NONRADIOACTIVE STANDARDS

Water Region V of the USEPA has issued a discharge permit under NPDES regulations covering both of the Mound Laboratory liquid effluent streams. The discharge limitations for each effluent stream are as follows:

Outfall Number 001

	Daily Average	Daily Maximum
Flow (10^6 gal/day)	0.53	0.92
BOD-5 Day (mg/l)	30	45
Suspended Solids (mg/l)	30	45
Dissolved Oxygen (mg/l)	5	--
Residual Chlorine (mg/l)		0.8
Oil and Grease (mg/l)		10
Fecal Coliform (No./100 ml)	200	400
pH	6-9	

Outfall Number 002

Flow (10^6 gal/day)	0.53	--
Suspended Solids (mg/l)	20	25
Dissolved Oxygen		
Oct.-April (mg/l)	≥8	--
May-Sept. (mg/l)	≥5	--
Residual Chlorine (mg/l)		0.1
Dissolved Solids (mg/l)	2000	3000
Oil and Grease (mg/l)		10
pH	6-9	

The Ohio EPA has established Water Quality Standards (EP-1-EP-9). The standards listed below are exerpted from these regulations. These standards are stream standards and apply to a stream beyond a suitable mixing zone permitted for discharges. They should not be compared with effluent concentrations.

Constituent	Average Concentration (mg/l)
Dissolved Oxygen	5.0
pH	6-9
Fecal Coliform	200 per 100 ml
Dissolved Solids	1500
Ammonia	1.5
Arsenic	0.05
Barium	0.8
Cadmium	0.005
Chloride	250
Chromium (Hexavalent)	0.05
Cyanide (Free)	0.005
Fluoride	1.3
Foaming Agents (MBAS)	0.5
Iron	1
Lead	0.04
Manganese	1
Mercury	0.0005
Oil & Grease	5
Phenols	0.01
Selenium	0.005
Silver	0.001
Copper	0.005 - 0.075[a]
Zinc	0.075 - 0.5[a]

[a]Dependent on $CaCO_3$ hardness.

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Annual Environmental Monitoring Report: Calendar Year 1974

D. G. Carfagno and B. Robinson

April 30, 1975

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Miamisburg, Ohio
operated by
MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company
for the
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FOREWORD

This report was prepared by the Environmental Control Section of the Personnel Safety, Waste Management, and Environmental Control Function in the Administrative Services Department at Mound Laboratory. Sample analyses and data reduction were performed by the Analytical and Development group of the Environmental Control Section. Particulate samples and data were also received from the Air Pollution Control Section of the Montgomery County Combined General Health District which acts as the Regional Air Pollution Control Agency in this region for the Ohio Environmental Protection Agency.

INTRODUCTION

Mound Laboratory is situated on 180 acres of land in Miamisburg, Ohio. This location is approximately 16 km (10 miles) southwest of Dayton. The predominant geographical feature in the five-county region surrounding the Laboratory is the Great Miami River which flows from the northeast to the southwest through Miamisburg. This river valley area is generally highly industrialized. The remainder of the region is predominantly agricultural with some light industry and scattered residential communities. The location and population of these communities are shown in Figure 1. The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately 10% of the land area in agricultural use is devoted to pasturing livestock.[1]

Weather conditions in the area are described as moderate. The average annual precipitation is approximately 91 cm (36 in.) and is evenly distributed throughout the year. Winds predominate out of the south or west except during the summer months when a higher frequency is observed out of the southwest. The wind speed averages about 16 km (10 miles) per hour annually.[2]

Mound Laboratory began operation in 1949. Its mission currently includes research, development, engineering, and production of components for the ERDA weapons program; research, development, and production of explosive materials; separation, purification, and sale of stable isotopes of the noble gases; and development, design, and fabrication of radioisotopic heat sources for medical application and space exploration. The chief radionuclides currently being handled include plutonium-238 and tritium.

Interest in the health and safety of employes and the public is manifested by an environmental control program which has been in existence continuously during the Laboratory's history. Fundamental objectives of the environmental control program are the containment of radioactive waste and control of nonradioactive effluents to levels well within existing or proposed standards. As part of this control function, all effluents containing polluting materials are controlled at each operating step. As a result of this control, any releases of low-level airborne and liquid wastes to the environment are carefully controlled and dispersed to ensure that concentrations are well within recommended standards.

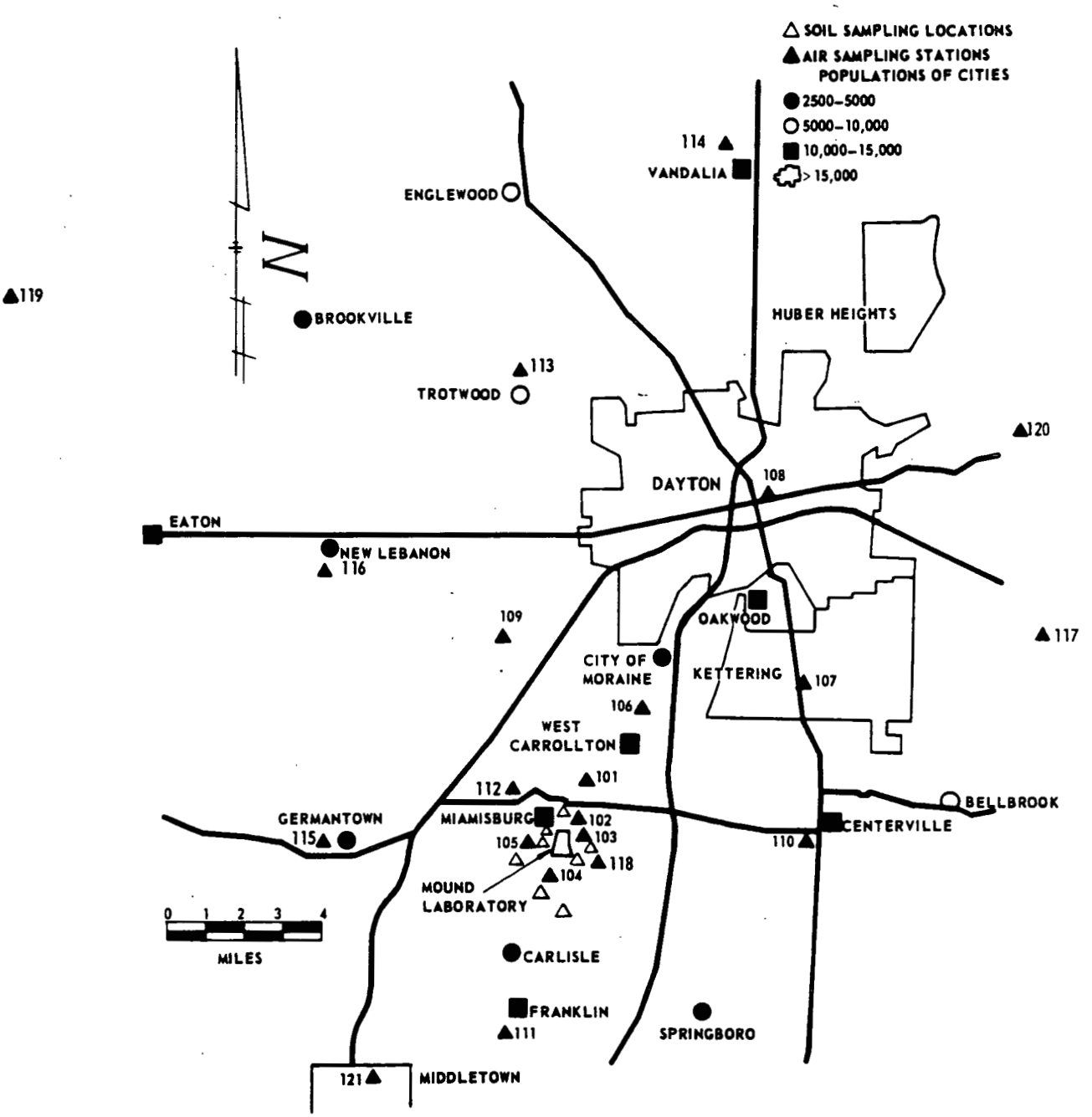

FIGURE 1 - Offsite air and soil sampling locations.

Radionuclides in particulate form are removed from air effluents by the use of high-efficiency particulate air (HEPA) filters. The air effluents are filtered first at the points of origin, i.e., glove boxes, and finally at the release point, i.e., the stack, by two banks of HEPA filters in series. Radionuclides are removed from liquid effluent by chemical processing. Solid radioactive wastes are packaged and shipped offsite for burial at ERDA-approved burial sites. Airborne and liquid wastes generated in the processing of explosive materials are collected and disposed of according to the Army Material Command Regulation 385-100.

A sanitary sewage treatment plant, which provides secondary treatment, is operated in accordance with State of Ohio regulations and handles all domestic sewage generated on site. Solid wastes are disposed of according to a recycling and reclamation program implemented during the first quarter of 1974. White paper, scrap metal, and wood are sold for reclamation. General refuse is transported to the Franklin Reclamation Center, Franklin, Ohio for processing and eventual use in recycled products. Waste solvents and chemicals are removed offsite by a commercial industrial waste disposal firm. As a result, onsite incineration has been discontinued and airborne pollutants resulting from that method of waste disposal have been eliminated.

As part of the Program's monitoring functions, air, water, foodstuff and soil samples are collected from the environment at distances up to 45 km (28 miles) from the Laboratory boundaries. These samples are analyzed for the specific radionuclides handled at the Laboratory as well as non-radioactive pollutants. The sampling techniques, analyses and counting methods are those best suited for the determination of the radionuclides of interest.

A quality control program for environmental analytical procedures has been in effect for several years. There are two parts to the program: internal and external. The internal portion consists of blank and duplicate analyses for each group of samples. The blank results have been consistently small and insignificant in comparison with sample results. The blank results are normally subtracted from the sample results. If a blank result is high, the sample analysis is performed again. The duplicate results for 1974 were also satisfactory. During the Mound Plutonium Study, an intensive quality control program was carried out on the plutonium analysis of silt. The results were satisfactory and indicated that the analytical work was under control throughout the program. The external part of the program consists of sending duplicate samples to an independent laboratory. These results for 1974 were also satisfactory. Three independent laboratories also performed duplicate analyses during the Mound Plutonium Study. Agreement was generally good at all concentration levels.

The results of the analyses for calendar year 1974 are provided in this report. Error limits, when given, reflect the uncertainties in the data at the 95% confidence level due to counting statistics.

SUMMARY

The environment surrounding Mound Laboratory was monitored and results reported for calendar year 1974. Samples analyzed included air, water, foodstuffs, soil, and silt. For radioactive species, the average concentrations of polonium-210, plutonium-238, and tritium detected were well within the stringent standards adopted by the Energy Research and Development Administration and the Environmental Protection Agency. Data concerning nonradioactive species in air and water are also presented.

The average concentrations of polonium-210, plutonium-238 and tritium measured in air during this period were less than 0.07%, 0.5% and 0.2% of their respective Radioactivity Concentration Guides (RCG's).

Water monitoring in the Great Miami River for radioactive species found the average concentrations of plutonium-238 and tritium measured at the water sampling locations during this period to be less than 0.07% and 0.3% of their respective RCG's.

Additionally, data concerning radioactive species in surface water, community drinking water, foodstuffs, and silt are presented. No significant uptake of radioactive species from air or water by plant or animal life has been observed. No significant reentrainment of radioactive species from soil or silt is indicated at this time. Soil core sample analyses will continue to establish a plutonium-238 soil inventory as part of the total program to assess the impact of the Laboratory's operations on the environment.

Water monitoring for nonradioactive species was conducted. These results indicate that Mound's effluent streams have no significant effect on the Great Miami River and most likely do not cause Ohio Stream Standards to be exceeded.

These data reflect the effectiveness of Mound Laboratory's Environmental Control Program. They indicate that the operation of the Laboratory does not have a measurable effect on the environment and that effluents are well within emission standards.

ENVIRONMENTAL MONITORING

Air - Radioactive

An offsite air sampling network consisting of 21 continuously operating air sampling stations is utilized to assess the effectiveness of systems controlling airborne emissions. Seven sampling stations are located within a 1.6-km (1-mile) radius of the Laboratory. This array of seven samplers surrounding the Laboratory ensure detection of any inadvertent release of radioactive materials and prompt assessment of the environmental impact, if any. Thirteen of the remaining samplers are located in or near population centers ranging from Vandalia, which is 33.6 km (21 miles) to the north, to Middletown, which is 16 km (10 miles) to the south. The remaining sampler (#119) is located at a distance approximately 44.8 km (28 miles) from the Laboratory in the least prevailing wind direction. This site should receive no measurable contribution from Mound Laboratory operations and serves as a background sample for comparison purposes. The sampling sites are shown in Figure 1.

Two types of samples are collected at each sampling station: a particulate air sample for plutonium-238 and polonium-210 analysis, and a gas bubbler sample for tritium oxide analysis. The particulate sample is collected on a 200mm diameter Microsoban disk by means of a continuously operating (24 hours, 7 days per week) high volume air sampler. The air is sampled at the rate of 1×10^6 cc/min (40 ft^3/min). The Microsorban disk is changed weekly, which represents a sample of approximately 10,000 m^3 of air. Polonium-210 analyses are performed on a weekly basis while the plutonium-238 analyses are performed on a monthly composite sample.

The analytical scheme for plutonium-238 incorporates the following basic steps: addition of a known amount of plutonium-242 tracer, ignition to 600° C., dissolution with nitric acid, separation of plutonium with anion exchange resin, electrodeposition of plutonium and finally alpha spectrometry. The use of plutonium-242 as an internal standard allows a correction to be made for chemical recovery. All plutonium analyses of environmental samples use this basic scheme after proper pre-treatment of the samples. The results reported represent total concentrations of the analyzed radionuclides including contribution from natural sources and atmospheric fallout.

Since commercial sales of polonium-210 from Mound Laboratory have ceased, and the concentration of polonium-210 measured in the atmosphere has significantly decreased, samples collected at only two offsite locations were analyzed weekly for polonium-210 during 1974. If a significant increase in the concentration of polonium-210 is observed at these locations, additional analyses at other locations will be performed to assure that control of emissions is still effective; i.e., well within stringent ERDA standards. The results of the polonium-210 analyses are summarized in Table 1. Average concentrations measured were only 0.07% or less of the Radioactivity Concentration Guide (RCG). As a result, no further analyses were performed. It should be noted that the more

restrictive RCG for the insoluble form of polonium was used for this comparison. (A listing and discussion of RCG's are located in the appendix of this report.)

The average plutonium-238 concentrations measured were all less than 0.5% of the RCG. The RCG used for comparison is the guide for the soluble form of the isotope and for the general population. This is the most restrictive RCG for plutonium-238 and is applied since the solubility of the measured particles in the potential receptor, i.e., the human body, is unknown at this time. The results are summarized in Table 2. Included in Table 2 are plutonium-239 concentrations and the ratio of plutonium-238 to plutonium-239 measured at these same locations. The relatively good agreement of the average ^{239}Pu concentrations from location to location is a good indicator of the reliability of the plutonium analyses. The range of ^{239}Pu values which made up the averages were 0.4 to 13 x 10^{-17} microcuries/ml. These ^{239}Pu values are well within the values of 0.8 to 28.3 x 10^{-17} microcuries/ml reported by HASL for the first part of 1974.[4] The ratio of ^{238}Pu to ^{239}Pu is approximately 0.2 for atmospheric fallout. A ratio significantly greater than 0.2 would indicate a concentration of ^{238}Pu greater than that due to atmospheric fallout and most likely due to Mound Laboratory operations.

The gas bubbler sample is also collected on a continuous basis by bubbling air at approximately 3 x 10^3cc/min through 500 ml of water. Any tritium oxide present in the air is collected in the solution. The sampling and analysis is directed to tritium oxide rather than elemental tritium since the RCG for the oxide is two hundred times more restrictive. A sample representing 30 m^3 of air is collected and an aliquot of this counted in a liquid scintillation spectrometer. The average concentrations of tritium oxide measured during 1974 were all less than 0.2% of the RCG. These results are summarized in Table 3. For averaging purposes, samples less than the minimum detection limit are assumed to be the value of the limit and the average is expressed as less than (<) the computed value.

TABLE 1

CONCENTRATION OF ^{210}Po IN AIR AT OFFSITE SAMPLING LOCATIONS
CY-1974

Location*	Number of Samples	Range (10^{-15}µCi/ml)	Average** (10^{-15}µCi/ml)	Percent of RCG***
101	52	0.59 - 3.0	1.2 ± 0.07	0.06
108	47	0.43 - 2.4	1.3 ± 0.08	0.07

* Samples from only two locations analyzed because of significant decrease in concentrations measured in atmosphere. See page 8.

** Minimum detection limit (MDL) for ^{210}Po in air is 0.02 x 10^{-15}µCi/ml, which is 0.0003% of the RCG.

*** RCG - Radioactivity Concentration Guide = 2000 x 10^{-15}µCi/ml.

TABLE 2

CONCENTRATION OF Pu IN AIR AT OFFSITE SAMPLING LOCATIONS
1974

Location	Number of Samples	^{238}Pu Range (10^{-17} μCi/ml)	^{238}Pu Average* (10^{-17} μCi/ml)	Percent of RCG**	^{239}Pu Average (10^{-17} μCi/ml)	^{238}Pu/^{239}Pu
101	52	2.3 - 31.6	10.0 ± 0.4	0.5	3.1 ± 0.2	3.2
102	53	0.96 - 29.3	6.0 ± 0.3	0.3	2.8 ± 0.2	2.1
103	53	1.8 - 33.5	6.4 ± 0.3	0.3	3.2 ± 0.2	2.0
104	53	0.38 - 3.4	1.3 ± 0.2	0.07	3.3 ± 0.2	0.39
105	35	0.33 - 3.6	1.2 ± 0.1	0.06	3.4 ± 0.3	0.35
106	22	0.21 - 2.1	0.63 ± 0.11	0.03	3.5 ± 0.3	0.18
107	30	0.06 - 3.7	0.60 ± 0.11	0.03	3.4 ± 0.3	0.18
108	47	0.60 - 8.4	3.2 ± 0.2	0.2	3.4 ± 0.3	0.94
109	53	0.12 - 1.6	0.56 ± 0.10	0.03	3.7 ± 0.3	0.15
110	18	0.19 - 4.3	1.3 ± 0.2	0.06	1.3 ± 0.2***	1.0
111	53	0.09 - 3.2	0.78 ± 0.12	0.04	3.0 ± 0.2	0.26
112	53	0.28 - 7.9	2.0 ± 0.2	0.1	2.7 ± 0.2	0.74
113	53	0.08 - 2.3	0.56 ± 0.10	0.03	2.9 ± 0.2	0.19
114	53	0.17 - 1.5	0.63 ± 0.11	0.03	2.8 ± 0.2	0.23
115	50	0.03 - 7.1	1.0 ± 0.1	0.05	3.4 ± 0.3	0.29
116	47	0.07 - 3.5	0.56 ± 0.10	0.03	2.9 ± 0.2	0.19
117	48	0.07 - 3.2	0.73 ± 0.12	0.04	3.0 ± 0.2	0.24
118	53	0.40 - 3.2	1.4 ± 0.2	0.07	3.0 ± 0.2	0.47
119	48	0.11 - 0.54	0.19 ± 0.06	0.01	2.9 ± 0.2	0.07
120	53	0.16 - 1.9	0.43 ± 0.09	0.02	3.6 ± 0.3	0.12
121	53	0.05 - 2.8	0.55 ± 0.10	0.03	3.2 ± 0.2	0.17

* Minimum Detection Limit (MDL) for ^{238}Pu is air is 0.036 x 10^{-17}μCi/ml which is 0.002% of of the RCG.

** RCG - Radioactivity Concentration Guide = 2000 x 10^{-17}μCi/ml.

*** Samples were collected only during the fall season at this location when ^{239}Pu concentrations are typically lower.

TABLE 3

CONCENTRATIONS OF TRITIUM OXIDE IN AIR AT OFFSITE SAMPLING LOCATIONS
1974

Location	Number of Samples	Range ($10^{-11}\mu Ci/ml$)	Average* ($10^{-11}\mu Ci/ml$)	Percent of RCG **
101	53	<0.2 - 90	<11.0 ± 1.0	<0.2
102	53	<0.2 - 170	<14.0 ± 1.1	<0.2
103	53	<0.2 - 249	<14.8 ± 1.1	<0.2
104	53	<0.2 - 52	< 4.9 ± 0.7	<0.07
105	53	<0.2 - 51	< 5.4 ± 0.8	<0.08
106	53	<0.2 - 23	< 2.9 ± 0.7	<0.04
107	52	<0.2 - 26	< 2.1 ± 0.6	<0.03
108	52	<0.2 - 14	< 1.6 ± 0.6	<0.02
109	53	<0.2 - 13	< 1.5 ± 0.6	<0.02
110	52	<0.2 - 9	< 1.7 ± 0.6	<0.03
111	52	<0.2 - 6	< 1.1 ± 0.5	<0.02
112	53	<0.2 - 53	< 4.0 ± 0.7	<0.06
113	53	<0.2 - 5	< 0.9 ± 0.5	<0.01
114	53	<0.2 - 6	< 0.8 ± 0.5	<0.01
115	53	<0.2 - 16	< 1.2 ± 0.6	<0.02
116	53	<0.2 - 10	< 1.0 ± 0.5	<0.01
117	53	<0.2 - 4	< 0.7 ± 0.5	<0.01
118	53	<0.2 - 180	< 8.7 ± 0.9	<0.1
119	52	<0.2 - 4	< 0.7 ± 0.5	<0.01
120	53	<0.2 - 3	< 0.6 ± 0.5	<0.01
121	53	<0.2 - 3	< 0.8 ± 0.5	<0.01

* Minimum Detection Limit (MDL) for tritium oxide in air is $0.2 \times 10^{-11}\mu Ci/ml$, which is 0.004% of the RCG.

** RCG - Radioactivity Concentration Guide = $7000 \times 10^{-11}\mu Ci/ml$.

An onsite perimeter network consisting of five continuous, high volume air samplers is used to further assess the effectiveness of control systems. The onsite sampling locations are shown in Figure 2. Particulate and gas samples are collected by the onsite samplers at the same flow rate as the offsite samplers, i.e., 1×10^6 cm^3/min and 3×10^3 cm^3/min, respectively. The samples are also analyzed in the same manner as the offsite samples with the exception that all onsite samples are also analyzed for polonium-210. The results of the onsite polonium-210 analyses are summarized in Table 4. The average concentrations of polonium-210, measured during 1974 at the onsite sampling stations, were all 0.02% or less of the RCG. The RCG used for comparison for these onsite samples as well as plutonium and tritium oxide samples is the guide for an uncontrolled area as listed in the appendix.

The average plutonium-238 concentrations measured onsite were all less than 1.2% of the RCG and are summarized in Table 5.

The results of the onsite tritium oxide analyses are summarized in Table 6. The average concentrations measured were all less than 0.2% of the RCG.

The total amounts of polonium-210, plutonium-238, and tritium discharged to the atmosphere during 1974 were 0.7 μCi, 28 μCi, and 10,000 Ci, respectively.

TABLE 4

CONCENTRATIONS OF ^{210}Po IN AIR AT ONSITE SAMPLING LOCATIONS 1974

Location	Number of Samples	Range (10^{-15}μCi/ml)	Average* (10^{-15}μCi/ml)	Percent of RCG**
211	52	0.31 - 2.8	1.1 ± 0.07	0.02
212	50	0.42 - 2.2	1.2 ± 0.07	0.02
213	53	0.60 - 2.5	1.1 ± 0.07	0.02
214	53	0.63 - 2.5	1.1 ± 0.07	0.02
215	52	0.46 - 2.4	1.1 ± 0.07	0.02

* Minimum Detection Limit (MDL) for ^{210}Po in air is 0.02×10^{-15}μCi/ml, which is 0.0001% of the RCG.

** RCG - Radioactivity Concentration Guide = 7000×10^{-15}μCi/ml.

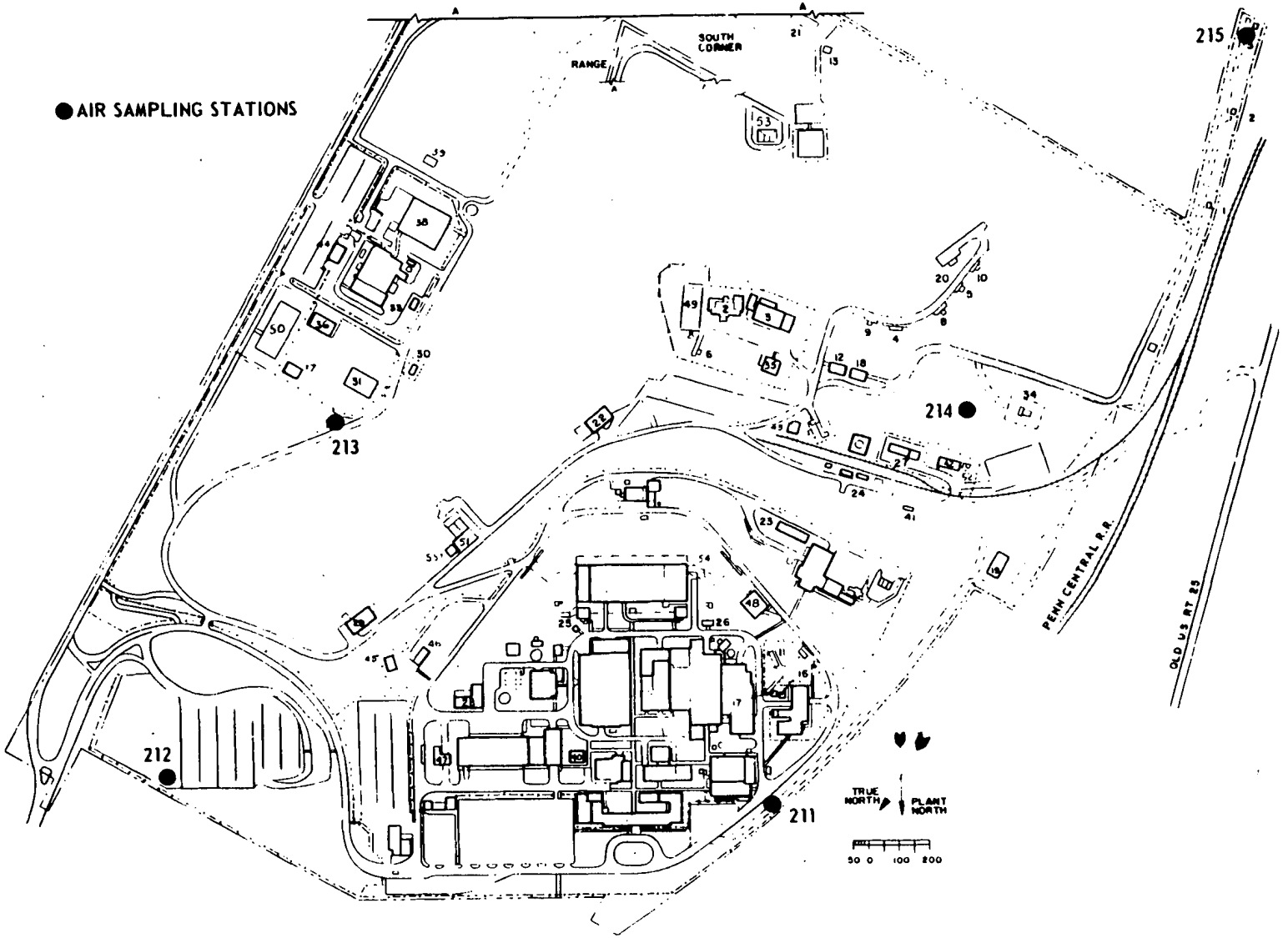

FIGURE 2 - Onsite air sampling locations.

TABLE 5

CONCENTRATION OF ^{238}Pu IN AIR AT ONSITE SAMPLING LOCATIONS
1974

Location	Number of Samples	Range ($10^{-17}\mu Ci/ml$)	Average* ($10^{-17}\mu Ci/ml$)	Percent of RCG**
211	52	5.1 - 392	81 ± 1.2	1.2
212	50	6.0 - 53	19 ± 0.6	0.3
213	53	20 - 190	57 ± 1.1	0.8
214	53	6.7 - 46	17 ± 0.6	0.3
215	52	2.3 - 19	8.2 ± 0.4	0.1

* Minimum Detection Limit (MDL) for ^{238}Pu in air is $0.036 \times 10^{-17}\mu Ci/ml$, which is 0.0007% of the RCG.

** RCG - Radioactivity Concentration Guide = $7000 \times 10^{-17}\mu Ci/ml$.

TABLE 6

CONCENTRATION OF TRITIUM OXIDE IN AIR AT ONSITE SAMPLING LOCATIONS
1974

Location	Number of Samples	Range ($10^{-11}\mu Ci/ml$)	Average ($10^{-11}\mu Ci/ml$)	Percent of RCG**
211	53	<0.3 - 55	< 8.6 ± 1.3	<0.04
212	50	<0.3 - 122	<11 ± 1.4	<0.05
213	53	2 - 333	32 ± 2.1	0.2
214	53	<0.3 - 144	<17 ± 1.6	<0.09
215	53	<0.3 - 175	<16 ± 1.5	<0.08

* Minimum Detection Limit (MDL) for tritium oxide in air in 0.3×10^{-11} $\mu Ci/ml$, which is 0.002% of the RCG.

** RCG - Radioactivity Concentration Guide = $20,000 \times 10^{-11}\mu Ci/ml$.

Air - Nonradioactive

Mound's steam power supply has been converted from fuel oil to natural gas on an interruptable basis. During unusually cold weather, natural gas supply to Mound is interrupted and fuel oil with much less than 1% sulfur content is burned. Except for these occasions, virtually all sulfur dioxide emissions have been eliminated. None of the operations presently carried on at Mound Laboratory involve amounts of material which would lead to significant particulate, carbon monoxide, photochemical oxidant or hydrocarbon emissions from stationary sources. Therefore, no sampling for these nonradioactive pollutants is carried on at this time.

Water - Radioactive

Water sampling locations along the bank of the Great Miami River were selected according to guidelines proposed by the Federal EPA. The locations, shown in Figure 3, provide samples which are representative of river water after suitable mixing of Mound's effluent has occurred. Water samples are collected at these locations five days per week and are subjected to specific analyses for plutonium-238 and tritium oxide. River samples are no longer analyzed for polonium-210 for the same reasons that air samples for polonium-210 have been reduced. Effluent streams leaving Mound are analyzed for polonium-210 as well as plutonium-238 and tritium. If a significant increase in these streams is detected, river samples are then analyzed for polonium-210. No significant increases were detected during 1974.

The plutonium-238 analyses are performed on a monthly composite of the daily samples. The concentrations of plutonium-238 measured in the Great Miami River are summarized in Table 7. The average concentrations were 0.07% or less of the RCG.

Tritium oxide analyses are performed on a weekly composite of the daily samples collected. The average concentrations of tritium oxide measured in the Great Miami River were all less than 0.3% of the RCG. These results are summarized in Table 8.

Results of plutonium-238 and tritium analyses for three sampling locations on the abandoned Miami-Erie canal and adjacent ponds are reported in Tables 9 and 10, respectively. These results represent levels in the site drainage ditch which discharges into the canal-pond system prior to mixing with the Great Miami River. These results, as expected, are higher than those concentrations found in the Great Miami River where mixing and dilution occur.

The total amounts of polonium-210, plutonium-238, and tritium discharged to the Great Miami River were 0.6 millicuries, 20 millicuries, and 105 curies, respectively.

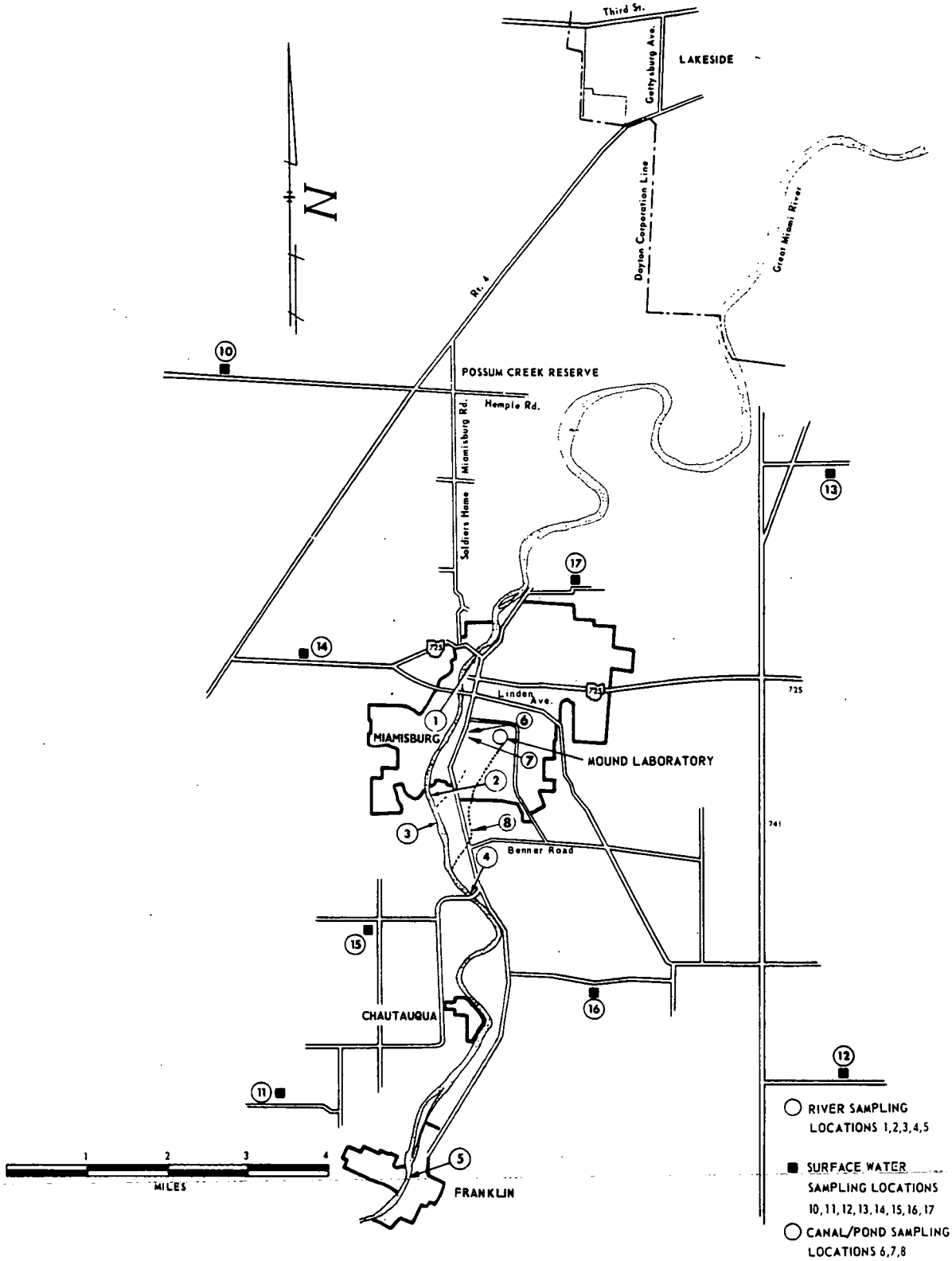

FIGURE 3 - Offsite water sampling locations.

TABLE 7

CONCENTRATION OF ^{238}Pu IN THE GREAT MIAMI RIVER
1974

Location	Number of Samples	Range ($10^{-8}\mu Ci/ml$)	Average* ($10^{-8}\mu Ci/ml$)	Percent of RCG**
1	249	<0.04 - 0.3	<0.06 ± 0.02	<0.03
2	249	<0.04 - 0.8	<0.14 ± 0.02	<0.07
3	249	<0.04 - 0.5	<0.08 ± 0.02	<0.04
4	249	<0.04 - 0.4	<0.05 ± 0.01	<0.03
5	249	<0.04 - 0.7	<0.08 ± 0.02	<0.04

* Minimum Detection Limit (MDL) for ^{238}Pu in water is $0.04 \times 10^{-8}\mu Ci/ml$, which is 0.02% of the RCG.

** RCG - Radioactivity Concentration Guide = $200 \times 10^{-8}\mu Ci/ml$.

TABLE 8

CONCENTRATION OF TRITIUM IN THE GREAT MIAMI RIVER
1974

Location	Number of Samples	Range ($10^{-6}\mu Ci/ml$)	Average* ($10^{-6}\mu Ci/ml$)	Percent of RCG**
1	249	<0.2 - 5.2	<1.0 ± 0.3	<0.1
2	249	<0.2 - 28	<2.8 ± 0.3	<0.3
3	249	<0.2 - 8.1	<2.9 ± 0.3	<0.3
4	249	<0.2 - 7.6	<2.0 ± 0.3	<0.2
5	249	<0.2 - 23	<1.4 ± 0.3	<0.1

* Minimum Detection Limit (MDL) for tritium in water is $0.2 \times 10^{-6}\mu Ci/ml$, which is 0.02% of the RCG.

** RCG - Radioactivity Concentration Guide = $1000 \times 10^{-6}\mu Ci/ml$.

TABLE 9

CONCENTRATION OF ^{238}Pu IN CANAL/POND AREA
1974

Location*	Number of Samples	Range ($10^{-8}\mu Ci/ml$)	Average** ($10^{-8}\mu Ci/ml$)	Percent of RCG***
6 (North Pond)	249	<0.04 - 1.2	<0.2 ± 0.03	<0.1
7 (North Canal)	249	0.05 - 1.2	0.5 ± 0.04	0.3
8 (South Canal)	249	0.2 - 4.6	1.9 ± 0.09	0.9

* Locations shown in Figure 3.

** Minimum Detection Limit (MDL) for ^{238}Pu in water is $0.04 \times 10^{-8}\mu Ci/ml$, which is 0.02% of the RCG.

*** RCG - Radioactivity Concentration Guide = $200 \times 10^{-8}\mu Ci/ml$.

TABLE 10

CONCENTRATION OF TRITIUM IN CANAL/POND AREA
1974

Location*	Number of Samples	Range ($10^{-6}\mu Ci/ml$)	Average** ($10^{-6}\mu Ci/ml$)	Percent of RCG***
6 (North Pond)	249	12 - 72	48 ± 0.8	4.8
7 (North Canal)	249	18 - 77	55 ± 0.8	5.5
8 (South Canal)	249	20 - 92	52 ± 0.8	5.2

* Locations are shown in Figure 3.

** Minimum Detection Limit (MDL) for tritium in water is $0.2 \times 10^{-6}\mu Ci/ml$, which is 0.02% of the RCG.

*** RCG - Radioactivity Concentration Guide = $1000 \times 10^{-6}\mu Ci/ml$.

Eight additional surface water locations such as ponds and streams are sampled quarterly. These locations are shown in Figure 3. A sample of approximately four liters is collected at each location and analyzed for plutonium-238, and tritium oxide. The average concentrations of plutonium-238 measured at these locations during 1974 were 0.05% or less of the RCG. The average concentrations of tritium oxide measured at these locations were 0.3% or less of the RCG. The results of the surface water monitoring program are summarized in Tables 11 and 12.

In the routine environmental monitoring program, data obtained for plutonium-238 in water overestimates actual concentrations. Water samples of 500 cm^3 and counting times of 16 hr have been used in the routine program and have been more than adequate to demonstrate compliance with guidelines. Larger volume samples of water and longer counting times would be required to obtain results comparable to background concentrations. As discussed in the preceding paragraphs, the plutonium-238 concentration in various environmental waters has been estimated as only a fraction of one percent of the RCG, which indicates that the impact on the environment has been minor.

Drinking water from communities in the surrounding area is sampled quarterly and analyzed for tritium oxide. These communities are shown in Figure 1. The concentrations of tritium oxide were found to be less than 1.4% of the RCG. The results of the community drinking water sampling program are summarized in Table 13. Several private wells in the vicinity of Mound Laboratory were also sampled and analyzed for tritium oxide during 1974. The results ranged from 32 to 101 x 10^{-6} μCi/ml which represent 3.2 to 10.1% of the RCG, respectively.

Water - Nonradioactive

It is difficult to measure the levels of nonradioactive pollutants in the Great Miami River resulting from Mound Laboratory's water effluent because of the relatively high level of these pollutants already present in the river upstream from the outfalls. Instead, a composite sample of both water effluent streams leaving the Laboratory is automatically collected and analyzed for various water quality parameters as reported below. The sample volume is proportionate to the flow in the stream. The composite effluent water samples are analyzed for the listed water quality parameters according to standard techniques[4] for waste water analysis accepted by the office of Water Programs of the Environmental Protection Agency. The effluent standards which EPA proposed in late 1974 for nine toxic pollutants have been withdrawn until the EPA can collect additional data. The results of the effluent stream analyses are summarized in Table 14. These results indicate that Mound's effluent streams have no significant effect on the Great Miami River and most likely do not cause Ohio Stream Standards to be exceeded.

TABLE 11

SUMMARY OF SURFACE WATER MONITORING FOR ^{238}Pu
1974

Location	Number of Samples	Range ($10^{-10}\mu Ci/ml$)	Average* ($10^{-10}\mu Ci/ml$)	Percent of RCG**
10	4	<3 - 15	<4.5 ± 1.4	<0.02
11	4	<3 - 9.1	<3.8 ± 1.3	<0.02
12	4	<3 - 4.0	<3.1 ± 1.2	<0.02
13	4	<3 - 3.7	<3.1 ± 3	<0.01
14	3	<3	<3 ± 3	<0.01
15	4	<3 - 11	<6.1 ± 1.6	<0.03
16	4	<3 - 24	<9.4 ± 2.0	<0.05
17	4	<3 - 9.6	<3.3 ± 1.2	<0.02

* Minimum Detection Limit (MDL) for ^{238}Pu is water is $3 \times 10^{-10}\mu Ci/ml$. The MDL = 0.01% of the RCG.

** RCG - Radioactivity Concentration Guide for ^{238}Pu in water = $20,000 \times 10^{-10}\mu Ci/ml$.

TABLE 12

SUMMARY OF SURFACE WATER MONITORING FOR TRITIUM
1974

Location	Number of Samples	Range ($10^{-6}\mu Ci/ml$)	Average ($10^{-6}\mu Ci/ml$)	Percent of RCG**
10	4	<0.2 - 4	<1.4 ± 0.3	<0.1
11	4	<0.2 - 2	<0.8 ± 0.3	<0.08
12	4	<0.2 - 2	<0.9 ± 0.3	<0.09
13	4	<0.2 - 4	<1.4 ± 0.3	<0.1
14	4	<0.2 - 5	<2.1 ± 0.3	<0.2
15	4	<0.2 - 6	<2.8 ± 0.3	<0.3
16	4	<0.2 - 2	<0.9 ± 0.3	<0.09
17	4	<0.2 - 6	<3.5 ± 0.3	<0.3

* Minimum Detection Limit (MDL) for tritium in water is $0.2 \times 10^{-6}\mu Ci/ml$. The MDL is 0.02% of the RCG.

** RCG - Radioactivity Concentration Guide for tritium oxide in water = $1000 \times 10^{-6}\mu Ci/ml$.

TABLE 13

SUMMARY OF TRITIUM OXIDE LEVELS IN COMMUNITY DRINKING WATER
1974

Location	Number of Samples	Range ($10^{-6}\mu Ci/ml$)	Average* ($10^{-6}\mu Ci/ml$)	Percent of RCG**
Bellbrook	4	<0.3 - 1.9	<0.8 ± 0.3	<0.08
Centerville	4	<0.3 - 1.5	<0.9 ± 0.3	<0.09
Dayton	4	<0.3 - 0.8	<0.4 ± 0.3	<0.04
Franklin	4	<0.3 - 0.9	<0.5 ± 0.3	<0.05
Germantown	4	<0.3 - 1.9	<0.9 ± 0.3	<0.09
Kettering	4	<0.3 - 0.6	<0.4 ± 0.3	<0.04
Miamisburg	4	9 - 24	13.3 ± 0.5	1.33
Middletown	4	<0.3 - 1.5	<0.8 ± 0.3	<0.08
Moraine	4	<0.3 - 1.3	<0.5 ± 0.3	<0.05
South Lebanon	4	<0.3 - 0.9	<1.2 ± 0.3	<0.12
Springboro	4	<0.3 - 7.9	<2.9 ± 0.3	<0.29
Waynesville	4	<0.3 - 0.9	<0.5 ± 0.3	<0.05
West Carrollton	4	<0.3 - 1.8	<1.1 ± 0.3	<0.11

* Minimum Detection Limit (MDL) for tritium oxide is $0.3 \times 10^{-6}\mu Ci/ml$. The MDL is 0.03% of the RCG.

** RCG - Radioactivity Concentration Guide for tritium oxide in water = $1000 \times 10^{-6}\mu Ci/ml$.

TABLE 14

SUMMARY OF EFFLUENT WATER MONITORING FOR NONRADIOACTIVE CONSTITUENTS
1974

Constituent	Average Value (mg/l)
Heavy Metals	
Antimony	<0.0005
Arsenic	<0.01
Barium	0.007
Beryllium	<0.0001
Bismuth	0.02
Boron	0.09
Cadmium	0.002
Chromium, Hexavalent	0.007
Cobalt	0.02
Copper	0.08
Iron	0.39
Lead	0.006
Manganese	0.02
Mercury	0.0008
Molybdenum	0.01
Nickel	0.01
Selenium	<0.001
Silver	0.002
Zinc	0.11
Other Inorganics	
Chloride	826
Cyanide	<0.003
Sulfate	102
Nitrate	4.2
pH	7.6 - 8.9
Total Dissolved Solids	1090
Dissolved Oxygen	7.2
Phosphate	4.9
Fluoride	0.2
Organic	
Oil & Grease	1.5
Physical Properties	
Suspended Solids	20

Foodstuffs and Vegetation - Radioactive

Various locally grown foodstuffs and vegetation samples are collected from the surrounding area. The intent of this portion of the Envrionmental Monitoring Program is to determine if there is any uptake and concentration of radionuclides by plant or animal life. Where possible, sampling sites are chosen at maximum deposition locations predicted on the basis of the diffusion model developed for Mound Laboratory. Field crops, fruit, and vegetables are collected on the basis of this diffusion model. Milk is collected from individual farms closest to the Laboratory. Aquatic life is trapped from the Miami River generally downstream of Miamisburg and adjacent waterways, dependent upon availability of fish. Grass samples are collected in the vicinity of the surface water locations listed in Tables 11 and 12. As mentioned previously, commercial sales of polonium-210 from Mound Laboratory have ceased. Since air and water are monitored for polonium-210, and no significant increases have been observed, foodstuff samples are not analyzed for polonium-210. The plutonium-238 content of the foodstuff and vegetation samples is determined by slowly evaporating the samples to dryness and then proceeding with the same techniques used for plutonium-238 analyses of air samples. Milk samples are analyzed for tritium oxide by distilling the water fraction from an aliquot of the entire sample. The distillate is then analyzed for tritium by liquid scintillation spectrometry in the same manner as the water samples previously discussed in this report. The remaining foodstuff samples are analyzed for tritium by oxidizing the samples in a controlled air stream and collecting the combustion products. The tritium content of the combustion products is then determined by liquid scintillation spectrometry as discussed above. This technique allows analysis for total tritium in the samples rather than tritium oxide only. The results of the foodstuff and vegetation analyses are summarized in Table 15. The concentration is given in terms of the sample weight before evaporation to dryness. The vegetables analyzed included potatoes and tomatoes. The field crops analyzed were the edible portions of corn and soybeans. The sample of aquatic life analyzed included only the edible fleshy portions of the fish. No evidence has been found, as yet, that there is any significant uptake and concentration by plant or animal life of these radionuclides handled at Mound Laboratory.

Soil and Silt - Radioactive

The soil sampling program has included two aspects of soil monitoring. One aspect, which was reported in MLM-1922 Environmental Monitoring Report, July - December 1971 and 1971 Summary, is the evaluation of the resuspendable amounts of plutonium-238 in soil. For this evaluation, surface scrapings, approximately one-eighth inch deep, of undisturbed soil are collected and analyzed. Review of the pathways to man that plutonium could follow from soil to man, indicate that the most likely pathway is inhalation of resuspended material. Therefore, evaluation of resuspendable plutonium in soil is best accomplished by continuous high volume air sampling, not only because this samples the direct

TABLE 15

SUMMARY OF FOODSTUFFS & VEGETATION ANALYSIS
1974

Type of Sample	Number of Samples	^{238}Pu ($10^{-8}\mu Ci/g$) Range	Average*	Percent RCG**	Tritium ($10^{-6}\mu Ci/g$) Range	Average***	Percent of RCG****
Milk	3	0.3 - 0.4	0.34 ± 0.1	0.2	0.5 - 0.9	0.7 ± 0.5	0.07
Fruits & Vegetables	2	<0.1 - 0.2	<0.17 ± 0.04	<0.09	0.9 - 3.3	1.4 ± 0.5	0.14
Grass	12	<0.1 - 1.7	<0.7 ± 0.02	<0.3	0.7 - 2.3	1.5 ± 0.5	0.15
Field Crops	1	- - -	0.8 ± 0.02	0.4	- - -	- - -	- -
Aquatic Life	3	<0.3 - 0.5	<0.37 ± 0.1	<0.2	<0.1 - 2.8	<1.2 ± 0.5	<0.12

* Minimum Detection Limit (MDL) for ^{238}Pu in foodstuffs ranges from 0.06×10^{-8} to $0.3 \times 10^{-8}\mu Ci/g$. The MDL ranges from 0.03 to 0.1% of the RCG.

** RCG - Radioactivity Concentration Guide for ^{238}Pu in water = $200 \times 10^{-8}\mu Ci/g$.

*** Minimum Detection Limit for tritium in foodstuffs is $0.1 \times 10^{-6}\mu Ci/g$. The MDA is 0.01% of the RCG.

**** RCG - Radioactivity Concentration Guide for ^{3}H oxide in water = $1000 \times 10^{-6}\mu Ci/g$.

pathway to man, but also because air sampling and analyses are more accurate and reproducible than soil sampling and analyses. If air sampling results indicate a potential problem in this area, surface soil sampling will be resumed.

The second aspect of soil monitoring, which was also reported in MLM-1922 and MLM-2028 (Environmental Monitoring Reports for 1971 and 1972), is soil core sampling. The purpose of this type of soil sampling is the documentation, for historical purposes, of the total accumulation and distribution of plutonium deposited offsite, and for verification of Mound Laboratory's atmospheric diffusion model. Present plans are to complete the initial total inventory during 1975 and to then repeat and refine the inventory over the next five-year interval, i.e., a revised and updated inventory completed by 1980. Soil core samples 3.5 inches in diameter, approximately 12 inches deep, are taken for the inventory determination. Core samples were collected at two locations in each quadrant around the Laboratory during 1974. These locations are shown in Figure 1. Ten cores were collected from a square area 30 ft (9.1m) on a side, at each location and composited to form one core sample.

Soil samples are digested with an acid mixture to extract the plutonium. The solution is then passed over an ion exchange column specific for plutonium and analyzed in the same manner as the particulate air samples previously discussed in this report. This leach method has been compared with a fusion method for soil analysis.[5] Good agreement was obtained between the two methods of analysis. The leach method was chosen for the soil analysis because larger samples, which minimize sampling and aliquoting errors, and increased sensitivity can be handled with this method. The results of the core sampling program for 1974 are summarized in Table 16. As mentioned previously in this report, no standards have been established for radioactive species in soil. Additional sample analyses are necessary before a total inventory can be calculated and these are continuing as part of Mound Laboratory's comprehensive Environmental Control Program.

Preliminary samples collected from offsite sediment in the Miami-Erie Canal area near Mound Laboratory indicated that plutonium-238 concentrations were substantially above baseline levels. As a result, an extensive sampling and analysis program was performed during 1974 to determine the plutonium-238 concentrations as a function of depth and location in a drainage ditch, the canal, two ponds, a run-off hollow, a canal overflow creek and the Great Miami River. The plutonium-238 concentration data was used to estimate the total inventory of plutonium-238 deposited in these waterways, to determine the extent of the contamination, and to evaluate the potential health hazards to the general population of the area.

The detailed hazard analysis of the presence of plutonium in the silt of the canal/ponds indicates that there is no significant radiological impact on the area and no short or long term health hazard.

TABLE 16

SUMMARY OF SOIL CORE ANALYSIS FOR ^{238}Pu
1974

Location * (Direction & Distance)			Pu ($10^{-3}\mu Ci/m^2$)**
15°	760m	(2500 ft.)	5.0 ± 0.6
105°	760m	(2500 ft.)	40 ± 1
115°	60m	(200 ft.)	79 ± 2
180°	1900m	(6300 ft.)	5.6 ± 0.5
205°	1500m	(5000 ft.)	4.4 ± 0.7
270°	150m	(500 ft.)	230 ± 3
270°	460m	(1500 ft.)	0.40 ± 0.20
320°	120m	(400 ft.)	42 ± 2

* Locations are shown in Figure 1. Direction is from approximate center of plant and distances are measured from site boundary.

** Minimum Detection Limit for ^{238}Pu in soil is $0.004 \times 10^{-3}\mu Ci/m^2$.

NOTE: No standards for radioactive species in soil have been established.

EVALUATION OF DOSE TO THE PUBLIC

A dose assessment was done for each radionuclide found in significant quantities in Mound Laboratory's effluent streams. These radionuclides are tritium(oxide) and plutonium-238. Tritium (oxide) is the only radionuclide for which the critical organ is the whole body. The critical organ for plutonium-238 is assumed to be the bone.

The dose estimates were based on environmental monitoring data for 1974. The dose estimates for air were based on perimeter and offsite continuous air sampling data, (minus background), and the waterborne radionuclide dose estimate was based only on tritium in drinking water for the local area. The levels of other radionuclides indicated background or non-detectable levels in drinking water and were thus not factored in. The estimates were arrived by use of the ratio of the observed concentration to the applicable RCG.

The dose estimates obtained for the maximum potential at the site boundary were based on the highest single annual average of the five onsite continuous air samplers located in the proximity of the site boundary.

The maximum dose to an individual was also based on the single highest yearly average of 5 onsite continuous air samplers. The maximum dose to population group(s) was based on the single highest yearly average of 20 offsite continuous air samplers surrounding the Laboratory. These results of dose estimates are given below:

Plutonium-238

As mentioned earlier, bone is the critical organ for plutonium. Therefore, the values indicated below are estimations for maximum potential dose to bone at: (1) the site boundary; (2) of individuals; and (3) of population group(s). The dose listed represents the annual internal dose following a continuous exposure for 50 years to airborne concentrations of plutonium-238 equivalent to those measured in the environment during 1974.

Maximum dose to bone at the site boundary	- 5.8 mrem
Maximum dose to bone in individuals	- 5.8 mrem
Maximum dose to bone in population group(s)	- 0.85 mrem

Tritium (oxide)

The critical organ for tritium (oxide) is the whole body. Therefore, these doses are estimations for whole body dose with the dose from tritium (oxide) in local

drinking water factored in. The other radionuclides apparently have had no effect on local drinking water since the values based on environmental monitoring are background or not detectable. The tritium (oxide) whole body dose estimations are shown below:

Maximum potential dose at site boundary	- 1.8 mrem/yr
Maximum dose to an individual	- 6.5 mrem/yr
Maximum dose to population group(s)	- 1.5 mrem/yr

The 50-mile (80 km) person-rem (whole body) dose estimates were based on average tritium (oxide) data from environmental air sampling stations out to a distance of 20 miles (32 km) from Mound Laboratory. The value from 20 to 50 miles was based on the average levels of tritium at 20 miles, extrapolated out to 50 miles. The dose from tritium (oxide) in the local drinking water was also included in this estimate. The results of the estimate, considering a total of 2,800,000 people in the 50-mile radius, is 56 person-rem.

For comparison the person-rem value from natural radiation, including cosmic rays and terrestrial radiation, would be approximately 320,000 person-rem. The dose commitment due to natural background tritium is 82 person-rem.

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APPENDIX

APPLICABLE STANDARDS

Radioactive Standards

In conformance with Federal Radiation Council (FRC) guidelines and ERDA Manual Chapter 0524, "Standards for Radiation Protection," offsite sample results are compared with RCG's established for the general population. These RCG's are derived by dividing the RCG's for an uncontrolled area by 3.

Onsite sample results are compared with the uncontrolled area RCG's rather than the controlled area RCG's which provides a conservative evaluation by approximately a factor of 10.

The RCG values (in microcuries per milliliter - μCi/ml) used for comparison purposes for the various types of samples in this report are listed below. In all cases, these are the most restrictive RCG's.

General Population

Air

Polonium-210 :	2×10^{-13}	μCi/ml
Plutonium-238:	2×10^{-14}	μCi/ml
Tritium :	7×10^{-8}	μCi/ml

Water

Polonium-210 :	2×10^{-7}	μCi/ml
Plutonium-238:	2×10^{-6}	μCi/ml
Tritium :	1×10^{-3}	μCi/ml

Uncontrolled Area

Air

Polonium-210 :	7×10^{-13}	μCi/ml
Plutonium-238:	7×10^{-14}	μCi/ml
Tritium :	2×10^{-7}	μCi/ml

Mixture

In addition to the RCG values for the individual radionuclides, the Standards for Radiation Protection (ERDA Manual Chapter 0524), indicate that if a mixture of more than one radionuclide occurs in air or water, the following guidelines shall be used. The ratio between the concentration of each radionuclide present in the mixture and its respective RCG

shall be determined. The sum of these ratios for all the radionuclides in the mixtures should not exceed unity. A radionuclide should not be considered part of the mixture if the ratio of the concentration of the radionuclide to its RCG is not greater than 1/10 provided that the sum of all such excluded ratios does not exceed 1/4.

Foodstuffs

There are no RCG values specied for foodstuffs as such since the water content of food was taken into account in the determination of RCG values for water. Consideration of radionuclides in food is necessary only in case of concentration in food during processing or in case it enters the food from other sources. For purposes of providing a reference point, the RCG for water converted to microcuries per gram is used for comparison.

Soil

There are no guidelines established for radioactive species in soil.

Nonradioactive Standards

The Ohio EPA has established Water Quality Standards (EP-1-EP-9) and Air quality Standards (EP-10-EP-19). The standards listed below are excerpted from these regulations.

Air

The standards listed below are State of Ohio Ambient Quality Standards. National Ambient Air Quality Standards are shown in parentheses. As previously stated, none of Mound Laboratory operations involve significant emissions to warrant environmental sampling for these nonradioactive pollutants at this time.

POLLUTANT	CONCENTRATION	REMARKS
Suspended Particulates (a)	60 micrograms/m^3 (75 primary, 60 secondary) (g)	Maximum annual geometric mean at any sampling site.
	150 micrograms/m^3 (260 primary, 150 secondary)	Maximum 24-hour concentration not to be exceeded more than 1 day per year.
Sulfur Dioxide (b)	60 microgram/m^3 (80 micrograms/m^3)	Maximum annual arithmetic mean concentration.
	260 micrograms/m^3 (365 micrograms/m^3)	Maximum 24-hour concentration not to be exceeded more than 1% of the time on annual basis.

POLLUTANT	CONCENTRATION	REMARKS
Carbon Monoxide (c)	10 milligrams/m^3 (10 milligrams/m^3)	Maximum 8-hour arithmetic mean concentration not be be exceeded more than one 8-hour period per year.
Photochemical Oxidants (d)	119 micrograms/m^3	Maximum 1-hour arithmetic mean.
	(160 micrograms/m^3)	
	79 micrograms/m^3	Maximum 4-hour arithmetic mean not to be exceeded more than one consecutive 4-hour period per year.
	40 micrograms/m^3	Maximum 24-hour arithmetic mean not to be exceeded more than one day per year.
NON METHANE Hydrocarbons (e)	126 micrograms/m^3 (160 micrograms)	Maximum 3-hour arithmetic mean concentration between the hours of 6 AM & 9 PM.
	331 micrograms/m^3	Maximum 24-hour arithmetic mean concentration not to be exceeded more than one day per year.
Nitrogen Oxides (f)	100 micrograms/m^3 (100 micrograms)	Annual arithmetic mean.
	250 micrograms/m^3 (250 micrograms)	24-hour concentration not to be exceeded more than one time per year.

(a) Housed high volume sampler.

(b) Hourly concentrations, continuous sampling, utilizing the colorometric analytical method.

Average 24-hour concentration - determined by hourly integrated data obtained as above, or through use of 24-hour bubblers, utilizing the West-Geake analytical procedure.

(c) Continuous sampling, utilizing the non-dispersive infrared principle.

(d) Continuous sampling, utilizing a chemiluminescent method.

(e) Determined as the difference between total hydrocarbon concentrations and methane concentrations, which are determined by the use of continuous sampling, utilizing the flame ionization methods providing a separate measurement of the methane fraction.

(f) Average 24-hour concentration - determined by hourly integrated data obtained as above, or through use of 24-hour bubblers, utilizing the Jacob-Hochheiser or arsenite analytical procedures.

(g) Primary standards: defines levels of air quality which are necessary to adequately protect the public health.

Secondary standard: defines levels of air quality which are necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

Water

The standards listed below are Water Quality Standards established by the Ohio EPA. These standards are stream standards and apply to a stream beyond a suitable mixing zone permitted for discharges. They should not be compared with effluent concentrations.

Constituent	Average Concentration (mg/l)
Dissolved Oxygen	5.0
pH	6-9
Fecal Coliform	200 per 100 ml
Dissolved Solids	1500
Ammonia	1.5
Arsenic	0.05
Barium	0.8
Cadmium	0.005
Chloride	250
Chromium (Hexavalent)	0.05
Cyanide (Free)	0.005
Fluoride	1.3
Foaming Agents (MBAS)	0.5
Iron	1
Lead	0.04
Manganese	1
Mercury	0.0005
Oil & Grease	5

Constituent	Average Concentration (mg/l)
Phenols	0.01
Selenium	0.005
Silver	0.001
Copper	0.005 - 0.075*
Zinc	0.075 - 0.5*

* Dependent on $CaCO_3$ hardness.

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MLM-2142

MLM-2142

Annual Environmental Monitoring Report: Calendar Year 1973

D. G. Carfagno and W. H. Westendorf

April 25, 1974

AEC Research and Development Report

MOUND LABORATORY
Miamisburg, Ohio
operated by

Monsanto

MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company
for the

U. S. ATOMIC ENERGY COMMISSION
U. S. Government Contract No. AT-33-1-GEN-53

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Annual Environmental Monitoring Report: Calendar Year 1973

D. G. Carfagno and W. H. Westendorf

Issued: April 25, 1974

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MOUND LABORATORY
Miamisburg, Ohio 45342

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FOREWORD

This report was prepared by the Environmental Control Section of the Personnel Safety and Environmental Control Function in the Administration Department at Mound Laboratory. Sample analyses and data reduction were performed by the Analytical and Development group of the Environmental Control Section. Particulate samples and data were also received from the Air Pollution Control Section of the Montgomery County Combined General Health District which acts as the Regional Air Pollution Control Agency in this region for the Ohio Environmental Protection Agency.

INTRODUCTION

Mound Laboratory is situated on 180 acres of land in Miamisburg, Ohio. This location is approximately 16 km (10 miles) southwest of Dayton. The predominant geographical feature in the five-county region surrounding the Laboratory is the Great Miami River which flows from the northeast to the southwest through Miamisburg. This river valley area is generally highly industrialized. The remainder of the region is predominantly agricultural with some light industry and scattered residential communities. The location and population of these communities are shown in Figure 1. The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately 10% of the land area in agricultural use is devoted to pasturing livestock.[1]

Weather conditions in the area are described as moderate. The average annual precipitation is approximately 91 cm (36 in.) and is evenly distributed throughout the year. Winds predominate out of the south or west except during the summer months when a higher frequency is observed out of the southwest. The wind speed averages about 16 km (10 miles) per hour annually.[2]

Mound Laboratory began operation in 1949. Its mission currently includes research, development, engineering, and production of components for the AEC weapons program; research, development, and production of explosive materials; separation, purification, and sale of stable isotopes of the noble gases; and development, design, and fabrication of radioisotopic heat sources for medical applications and use in space exploration. Radionuclides currently being handled include plutonium-238, polonium-210, and tritium.

Interest in the health and safety of employes and the public is manifested by an Environmental Control Program which has been in existence continuously throughout the Laboratory's history. Fundamental objectives of the Environmental Control Program are the containment of radioactive waste and control of nonradioactive effluents to levels well within existing or proposed standards. As part of this control function, all effluents containing polluting materials are controlled at each operating step. As a result of this control, any releases of low-level gaseous and liquid wastes to the environment are carefully controlled and dispersed to ensure that concentrations are well within recommended standards.

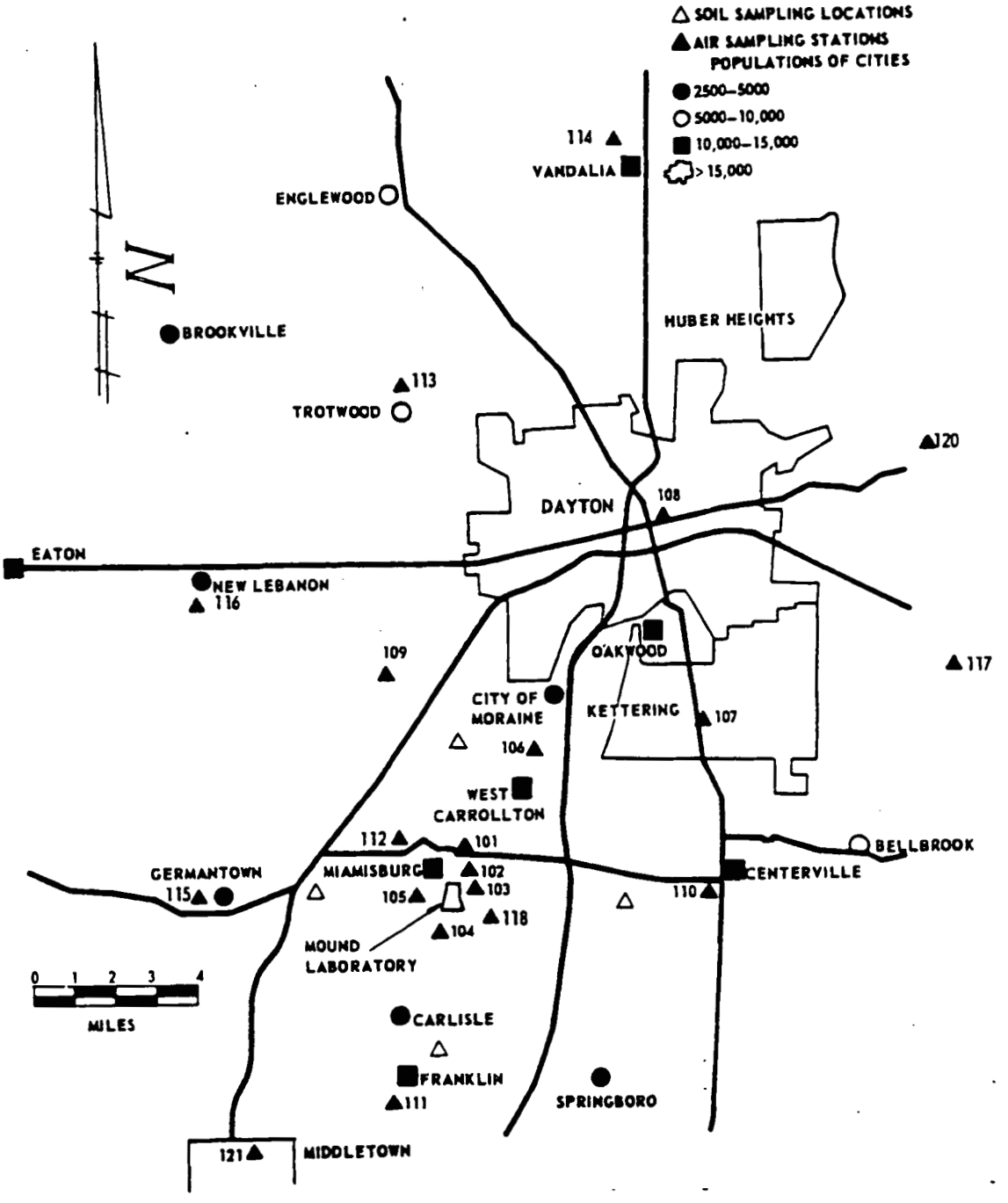

FIGURE 1 - Off-site air and soil sampling locations.

Radionuclides in particulate form are removed from air effluents by the use of high-efficiency particulate air (HEPA) filters. The air effluents are filtered first at the points of origin, i.e., glove boxes, and finally at the release point, i.e., the stack, by two banks of HEPA filters in series. Radionuclides are removed from liquid effluent by chemical processing. Solid radioactive wastes are packaged and shipped off site for burial at AEC-approved burial sites. Airborne and liquid wastes generated in the processing of explosive materials are collected and disposed of according to the Army Material Command Regulation 385-100.

A sanitary sewage treatment plant, which is operated in accordance with State of Ohio regulations, handles all domestic sewage generated on site. A general waste incinerator handles all combustible domestic waste. Ash from the incinerator is disposed of at an on-site sanitary land fill.

As part of the monitoring function of the program, air, water, foodstuff, and soil samples are collected from the environment at distances up to 32 km (20 miles) from the Laboratory boundaries. These samples are analyzed for the specific radionuclides handled at the Laboratory as well as for nonradioactive pollutants. The sampling techniques, analyses, and counting methods are those best suited for the determination of the radionuclides of interest and are designed to detect levels as low as background.

The results of the analyses for calendar year 1973 are provided in this report. Error limits, when given, reflect the overall analytical uncertainty in the data at the 95% confidence level.

SUMMARY

The environment surrounding Mound Laboratory was monitored and the results are reported for calendar year 1973. Samples analyzed included air, water, foodstuffs, soil, and silt. For radioactive species, the average concentrations of polonium-210, plutonium-238, and tritium detected were well within the stringent standards adopted by the Atomic Energy Commission and the Environmental Protection Agency. Data concerning nonradioactive species in air and water are also presented.

Atmospheric monitoring for radioactive species was upgraded by the addition of 11 air sampling stations to the existing off-site network of ten continuous, high-volume air sampling stations. The average concentrations of polonium-210, plutonium-238, and tritium measured in air during this period were less than 0.07%, 0.3% and 0.2% of the respective Radioactivity Concentration Guide (RCG) values.

Water monitoring for radioactive species showed the average concentrations of plutonium-238 and tritium measured at the water sampling locations during this period to be less than 0.1% and 0.5% of the respective RCG values.

Additionally, data concerning radioactive species in surface water, community drinking water, foodstuffs, and silt are presented. No significant uptake of radioactive species from air or water by plant or animal life has been observed. No reentrainment of radioactive species from soil or silt is indicated at this time. Soil core sample analyses will continue to establish a plutonium-238 soil inventory as part of the total program to assess the impact of the Laboratory's operations on the environment.

Water monitoring for nonradioactive species was conducted. Standards have been proposed for only three constituents of Mound's effluent streams. Their concentrations in the effluent streams are well within the proposed standards.

These data reflect the effectiveness of Mound's Environmental Control Program and indicate that the operation of the Laboratory does not have a measurable effect on the environment.

ENVIRONMENTAL MONITORING

Air - Radioactive

An off-site air sampling network consisting of 21 continuously operating air sampling stations is utilized to assess the effectiveness of systems controlling airborne emissions. Seven sampling stations are located within a 1.6-km (1-mile) radius of the Laboratory. This array of seven samplers surrounding the Laboratory ensures detection of any inadvertent release of radioactive materials and prompt assessment of the environmental impact, if any. Thirteen of the remaining samplers are located in or near population centers ranging from Vandalia, which is 33.6 km (21 miles) to the north, to Middletown, which is 16 km (10 miles) to the south. The remaining sampler (#119) is located at a distance approximately 44.8 km (28 miles) from the Laboratory in the least prevailing wind direction. This site should receive no measurable contribution from Mound Laboratory operations and will serve as a background sample for comparison purposes. The sampling sites are shown in Figure 1.

Two types of samples are collected at each sampling station: a particulate air sample for plutonium-238 and polonium-210 analysis; and a gas bubbler sample for tritium oxide analysis. The particulate sample is collected on a Microsorban disk of 200 mm diameter by means of a continuously operating (24 hrs per day, seven days per week) high-volume air sampler. The air is sampled at the rate of 1.1×10^6 cm^3/min (40 ft^3 /min). The Microsorban disk is changed weekly, which represents a sample of approximately 10,000 m^3 of air. Polonium-210 analyses are performed on a weekly basis while the plutonium-238 analyses are performed on a monthly composite sample. In the plutonium-238 analysis, plutonium-236 is used as an internal standard in the alpha pulse height analysis, thus allowing correction to be made for chemical recovery. The results reported represent total concentrations of the analyzed radionuclides including contributions from natural sources and atmospheric fallout.

Because commercial sales of polonium-210 from Mound Laboratory have ceased and the concentration of polonium-210 measured in the atmosphere has significantly decreased, weekly analyses for polonium-210 were performed during 1973 on samples collected at only two off-site locations.

If a significant increase in the concentration of polonium-210 is observed at these locations, additional analyses at other locations will be performed to ensure that control of emissions is still effective, i.e., well within stringent AEC standards. The results of the polonium-210 analyses are summarized in Table 1. Average concentrations measured were only 0.07% or less of the Radioactivity Concentration Guide (RCG). As a result, no further analyses were performed. It should be noted that the more restrictive RCG for the insoluble form of polonium was used for this comparison. This evaluation is therefore more conservative than in past years and is more consistent with other comparisons made in this report. (There is a discussion of RCG's in the appendix of this report.)

The average plutonium-238 concentrations measured were all less than 0.3% of the RCG. The RCG used for comparison is the guide for the soluble form of the isotope and for the general population. The most restrictive RCG for plutonium-238 is applied since the solubility of the measured particles in the potential receptor, the human body, is unknown at this time. The results are summarized in Table 2. For averaging purposes, samples below the minimum detection limit are assumed to be the value of the limit.

The gas bubbler sample is also collected on a continuous basis by bubbling air at approximately 3×10^3 cm^3/min through 500 ml of water. Any tritium oxide present in the air is collected in the solution. The sampling and analysis are directed to tritium oxide rather than to elemental tritium, since the RCG for the oxide is 200 times more restrictive. A sample representing 30 m^3 of air is collected, and an aliquot is counted in a liquid scintillation spectrometer. The average concentrations of tritium oxide measured during 1973 were all less than approximately 0.2% of the RCG. These results are summarized in Table 3. For averaging purposes, samples below the minimum detection limit are assumed to be the value of the limit.

Table 1

CONCENTRATION OF ^{210}Po IN AIR AT OFF-SITE SAMPLING LOCATIONS
CY-1973

Location*	Number of Samples	Range (10^{-15} µCi/ml)	Average** (10^{-15} µCi/ml)	Percent of RCG***
101	50	0.37 - 2.4	1.1 ± 0.1	0.05
108	52	0.45 - 2.2	1.3 ± 0.1	0.07

*Locations are shown in Figure 1. Samples from only two locations analyzed because of significant decrease in concentrations measured in atmosphere. (See page 8).

**Minimum detection limit (MDL) for ^{210}Po in air is 0.02×10^{-15} µCi/ml, which is 0.0003% of the RCG.

***RCG - Radioactivity Concentration Guide = 2000×10^{-15} µCi/ml.

Table 2

CONCENTRATION OF ^{238}Pu IN AIR AT OFF-SITE SAMPLING LOCATIONS
CY-1973

Location*	Number of Samples	Range (10^{-17} µCi/ml)	Average** (10^{-17} µCi/ml)	Percent of RCG***
101	50	1.1 - 15.7	4.7 ± 0.4	0.2
102	43	0.99 - 14.6	5.6 ± 0.5	0.3
103	52	0.46 - 18.4	5.7 ± 0.5	0.3
104	51	0.40 - 44.4	5.1 ± 0.4	0.3
105	51	0.06 - 5.5	1.6 ± 0.2	0.08
106	40	0.05 - 2.1	0.78± 0.17	0.04
107	45	<MDL - 6.1	0.88± 0.18	0.04
108	52	0.26 - 14.3	2.5 ± 0.3	0.1
109	49	0.06 - 59.4	5.2 ± 0.5	0.3
110	38	<MDL - 1.9	0.46 ± 0.13	0.02
111	52	<MDL - 2.6	0.40 ± 0.12	0.02
112	50	0.07 - 6.0	1.6 ± 0.2	0.08
113	46	<MDL - 1.1	0.42 ± 0.13	0.02
114	51	<MDL - 1.2	0.25 ± 0.10	0.01
115	49	<MDL - 1.2	0.31 ± 0.11	0.02
116	48	<MDL - 1.8	0.39 ± 0.12	0.02
117	50	<MDL - 1.0	0.19 ± 0.09	0.01
118	30	0.28 - 2.6	0.91 ± 0.19	0.05
119	41	<MDL - 2.0	0.39 ± 0.12	0.02
120	42	<MDL - 1.2	0.30 ± 0.11	0.01
121	42	<MDL - 1.0	0.26 ± 0.10	0.01

*Locations are shown in Figure 1.

**Minimum detection limit (MDL) for ^{238}Pu in air is 0.036 x 10^{-17} µCi/ml, which is 0.002% of the RCG.

***RCG - Radioactivity Concentration Guide = 2000 x 10^{-17} µCi/ml.

Table 3

CONCENTRATION OF TRITIUM OXIDE IN AIR AT OFF-SITE SAMPLING LOCATIONS
CY-1973

Location*	Number of Samples	Range (10^{-11} µCi/ml)	Average** (10^{-11} µCi/ml)	Percent of RCG***
101	49	<0.3 - 81	8.7 ± 1.0	0.1
102	51	<0.3 - 97	12.4 ± 1.2	0.2
103	52	<0.3 - 304	11.5 ± 1.1	0.2
104	51	<0.3 - 57	4.0 ± 0.9	0.06
105	52	<0.3 - 35	2.4 ± 0.8	0.03
106	51	<0.3 - 13	1.4 ± 0.8	0.02
107	52	<0.3 - 20	1.5 ± 0.8	0.02
108	52	<0.3 - 11	0.8 ± 0.8	0.01
109	52	<0.3 - 66	2.6 ± 0.9	0.04
110	52	<0.3 - 8	0.8 ± 0.8	0.01
111	52	<0.3 - 8	0.9 ± 0.8	0.01
112	50	<0.3 - 49	3.7 ± 0.9	0.05
113	51	<0.3 - 13	1.3 ± 0.8	0.02
114	51	<0.3 - 11	1.0 ± 0.8	0.01
115	50	<0.3 - 8	1.0 ± 0.8	0.01
116	49	<0.3 - 21	1.4 ± 0.8	0.02
117	50	<0.3 - 10	0.9 ± 0.8	0.01
118	45	<0.3 - 91	4.5 ± 0.9	0.06
119	41	<0.3 - 6	0.5 ± 0.7	0.01
120	42	<0.3 - 10	0.9 ± 0.8	0.01
121	44	<0.3 - 5	0.7 ± 0.7	0.01

*Locations are shown in Figure 1.

**Minimum Detection Limit (MDL) for tritium oxide in air is 0.3×10^{-11} µCi/ml, which is 0.004% of the RCG.

***RCG - Radioactivity Concentration Guide = 7000×10^{-11} µCi/ml.

An on-site perimeter network consisting of five continuous, high-volume air samplers is used to further assess the effectiveness of control systems. The on-site sampling locations are shown in Figure 2. Particulate and gas samples are collected by the on-site samplers at the same flow rate as the off-site samplers, i.e., 1.1×10^6 cm^3/min and 3×10^3 cm^3/min, respectively. The samples are also analyzed in the same manner as the off-site samples with the exception that all on-site samples are also analyzed for polonium-210. The results of the on-site polonium-210 analyses are summarized in Table 4. The average concentrations of polonium-210 measured during 1973 at the on-site sampling stations were all 0.02% or less of the RCG. The RCG used for comparison of these on-site samples, as well as of plutonium and tritium oxide samples, is the guide for an uncontrolled area as listed in the appendix.

The average plutonium-238 concentrations measured on site were all less than 2% of the RCG and are summarized in Table 5. The results of the on-site tritium oxide analyses are summarized in Table 6. The average concentrations measured were all less than 0.05% of the RCG. The total amounts of polonium-210, plutonium-238, and tritium discharged to the atmosphere during 1973 were 68 μCi, 84 μCi, and 15,000 Ci, respectively.

Table 4

CONCENTRATION OF ^{210}Po IN AIR AT ON-SITE SAMPLING LOCATIONS
CY-1973

Location*	Number of Samples	Range (10^{-15} μCi/ml)	Average** (10^{-15} μCi/ml)	Percent of RCG***
211	51	0.59 - 6.5	1.5 ± 0.1	0.02
212	51	0.48 - 2.0	1.1 ± 0.1	0.02
213	52	0.50 - 5.5	1.1 ± 0.1	0.02
214	49	0.26 - 3.3	1.0 ± 0.1	0.01
215	51	0.50 - 1.9	1.0 ± 0.1	0.01

*Locations are shown in Figure 2.

**Minimum Detection Limit (MDL) for ^{210}Po in air is 0.02×10^{-15} μCi/ml, which is 0.0001% of the RCG.

***RCG - Radioactivity Concentration Guide = 7000×10^{-15} μCi/ml.

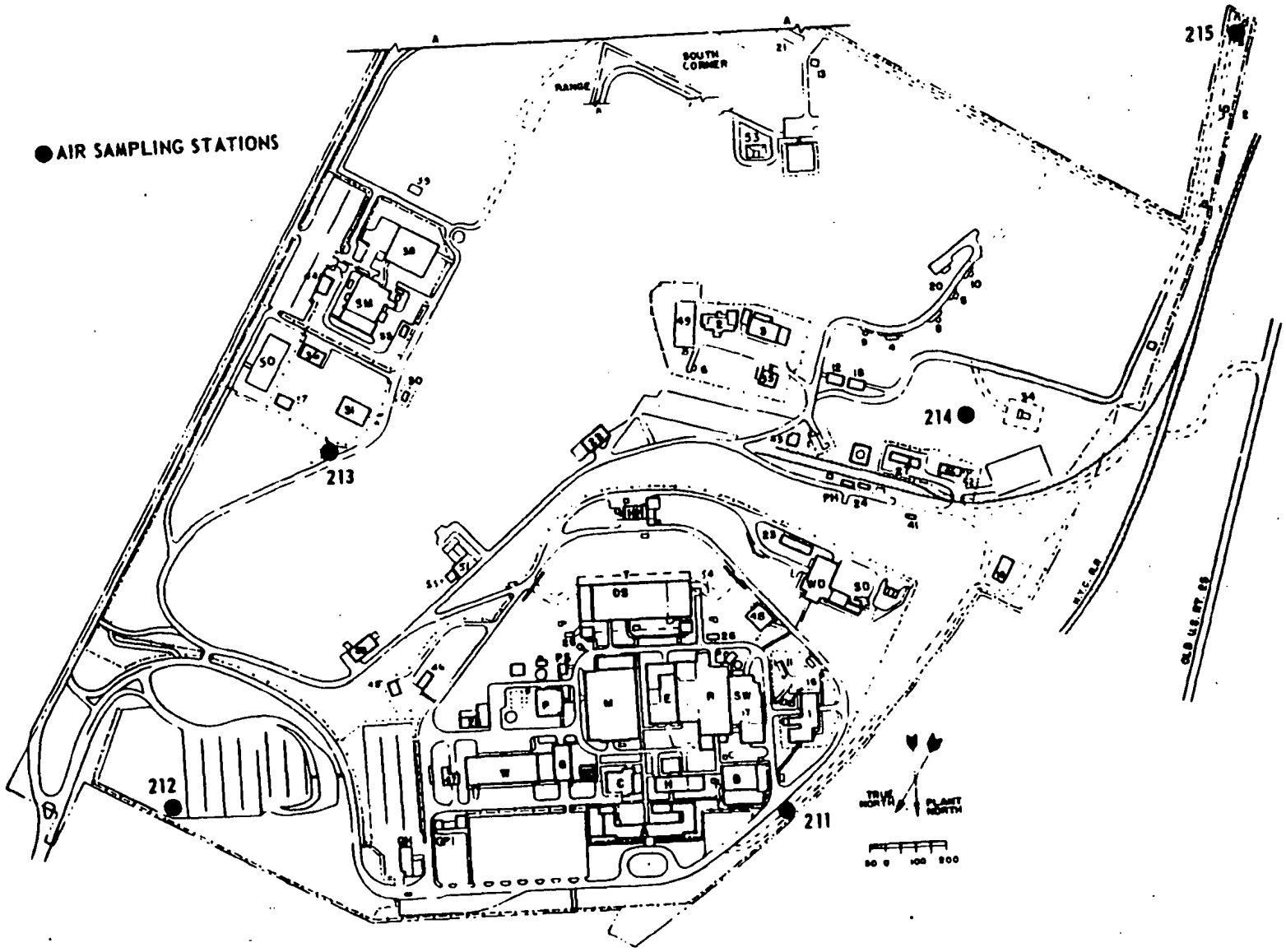

FIGURE 2 - On-site air sampling locations.

Table 5

CONCENTRATION OF ^{238}Pu IN AIR AT ON-SITE SAMPLING LOCATIONS
CY-1973

Location*	Number of Samples	Range (10^{-17} µCi/ml)	Average** (10^{-17} µCi/ml)	Percent of RCG***
211	51	18 - 285	94 ± 1.9	1.3
212	51	4.7 - 60	16 ± 0.8	0.2
213	51	13 - 900	139 ± 2	2.0
214	48	5.9 - 18	11 ± 0.7	0.2
215	50	1.8 - 35	6.8 ± 0.5	0.1

*Locations are shown in Figure 2.

**Minimum detection limit (MDL) for ^{238}Pu in air is 0.05×10^{-17} µCi/ml, which is 0.0007% of the RCG.

***RCG - Radioactivity Concentration Guide = 7000×10^{-17} µCi/ml.

Table 6

CONCENTRATION OF TRITIUM OXIDE IN AIR AT ON-SITE SAMPLING LOCATIONS
CY-1973

Location*	Number of Samples	Range (10^{-11} µCi/ml)	Average** (10^{-11} µCi/ml)	Percent of RCG***
211	52	<0.3 - 28	5.9 ± 1.4	0.03
212	52	<0.3 - 88	8.1 ± 1.6	0.04
213	52	<0.3 - 67	9.7 ± 1.9	0.05
214	50	<0.3 - 57	7.9 ± 1.5	0.04
215	51	<0.3 - 34	3.3 ± 1.3	0.02

*Locations are shown in Figure 2.

**Minimum Detection Limit (MDL) for tritium oxide in air is 0.3×10^{-11} µCi/ml, which is 0.002% of the RCG.

***RCG - Radioactivity Concentration Guide = $20,000 \times 10^{-11}$ µCi/ml.

Air - Nonradioactive

None of the operations presently carried on at Mound Laboratory involves amounts of material which would lead to significant carbon monoxide, photochemical oxidant, or hydrocarbon emissions from stationary sources. The steam power supply has been converted from fuel oil to natural gas, thus eliminating virtually all sulfur dioxide emissions. Therefore, no sampling for these pollutants is carried on at this time.

Particulate concentrations are determined on site by means of a low-volume air sampler continuously operating at 2.8×10^4 cm^3/min (1 ft^3/min). The annual geometric mean of the particulate concentrations measured on site was 42 $\mu g/m^3$ as compared to the annual geometric mean of 84 $\mu g/m^3$ measured by the Regional Air Pollution Control Authority within 1.6 km (1 mile) of the Laboratory. These measured levels represent the ambient air levels in the region including any contribution from Mound Laboratory.

Water - Radioactive

Water sampling locations along the bank of the Great Miami River were selected according to guidelines proposed by the Federal Environmental Protection Agency (EPA). The locations, shown in Figure 3, provide samples which are representative of river water after proper mixing with Mound's effluent. Water samples are collected at these locations five days per week and are subjected to specific analyses for plutonium-238 and tritium oxide. River samples are no longer analyzed for polonium-210 for the same reasons that air samples for polonium-210 have been reduced. Effluent streams leaving Mound are analyzed for polonium-210 as well as plutonium-238 and tritium. If a significant increase in these streams is detected, river samples will then be analyzed for polonium-210. No such increase was detected during 1973.

The plutonium-238 analyses are performed on a monthly composite of the daily samples. The concentrations of plutonium-238 measured in the Great Miami River are summarized in Table 7. The average concentrations were 0.1% or less of the RCG.

Tritium oxide analyses are performed on a weekly composite of the daily samples collected. The average concentrations of tritium oxide measured in the Great Miami River were all less than 0.5% of the RCG. These results are summarized in Table 8. The total amounts of polonium-210, plutonium-238, and tritium discharged to the Great Miami River are 12 mCi, 16 mCi, and 150 Ci, respectively.

Eight additional surface water locations, such as ponds and streams, are sampled quarterly. These locations are shown in Figure 3. A sample of approximately 4 liters is collected at each location and analyzed for plutonium-238 and tritium oxide. The average concentrations of plutonium-238 measured at these locations during 1973 were 0.06% or less

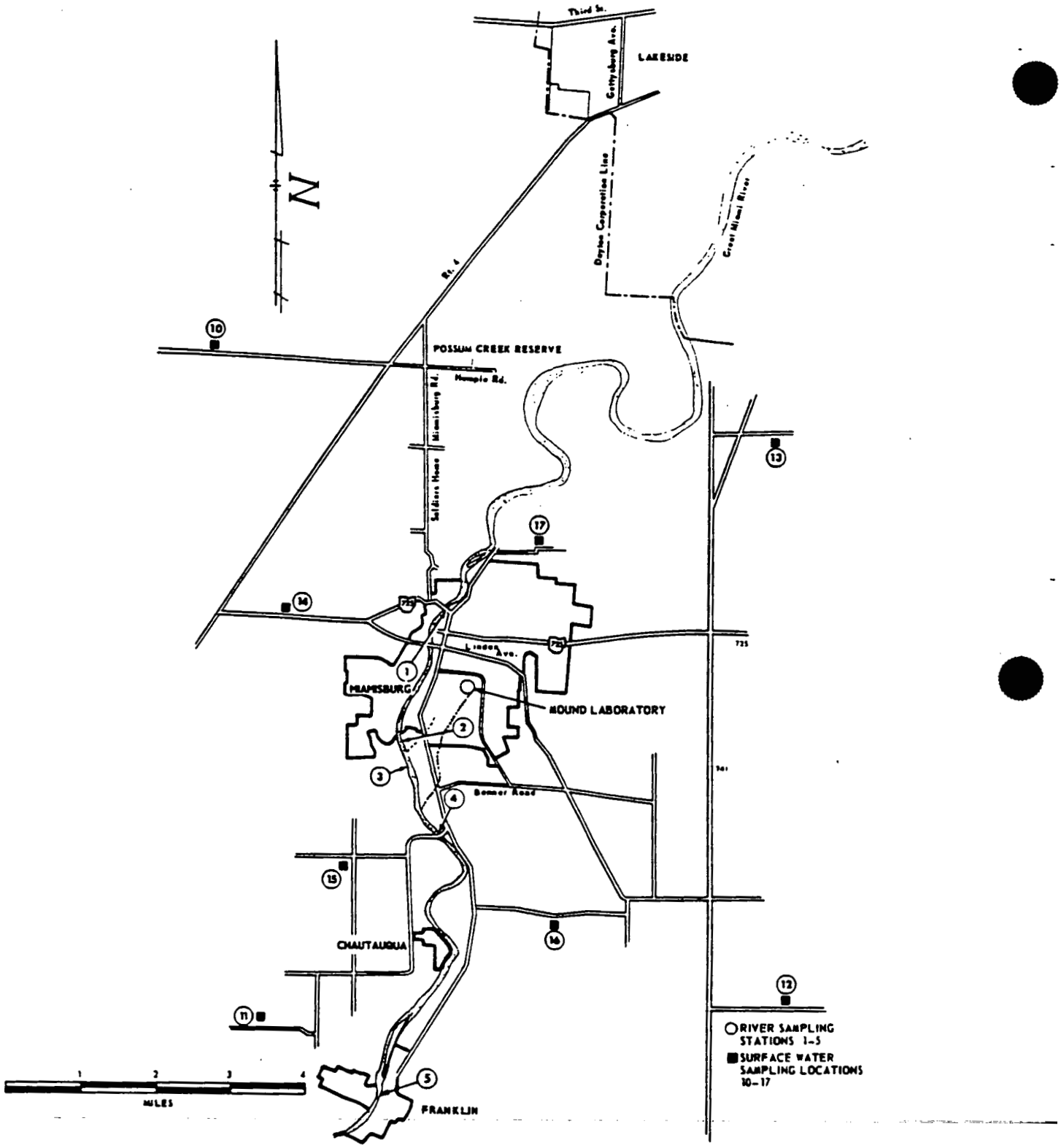

FIGURE 3 - Off-site water sampling locations.

Table 7

CONCENTRATION OF ^{238}Pu IN THE GREAT MIAMI RIVER
CY-1973

Location*	Number of Samples	Range (10^{-8} µCi/ml)	Average** (10^{-8} µCi/ml)	Percent of RCG***
1	251	0.01 - 0.5	0.09 ± 0.009	0.05
2	251	0.04 - 1.3	0.2 ± 0.01	0.1
3	251	0.02 - 1.3	0.2 ± 0.01	0.1
4	251	0.009- 3.5	0.1 ± 0.01	0.05
5	251	0.009- 0.2	0.05 ± 0.008	0.03

*Locations are shown in Figure 3.

**Minimum Detection Limit (MDL) for ^{238}Pu in water is 0.0009×10^{-8} µCi/ml, which is 0.0005% of the RCG.

***RCG - Radioactivity Concentration Guide = 200×10^{-8} µCi/ml.

Table 8

CONCENTRATION OF TRITIUM IN THE GREAT MIAMI RIVER
CY-1973

Location*	Number of Samples	Range (10^{-6} µCi/ml)	Average** (10^{-6} µCi/ml)	Percent of RCG***
1	251	<0.2 - 2.1	0.4 ± 0.4	0.04
2	251	<0.2 - 5.4	0.6 ± 0.4	0.06
3	251	<0.2 - 109	4.5 ± 0.5	0.5
4	251	<0.2 - 2.0	0.5 ± 0.4	0.05
5	251	<0.2 - 2.1	0.5 ± 0.4	0.05

*Locations are shown in Figure 3.

**Minimum Detection Limit (MDL) for tritium in water is 0.2×10^{-6} µCi/ml, which is 0.02% of the RCG.

***RCG - Radioactivity Concentration Guide = 1000×10^{-6} µCi/ml.

of the RCG. The average concentrations of tritium oxide measured at these locations were 0.2% or less of the RCG. The results of the surface water monitoring program are summarized in Tables 9 and 10.

Drinking water from communities in the surrounding area is sampled quarterly and analyzed for tritium oxide. These communities are shown in Figure 1. The concentrations of tritium oxide were found to be less than 1.2% of the RCG. The results of the community drinking water sampling program are summarized in Table 11.

Water - Nonradioactive

It is difficult to measure the levels of nonradioactive pollutants in the Great Miami River resulting from Mound Laboratory's water effluent because of the relatively high level of these pollutants already present in the river upstream from the outfalls. Therefore, a composite sample of both water effluent streams leaving the Laboratory is automatically collected and analyzed for various water quality parameters as reported below. The sample volume is proportionate to the flow in the stream. The composite effluent water samples are analyzed for the listed water quality parameters according to standard techniques for waste water analysis accepted by the Office of Water Programs of the Environmental Protection Agency.[3] The EPA has recently proposed effluent standards for nine toxic pollutants. Only three of these pollutants are found in Mound's effluent streams. The concentrations of these pollutants in Mound's effluent streams are well within the proposed standards. There are no effluent standards in effect at this time. The results of the effluent stream analyses are summarized in Table 12.

Foodstuffs and Vegetation - Radioactive

Various locally grown foodstuffs and vegetation samples are collected from the surrounding area. The intent of this portion of the Environmental Monitoring Program is to determine whether there is uptake and concentration of radionuclides by plant or animal life. Where possible, sampling sites are chosen at maximum deposition locations predicted on the basis of the diffusion model developed for Mound Laboratory. Field crops, fruit, and vegetables are collected on the basis of this diffusion model. Milk is collected from individual farms closest to the Laboratory. Aquatic life is trapped from the Miami River generally downstream of Miamisburg, dependent upon availability of fish. Grass samples are collected in the vicinity of the surface water locations listed in Tables 9 and 10.

As mentioned previously, commercial sales of polonium-210 from Mound Laboratory have ceased. Since air and water are monitored for polonium-210 and no significant increases have been observed, foodstuff samples are not analyzed for polonium-210. The plutonium-238 content of the foodstuff and vegetation samples is determined by slowly evaporating the samples to dryness and then proceeding with the same techniques used for plutonium-238 analyses of air samples.

Table 9

SUMMARY OF SURFACE WATER MONITORING FOR ^{238}Pu
CY-1973

Location*	Number of Samples	Range (10^{-10} µCi/ml)	Average** (10^{-10} µCi/ml)	Percent of RCG***
10	4	1.8 - 31	12 ± 1	0.06
11	4	1.3 - 4	2.3 ± 0.7	0.01
12	4	1.3 - 6	3.0 ± 0.8	0.01
13	4	0.9 - 1.8	1.3 ± 0.4	0.007
14	4	1.3 - 5	2.5 ± 0.7	0.01
15	4	0.7 - 5	2.2 ± 0.7	0.01
16	4	0.9 - 3	1.4 ± 0.4	0.007
17	4	0.9 - 12	3.7 ± 0.9	0.02

*Locations are shown in Figure 3.

**Minimum Detection Limit (MDL) for plutonium-238 in water is 0.4×10^{-10} µCi/ml. The MDL is 0.002% of the RCG.

***RCG - Radioactivity Concentration Guide for plutonium-238 in water = $20,000 \times 10^{-10}$ µCi/ml.

Table 10

SUMMARY OF SURFACE WATER MONITORING FOR TRITIUM
CY-1973

Location*	Number of Samples	Range (10^{-6} µCi/ml)	Average** (10^{-6} µCi/ml)	Percent of RCG***
10	4	<0.3	<0.3 ± 0.3	0.03
11	4	<0.3	<0.3 ± 0.3	0.03
12	4	<0.3	<0.3 ± 0.3	0.03
13	4	<0.3	<0.3 ± 0.3	0.03
14	4	0.6-3	1.9 ± 0.4	0.2
15	4	0.9-4	2.0 ± 0.4	0.2
16	4	<0.3	<0.3 ± 0.3	0.03
17	4	<0.03-3	1.2 ± 0.4	0.1

*Locations are shown in Figure 3.

**Minimum Detection Limit (MDL) for tritium in water is 0.3×10^{-6} µCi/ml. The MDL is 0.03% of the RCG.

***RCG - Radioactivity Concentration Guide for tritium oxide in water = 1000×10^{-6} µCi/ml.

Table 11

SUMMARY OF TRITIUM OXIDE LEVELS IN COMMUNITY DRINKING WATER
CY-1973

Location	Number of Samples	Range (10^{-6} µCi/ml)	Average* (10^{-6} µCi/ml)	Percent of RCG**
Bellbrook	4	<0.3 - 1.2	0.5 ± 0.3	0.05
Centerville	4	<0.3 - 0.8	0.4 ± 0.3	0.04
Dayton	4	<0.3 - 0.4	0.3 ± 0.3	0.03
Franklin	4	<0.3 - 0.9	0.5 ± 0.3	0.05
Germantown	4	<0.3 - 1.1	0.7 ± 0.3	0.07
Kettering	4	<0.3 - 0.8	0.4 ± 0.3	0.04
Miamisburg	4	8 - 15	11.2 ± 0.6	1.12
Middletown	4	<0.3 - 0.5	0.4 ± 0.3	0.04
Moraine	4	<0.3 - 0.9	0.5 ± 0.3	0.05
South Lebanon	4	<0.3	<0.3 ± 0.3	<0.03
Springboro	4	<0.3	<0.3 ± 0.3	<0.03
Waynesville	4	<0.3	<0.3 ± 0.3	<0.03
West Carrollton	4	<0.3 - 0.8	0.4 ± 0.3	<0.04

*Minimum Detection Limit (MDL) for tritium oxide is 0.3 x 10^{-6} µCi/ml. The MDL is 0.03% of the RCG.

**RCG - Radioactivity Concentration Guide for tritium oxide in water = 1000 x 10^{-6} µCi/ml.

Table 12

SUMMARY OF EFFLUENT WATER MONITORING FOR NONRADIOACTIVE CONSTITUENTS
CY-1973

Constituent	Average Value (mg/l)	Proposed EPA Effluent Standard (mg/l)
Heavy Metals		
Arsenic	<0.02	
Barium	0.11	
Bismuth	0.03	
Boron	0.15	
Cadmium	0.004	0.04
Chromium, hexavalent	0.01	
Cobalt	0.03	
Copper	0.10	
Iron	0.43	
Lead	0.02	
Manganese	0.03	
Mercury	<0.0008	0.02
Nickel	0.02	
Selenium	0.002	
Silver	0.006	
Zinc	0.1	
Other Inorganics		
Ammonia	0.3	
Chlorides	925	
Cyanide	<0.003	0.1
Dissolved Oxygen	8.2	
Fluoride	0.13	
Nitrates	1.6	
pH	7.6	
Phosphates	1.6	
Sulfates	103	
Total Dissolved Solids	1683	
Organic		
BOD	7.5	
Oil and Grease	2.6	
Physical Properties		
Suspended Solids	15	
Turbidity	<25-JTU*	
Biological Indicators		
Total Coliform	503/100ml	
Fecal Coliform	25/100ml	

*JTU represents a Jackson Turbidity Unit, a standard unit used to describe turbidity. This particular value is at the limit of sensitivity of the instrument used and basically indicates absence of any turbidity.

Milk samples are analyzed for tritium oxide by distilling the water fraction from an aliquot of the entire sample. The distillate is then analyzed for tritium by liquid scintillation spectrometry in the same manner as the water samples previously discussed in this report. The remaining foodstuff samples are analyzed for tritium by oxidizing the samples in a controlled air stream and collecting the combustion products. The tritium content of the combustion products is then determined by liquid scintillation spectrometry as discussed above. This technique allows analysis for total tritium in the samples rather than tritium oxide. The results of the foodstuff and vegetation analyses are summarized in Table 13. The concentration is given in terms of the sample weight before evaporation to dryness. The vegetables analyzed included potatoes and tomatoes. The field crops analyzed were the edible portions of corn and soybeans. The sample of aquatic life analyzed included only the edible fleshy portions of the fish. The concentration of tritium measured in grass samples (not including roots) for 1973 approaches background concentration, which is an order of magnitude lower than 1972 results. This would indicate that tritium uptake does occur in grass but that exchange with environmental hydrogen is rapid and there is no concentration or buildup of tritium in grass. No evidence has been found, as yet, that there is any significant uptake and concentration by plant or animal life of these radionuclides handled at Mound Laboratory.

Soil and Silt - Radioactive

The soil sampling program has included two aspects of soil monitoring. One aspect, which was reported in MLM-1922, Environmental Monitoring Report: July - December 1971 and 1971 Summary, is the evaluation of the the resuspendable amounts of plutonium-238 in soil. For this evaluation, surface scrapings of undisturbed soil, from a depth of approximately 3/10 cm (1/8 in.) are collected and analyzed. Review of the possible pathways that plutonium could follow from soil to man, indicate that the most likely pathway is inhalation of resuspended material. Therefore, evaluation of resuspendable plutonium in soil is best accomplished by continuous high-volume air sampling, not only because this samples the direct pathway to man, but also because air sampling and analyses are more accurate and reproducible than soil sampling and analyses. If air sampling results indicate a potential problem in this area, surface soil sampling will be resumed.

The second aspect of soil monitoring, which was also reported in the Environmental Monitoring Reports for 1971 and 1972 (MLM-1922 and MLM-2028), is soil core sampling. The purpose of this type of soil sampling is the documentation, for historical purposes, of the total accumulation and distribution of plutonium deposited off site, and the verification of Mound Laboratory's atmospheric diffusion model. Present plans are to complete the initial total inventory during 1975 and then to repeat and refine the inventory over the next five-year interval, i.e., complete a revised and updated inventory by 1980. Soil core samples 8.9 cm (3.5 in.) in diameter and approximately 30.5 cm (12 in.) deep are taken for the

Table 13

SUMMARY OF FOODSTUFFS AND VEGETATION ANALYSES
CY-1973

Type of Sample	Number of Samples	^{238}Pu (10^{-8} μCi/g) Range	^{238}Pu (10^{-8} μCi/g) Average*	^{238}Pu (10^{-8} μCi/g) Percent of RCG**	Tritium (10^{-6} μCi/g) Range	Tritium (10^{-6} μCi/g) Average***	Tritium (10^{-6} μCi/g) Percent of RCG****
Milk	12	0.02 - 0.4	0.09 ± 0.03	0.05	<0.1 - 3.8	1.2 ± 0.5	0.12
Fruits and Vegetables	2	0.07 - 0.3	0.16 ± 0.04	0.08	0.2 - 1.3	0.7 ± 0.5	0.07
Grass	32	0.2 - 1.6	0.7 ± 0.02	0.3	<0.1 - 1.5	0.5 ± 0.5	0.05
Field Crops	2	---	---	---	1.2 - 1.5	1.4 ± 0.5	0.14
Aquatic Life	4	0.2 - 0.6	0.4 ± 0.1	0.2	<0.1 - 3.7	1.4 ± 0.5	0.14

NOTE: There are no RCG's for foodstuffs. Water RCG's are used merely for reference purposes.

*Minimum Detection Limit (MDL) for ^{238}Pu in foodstuffs is 0.0015×10^{-8} μCi/g. The MDL is 0.0007% of the RCG.

**RCG - Radioactivity Concentration Guide for ^{238}Pu in water = 200×10^{-8} μCi/g.

***Minimum Detection Limit for tritium in foodstuffs is 0.1×10^{-6} μCi/g. The MDL is 0.01% of the RCG.

****RCG - Radioactivity Concentration Guide for ^{3}H oxide in water = 1000×10^{-6} μCi/g.

inventory determination. Core samples were collected at one location in each quadrant of the Laboratory grounds during 1973. At each of these four locations, shown in Figure 1, ten cores were collected from an area of 2.78 m^2 (30 ft^2) and were composited to form one core sample. Additional core samples for background control data were taken from locations farther than 32 km (20 miles) from the Laboratory.

Soil samples are digested with an acid mixture to extract the plutonium. The solution is then passed over an ion exchange column specific for plutonium and analyzed in the same manner as the particulate air samples previously discussed in this report. This leach method has been compared with a fusion method for soil analysis.[4] Although good agreement was obtained between the two methods, the leach method was chosen for the soil analysis because larger samples, which minimize sampling and aliquoting errors and increase sensitivity, can be handled with this method. The results of the core sampling program for 1973 are summarized in Table 14. As mentioned previously in this report, no standards have been established for radioactive species in soil. Additional sample analyses are necessary before a total inventory can be calculated and these are continuing as part of Mound Laboratory's comprehensive Environmental Control Program.

Silt samples are collected annually from the same surface water locations which are sampled monthly. The silt samples are analyzed in the same manner as the soil samples. The results of the silt sampling from the area ponds are summarized in Table 15. No significant accumulation is indicated by the pond silt data. As previously mentioned in this report, there are no standards for radioactive species in soil or silt.

EVALUATION OF DOSE TO THE PUBLIC

A dose estimate was made for each radionuclide found in Mound Laboratory's effluent streams. Tritium (oxide) is the only radionuclide for which the critical organ is the whole body. The other radionuclides emitted from Mound Laboratory, plutonium-238 and polonium-210, will concentrate in specific organs, namely, plutonium in bone and polonium in the kidney.

The dose estimates were based on environmental monitoring data for CY-1973. The dose estimates for air were based on perimeter and off-site continuous air sampling data (including background), and the dose estimate for waterborne radionuclides was based only on tritium in drinking water for the local area. The levels of other radionuclides indicated background or nondetectable levels in drinking water and were thus not factors in the estimates.

The dose estimates obtained for the maximum potential at the site boundary were based on the single highest annual average of the five on-site continuous air samplers located in the proximity of the site boundary. The maximum dose to an individual was also based on the single highest yearly average of the five continuous on-site samplers.

Table 14

SUMMARY OF SOIL CORE ANALYSES FOR ^{238}Pu
CY-1973

Location* (Direction and Distance)		^{238}Pu (10^{-3} μCi/m^2)**
North	5.9 km (3.7 miles)	0.71 ± 0.09
East	6.4 km (4.0 miles)	1.09 ± 0.11
South	5.4 km (3.4 miles)	1.37 ± 0.19
West	5.4 km (3.4 miles)	1.49 ± 0.20
Background	>32 km (>20 miles)	1.27 ± 0.37

*Locations are shown in Figure 1.

**Minimum Detection Limit for ^{238}Pu in soil is 0.004 x 10^{-3} μCi/m^2.

NOTE: No standards for radioactive species in soil have been established.

Table 15

SUMMARY OF POND SILT ANALYSES FOR ^{238}Pu
CY-1973

Location*	^{238}Pu (10^{-8} μCi/g)**
10	1.7 ± 0.4
11	3.8 ± 0.6
12	---
13	2.9 ± 0.5
14	1.9 ± 0.4
15	9.0 ± 0.9
16	5.2 ± 0.7
17	2.3 ± 0.5

*Locations are shown in Figure 3.

**Minimum Detection Limit for ^{238}Pu in silt samples is 0.05 x 10^{-8} μCi/g. The concentration is in terms of standard dry weight.

NOTE: No standards for radioactive species in silt have been established.

The maximum dose to population group(s) was based on the single highest yearly average of 20 off-site continuous air samplers surrounding the Laboratory, with the exception of that for polonium-210. The maximum dose estimates for polonium-210 were based on the single highest yearly average of two off-site samplers. The results of these dose estimates are given below:

Plutonium-238

As mentioned earlier, bone is the critical organ for plutonium. Therefore, the values indicated below are estimates for maximum potential dose to bone 1) at the site boundary, 2) of an individual, and 3) of population group(s).

Maximum dose to bone at the site boundary	9.9 mrem/yr
Maximum dose to bone of an individual	9.9 mrem/yr
Maximum dose to bone of population group(s)	0.48 mrem/yr

Polonium-210

As mentioned earlier, the kidney is the critical organ for polonium. Therefore, the values indicated below are estimated for maximum potential dose to the kidney 1) at the site boundary, 2) of an individual, and 3) of population group(s).

Maximum dose to the kidney at the site boundary	0.11 mrem/yr
Maximum dose to the kidney of an individual	0.11 mrem/yr
Maximum dose to the kidney of population group(s)	0.11 mrem/yr

Tritium (oxide)

The critical organ for tritium (oxide) is the whole body. Therefore, these doses are estimates for whole body dose with the dose from tritium (oxide) in local drinking water factored in. The other radionuclides apparently have had no effect on local drinking water since their levels based on environmental monitoring are either background or not detectable. The tritium (oxide) potential whole body dose estimates are shown below.

Maximum dose at the site boundary	1.1 mrem/yr
Maximum dose to an individual	1.1 mrem/yr
Maximum dose to population group(s)	1.3 mrem/yr

The 80-km (50-mile) man-rem, or whole body, dose estimates were based on average tritium (oxide) data from environmental air sampling stations out to a distance of only 32 km (20 miles) from Mound Laboratory, thereby giving more conservative figures than if they were actually based on values from 20 to 50 miles. The dose from tritium (oxide) in the local drinking water was also included in this estimate. The results of the estimate, considering a total of 2,800,000 people in the 80-km (50-mile)

radius, is 51 man-rem. For comparison, the man-rem value from natural radiation, including cosmic rays and terrestrial radiation, would be 392,000 man-rem.

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APPENDIX

ADDITIVE LEVELS DUE TO RADIONUCLIDE MIXTURE

The "Standards for Radiation Protection" (AEC Manual Chapter 0524) states that a radionuclide should not be considered part of the mixture if the ratio of the concentration of the radionuclide to its RCG is not greater than 1/10. Furthermore, the sum of all such excluded ratios cannot exceed 1/4. The sum of the ratios of the concentrations of radionuclides to their respective RCG's are listed below. The sum is presented for the maximum levels detected off site in both air and water.

	AIR	WATER
Concentration of ^{210}Po/RCG for ^{210}Po	0.001	*
Concentration of ^{238}Pu/RCG for ^{238}Pu	0.030	0.017
Concentration of tritium oxide/RCG for tritium oxide	0.043	0.109
SUM	0.074	0.126

The data indicate that, according to the criteria of AEC Manual Chapter 0524, a mixture of radionuclides did not occur during 1973.

*Off-site water samples no longer analyzed for ^{210}Po for the same reasons that air samples have been reduced. See page 8.

APPLICABLE STANDARDS

Radioactive Standards

In conformance with Federal Radiation Council (FRC) guidelines and AEC Manual Chapter 0524, "Standards for Radiation Protection," off-site sample results are compared with RCG's established for the general population. RCG's for the general population are derived by dividing the RCG's for an uncontrolled area by 3.

On-site sample results are compared with the RCG's for an uncontrolled area rather than with the RCG's for a controlled area, thus providing an evaluation more conservative by a factor of approximately 10.

The RCG values used for comparison purposes for the various types of samples in this report are listed below. In all cases, these are the most restrictive RCG's.

General Population

Air

Polonium-210 : 2×10^{-12} microcuries per milliliter (μCi/ml)

Plutonium-238: 2×10^{-14} microcuries per milliliter (μCi/ml)

Tritium : 7×10^{-8} microcuries per milliliter (μCi/ml)

Water

Polonium-210 : 2×10^{-7} microcuries per milliliter (μCi/ml)

Plutonium-238: 2×10^{-6} microcuries per milliliter (μCi/ml)

Tritium : 1×10^{-3} microcuries per milliliter (μCi/ml)

Uncontrolled Area

Air

Polonium-210 : 7×10^{-12} microcuries per milliliter (μCi/ml)

Plutonium-238: 7×10^{-14} microcuries per milliliter (μCi/ml)

Tritium : 2×10^{-7} microcuries per milliliter (μCi/ml)

Mixture

In addition to setting the RCG values for the individual radionuclides, the "Standards for Radiation Protection" (AEC Chapter 0524) states that if a mixture with more than one radionuclide occurs in air or water, the following guidelines shall be used. The ratio between the concentration of each radionuclide present in the mixture and its respective RCG shall be determined. The sum of these ratios for all the radionuclides in the mixture should not exceed "unity". A radionuclide is not to be considered part of the mixture unless the ratio of the concentration of the radionuclide to its RCG is greater than 1/10, provided that the sum of all such excluded ratios does not exceed 1/4.

Foodstuffs

There are no RCG values specified for foodstuffs as such, since the water content of food is taken into account in the determination of RCG values for water. Consideration of radionuclides in food is necessary only in case of concentration in food during processing or in case of entrance into the food from other sources. For purposes of providing a reference point, the RCG for water converted to microcuries per gram is used for comparison.

Soil

There are no guidelines established for radioactive species in soil.

Nonradioactive Standards

Concentrations of nonradioactive species in air and water are compared with standards promulgated by the Offices of Air and Water Programs of the Environmental Protection Agency. If a local standard which is more restrictive than the national standard is in effect it will be used for comparison. The following air and water standards are ambient standards since emission or effluent standards do not exist at this time for the State of Ohio. Ambient standards are more restrictive since dilution by the environment is taken into account and no further dilution is expected.

Air

The National Ambient Air Quality Standards should be used for comparison since they are more restrictive than the State of Ohio Ambient Air Quality Standards. The national standards are:

Particulate Matter	60 micrograms/cubic meter ($\mu g/m^3$)[a]
Sulfur Dioxide	60 micrograms/cubic meter ($\mu g/m^3$)[b]
Carbon Monoxide	10 milligrams/cubic meter (mg/m^3)[c]
Photochemical Oxidants	160 micrograms/cubic meter ($\mu g/m^3$)[d]
Hydrocarbons	160 micrograms/cubic meter ($\mu g/m^3$)[e]
Oxides of Nitrogen	100 micrograms/cubic meter ($\mu g/m^3$)[b]

[a] Annual geometric mean
[b] Annual arithmetic mean
[c] Eight-hour mean, not to be exceeded more than once per year
[d] One-hour mean, not to be exceeded more than once per year
[e] Three-hour mean, not to be exceeded more than once per year

Water

There are no standards in effect at this time for concentrations of pollutants in effluent streams. The EPA has proposed, for nine toxic pollutants, effluent standards which will go into effect one year after their promulgation. Listed below are the proposed effluent standards for discharges into fresh water streams which have a low flow greater than 2.8×10^5 cm^3/sec (10 ft^3/sec), and a low flow greater than or equal to 10 times the waste stream flow with the provision that an immediate 1:10 diffusion is ensured.

Constituent	Proposed Effluent Standard (μg/liter)
Aldrin-Dieldrin	0.5
Benzidine	1.8
Cadmium	40
Cyanide	100
DDT	0.2
Endrin	0.2
Mercury	20
Polychlorinated Biphenyls (PCB's)	280
Toxaphene	1

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1972

Annual Environmental Monitoring Report: Calendar Year 1972

D. G. Carfagno and W. H. Westendorf

March 15, 1973

AEC Research and Development Report

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Miamisburg, Ohio 45342

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ABSTRACT

The environment surrounding Mound Laboratory was monitored and reported on for calendar year 1972. Samples analyzed and reported on included air, water, foodstuffs, soil and silt. For radioactive species, the average concentrations of polonium-210, plutonium-238 and tritium detected were well within the stringent standards adopted by the Atomic Energy Commission and the Environmental Protection Agency. Data concerning nonradioactive species in air and water are also presented. Data for these indicate that Mound Laboratory operations have negligible effect on the environment.

FOREWORD

This report was prepared by the Environmental Control Section of the Administration Department at Mound Laboratory. Sample analysis and data reduction were performed by the Analytical and Development group of the Environmental Control Section. Several special samples were analyzed by the Nuclear Operations General Analytical Group. Particulate samples and data were also received from the Air Pollution Control Section of the Montgomery County Combined General Health District which acts as the Regional Air Pollution Control Agency in this region for the State of Ohio Environmental Protection Agency.

INTRODUCTION

Mound Laboratory is situated on 180 acres of land in Miamisburg, Ohio. This location is 12 miles southwest of Dayton. The area within a 20-mile radius of the Laboratory includes essentially all of Montgomery County and approximately 30 to 60% of the adjoining counties of Butler, Greene, Preble and Warren. The predominant geographical feature in the five-county region is the Great Miami River which flows through Miamisburg from the northeast to the southwest. This river valley area is generally highly industrialized. The remainder of the region is predominantly agricultural with some light industry and scattered residential communities. The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately 10% of the land area in agricultural use is devoted to pasturing livestock.[1]

Weather conditions in the area are considered moderate. The average annual precipitation is approximately 36 in. and is evenly distributed throughout the year. Winds predominate out of the south and west except during the summer months when a higher frequency is observed out of the southwest. The wind speed averages about 10 miles per hour annually.[2]

Mound Laboratory began operation in 1949. Its mission currently includes research, development, engineering, and production of components for the AEC weapons program; research, development, and production of explosive materials; separation, purification, and sale of stable isotopes of the noble gases; and development, design, and fabrication of radioisotopic heat sources for medical application and space exploration. Radionuclides currently being worked with include plutonium-238, polonium-210 and tritium.

Interest in the health and safety of employes and the public is manifested by an Environmental Control Program which has been in existence continuously during the Laboratory's history. Fundamental objectives of the environmental control program are the containment of radioactive waste and control of nonradioactive effluents to levels well within existing or proposed standards. As part of the program's control function, all effluents containing polluting materials are controlled at each operating step. As a result of this control, any releases of low-level gaseous and liquid wastes to the environment are carefully controlled and dispersed to ensure that concentrations are well within recommended standards.

Radioisotopes in particulate form are removed from air effluents by the use of high-efficiency particulate air (HEPA) filters. The air effluents are filtered at the points of origin (i.e., gloveboxes) and finally at the release point (i.e., the stack) by two banks of HEPA filters in series. Radioisotopes are removed from liquid effluent by chemical processing.

Solid radioactive wastes are packaged and shipped off site for burial at AEC-approved burial sites. Airborne and liquid wastes generated in the processing of explosive materials are collected and disposed of according to the Army Material Command Regulation 385-100.

A sanitary sewage treatment plant, which is operated in accordance with State of Ohio regulations, handles all domestic sewage generated on site. A general waste incinerator, which was completed during the year, handles all combustible domestic waste. Ash from the incinerator is disposed of at an on-site sanitary land fill.

As part of the program's monitoring function, air, water, foodstuff and soil samples are collected in a 380-square mile area. These samples are analyzed for the specific radionuclides handled at the Laboratory as well as nonradioactive pollutants. The sampling techniques, analyses and counting methods are those best suited for the determination of the radionuclides of interest and are designed to detect levels as low as background.

The results of the analyses for calendar year 1972 are provided in this report. Error limits, when given, reflect analytical uncertainties in the data at the 95% confidence level.

ENVIRONMENTAL MONITORING

Air - Radioactive

Mound Laboratory, through the AEC, has entered into a contractual agreement with the Montgomery County Combined General Health District (MCCGHD) for the installation and operation of a sampling network consisting initially of ten off-site air sampling stations. Installation of the sampling stations was completed during February 1972. The sampling sites were located on the basis of a diffusion model[3] developed by the Dayton Laboratory of Monsanto Research Corporation. Five of the samplers are located within a 1-mile radius of the Laboratory perimeter. The remaining five samplers are located in adjacent population centers in the northeastern quadrant up to 10 miles from the Laboratory. The sampling sites are shown on Figure 1. Eleven additional sampling stations will be completed during the first quarter of 1973. Two types of samples are collected: a particulate sample for plutonium-238 and polonium-210 analysis, and a gas bubbler sample for tritium oxide analysis.

The particulate sample is collected on a 200-mm-diameter Microsorban disk by means of a continuously operating high-volume air sampler. The air is sampled at the rate of 40 ft^3/min (1×10^8 cc/min). The Microsorban disk is changed weekly, which represents a sample of approximately 10,000 m^3 of air. Polonium-210 analyses are performed on a weekly basis while the plutonium-238 analyses are performed on a monthly composite sample. The plutonium-238 analysis includes the use of plutonium-236 as an internal standard in conjunction with alpha pulse height analysis which allows correction for chemical and counting losses to be made. The results reported below represent total concentrations of the analyzed radionuclides including contributions from natural sources and atmospheric fallout.

Since commercial sales of polonium-210 from Mound Laboratory have ceased, and the concentration of polonium-210 measured in the atmosphere has significantly decreased, samples collected at only two off-site locations were analyzed for polonium-210 during 1972. If a significant increase in the concentration of polonium-210 is observed at these locations, additional analyses at other locations will be performed to assure that control of emissions is still effective (i.e., well within stringent AEC standards). The results of the polonium-210 analyses are summarized in Table 1. Average concentrations measured were only 0.02% of the Radioactivity Concentration Guide (RCG). A listing and discussion of RCG's are located in the appendix of this report.

The average plutonium-238 concentrations measured were all less than 0.3% of the RCG. The RCG used for comparison is the guide for the soluble form

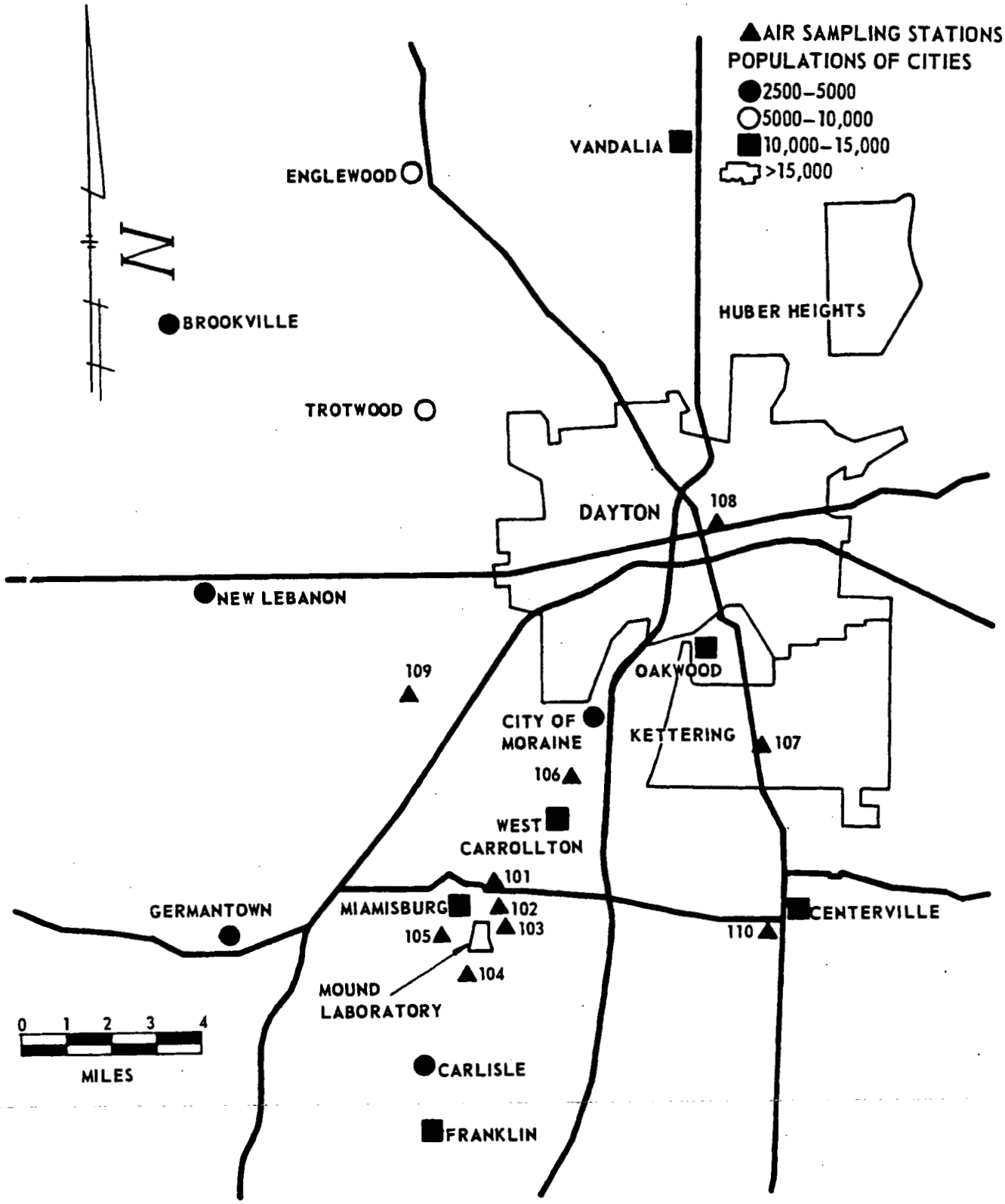

FIGURE 1 - Air sampling locations.

of the isotope and for the general population. This is the most restrictive RCG for plutonium-238 and is applied since the solubility of the measured particles in the potential receptor (i.e., the human body) is unknown at this time. These results are summarized in Table 2.

The gas bubbler sample is also collected on a continuous basis at approximately 3×10^3 cc/min. The sample is collected by bubbling air through 500 ml of a water-ethylene glycol mixture. Any tritium oxide present in the air is collected in the solution. The ethylene glycol is added to the water to lower both its vapor pressure and freezing point. The sampling and analysis are directed to tritium oxide rather than elemental tritium since the RCG for the oxide is 200 times more restrictive. A sample representing 30 m^3 of air is collected and an aliquot of this is counted in a liquid scintillation spectrometer. The average concentrations of tritium oxide measured during 1972 were all less than approximately 0.1% of the RCG. These results are summarized in Table 3.

An on-site perimeter network of five continuous, high-volume air samplers became operational during July 1972. This network replaced three interim samplers in operation since 1970. The on-site sampling locations are shown in Figure 2. Particulate and gas samples are collected by the on-site samplers at the same flow rate as the off-site samplers (i.e., 40 ft^3/min and 3×10^3 cc/min, respectively).

The samples are also analyzed in the same manner as the off-site samples with the exception that all on-site samples are analyzed for polonium-210. The results of the on-site polonium-210 analyses are summarized in Table 4. The average concentrations of polonium-210, measured during 1972 at the on-site sampling stations, were all less than 0.01% of the RCG. The RCG used for comparison for these on-site samples as well as plutonium and tritium oxide samples is the guide for an uncontrolled area.

The average plutonium-238 concentrations measured on-site were all less than 0.6% of the RCG and are summarized in Table 5.

The results of the on-site tritium oxide analyses are summarized in Table 6. The average concentrations measured were all less than 0.1% of the RCG.

Air - Nonradioactive

None of the operations presently carried on at Mound Laboratory involve amounts of material which would lead to significant carbon monoxide, photochemical oxidant or hydrocarbon emissions from stationary sources. The steam power supply has been converted form fuel oil to natural gas, thus eliminating virtually all sulfur dioxide emissions. Therefore, no sampling for these pollutants is carried on at this time. Particulate sampling prior to incinerator operation has been carried out on-site to establish a background level. The particulate concentrations were determined on-site by means of a low-volume air sampler continuously operating at 1 ft^3/min. The annual geometric mean of the particulate concentrations measured was 42 $\mu g/m^3$ as compared to the annual geometric mean of 84 $\mu g/m^3$ measured by the Regional Air Pollution Control Authority within 1 mile of the Laboratory. It should be noted that the Mound Laboratory operations do not at this time result in measurable particulate discharges, and this measured level represents the ambient air levels in the region.

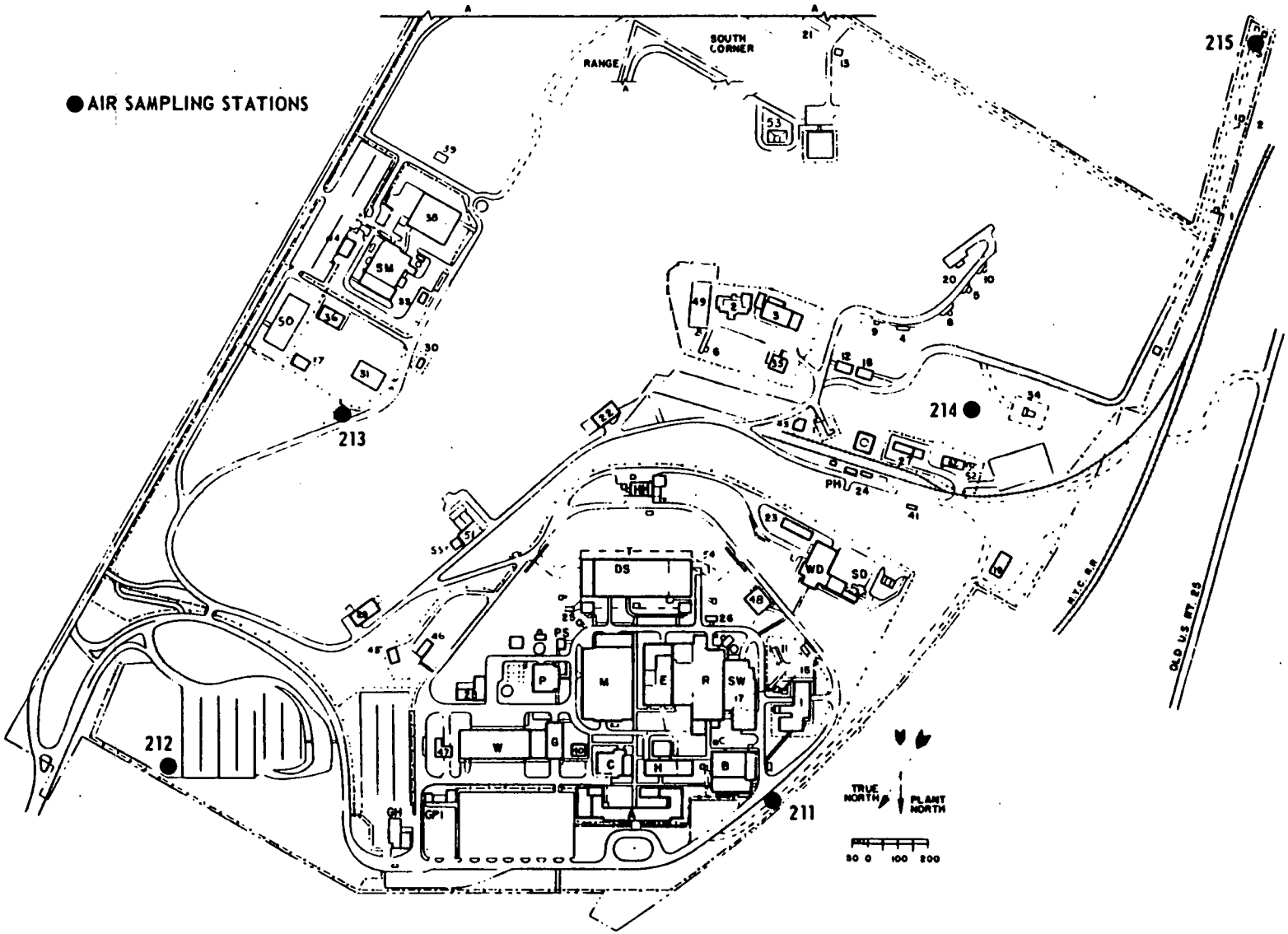

FIGURE 2 - On-site air sampling locations.

Water - Radioactive

Water sampling locations along the bank of the Great Miami River were revised during the first half of 1972. The revised locations will provide samples which are more representative of river water after proper mixing of Mound's effluent has occurred. Guidelines proposed by the federal EPA were utilized in selecting the new sampling locations. These locations are shown in Figure 3. Water samples are collected at these locations daily and are subjected to specific analyses for polonium-210, plutonium-238 and tritium oxide. The concentrations of polonium-210 measured in the Great Miami River are summarized in Table 7. The average concentrations were all less than 0.3% of the RCG.

The concentrations of plutonium-238 measured in the Great Miami River are summarized in Table 8. The average concentrations were all less than 0.1% of the RCG.

The average concentrations of tritium oxide measured in the Great Miami River were all less than 0.5% of the RCG. These results are summarized in Table 9.

Eight additional surface water locations such as ponds and streams are sampled quarterly. These locations are shown in Figure 3. A sample of approximately 4 liters is collected at each location and analyzed for plutonium-238, polonium-210 and tritium oxide. The average concentrations of polonium-210 measured at the surface water locations during 1972 were less than 0.1% of the RCG. The average concentrations of plutonium-238 measured at these locations during 1972 were less than 0.03% of the RCG. The average concentrations of tritium oxide measured at these locations were less than 0.6% of the RCG. The results of the surface water monitoring program are summarized in Tables 10, 11 and 12.

Drinking water from communities in the surrounding area is sampled quarterly and analyzed for tritium oxide. These communities are shown in Figure 1. The concentrations of tritium oxide were found to be less than 1.3% of the RCG. The results of the community drinking water sampling program are summarized in Table 13.

Water - Nonradioactive

It is difficult to measure the levels of nonradioactive pollutants in the Great Miami River resulting from Mound Laboratory's water effluent because of the relatively high level of these pollutants already present in the river upstream from the outfalls. Therefore, a composite sample of both water effluent streams leaving the Laboratory is automatically collected and analyzed for various water quality parameters as reported below. The sample volume is proportionate to the flow in the stream. The composite effluent water samples are analyzed for the listed water quality parameters according to standard techniques[4] for waste water analysis accepted by the Office of Water Programs of the Environmental Protection Agency. The results of the effluent stream analyses are summarized in Table 14.

Foodstuffs and Vegetation - Radioactive

Various locally grown foodstuffs and vegetation samples are collected from the surrounding area. Where possible, sampling sites are chosen at

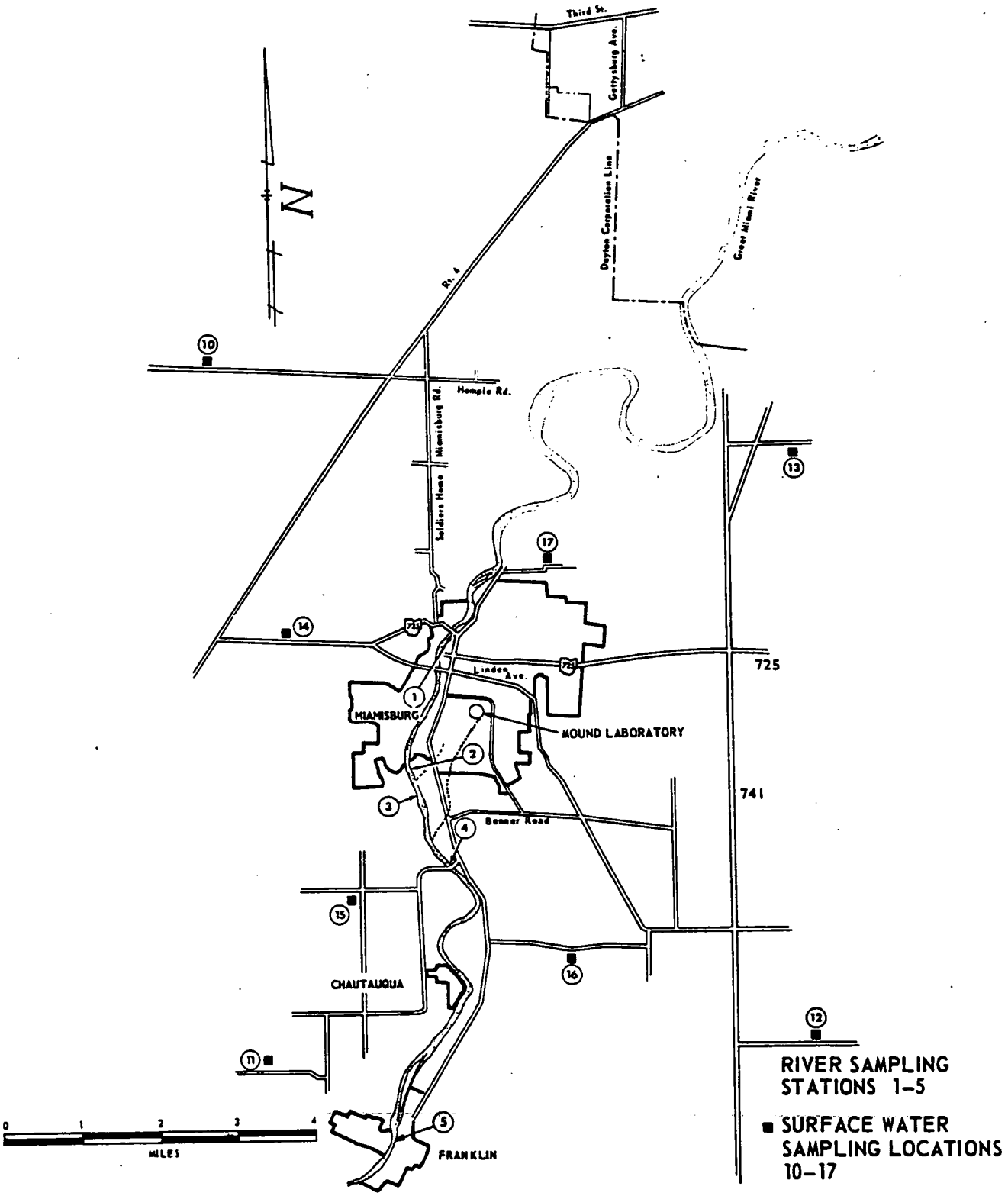

FIGURE 3 - Off-site water sampling locations.

maximum deposition locations predicted on the basis of the diffusion model previously mentioned. The samples collected include milk, fruits and vegetables, grass, field crops and aquatic life. The intent of this portion of the Environmental Monitoring Program is to determine if there is any uptake and concentration of radionuclides by plant or animal life. As mentioned previously, commercial sales of polonium-210 from Mound Laboratory have ceased and, since air and water are monitored for polonium-210, foodstuff samples are not analyzed for polonium-210. The plutonium-238 content of the foodstuff and vegetation samples is determined by slowly evaporating the samples to dryness and then proceeding with the same techniques used for plutonium-238 analyses of air samples. Milk samples are analyzed for tritium oxide by distilling the water fraction from an aliquot of the entire sample. The distillate is then analyzed for tritium by liquid scintillation spectrometry in the same manner as the water samples previously discussed in this report. The remaining foodstuff samples are analyzed for tritium by oxidizing the samples in a controlled air stream and collecting the combustion products. The tritium content of the combustion products is then determined by liquid scintillation spectrometry as discussed above. This technique allows analysis for total tritium in the samples rather than tritium oxide. The results of the foodstuff and vegetation analyses are summarized in Table 15. The concentration is given in terms of the sample weight before evaporation to dryness. The vegetables analyzed included cucumbers, turnips, onions and tomatoes. The sample of aquatic life analyzed included only the edible fleshy portions from six small blue gills. The concentration of tritium measured in grass samples appears to be measurably above background concentrations, but still well within the RCG. These results are the first utilizing the total tritium technique at Mound Laboratory. More data must be accumulated before any conclusion can be reached. No other indication has been found that there is any significant uptake and concentration by plant or animal life of these radionuclides handled at Mound Laboratory.

Soil and Silt - Radioactive

The soil sampling program has included two aspects of soil monitoring. One aspect, which was reported in MLM-1922 Environmental Monitoring Report July - December 1971 and 1971 Summary, is the evaluation of the resuspendable amounts of plutonium-238 in soil. For this evaluation surface scrapings, approximately one-eighth inch deep, of undisturbed soil are collected and analyzed. Review of data reported in 1971 revealed that evaluation of resuspendable plutonium in soil is best accomplished by the network of continuous high-volume air samplers. Therefore, surface soil sampling was suspended during 1972. If air sampling results indicate a potential problem in this area, surface soil sampling will be resumed. The second aspect of soil monitoring is the documentation for historical purposes of the total accumulation and distribution of plutonium deposited off-site, and for verification of Mound Laboratory's atmospheric diffusion model. Present plans are to repeat and refine the total inventory at 5-yr intervals once the initial inventory is completed.

Soil core samples 3-1/2 in. in diameter, approximately 12 in. deep, are taken for the inventory determination. Core samples were collected at two locations in each quadrant around the Laboratory during 1972. Five cores were collected from a square area 30 ft on a side at each location and composited to form one core sample. Additional core samples for

background control data were taken from locations greater than 50 miles from the Laboratory.

Soil samples are digested with an acid mixture to extract the plutonium. The solution is then passed over an ion exchange column specific for plutonium and analyzed in the same manner as the particulate air samples previously discussed in this report. This leach method has been compared with a fusion method for soil analysis.[5] Good agreement was obtained between the two methods of analysis. The leach method was chosen for the soil analysis because larger samples, which minimize sampling and aliquoting errors and increase sensitivity, can be handled with this method. The results of the core sampling program are summarized in Table 16. As mentioned previously in this report, no standards have been established for radioactive species in soil. Additional sample analyses are necessary before a total inventory can be calculated, and these are continuing as part of Mound Laboratory's comprehensive Environmental Control Program.

Silt samples are collected quarterly from four locations on the Great Miami River. These samples are taken at four of the same locations that water samples are taken from and are identified by the same numbers shown in Figure 2. Additional silt samples are collected annually from the same surface water locations which are sampled monthly. The silt samples are analyzed in the same manner as the soil samples. The results of Great Miami River silt sampling for 1972 are summarized in Table 17. The results of the silt sampling from the area ponds are summarized in Table 18. There appears to be a very slight accumulation of plutonium-238 in river silt from the very small amounts of plutonium-238 which are discharged to the river. However, as mentioned previously, there does not appear to be any reentrainment of plutonium-238 by plant or animal life in the river nor by the river itself. No significant accumulation is indicated, however, by the pond silt data. As previously mentioned in this report, there are no standards for radioactive species in soil or silt.

SUMMARY

The average concentrations of polonium-210, plutonium-238 and tritium detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, are presented for calendar year 1972. The average concentrations of these radioisotopes were well within the stringent standards adopted by the Atomic Energy Commission.

Atmospheric monitoring for radioactive species was upgraded by the completion of an off-site network of ten continuous, high-volume air sampling stations during February 1972. Prior to that time a routine off-site grab sampling program had been in effect since Laboratory operations began in 1949. An additional eleven air sampling stations are scheduled for completion by the first quarter of 1973. The average concentrations of polonium-210, plutonium-238 and tritium measured in air during this period were less than 0.02%, 0.3% and 0.1% of their respective RCG's. A comparison to results obtained from grab sampling during 1971 is not warranted since the off-site network in 1972 utilized continuous sampling rather than grab sampling.

Water monitoring for radioactive species found the average concentrations of polonium-210, plutonium-238 and tritium measured at the water sampling locations during this period to be less than 0.3%, 0.1% and 0.5% of their

respective RCG's. These results represent a significant reduction in concentrations of polonium-210 and tritium over those measured in 1971. The average concentrations of plutonium-238 measured during 1972 were slightly lower than but within the range of those measured during 1971.

Water monitoring for non-radioactive species was conducted.

Additionally, data concerning radioactive species in surface water, community drinking water, foodstuffs, soil and silt are presented. No significant uptake of radioactive species from air or water by plant or animal life has been observed. No reentrainment of radioactive species from soil or silt is indicated at this time. Soil core sample analyses will continue to establish a plutonium-238 soil inventory as part of the total program to assess the impact of the Laboratory's operations on the environment.

These data reflect the effectiveness of Mound's Environmental Control Program and indicate that the operation of the Laboratory has negligible effect on the environment.

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APPENDIX

ADDITIVE LEVELS DUE TO RADIONUCLIDE MIXTURE

The Standards for Radiation Protection (AEC Chapter 0524) states that a radionuclide should not be considered part of the mixture if the ratio of the concentration of the radionuclide to its RCG is not greater than 1/10. Furthermore the sum of all such excluded ratios can not exceed 1/4. The sum of the ratios of the concentration of radionuclides to their respective RCG's for the first half of 1972 are listed below. The sum is presented for the maximum levels detected in both air and water.

	Air	Water
Concentration of ^{210}Po/RCG for ^{210}Po	0.001	0.011
Concentration of ^{238}Pu/RCG for ^{238}Pu	0.009	0.013
Concentration of tritium oxide/RCG for tritium oxide	0.023	0.105
Sum	0.033	0.129

The data indicate that, for purposes of AEC Manual Chapter 0524, a mixture of radionuclides did not occur during 1972.

APPLICABLE STANDARDS

RADIOACTIVE STANDARDS

Concentrations of radioactive species in air and water are compared with the Radioactivity Concentration Guide (RCG) values as promulgated by AEC Manual Chapter 0524, "Standards for Radiation Protection." The RCG values, as defined in AEC Manual Chapter 0524, for the various types of samples are listed below.

General Population

Air

Polonium-210 : 7×10^{-12} microcuries per milliliter (μCi/ml)
Plutonium-238: 2×10^{-14} microcuries per milliliter (μCi/ml)
Tritium : 7×10^{-8} microcuries per milliliter (μCi/ml)

Water

Polonium-210 : 2×10^{-7} microcuries per milliliter (μCi/ml)
Plutonium-238: 2×10^{-6} microcuries per milliliter (μCi/ml)
Tritium : 1×10^{-3} microcuries per milliliter (μCi/ml)

Uncontrolled Area

Air

Polonium-210 : 2×10^{-11} microcuries per milliliter (μCi/ml)
Plutonium-238: 7×10^{-14} microcuries per milliliter (μCi/ml)
Tritium : 2×10^{-7} microcuries per milliliter (μCi/ml)

Mixture

In addition to the RCG values for the individual radionuclides, the Standards for Radiation Protection (AEC Chapter 0524), indicate that if a mixture of more than one radionuclide occurs in air or water, the following guidelines shall be used. The ratio between the concentration of each radionuclide present in the mixture and its respective RCG shall be determined. The sum of these ratios for all the radionuclides in the mixture should not exceed "unity". A radionuclide should not be considered part of the mixture if the ratio of the concentration of the radionuclide to its RCG is not greater than 1/10 provided that the sum of all such excluded ratios does not exceed 1/4.

Foodstuffs

There are no RCG values specified for foodstuffs as such since the water content of food was taken into account in the determination of RCG values for water. Consideration of radionuclides in food is necessary only in case of concentration in food during processing or in case it enters the food from other sources. In this event the recommendation is to use the RCG for water converted to microcuries per gram. For comparison purposes the recommendation is followed in this report.

Soil

There are no guidelines established for radioactive species in soil.

NON-RADIOACTIVE STANDARDS

Concentrations of non-radioactive species in air and water are compared with standards promulgated by the Offices of Air and Water Programs of the Environmental Protection Agency. If a local standard which is more restrictive than the national standard is in effect it will be used for comparison. The following air and water standards are ambient standards since emission or effluent standards did not exist for most of 1972 for the State of Ohio. Ambient standards are more restrictive since dilution by the environment is taken into account and no further dilution is expected.

Air

The National Ambient Air Quality Standards should be used for comparison since they are more restrictive than the State of Ohio Ambient Air Quality Standards. The National standards are:

Particulate Matter	60 micrograms/cubic meter ($\mu g/m^3$)[a]
Sulfur Dioxide	60 micrograms/cubic meter ($\mu g/m^3$)[b]
Carbon Monoxide	10 milligrams/cubic meter (mg/m^3)[c]
Photochemical Oxidants	160 micrograms/cubic meter ($\mu g/m^3$)[d]
Hydrocarbons	160 micrograms/cubic meter ($\mu g/m^3$)[e]
Oxides of Nitrogen	100 micrograms/cubic meter ($\mu g/m^3$)[b]

[a]Annual geometric mean
[b]Annual arithmetic mean
[c]Eight-hour mean, not to be exceeded more than once per year
[d]One-hour mean, not to be exceeded more than once per year
[e]Three-hour mean, not to be exceeded more than once per year

Surface Water Criteria for Public Water Supplies

The Surface Water Criteria for Public Water Supplies adopted by the Environmental Protection Agency should be used for comparison of concentrations of non-radioactive pollutants in water. The criteria are:

Constituent	Criterion (mg/liter)
Heavy Metals	
Barium	1.0
Boron	1.0
Cadmium	0.01
Chromium, Hexavalent	0.05
Copper	1.0
Iron	0.3
Lead	0.05
Manganese	0.05
Mercury	0.05
Silver	0.05
Zinc	5.0
Other Inorganics	
Chlorides	250
Sulfates	250
Nitrates	10
pH	6.0-8.5
Total Dissolved Solids	500
Dissolved Oxygen	≥4
Organic	
BOD	-
Oil and Grease	Virtually absent
Physical Properties	
Suspended Solids	20*
Turbidity	-

*Treatment plant criteria

Biological

Total Coliform	10,000/100 ml
Fecal Coliform	2,000/100 ml

Table 1

CONCENTRATION OF POLONIUM-210 IN AIR AT OFF-SITE SAMPLING LOCATIONS
CY-1972

Location	Number of Samples	Range (10^{-15} µCi/ml)	Average* (10^{-15} µCi/ml)	Percent of RCG**
101	46	0.52 - 3.7	1.3 ± 0.1	0.02
108	42	0.6 - 2.9	1.3 ± 0.1	0.02

*Minimum detection limit (MDL) for ^{210}Po in air is 2×10^{-17} µCi/ml. The MDL is 0.0003% of the RCG.

**RCG - Radioactivity Concentration Guide = 7×10^{-12} µCi/ml.

Table 2

CONCENTRATION OF PLUTONIUM-238 IN AIR AT OFF-SITE SAMPLING LOCATIONS
CY-1972

Location	Number of Samples	Range (10^{-17} µCi/ml)	Average* (10^{-17} µCi/ml)	Percent of RCG**
101	46	1.1 - 9.5	3.4 ± 0.3	0.2
102	3***	---	6.9 ± 0.5	0.3
103	44	0.47 - 18.8	5.6 ± 0.4	0.3
104	45	0.57 - 5.1	2.0 ± 0.2	0.1
105	45	0.38 - 2.7	0.96 ± 0.1	0.05
106	45	0.27 - 7.8	1.3 ± 0.2	0.07
107	25	0.22 - 1.1	0.49 ± 0.13	0.02
108	43	0.32 - 1.4	0.77 ± 0.15	0.04
109	41	0.24 - 0.92	0.50 ± 0.13	0.02
110	27	0.35 - 0.72	0.51 ± 0.13	0.03

*Minimum detection limit (MDL) for ^{238}Pu in air is 5×10^{-19} µCi/ml. The MDL is 0.003% of the RCG.

**RCG - Radioactivity Concentration Guide = 2×10^{-14} µCi/ml.

***Combined to form a single, composite sample.

Table 3

CONCENTRATION OF TRITIUM OXIDE IN AIR AT OFF-SITE SAMPLING LOCATIONS
CY-1972

Location	Number of Samples	Range (10^{-11} μCi/ml)	Average* (10^{-11} μCi/ml)	Percent of RCG**
101	46	<0.3 - 58	10.1 ± 0.6	0.1
102	37	<0.3 - 25	6.1 ± 0.5	0.09
103	45	<0.3 - 164	8.1 ± 0.6	0.1
104	42	<0.3 - 27	3.0 ± 0.4	0.04
105	45	<0.3 - 11	1.2 ± 0.2	0.02
106	45	<0.3 - 5.9	0.75 ± 0.16	0.01
107	43	<0.3 - 2.5	0.36 ± 0.11	0.005
108	44	<0.3 - 1.6	0.32 ± 0.11	0.005
109	45	<0.3 - 2.1	0.41 ± 0.11	0.006
110	43	<0.3 - 7.9	0.49 ± 0.12	0.007

*Minimum Detection Limit (MDL) for tritium oxide in air is 0.3×10^{-11} μCi/ml. The MDL is 0.004% of the RCG.

**RCG - Radioactivity Concentration Guide = 7×10^{-8} μCi/ml.

Table 4

CONCENTRATION OF POLONIUM-210 IN AIR AT ON-SITE SAMPLING LOCATIONS
CY-1972

Location	Number of Samples	Range (10^{-15} μCi/ml)	Average* (10^{-15} μCi/ml)	Percent of RCG**
211	26	0.93 - 3.7	2.3 ± 0.1	0.01
212	26	0.70 - 2.4	1.3 ± 0.1	0.006
213	26	0.66 - 2.6	1.2 ± 0.1	0.006
214	26	0.74 - 4.5	1.3 ± 0.1	0.007
215	26	0.59 - 2.3	1.2 ± 0.1	0.006

*Minimum Detection Limit (MDL) for ^{210}Po in air is 2×10^{-17} μCi/ml. The MDL is 0.0001% of the RCG.

**RCG - Radioactivity Concentration Guide = 2×10^{-11} μCi/ml.

Table 5

CONCENTRATION OF PLUTONIUM-238 IN AIR AT ON-SITE SAMPLING LOCATIONS
CY-1972

Location	Number of Samples	Range (10^{-17} μCi/ml)	Average* (10^{-17} μCi/ml)	Percent of RCG**
211	26	1.0 - 92.8	40 ± 1	0.6
212	26	1.0 - 12.9	5.8 ± 0.4	0.08
213	26	0.8 - 110.1	40 ± 1	0.6
214	26	3.9 - 15.3	14 ± 0.6	0.2
215	26	1.8 - 3.3	2.2 ± 0.2	0.03

*Minimum Detection Limit (MDL) for ^{238}Pu in air is 5×10^{-19} μCi/ml. The MDL is 0.0007% of the RCG.

**RCG - Radioactivity Concentration Guide = 7×10^{-14} μCi/ml.

Table 6

CONCENTRATION OF TRITIUM OXIDE IN AIR AT ON-SITE SAMPLING LOCATIONS
CY-1972

Location	Number of Samples	Range (10^{-11} μCi/ml)	Average* (10^{-11} μCi/ml)	Percent of RCG**
211	26	<0.3 - 29	7.7 ± 0.7	0.04
212	26	<0.3 - 220	20 ± 1	0.1
213	26	<0.3 - 125	11 ± 0.8	0.05
214	26	<0.3 - 69	8.2 ± 0.7	0.04
215	26	<0.3 - 43	5.1 ± 0.6	0.03

*Minimum Detection Limit (MDL) for tritium oxide in air is 0.3×10^{-11} μCi/ml. The MDL is 0.002% of the RCG.

**RCG - Radioactivity Concentration Guide = 2×10^{-7} μCi/ml.

Table 7

CONCENTRATION OF POLONIUM-210 IN THE GREAT MIAMI RIVER
CY-1972

Location	Number of Samples	Range (10^{-10} µCi/ml)	Average* (10^{-10} µCi/ml)	Percent of RCG**
1	165	<1.3 - 15	4.4 ± 3.7	0.2
2	165	<1.3 - 16	4.1 ± 3.6	0.2
3	165	<1.3 - 17	5.9 ± 3.8	0.3
4	165	<1.3 - 11	3.7 ± 3.4	0.2
5	165	<1.3 - 22	4.0 ± 3.5	0.2

*Minimum Detection Limit (MDL) for ^{210}Po in water is 1.3×10^{-10} µCi/ml. The MDL is 0.07% of the RCG.

**RCG - Radioactivity Concentration Guide = 2×10^{-7} µCi/ml.

Table 8

CONCENTRATION OF PLUTONIUM-238 IN THE GREAT MIAMI RIVER
CY-1972

Location	Number of Samples	Range (10^{-8} µCi/ml)	Average* (10^{-8} µCi/ml)	Percent of RCG**
1	165	0.01 - 1.6	0.10 ± 0.01	0.05
2	165	0.03 - 0.80	0.06 ± 0.009	0.03
3	165	0.02 - 0.65	0.22 ± 0.02	0.1
4	165	0.01 - 0.87	0.20 ± 0.02	0.1
5	165	0.01 - 2.7	0.23 ± 0.02	0.1

*Minimum Detection Limit (MDL) for ^{238}Pu in water is 0.0003×10^{-8} µCi/ml. The MDL is 0.00015% of the RCG.

**RCG - Radioactivity Concentration Guide = 2×10^{-6} µCi/ml.

Table 9

CONCENTRATION OF TRITIUM IN THE GREAT MIAMI RIVER
CY-1972

Location	Number of Samples	Range (10^{-6} µCi/ml)	Average* (10^{-6} µCi/ml)	Percent of RCG**
1	165	<0.3 - 2.5	0.8 ± 0.3	0.08
2	165	<0.3 - 105	4.8 ± 0.5	0.5
3	165	<0.3 - 15	2.2 ± 0.4	0.2
4	165	<0.3 - 8.2	1.1 ± 0.4	0.1
5	165	<0.3 - 1.9	0.9 ± 0.4	0.09

*Minimum Detection Limit (MDL) for tritium in water is 0.3 x 10^{-6} µCi/ml. The MDL is 0.03% of the RCG.

**RCG - Radioactivity Concentration Guide = 1 x 10^{-3} µCi/ml.

Table 10

SUMMARY OF SURFACE WATER MONITORING FOR POLONIUM-210
CY-1972

Location	Number of Samples	Range (10^{-10} µCi/ml)	Average* (10^{-10} µCi/ml)	Percent of RCG**
10	3	0.5 - 4.5	2.7 ± 1.7	0.1
11	3	1.5 - 2.7	2.0 ± 1.5	0.1
12	3	<0.3 - 2.7	1.6 ± 1.5	0.08
13	3	<0.3 - 4.5	1.8 ± 1.5	0.09
14	3	<0.3 - 3.2	1.6 ± 1.5	0.08
15	3	<0.3 - 1.4	0.9 ± 1.4	0.05
16	3	0.9 - 3.1	2.2 ± 1.6	0.1
17	3	<0.3 - 3.2	1.3 ± 1.5	0.07

*Minimum Detection Limit (MDL) for polonium-210 in water is 0.0003 x 10^{-7} µCi/ml. The MDL = 0.01% of the RCG.

**RCG - Radioactivity Concentration Guide for polonium-210 in water = 2 x 10^{-7} µCi/ml.

Table 11

SUMMARY OF SURFACE WATER MONITORING FOR PLUTONIUM-238
CY-1972

Location	Number of Samples	Range (10^{-10} µCi/ml)	Average* (10^{-10} µCi/ml)	Percent of RCG**
10	2	0.7 - 1.1	0.9 ± 0.1	0.005
11	2	0.2 - 0.5	0.4 ± 0.03	0.002
12	2	0.7 - 0.9	0.8 ± 0.04	0.004
13	2	0.5 - 1.5	1.0 ± 0.1	0.005
14	2	0.7 - 1.5	1.1 ± 0.1	0.005
15	2	0.7 - 1.0	0.9 ± 0.1	0.005
16	2	0.7 - 1.7	1.0 ± 0.1	0.005
17	2	2.7 - 7.8	5.3 ± 0.4	0.026

*Minimum Detection Limit (MDL) for ^{238}Pu in water is 0.00004 x 10^{-6} µCi/ml. The MDL = 0.002% of the RCG.

**RCG - Radioactivity Concentration Guide for ^{238}Pu in water = 2 x 10^{-6} µCi/ml.

Table 12

SUMMARY OF SURFACE WATER MONITORING FOR TRITIUM
CY-1972

Location	Number of Samples	Range (10^{-6} µCi/ml)	Average* (10^{-6} µCi/ml)	Percent of RCG**
10	4	<0.3 - 1.4	0.7 ± 0.2	0.07
11	4	<0.3 - 1.0	0.6 ± 0.2	0.06
12	4	<0.3 - 1.5	0.5 ± 0.2	0.05
13	4	<0.3 - 0.5	0.3 ± 0.2	0.03
14	4	3.1 - 9.3	6.0 ± 0.2	0.60
15	4	1.8 - 4.4	3.5 ± 0.2	0.35
16	4	0.4 - 2.8	1.3 ± 0.2	0.13
17	4	3.7 - 6.2	4.7 ± 0.2	0.47

*Minimum Detection Limit (MDL) for tritium in water is 0.3 x 10^{-6} µCi/ml. The MDL is 0.03% of the RCG.
**RCG - Radioactivity Concentration Guide for tritium oxide in water = 1 x 10^{-3} µCi/ml.

Table 13

SUMMARY OF COMMUNITY DRINKING WATER
TRITIUM OXIDE LEVELS FOR 1972

Location	Number of Samples	Range (10^{-6} μCi/ml)	Average* (10^{-6} μCi/ml)	Percent of RCG**
Bellbrook	4	<0.3 - 0.8	0.4 ± 0.2	0.04
Carlisle	1	---	1.4 ± 0.2	0.14
Centerville	2	0.4 - 0.5	0.4 ± 0.2	0.04
Dayton	4	<0.3 - 0.5	0.3 ± 0.2	0.03
Eaton	1	---	<0.3 ± 0.2	<0.03
Franklin	3	0.3 - 1.6	1.0 ± 0.2	0.10
Germantown	1	---	1.1 ± 0.2	0.11
Miamisburg	5	10 - 17	12.5 ± 0.2	1.25
Middletown	1	---	0.3 ± 0.2	0.03
Moraine	1	---	0.3 ± 0.2	0.03
Springboro	3	<0.3	<0.3 ± 0.2	<0.03
Tipp City	1	---	<0.3 ± 0.2	<0.03
Waynesville	2	<0.3 - 0.5	0.4 ± 0.2	0.04
West Carrollton	1	---	0.4 ± 0.2	0.04
West Milton	1	---	<0.3 ± 0.2	<0.03

*Minimum Detection Limit (MDL) for tritium oxide is 0.3×10^{-6} μCi/ml. The MDL is 0.03% of the RCG.

**RCG - Radioactivity Concentration Guide for tritium oxide in water = 1×10^{-3} μCi/ml.

Table 14

SUMMARY OF EFFLUENT WATER MONITORING FOR
NON-RADIOACTIVE CONSTITUENTS
CY-1972

Constituent	Average Value (mg/liter)
Heavy Metals	
Barium	0.14
Boron	0.2
Cadmium	0.005
Chromium, Hexavalent	0.01
Copper	0.07
Iron	0.4
Lead	0.04
Manganese	0.04
Mercury	0.001
Silver	0.02
Zinc	0.08
Other Inorganics	
Chlorides	965
Sulfates	109
Nitrates	4
pH	8.1
Total Dissolved Solids	2084
Dissolved Oxygen	9.5
Organic	
BOD	4.5
Oil and Grease	1.7
Physical Properties	
Suspended Solids	18
Turbidity	<25 JTU*
Biological	
Total Coliform	2900/100 ml
Fecal Coliform	22/100 ml

*JTU - Jackson Turbidity Units - a standard unit used to describe turbidity. This value is at the limit of sensitivity of the instrument used and basically indicates absence of any turbidity.

Table 15

SUMMARY OF FOODSTUFFS AND VEGETATION ANALYSIS
CY-1972

Type of Sample	Number of Samples	Plutonium-238 (10^{-8} μCi/g)			Tritium (10^{-6} μCi/g)		
		Range	Average*	Percent of RCG**	Range	Average***	Percent of RCG****
Milk	7	0.009 - 0.46	0.14 ± 0.007	0.07	<0.1	<0.1	<0.01
Fruits & Vegetables	6	0.17 - 0.21	0.20 ± 0.02	0.1	2.2 - 2.3	2.3 ± 0.1	0.23
Grass	8	0.05 - 0.20	0.11 ± 0.01	0.05	28 - 103	49 ± 0.2	4.9
Field Crops	2	0.057 - 0.064	0.06 ± 0.01	0.03	<0.1 - 16	8.2 ± 0.2	0.8
Aquatic Life	1	---	0.60 ± 0.06	0.3	<0.1	<0.1	<0.01

*Minimum Detection Limit (MDL) for ^{238}Pu in foodstuffs is 0.0015 x 10^{-8} μCi/g. The MDL is 0.0007% of the RCG.

**RCG - Radioactivity Concentration Guide for ^{238}Pu = 2 x 10^{-6} μCi/g.

***Minimum Detection Limit for tritium in foodstuffs is 0.1 x 10^{-6} μCi/g. The MDL is 0.01% of the RCG.

****RCG - Radioactivity Concentration Guide for tritium oxide = 1 x 10^{-3} μCi/g.

Table 16

SUMMARY OF SOIL CORE ANALYSES FOR PLUTONIUM-238
CY-1972

Location		^{238}Pu
Direction	Distance (miles)	($\mu Ci/m^2$)*
North	0.9	0.018 ± 0.002
North	2.6	0.0017 ± 0.0002
East	0.5	0.094 ± 0.009
East	1.2	0.0089 ± 0.0009
South	0.6	0.0030 ± 0.0003
South	1.4	0.0037 ± 0.0004
West	0.5	0.0090 ± 0.0009
West	1.3	0.0023 ± 0.0002
Background		0.00005 ± 0.000005

*Minimum Detection Limit for ^{238}Pu in soil is 0.000004 $\mu Ci/m^2$.

Table 17

SUMMARY OF GREAT MIAMI RIVER SILT SAMPLES FOR PLUTONIUM-238
CY-1972

Location	Number of Samples	Range (10^{-6} $\mu Ci/g$)	Average (10^{-6} $\mu Ci/g$)*
1	3	0.05 - 0.19	0.121 ± 0.003
2	3	0.06 - 3.5	1.33 ± 0.01
3	4	0.04 - 0.13	0.0944 ± 0.003
4	4	0.20 - 1.7	0.531 ± 0.006
5	2	0.29 - 1.35	0.821 ± 0.008

*Minimum Detection Limit for ^{238}Pu in silt samples is 0.000005 $\mu Ci/g$. The concentration is in terms of standard dry weight.

Table 18

SUMMARY OF POND SILT FOR PLUTONIUM-238
CY-1972

Location	^{238}Pu Content (10^{-8} μCi/g)*
10	1.09 ± 0.09
11	0.61 ± 0.07
12	1.30 ± 0.10
13	0.31 ± 0.05
14	0.85 ± 0.08
15	0.76 ± 0.08
16	1.18 ± 0.10
17	5.82 ± 0.21

*Minimum Detection Limit for ^{238}Pu in silt samples is 0.000005 μCi/g. The concentration is in terms of standard dry weight.

R. P. Ratay, Editor

ENVIRONMENTAL MONITORING REPORT

1971

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A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

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MOUND LABORATORY
Miamisburg, Ohio
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ABSTRACT

The average concentrations of polonium-210, plutonium-238 and tritium detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, are presented for the first half of 1971. The average concentrations of these radioisotopes at the water sampling locations and the air sampling stations were well within the stringent standards adopted by the Atomic Energy Commission. The highest average concentrations of polonium, plutonium and tritium detected in the air sampling areas during the first half of 1971 were 39, 48 and 60% lower, respectively, than those measured during 1970. The highest average concentrations of polonium, plutonium and tritium measured at any of the water sampling locations during the first half of 1971 were 92, 75, and 89% lower, respectively, than those measured during 1970. The highest level of plutonium-238 found during the first half of 1971 in soil surface scrapings was approximately 2% of the most restrictive levels suggested by Kathren for urban areas. Soil core samples taken during the same period were considerably lower than those reported by Krey and Hardy in an independent Health and Safety Laboratory (HASL) study.

INTRODUCTION

Mound Laboratory is situated on 180 acres of land in Miamisburg, Ohio. This location is 12 miles southwest of Dayton. The Laboratory began operation in 1949. Its mission currently includes research, development, engineering, and production of components for the AEC weapons program; separation, purification, and sale of stable isotopes of the nobel gases; and development, design, and fabrication of radioisotopic heat sources for medical application and space exploration.

Interest in the health and safety of employes and the public is manifested by the fact that Laboratory operations have as a fundamental objective the containment of radioactive waste as a part of its environmental control program. Any release of low-level gaseous and liquid wastes to the environment are carefully controlled and dispersed to ensure that concentrations are well within recommended standards.

An Environmental Control Program has been in existence continuously during the Laboratory's history. As part of the Program's control function, all effluents containing radioisotopes are controlled at each operating step. Radioisotopes are removed from air effluents by the use of high-efficiency particulate absolute (HEPA) filters. Radioisotopes are removed from liquid effluent by chemical processing. As part of the Program's monitoring function, air, water, and soil samples are collected in a 1,250 square mile area to determine the concentrations of radioactive materials. The sampling techniques, analyses, and counting methods are those best suited for the detection and measurement of the radioactive materials involved.

Concentrations of radionuclides in air and water are compared with the Radioactivity Concentration Guide (RCG) values as promulgated by the Office of Radiation Programs of the Environmental Protection Agency and can be interpreted as the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The RCG values[1] for these radioisotopes are:

Polonium-210

Air: 7×10^{-12} microcuries per milliliter (μCi/ml)
Water: 2×10^{-7} microcuries per milliliter (μCi/ml)

[1]The RCG values listed above reflect a reduction by a factor of three as recommended by the Standards for Radiation Protection (AEC Chapter 0524, II, C, 1).

Plutonium-238

Air: 3×10^{-13} microcuries per milliliter (μCi/ml)
Water: 2×10^{-6} microcuries per milliliter (μCi/ml)

Tritium

Air: 7×10^{-8} microcuries per milliliter (μCi/ml)
Water: 1×10^{-3} microcuries per milliliter (μCi/ml)

The Standards for Radiation Protection (AEC Chapter 0524) guidelines for a mixture of radionuclides does not apply for the data presented in this report as discussed within.

OFF-SITE AIR SAMPLING

Air samples are collected three times per week to a distance of 20 miles from the Laboratory--an area of 1250 square miles. The samples are collected upwind and downwind from the Laboratory. Analysis of these samples is performed using equipment which is capable of detecting traces of radioactivity less than 0.1% of the concentration standards that have been adopted by Federal agencies. These standards are called Radioactivity Concentration Guides and are abbreviated as RCG. Figure 1 shows the zones routinely sampled.

AIRBORNE SAMPLE HANDLING AND RESULTS

Polonium-210 and Plutonium-238 Samples are collected using a high volume air sampler. Particulates are collected on 4-in. diameter Whatman No. 41 filter paper through which air is passed at a rate of 20 ft^3/min (5.7×10^5 cc/min). The sampling port is atop a mobile unit, in which the apparatus is contained. This mobile unit--a truck--is parked safely off the road while the sample is taken. A 2-in. diameter circle cut from the center of the filter paper is processed and analyzed for polonium-210, while plutonium-238, due to its lower specific activity, is analyzed using the remaining filter paper.

Polonium-210 Analysis The 2-in. diameter circle cut from the center of the filter paper is digested by heating with 5.8 M hydrochloric acid. After cooling, the solution is transferred quantitatively to a plastic plating cell that accommodates a 1 7/8-in. diam stainless steel disc. The solution in the cell is made approximately 1 M in hydrochloric acid, stirred for 2 hr, and the polonium-210 spontaneously plated by simple replacement onto the stainless steel disc. The disc is then removed from the cell, rinsed, dried, and alpha counted in a low background, gas flow proportional counter.

Results Analysis of the monitoring data for this report period shows that the average concentration of the polonium-210 measured at all locations upwind and downwind in all zones was only slightly above one-tenth of 1% of the RCG. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The data demonstrate that the average concentrations in all sampling areas were well below that level. The highest average concentration for this report period was 13/100 of 1% of the RCG in the 0-3 mile range upwind and 5-10 mile range downwind. Results for this report period are shown in Figure 2.

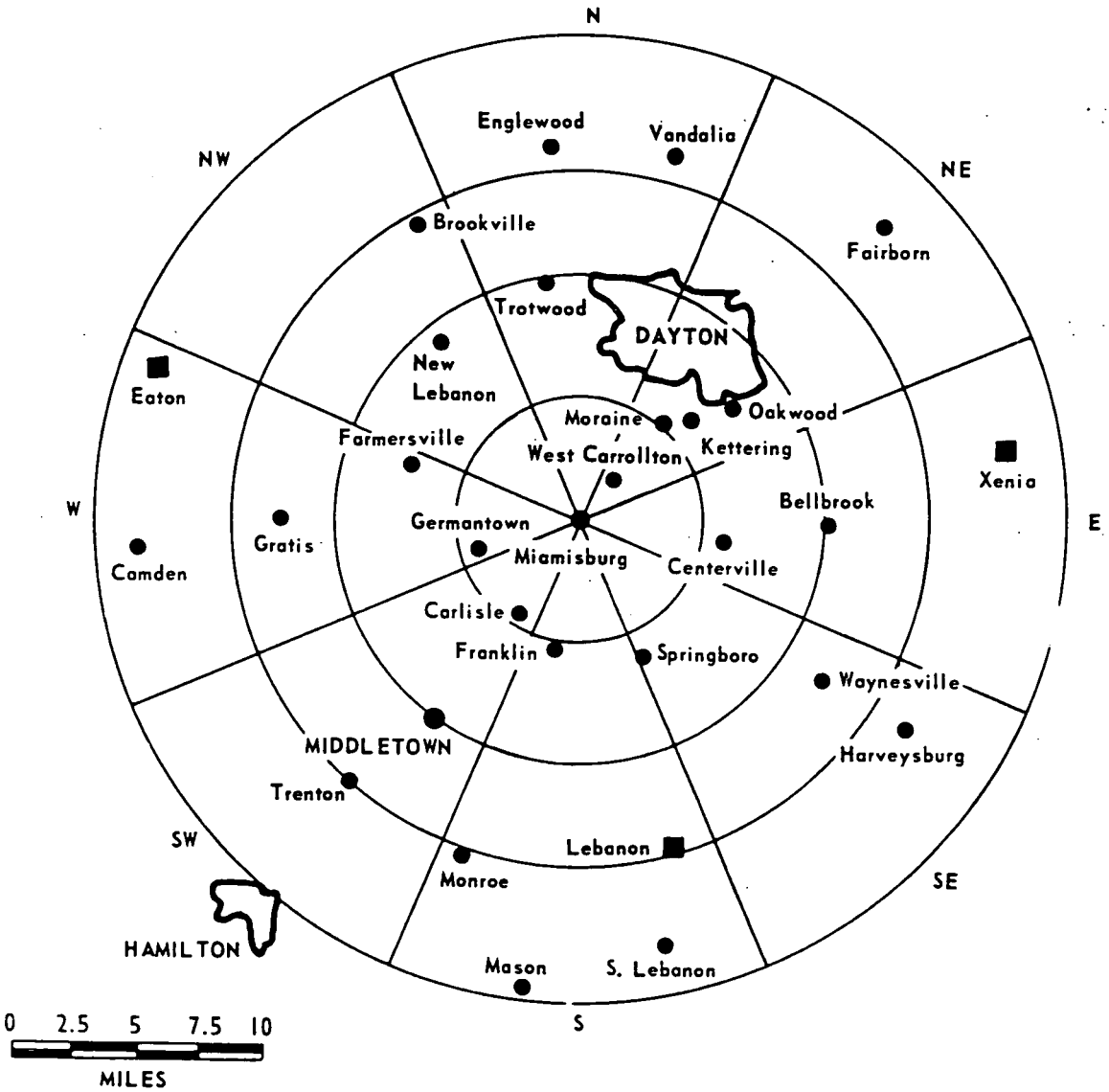

FIGURE 1 - Off-site air sampling zones.

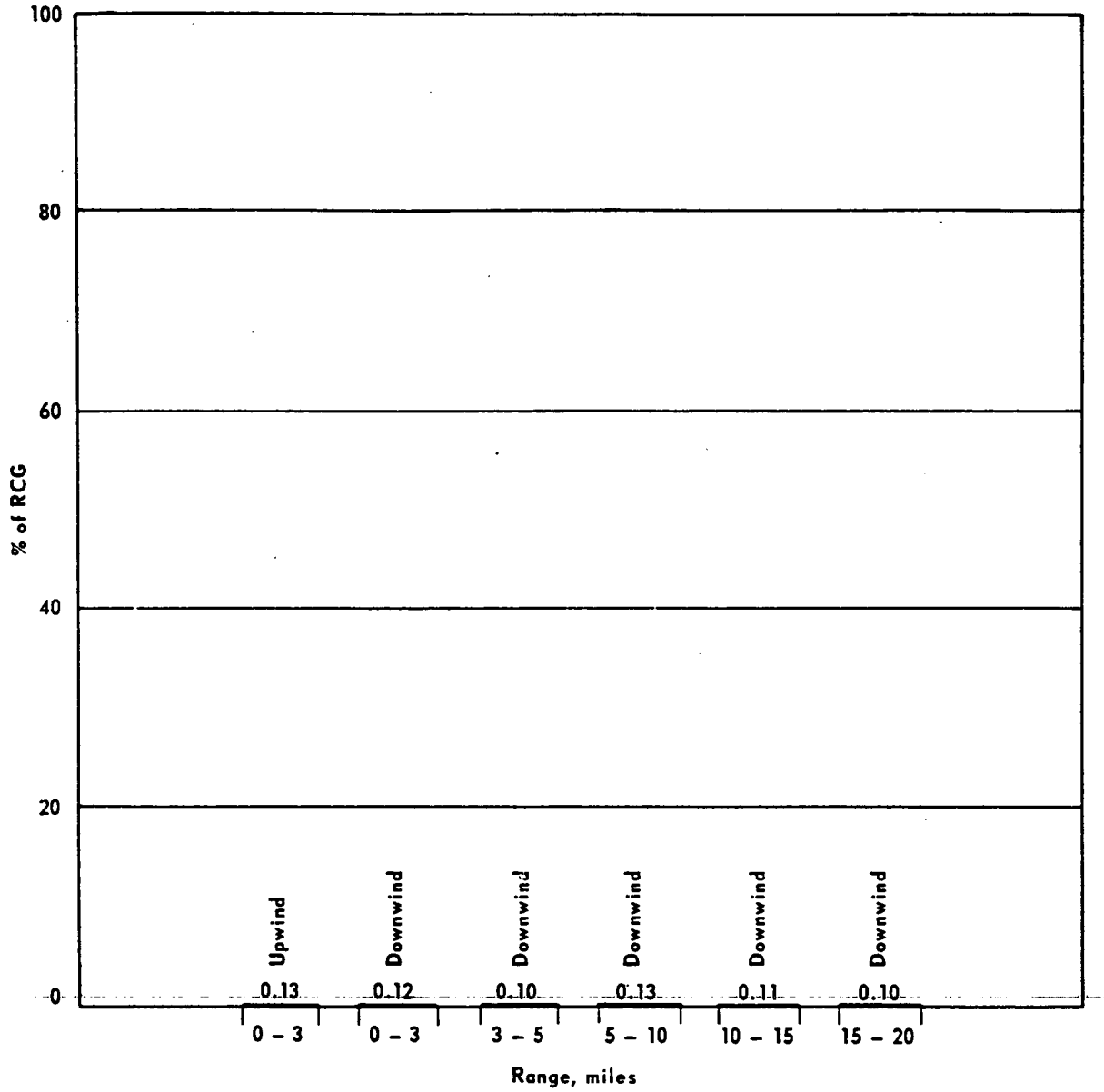

FIGURE 2 - Off-site air monitoring data for polonium-210--January-July 1971.

Plutonium-238 Analysis The remaining filter paper, after removal of the 2 in. diameter circle for polonium analysis, is spiked with a known amount of plutonium-236 tracer. The filter paper is ashed at 600°C in a muffle furnace for a minimum of 2 hr. The filter residue is taken up in concentrated HNO_3 with a trace of HF and evaporated to dryness. The residue is taken up in 10 M HCl and passed over a chloride anion exchange column. The plutonium is selectively eluted from the column and electroplated. After electroplating, the plutonium-238 content is determined by alpha pulse height analysis by means of counting for 1000 min. in a low background, high resolution surface barrier detector. The plutonium-238 content is corrected for chemical and counting losses as determined by the recovery of the added plutonium-236 tracer.

Results Plutonium-238 concentrations measured in all zones for this report period were less than 1% of the RCG with a maximum of 57/100 of 1% occurring in the 0-3 mile range upwind. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The data demonstrate that the average concentrations in all sampling areas were well below that level. Results for this report period are shown in Figure 3.

Tritium Oxide Analysis Samples are collected (at the same time that particulate samples of plutonium-238 and polonium-210 are taken) by bubbling air through 100 ml of p-dioxane-based scintillation fluid at a rate of 0.35 ft^3/min (0.99×10^4 cc/min). Tritium oxide is collected in the p-dioxane solution, and a 20 ml aliquot of the resulting solution is counted directly for 10 min in a liquid scintillation spectrometer. The sampling and analysis is directed to tritium oxide rather than the gas since the RCG for the oxide is 200 times more restrictive.

Results The highest average concentration of tritium oxide detected in the environment during this report period was 2.24% of the RCG in the 0-3 mile range downwind. The concentration diminished to less than 7/10 of 1% in the 3-5 mile range downwind. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The data demonstrate that the average concentrations in all sampling areas were well below that level. Results for this report period are shown in Figure 4.

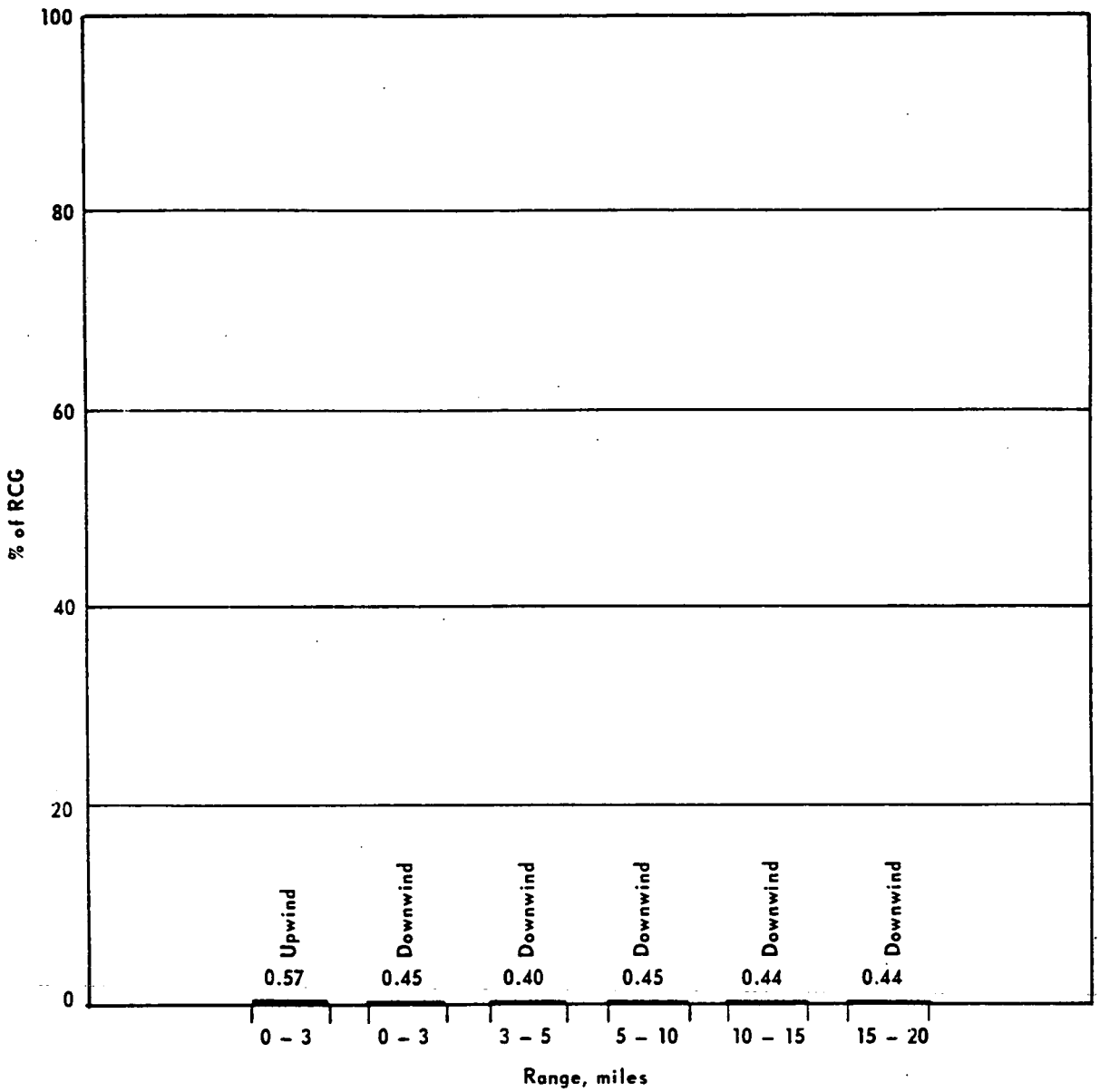

FIGURE 3 - Off-site air monitoring data for plutonium-238--January-July 1971.

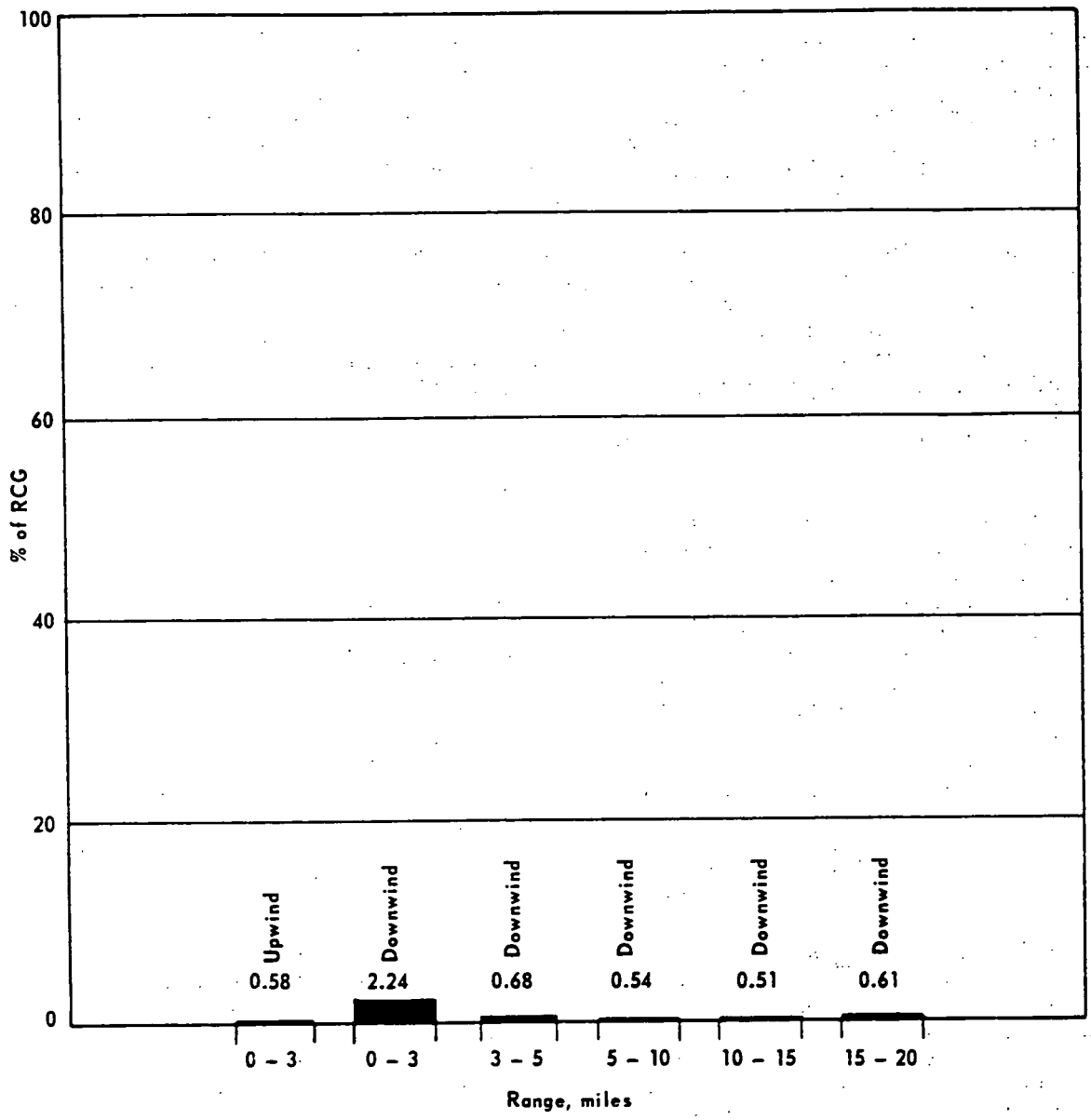

FIGURE 4 - Off-site air monitoring data for tritium oxide--January-July 1971.

OFF-SITE WATER SAMPLING

Water samples are collected twice per week along the bank of the Great Miami River and two ponds northeast of the Laboratory. Analysis of these samples is performed using equipment which is capable of detecting traces of radioactivity far below the RCG. All samples are analyzed for polonium-210, plutonium-238, and tritium oxide. A sample of approximately 200 ml is taken at each of 9 sampling locations. These locations are shown in Figure 5.

Polonium-210 Analysis A 100-ml aliquot from each water sample (representing a water sampling location) is quantitatively transferred to a plastic plating cell that accommodates a 1 7/8-in. diameter stainless steel disc. The solution in the cell is made approximately 1 M in hydrochloric acid, stirred for 2 hr, and the polonium-210 spontaneously plated by simple replacement onto the stainless steel disc. The disc is then removed from the cell, rinsed, dried, and alpha counted in a low background, gas flow proportional counter.

Results The highest average concentration of polonium-210 detected during this report period at any sampling location was 2.82% of the RCG. This was detected 250 yd downstream from the Mound Laboratory effluent (location 4 in Figure 5). The average concentration at the next sampling location downstream (location 5) as reported in Table 7 is below the limit of detection. A number is reported in the table because a value was assigned to those samples which were determined to be below the detectable limit. The number assigned to those samples was arrived at by multiplying the lowest detectable limit for polonium by a fraction which was the number of samples above the limit divided by the total number of samples analyzed. The average concentrations for this report period for all locations are shown in Figure 6. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The data demonstrate that the average concentrations in all sampling locations were well below that level.

Plutonium-238 Analysis A 100 ml aliquot from each water sample (representing a water sampling location) is analyzed for plutonium using an anion exchange method that is specific for plutonium. The plutonium eluted from the column is planchetted directly on a 1 7/8 in. diameter stainless steel disk and alpha counted in a low background, gas flow proportional alpha counter for a minimum of 4 hr. When a positive result is obtained the sample is counted by alpha pulse height equipment to confirm the presence of plutonium-238.

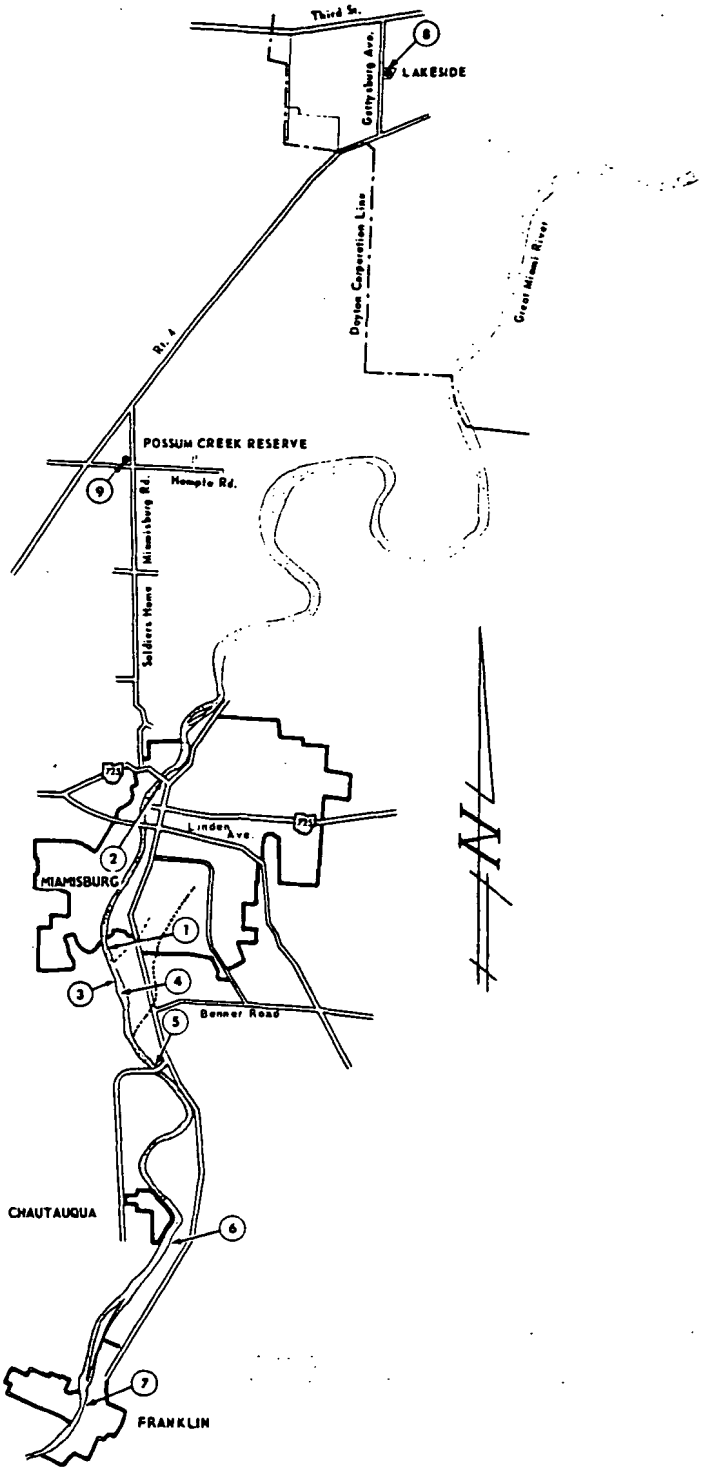

FIGURE 5 - Off-site water sampling locations.

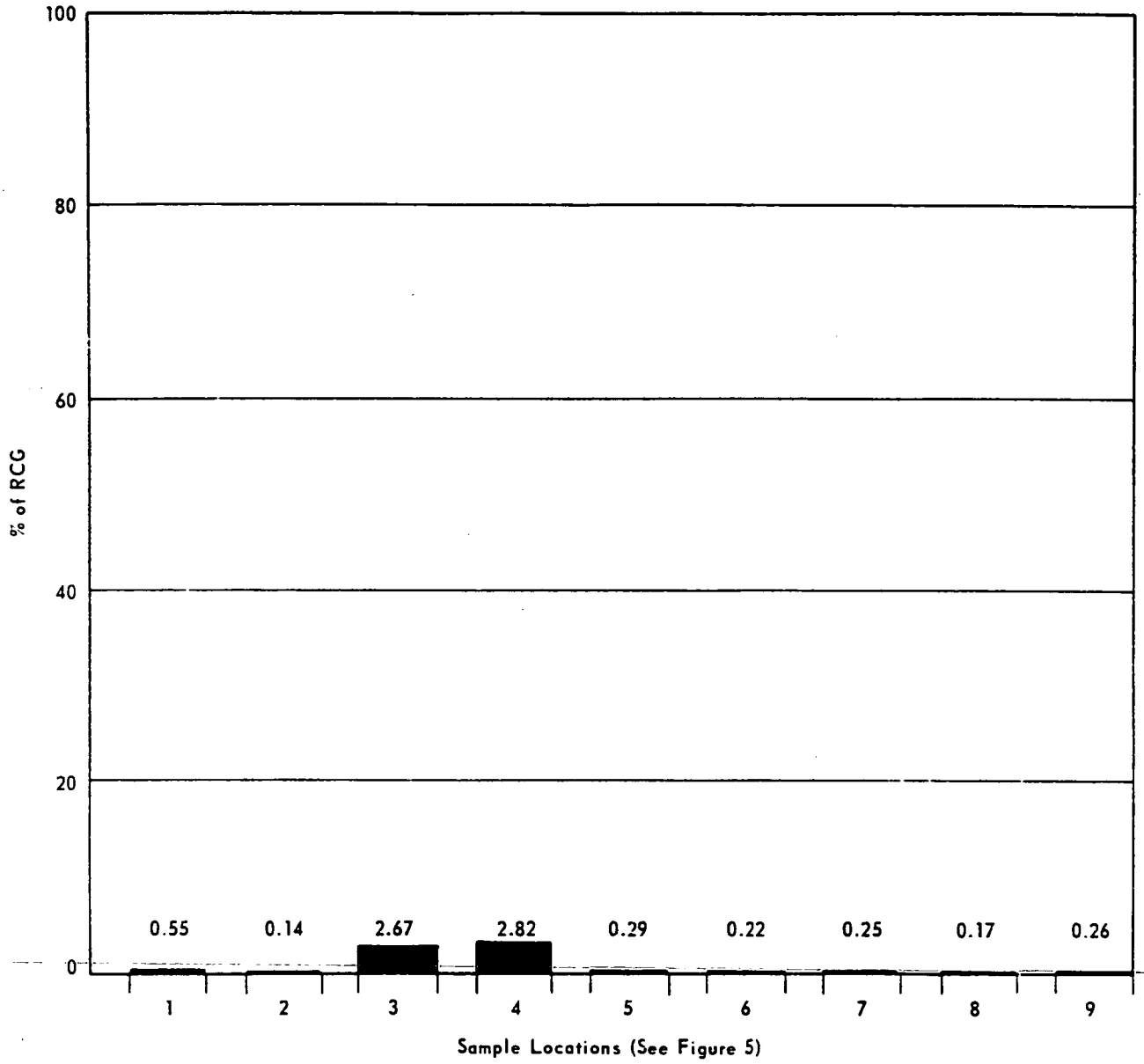

FIGURE 6 - Off-site water monitoring data for polonium-210--January-July 1971.

Results Plutonium-238 concentrations measured at all locations were much less than 1% of the RCG with the maximum being 26/100 of 1% of the RCG. This was detected 10 ft downstream from the point the Mound Laboratory effluent enters the Great Miami River (location 3 in Figure 5). The average concentrations found at the remainder of the Great Miami River locations downstream from the Mound Laboratory outfall were at approximately the same concentration level as found at the sampling location upstream from Mound Laboratory outfall (location 2 in Figure 5). The average concentrations for this report period for all locations are shown in Figure 7. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The data demonstrate that the average concentrations in all sampling locations were well below that level.

Tritium Oxide Analysis A 1-ml aliquot from each water sample (representing a water sampling location) is pipetted into a vial containing 17 ml of p-dioxane-based scintillation fluid. The vial is then placed in a liquid scintillation counter and counted for a minimum of 10 min for tritium.

Results The highest average concentration of tritium oxide for this report period was 4.74% of the RCG detected 10 ft downstream from the Mound Laboratory effluent (location 3). The next highest average concentration detected was 2.74% of the RCG 250 yd downstream from the Laboratory effluent (location 4). The average concentrations found at the remainder of the Miami River sampling locations downstream from the Laboratory outfall were below the concentration detected upstream from the outfall. The average concentrations for all sampling locations are shown in Figure 8. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling locations were well below that level.

Additive Levels Due to Radionuclide Mixture

The Standards for Radiation Protection (AEC Chapter 0524) states that a radionuclide should not be considered part of the mixture if the ratio of the concentrations of the radionuclide to its RCG is not greater than 1/10 provided that the sum of all such excluded ratios does not exceed 1/4. The sum of the ratios of the concentration of radionuclides to their respective RCG's for the first half of 1971 are listed below. The sum is presented for the maximum levels detected in both air and water

	Air	Water
Concentration of Po/RCG for Po	0.001	0.027
Concentration of ^{238}Pu/RCG for ^{238}Pu	0.006	0.003
Concentration of tritium/RCG for tritium	0.022	0.047
SUM	0.029	0.077

As can be seen from the data the Standards for a mixture do not apply.

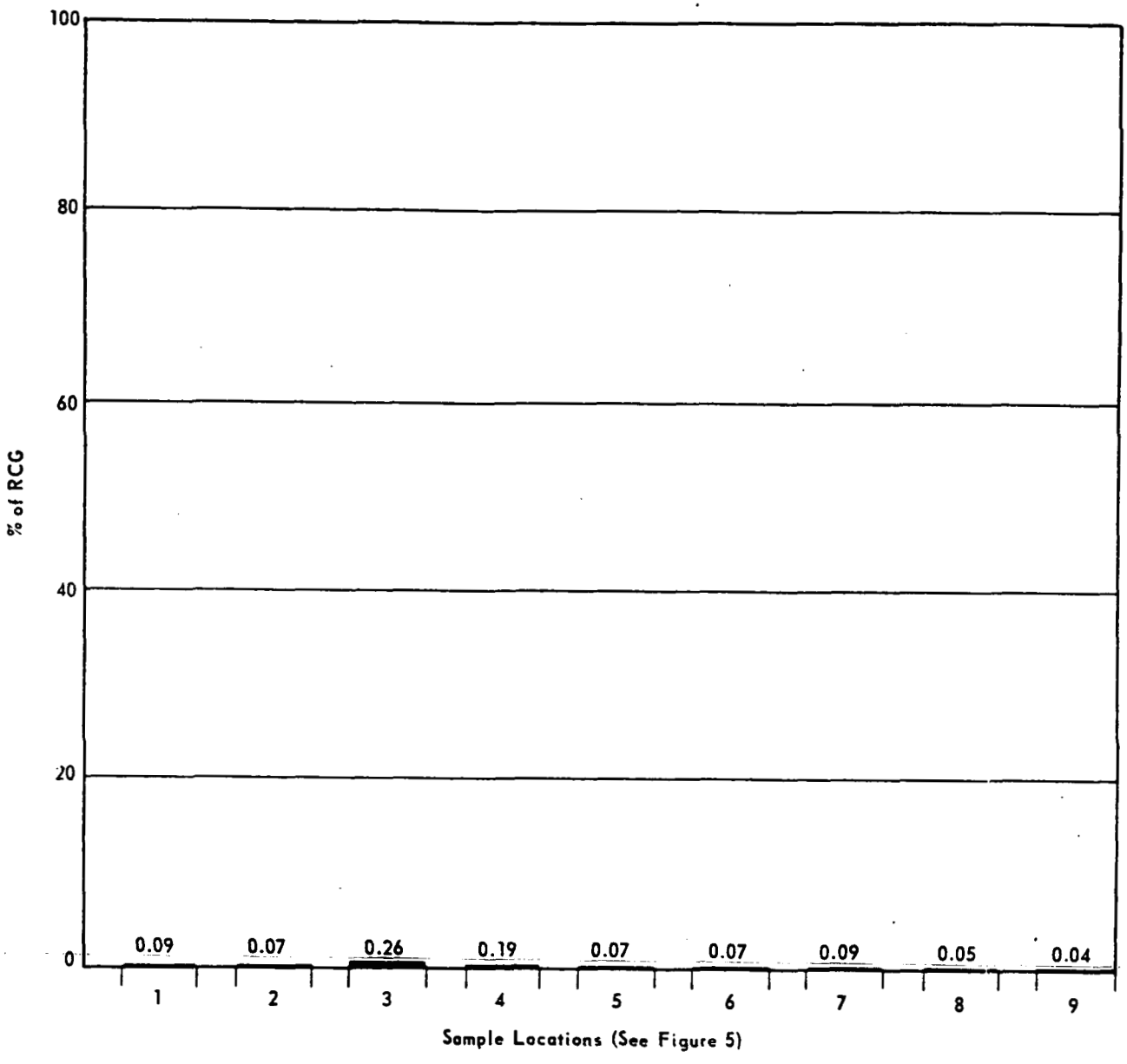

FIGURE 7 - Off-site water monitoring data for plutonium-238--January-July 1971.

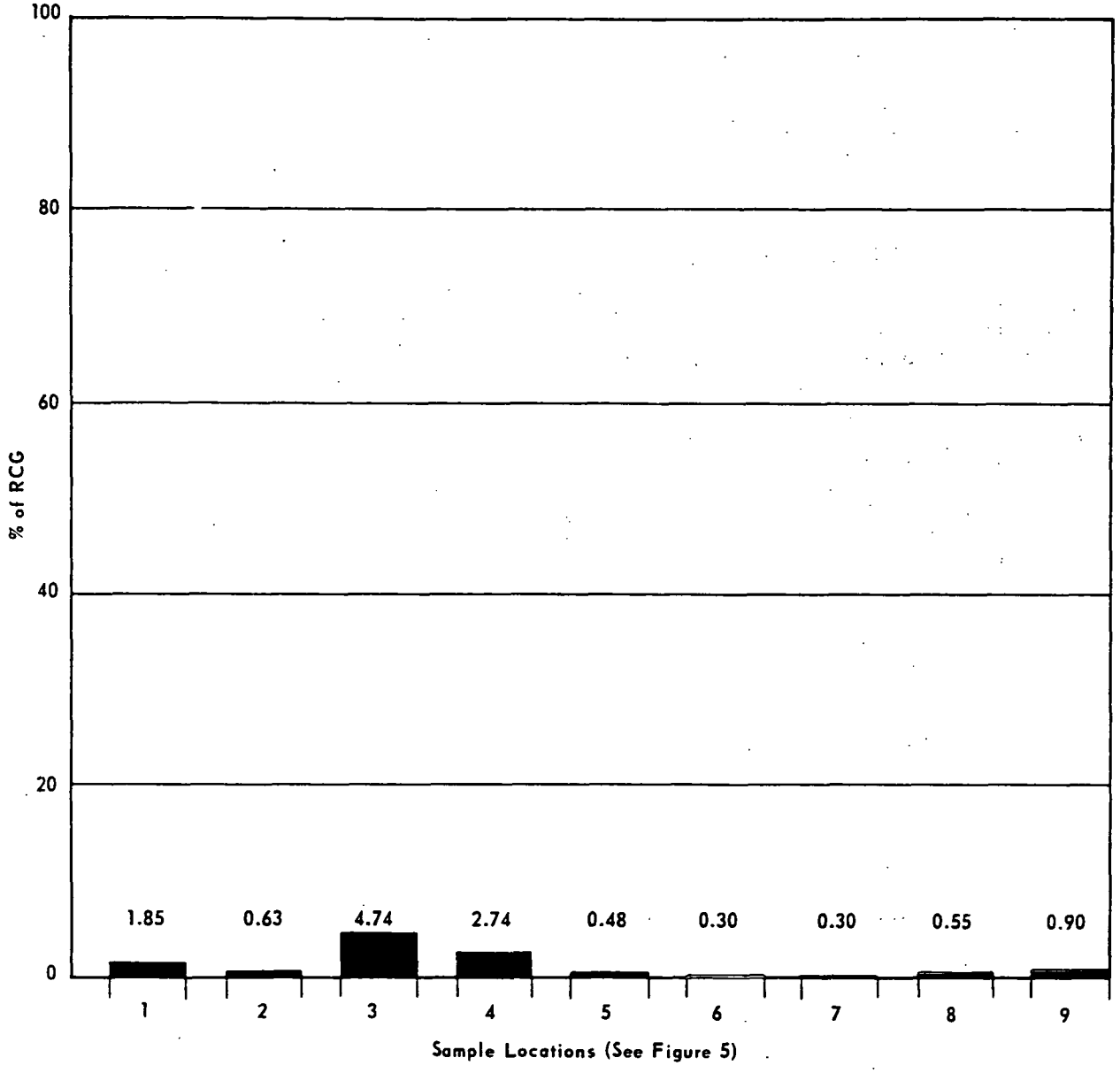

FIGURE 8 - Off-site water monitoring data for tritium oxide--January-July 1971.

SOIL SAMPLING

This section represents a new area of environmental reporting and indicates further efforts to evaluate the environmental impact of Mound Laboratory operations. No standards have been established as yet for comparison of concentration of radioactive species in soil. The sampling and analysis techniques described represent the state of the art in this area of environmental monitoring.

Two types of soil samples from areas surrounding the Laboratory have been analyzed for plutonium-238. One type of sample is used to evaluate the resuspendible amounts of plutonium-238 in the soil surrounding Mound Laboratory. Surface scrapings (approximately 1/8 in. deep) of undisturbed soil were collected for this evaluation. The second type of sample is used to determine the inventory amounts of plutonium-238 in the soil surrounding Mound Laboratory. A 3-1/2 in. diameter core of soil approximately 1-1/2 in. deep is taken for this determination.

Surface Scraping Analysis Surface scraping samples were taken from twenty sectors surrounding Mound Laboratory to a distance of ten miles. These sectors are shown in Figure 9. In addition, surface scrapings were taken fifty miles northwest, southeast, southwest, and northwest of the Laboratory to serve as background control samples. Twenty-five scrapings are composited to form a sample for each sector. The soil is digested with an acid mixture to extract the plutonium. The solution is then passed over an ion exchange column specific for plutonium and analyzed in the same manner as the particulate air samples previously discussed in this report. This leach method has been compared with a fusion method for soil analysis.[2] Good agreement was obtained between the two methods of analysis. The leach method was chosen for the soil analysis because larger samples, which minimize sampling and aliquoting errors, and increase sensitivity can be handled with this method.

Results The results of the surface scraping study for 1971 are shown in Table 10. There are no guidelines established by the Office of Radiation Programs of the Environmental Protection Agency or the AEC for radioactive species in soil. There have been several studies published which suggest maximum surface contamination levels. Of these, the levels suggested by Kathren[3] are the most restrictive. Kathren gives the following as acceptable levels for occupancy by the general public:

[2] C. T. Bishop, W. E. Sheehan, R. K. Gillette, and B. Robinson, "Comparison of a Leaching Method and a Fusion Method for the Determination of of Plutonium-238 in Soil," presented at a meeting on "Distribution and Measurement of Plutonium in the Environment," at Los Alamos Scientific Laboratory, August 4-5, 1971.

[3] R. L. Kathren, Towards Interim Acceptable Surface Contamination Levels for Environmental PuO_2, BNWL-SA-1510, Battelle Memorial Institute, Pacific Northwest Laboratory, Richland, Washington (Mar. 14, 1968), p. 10.

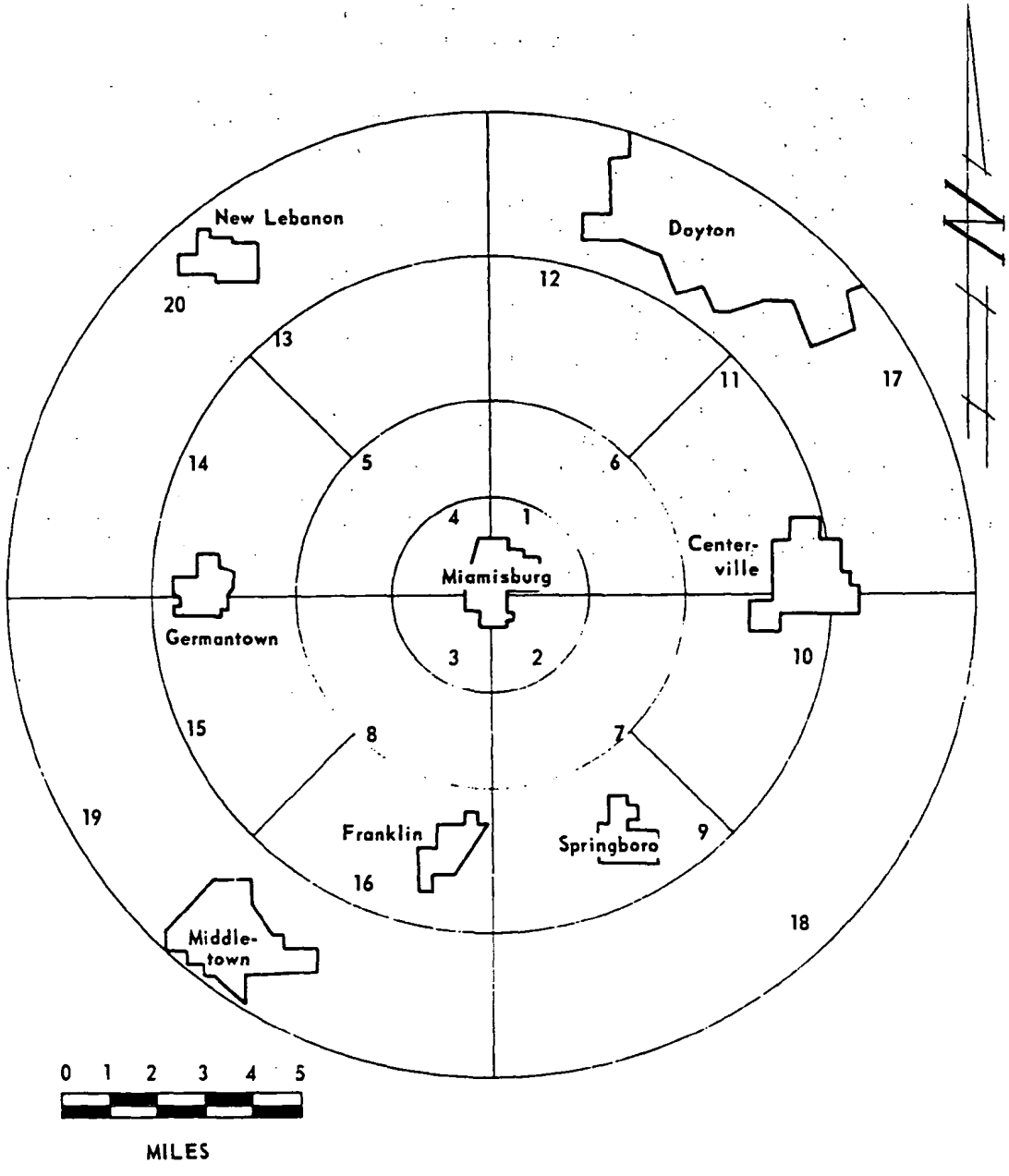

FIGURE 9 - Soil sampling sectors.

	Average	Maximum
Urban Areas	10 d/m/cm^2	100 d/m/cm^2 (for ≤ 10% of area)
Rural Areas	100 d/m/cm^2	

The highest level of plutonium-238 found in 1971 was approximately 2% of the most restrictive levels suggested by Kathren for urban areas.

Core Sampling Analysis The site selection and sampling techniques used in core sampling were adopted from the criteria given for "Soil Sampling for Plutonium Analysis"[4] as distributed by the AEC Division of Operational Safety. Core samples were collected from various locations within approximately one mile from the Laboratory. Additional samples for background control data were taken from locations fifty miles from the laboratory. Five cores were collected from a twenty foot square area at each location and composited to form one sample. The background control samples consisted of twenty cores, four cores from each of five locations. The soil from the core samples is analyzed in the same manner as the surface scraping samples previously discussed.

Results The results of the core sampling program are given in Table 11. The sectors referred to are those shown in Figure 9. The levels of plutonium found around Mound Laboratory were considerably lower than those reported by Krey and Hardy[5] in an independent Health and Safety Laboratory (HASL) study. Additional sample analyses are necessary before a total inventory can be calculated and these are continuing as part of Mound Laboratory's comprehensive Environmental Control Program.

[4]Memorandum, AEC/DAO to MRC, Mound Laboratory dated October 27, 1970, "Soil Sampling for Plutonium Analysis."
[5]P. W. Krey and E. P. Hardy, Plutonium in Soil Around the Rocky Flats Plant, HASL-235, Health and Safety Laboratory, New York, N. Y., (August, 1970), p. 20.

APPENDIX

Table 1

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210
JANUARY-JUNE 1971,
ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/ml)	Percent of RCG**
0 - 3 (upwind)	70	0.0095	0.13
0 - 3 (downwind)	70	0.0081	0.12
3 - 5 (downwind)	70	0.0073	0.10
5 - 10 (downwind)	70	0.0094	0.13
10 - 15 (downwind)	70	0.0077	0.11
15 - 20 (downwind)	70	0.0067	0.10

*Lowest detectable limit (LDL) for polonium in air is 0.002×10^{-12} microcurie/ml. The LDL = 0.03 percent of the RCG.

**RCG - Radioactivity concentration guide = 7×10^{-12} microcurie/ml.

Table 2

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238
JANUARY-JUNE 1971,
ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-13} microcurie/ml)	Percent of RCG**
0 - 3 (upwind)	72	0.0170	0.57
0 - 3 (downwind)	72	0.0136	0.45
3 - 5 (downwind)	71	0.0121	0.40
5 - 10 (downwind)	66	0.0135	0.45
10 - 15 (downwind)	68	0.0132	0.44
15 - 20 (downwind)	64	0.0133	0.44

*Lowest detectable limit (LDL) for plutonium in air is 0.0003×10^{-13} microcurie/ml. The LDL = 0.01 percent of the RCG.

**RCG - Radioactivity concentration guide = 3×10^{-13} microcurie/ml.

Table 3

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM
JANUARY-JUNE 1971,
ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-8} microcurie/ml)	Percent of RCG**
0 - 3 (upwind)	71	0.0409	0.58
0 - 3 (downwind)	71	0.1557	2.24
3 - 5 (downwind)	71	0.0473	0.68
5 - 10 (downwind)	71	0.0378	0.54
10 - 15 (downwind)	71	0.0357	0.51
15 - 20 (downwind)	71	0.0428	0.61

*Lowest detectable limit (LDL) for tritium in air is 0.005×10^{-8} microcurie/ml. The LDL = 0.07 percent of the RCG.

**RCG - Radioactivity concentration guide = 7×10^{-8} microcurie/ml.

Table 4

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210
JANUARY-JUNE 1971

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/ml)	Percent of RCG**
	North Zone		
	No samples collected.		
	Northeast Zone		
0 - 3 (upwind)	8	0.0121	0.17
0 - 3 (downwind)	8	0.0072	0.10
3 - 5 (downwind)	8	0.0105	0.15
5 - 10 (downwind)	8	0.0067	0.10
10 - 15 (downwind)	8	0.0114	0.16
15 - 20 (downwind)	8	0.0082	0.12
	East Zone		
0 - 3 (upwind)	7	0.0112	0.16
0 - 3 (downwind)	7	0.0072	0.10
3 - 5 (downwind)	7	0.0082	0.12
5 - 10 (downwind)	7	0.0127	0.18
10 - 15 (downwind)	7	0.0090	0.13
15 - 20 (downwind)	7	0.0090	0.13

Table 4 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/ml)	Percent of RCG**
		South Zone	
0 - 3 (upwind)	9	0.0100	0.14
0 - 3 (downwind)	9	0.0054	0.08
3 - 5 (downwind)	9	0.0066	0.09
5 - 10 (downwind)	9	0.0060	0.09
10 - 15 (downwind)	9	0.0103	0.15
15 - 20 (downwind)	9	0.0060	0.09
		Southwest Zone	
0 - 3 (upwind)	14	0.0141	0.20
0 - 3 (downwind)	14	0.0130	0.19
3 - 5 (downwind)	14	0.0149	0.21
5 - 10 (downwind)	14	0.0157	0.22
10 - 15 (downwind)	14	0.0101	0.14
15 - 20 (downwind)	14	0.0083	0.12

Table 4 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/ml)	Percent of RCG**
		Southeast Zone	
0 - 3 (upwind)	4	0.0013	0.02
0 - 3 (downwind)	4	0.0059	0.08
3 - 5 (downwind)	4	0.0034	0.05
5 - 10 (downwind)	4	0.0031	0.04
10 - 15 (downwind)	4	0.0027	0.04
15 - 20 (downwind)	4	0.0037	0.05
		West Zone	
0 - 3 (upwind)	14	0.0063	0.09
0 - 3 (downwind)	14	0.0058	0.08
3 - 5 (downwind)	14	0.0053	0.08
5 - 10 (downwind)	14	0.0118	0.17
10 - 15 (downwind)	14	0.0069	0.10
15 - 20 (downwind)	14	0.0059	0.08

Table 4 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/ml)	Percent of RCG**
		Northwest Zone	
0 - 3 (upwind)	14	0.0079	0.11
0 - 3 (downwind)	14	0.0045	0.06
3 - 5 (downwind)	14	0.0049	0.07
5 - 10 (downwind)	14	0.0054	0.08
10 - 15 (downwind)	14	0.0031	0.04
15 - 20 (downwind)	14	0.0051	0.07

*Lowest detectable limit (LDL) for polonium in air is 0.002×10^{-12} microcurie/ml. The LDL = 0.03 percent of the RCG.

**RCG - Radioactivity concentration guide = 7×10^{-12} microcurie/ml.

Table 5

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238
JANUARY-JUNE 1971

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-13} microcurie/ml)	Percent of RCG**
North Zone			
No samples collected.			
Northeast Zone			
0 - 3 (upwind)	8	0.0171	0.57
0 - 3 (downwind)	8	0.0102	0.34
3 - 5 (downwind)	8	0.0113	0.38
5 - 10 (downwind)	8	0.0065	0.22
10 - 15 (downwind)	8	0.0154	0.51
15 - 20 (downwind)	8	0.0081	0.27
East Zone			
0 - 3 (upwind)	8	0.0195	0.65
0 - 3 (downwind)	8	0.0111	0.37
3 - 5 (downwind)	8	0.0115	0.38
5 - 10 (downwind)	8	0.0122	0.41
10 - 15 (downwind)	8	0.0148	0.49
15 - 20 (downwind)	8	0.0108	0.36

Table 5 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-13} microcurie/ml)	Percent of RCG**
		Southeast Zone	
0 - 3 (upwind)	4	0.0256	0.85
0 - 3 (downwind)	4	0.0218	0.73
3 - 5 (downwind)	4	0.0168	0.56
5 - 10 (downwind)	1	0.0126	0.42
10 - 15 (downwind)	1	0.0147	0.49
15 - 20 (downwind)	1	0.0157	0.52
		South Zone	
0 - 3 (upwind)	8	0.0120	0.40
0 - 3 (downwind)	8	0.0046	0.15
3 - 5 (downwind)	8	0.0055	0.18
5 - 10 (downwind)	8	0.0208	0.69
10 - 15 (downwind)	8	0.0106	0.35
15 - 20 (downwind)	8	0.0033	0.11

Table 5 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-13} microcurie/ml)	Percent of RCG**
		Southwest Zone	
0 - 3 (upwind)	14	0.0091	0.30
0 - 3 (downwind)	14	0.0075	0.25
3 - 5 (downwind)	14	0.0085	0.28
5 - 10 (downwind)	14	0.0068	0.23
10 - 15 (downwind)	14	0.0094	0.31
15 - 20 (downwind)	14	0.0236	0.79
		West Zone	
0 - 3 (upwind)	16	0.0172	0.57
0 - 3 (downwind)	16	0.0116	0.39
3 - 5 (downwind)	15	0.0120	0.40
5 - 10 (downwind)	13	0.0106	0.35
10 - 15 (downwind)	15	0.0103	0.34
15 - 20 (downwind)	15	0.0079	0.26

Table 5 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-13} microcurie/ml)	Percent of RCG**
	Northwest Zone		
0 - 3 (upwind)	14	0.0232	0.77
0 - 3 (downwind)	14	0.0140	0.47
3 - 5 (downwind)	14	0.0189	0.63
5 - 10 (downwind)	14	0.0233	0.78
10 - 15 (downwind)	14	0.0192	0.64
15 - 20 (downwind)	10	0.0208	0.69

*Lowest detectable limit (LDL) for plutonium in air is 0.0003×10^{-13} microcurie/ml. The LDL = 0.01 percent of the RCG.

**RCG - Radioactivity concentration guide = 3×10^{-13} microcurie/ml.

Table 6

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM
JANUARY-JUNE 1971

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-8} microcurie/ml)	Percent of RCG**
	North Zone		
	No samples collected.		
	Northeast Zone		
0 - 3 (upwind)	8	0.0106	0.15
0 - 3 (downwind)	8	0.0629	0.90
3 - 5 (downwind)	8	0.0189	0.27
5 - 10 (downwind)	8	0.0041	0.06
10 - 15 (downwind)	8	0.0069	0.10
15 - 20 (downwind)	8	0.0027	0.04
	East Zone		
0 - 3 (upwind)	8	0.0349	0.50
0 - 3 (downwind)	8	0.1802	2.57
3 - 5 (downwind)	8	0.0145	0.21
5 - 10 (downwind)	8	0.0108	0.15
10 - 15 (downwind)	8	0.0177	0.25
15 - 20 (downwind)	8	0.0283	0.40

Table 6 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-8} microcurie/ml)	Percent of RCG**
		Southeast Zone	
0 - 3 (upwind)	4	0.1166	1.67
0 - 3 (downwind)	4	0.1400	2.00
3 - 5 (downwind)	4	0.1187	1.70
5 - 10 (downwind)	4	0.0384	0.55
10 - 15 (downwind)	4	0.1049	1.50
15 - 20 (downwind)	4	0.0595	0.85
		South Zone	
0 - 3 (upwind)	8	0.0246	0.35
0 - 3 (downwind)	8	0.4964	7.09
3 - 5 (downwind)	8	0.0419	0.60
5 - 10 (downwind)	8	0.0437	0.62
10 - 15 (downwind)	8	0.0230	0.33
15 - 20 (downwind)	8	0.0688	0.98

Table 6 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-8} microcurie/ml)	Percent of RCG**
		Southwest Zone	
0 - 3 (upwind)	15	0.0811	1.16
0 - 3 (downwind)	15	0.1028	1.47
3 - 5 (downwind)	15	0.0804	1.15
5 - 10 (downwind)	15	0.0837	1.20
10 - 15 (downwind)	15	0.0935	1.34
15 - 20 (downwind)	15	0.0798	1.14
		West Zone	
0 - 3 (upwind)	14	0.0161	0.23
0 - 3 (downwind)	14	0.1674	2.39
3 - 5 (downwind)	14	0.0707	1.01
5 - 10 (downwind)	14	0.0308	0.44
10 - 15 (downwind)	14	0.0113	0.16
15 - 20 (downwind)	14	0.0507	0.72

Table 6 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-8} microcurie/ml)	Percent of RCG**
	Northwest Zone		
0 - 3 (upwind)	14	0.0311	0.44
0 - 3 (downwind)	14	0.0498	0.71
3 - 5 (downwind)	14	0.0060	0.09
5 - 10 (downwind)	14	0.0029	0.04
10 - 15 (downwind)	14	0.0150	0.21
15 - 20 (downwind)	14	0.0046	0.07

*Lowest detectable limit (LDL) for tritium in air is 0.005×10^{-8} microcurie/ml. The LDL = 0.07 percent of the RCG.

**RCG - Radioactivity concentration guide = 7×10^{-8} microcurie/ml.

Table 7

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM-210
JANUARY-JUNE 1971

Sample Location	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/ml)	Percent of RCG**
The river, 25 yd upstream from Mound Lab Effluent (location No. 1 on map)	50	0.0109	0.55
Sycamore St. Bridge Miamisburg, Ohio (upstream-location No. 2 on map)	50	0.0028	0.14
The river, 10 ft downstream from Mound Lab Effluent (location No. 3 on map)	50	0.0533	2.67
250 yd downstream from Mound Lab Effluent (location No. 4 on map)	50	0.0565	2.82
Chautauqua Road Bridge (location No. 5 on map)	50	0.0059	0.29
Chautauqua Dam (location No. 6 on map)	50	0.0045	0.22
Franklin, Ohio (location No. 7 on map)	50	0.0051	0.25
Pond-opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, Location 8 on map)	50	0.0033	0.17
Pond-Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, Location 9 on map)	50	0.0052	0.26

*Lowest detectable limit for polonium in water is 0.0128×10^{-7} microcurie/ml. The LDL = 0.64 percent of the RCG.

**RCG - Radioactivity concentration guide = 2×10^{-7} microcurie/ml.

Table 8

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM-238
JANUARY-JUNE 1971

Sample Location	Number of Samples Collected	Average Concentration* (10^{-6} microcurie/ml)	Percent of RCG**
The river, 25 yd upstream from Mound Lab Effluent (location No. 1 on map)	50	0.0018	0.09
Sycamore St. Bridge Miamisburg, Ohio (upstream-location No. 2 on map)	50	0.0013	0.07
The river, 10 ft downstream from Mound Lab Effluent (location No. 3 on map)	50	0.0052	0.26
250 yd downstream from Mound Lab Effluent (location No. 4 on map)	50	0.0038	0.19
Chautauqua Road Bridge (location No. 5 on map)	50	0.0015	0.07
Chautauqua Dam (location No. 6 on map)	50	0.0014	0.07
Franklin, Ohio (location No. 7 on map)	50	0.0018	0.09
Pond-opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, Location 8 on map)	50	0.0010	0.05
Pond-Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, Location 9 on map)	50	0.0008	0.04

*Lowest detectable limit for plutonium in water is 0.00013×10^{-6} microcurie/ml. The LDL = 0.007 percent of the RCG.

**RCG - Radioactivity concentration guide = 2×10^{-6} microcurie/ml.

Table 9

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM
JANUARY-JUNE 1971

Sample Location	Number of Samples Collected	Average Concentration* (10^{-3} microcurie/ml)	Percent of RCG**
The river, 25 yd upstream from Mound Lab Effluent (location No. 1 on map)	50	0.0185	1.85
Sycamore St. Bridge Miamisburg, Ohio (upstream-location No. 2 on map)	50	0.0063	0.63
The river, 10 ft downstream from Mound Lab Effluent (location No. 3 on map)	50	0.0474	4.74
250 yd downstream from Mound Lab Effluent (location No. 4 on map)	50	0.0274	2.74
Chautauqua Road Bridge (location No. 5 on map)	50	0.0048	0.48
Chautauqua Dam (location No. 6 on map)	50	0.0030	0.30
Franklin, Ohio (location No. 7 on map)	50	0.0030	0.30
Pond-opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, Location 8 on map)	50	0.0055	0.55
Pond-Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, Location 9 on map)	50	0.0090	0.90

*Lowest detectable limit for tritium in water is 0.0002×10^{-3} microcurie/ml. The LDL = 0.02 percent of the RCG.

**RCG - Radioactivity concentration guide = 1×10^{-3} microcurie/ml.

MLM-1922

MLM-1922

Environmental Monitoring Report: July-December 1971 and 1971 Summary

D. G. Carfagno and W. H. Westendorf

May 22, 1972

AEC Research and Development Report

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a subsidiary of Monsanto Company
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Issued: May 22, 1972

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ABSTRACT

The environment surrounding Mound Laboratory was monitored and reported on for the second half of 1971 and for the entire year. Samples analyzed and reported on include air, water, foodstuffs, soil and silt. For radioactive species the average concentrations of polonium-210, plutonium-238 and tritium detected were well within the stringent standards adopted by the Atomic Energy Commission and the Environmental Protection Agency. Data concerning non-radioactive species in air and water are presented for the first time. Data for these indicate that Mound Laboratory operations have negligible effect on the environment.

FOREWORD

This report was prepared by the Environmental Control Section of the Administration Department at Mound Laboratory. Sample analysis and data reduction were performed by the Analytical and Development group of the Environmental Control Section. Several special samples were analyzed by the Nuclear Operations General Analytical Group. Particulate samples and data were also received from the Air Pollution Control Section of the Montgomery County Combined General Health District.

INTRODUCTION

Mound Laboratory is situated on 180 acres of land in Miamisburg, Ohio. This location is 12 miles southwest of Dayton. The area within a twenty mile radius of the Laboratory includes essentially all of Montgomery County and approximately thirty to sixty percent of the adjoining counties of Butler, Greene, Preble and Warren. The predominant geographical feature in the five county region is the Great Miami River which flows through Miamisburg from the northeast to the southwest. This river valley area is generally highly industrialized. The remainder of the region is predominantly agricultural with some light industry and scattered residential communities. The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately ten percent of the land area in agricultural use is devoted to pasturing livestock.[1]

Weather conditions in the area are considered moderate. The average annual precipitation is approximately thirty-six inches and is evenly distributed throughout the year. Winds predominate out of the south and west except during the summer months when a higher frequency is observed out of the southwest. The wind speed averages about ten miles per hour annually.[2]

Mound Laboratory began operation in 1949. Its mission currently includes research, development, engineering, and production of components for the AEC weapons program; research, development and production of explosive materials; separation, purification, and sale of stable isotopes of the noble gases; and development, design, and fabrication of radioisotopic heat sources for medical application and space exploration.

Interest in the health and safety of employes and the public is manifested by an Environmental Control Program which has been in existence continuously during the Laboratory's history. Fundamental objectives of the environmental control program are the containment of radioactive waste and control of non-radioactive effluents to levels well within existing or proposed standards. As part of the Program's control function, all effluents containing polluting materials are controlled at each operating step. As a result of this control, any releases of low-level gaseous and liquid wastes to the environment are carefully controlled and dispersed to ensure that concentrations are well within recommended standards.

Radioisotopes in particulate form are removed from air effluents by the use of high-efficiency particulate absolute (HEPA) filters. The air effluents are filtered by two banks of HEPA filters in series. Radioisotopes are removed from liquid effluent by chemical processing. Airborne and liquid wastes generated in the processing of explosive materials are collected and disposed of according to the Army Material Command Regulation 385-100.

A sanitary sewage treatment plant which is operated in accordance with State of Ohio regulations, handles all domestic sewage generated on-site. Pending completion of a general waste incinerator, solid domestic waste is disposed of at an on-site sanitary land fill.

As part of the Program's monitoring function, air, water, foodstuff and soil samples are collected in a 1,250 square mile area. These samples are analyzed for the specific radionuclides handled at the Laboratory as well as non-radioactive pollutants. The sampling techniques, analyses and counting methods are those best suited for the determination of the radionuclides of interest and are designed to detect levels as low as background.

The results of the analyses are provided in this report. Error limits, when given, reflect uncertainties in the data at the 95% confidence level due to analytical procedures.

ENVIRONMENTAL MONITORING

Air - Radioactive

Air samples are collected off-site three times per week by means of a mobile sampling unit mounted in a panel truck. Samples are collected upwind and downwind as far as twenty miles from the Laboratory covering an area of 1250 square miles. Specific collection routes are drawn for the different wind directions. The route is selected on any given day corresponding to the wind direction for that day. Figure 1 shows the zones corresponding to the eight sampling routes. The mobile unit is parked safely off the road while the sample is taken. Two types of samples are collected, a particulate sample for plutonium-238 and polonium-210 analysis and a gas bubbler sample for tritium oxide analysis. The particulate sample is collected on a four inch diameter Whatman No. 41 filter paper by means of a high volume air sampler. The air is sampled at a rate of 20 ft^3/min (5.7×10^5 cc/min). The particulate sample collected represents approximately 10 m^3 of air and is analyzed specifically for polonium-210 and plutonium-238. The plutonium-238 analysis includes the use of plutonium-236 as an internal standard in conjunction with alpha pulse height analysis which allows correction for chemical and counting losses to be made.

Analysis of the data obtained from samples collected by the mobile unit during the second half of 1971 shows that the average concentrations of polonium-210 measured at all locations upwind and downwind in all zones were less than three-tenths of 1% of the Radioactivity Concentration Guide (RCG). A listing and discussion of RCG's is located in the appendix of this report. The average concentrations over the entire year were approximately two-tenths of 1% of the RCG. These results are summarized in Table 1. Plutonium-238 concentrations measured in samples collected by the mobile unit in all zones during the second half of 1971 were less than 2% of the RCG. The average concentrations for the entire year were 1% or less of the RCG. These results are summarized in Table 2.

The sample for tritium oxide analysis is collected by bubbling air through 50 ml of water at a rate of 0.35 ft^3/min (0.99×10^4 cc/min). Any tritium oxide present in the air is collected in the water. The sampling and analysis is directed to tritium oxide rather than elemental tritium since the RCG for the oxide is two hundred times more restrictive. A sample representing 0.1 m^3 of air is collected and an aliquot of this counted

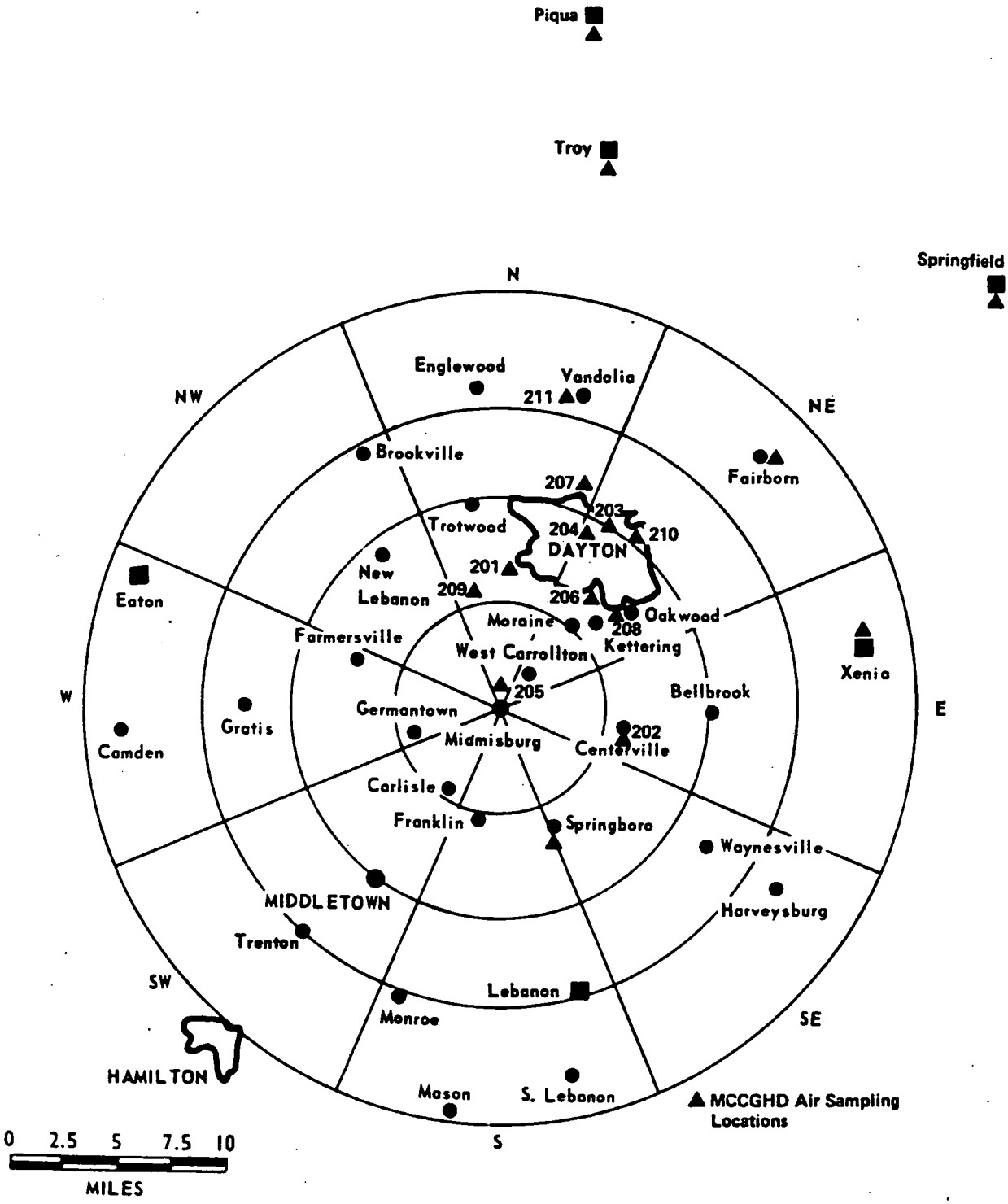

FIGURE 1 - Off-site air sampling zones.

in a liquid scintillation spectrometer. The average concentrations of tritium oxide measured during the second half of 1971 varied from approximately 6% of the RCG in one range (zero to three miles downwind) to five-tenths of 1% of the RCG. The average concentrations for the entire year varied from 4% to five-tenths of 1% of the RCG. These results are summarized in Table 3.

Additional particulate air samples are obtained from the Air Pollution Control Section of the Montgomery County Combined General Health District (MCCGHD). These samples are collected from various locations in Montgomery County. The locations can also be found in Figure 1. The particulate sample in this case is collected on a 8 x 10 inch fiber glass filter by means of a high volume air sampler. The air is sampled at a rate of 40 ft^3/min (1 x 10^6 cc/min) for a twenty-four hour period every four days. This sample represents approximately 1000 m^3 of air. The MCCGHD determines the weight of particulates collected and then submits one-half of the filter to Mound Laboratory which is analyzed specifically for polonium-210 and plutonium-238. The MCCGHD also supplies particulate data from the network to Mound Laboratory. Analysis of the data obtained from the MCCGHD particulate air samples during 1971 indicate that the average concentration of polonium-210 and plutonium-238 detected at any location was approximately one-tenth of 1% or less of the RCG. During the last quarter of 1971, additional particulate samples from communities outside Montgomery County were made available by the MCCGHD. While not as many samples were obtained from these locations as the Montgomery County locations, they are included for comparison since they are distant enough (19 to 34 miles) to be considered background for this general area. The concentrations of polonium-210 measured at the Montgomery County locations are approximately the same as the concentrations measured at the distant locations. The polonium-210 results are summarized in Table 4. The concentrations of plutonium-238 measured at the Montgomery County locations are of the same order of magnitude as the concentrations measured at the distant stations with the highest average value being a factor of five greater than the average value of the seven distant stations. This highest average value, however, is only 5/100 of 1% of the RCG. The plutonium-238 results are summarized in Table 5. The data obtained from the MCCGHD samples indicate the increased sensitivity achieved by sampling a larger volume of air in comparison to the routine samples collected by the mobile unit (1000 m^3 vs 10 m^3). These data further demonstrate that the average concentrations of polonium-210 and plutonium-238 in the environment are well below the RCG.

A continuously operating high volume air sampler and gas bubbler have been in operation in Miamisburg since the middle of September 1971. The sampler is located approximately one mile due north of the Laboratory. The high volume sampler collects a particulate sample on a 200 mm diameter Microsorban disk. The sampling rate is 40 ft^3/min (1 x 10^6 cc/min) resulting in a total sample volume of 10,000 m^3 of air. The gas bubbler sample is also collected on a continuous basis at approximately 1 x 10^3 cc/min with a total volume of 10 m^3 of air sampled. The average concentration of polonium-210 detected at the continuous high volume air sampling

station in Miamisburg was only 0.03% of the RCG and the average concentration of plutonium-238 detected at this location was only 0.01% of the RCG. The average concentration of tritium oxide detected at this location was only 1% of the RCG. The data obtained from the continuous air sampling station demonstrates the increase in sensitivity achieved by collecting very large samples of air for both particulate samples ($\approx$10,000 m^3) and gas bubbler samples (10 m^3). A network of ten continuous high volume air sampling stations is scheduled to be in operation by mid February 1972 with an additional ten planned to be in operation during the second half of 1972.

An on-site perimeter network of five continuous, high volume air samplers is scheduled for installation during the first half of 1972. In the interim three sampling stations have been in operation. A continuous high volume air sampler has been located at the southern site perimeter The air is sampled at the rate of 40 ft^3/min (1.1×10^6 cc/min). The remaining two sampling stations contain continuous low volume air samplers. In these cases air is sampled at the rate of 1 ft^3/min (2.8×10^4 cc/min). One low volume station is located at approximately the center of the site and the other at the northern site perimeter. Gas bubbler samples at the rate of 1×10^3 cc/min are also collected at all three sampling locations. Both high and low volume particulate samples are analyzed for polonium-210 and plutonium-238. The average concentrations of polonium-210, plutonium-238 and tritium oxide detected during 1971 at the on-site high volume air sampling station were 0.01%, 0.05%, and 0.07%, respectively, of their respective RCG's. The RCG used for comparison for these on-site samples is the guide listed in the appendix of this report for an uncontrolled area. The average concentration of polonium-210, plutonium-238 and tritium oxide detected during 1971 at the on-site low volume air sampling station located at the site center were 0.02%, 0.04% and 2.7%, respectively, of their respective RCG's. These values for the other low volume air sampling station located at the northern perimeter were 0.01%, 0.03%, and 2.4%, respectively.

Air - Non-radioactive

None of the operations presently carried on at Mound Laboratory involve amounts of material which would lead to significant carbon monoxide, photochemical oxidant or hydrocarbon emissions from stationary sources. The steam power supply has been converted from fuel oil to natural gas thus eliminating virtually all sulfur dioxide emissions. Therefore, no sampling for these pollutants is carried on at this time. A general waste incinerator has been constructed on-site and will be in operation shortly. This will provide effective disposal of all combustible wastes in compliance with air quality standards. In order to demonstrate this, particulate sampling prior to incinerator operation has been carried out on-site to establish a background level. The particulate concentrations were determined at the on-site low-volume air sampling stations and exceeded the State of Ohio Ambient Air Quality Standards during one week only for the entire year. The maximum value obtained was 73 micrograms

per cubic meter ($\mu g/m^3$). This was recorded during a week of thermal inversion and is not normally representative. By comparison, the particulate concentration during the same week in downtown Miamisburg was 254 $\mu g/m^3$ as reported by the MCCGHD. The annual geometric mean of the particulate concentrations measured was 37 $\mu g/m^3$ which is approximately 60% of the State of Ohio Ambient Air Quality Standards. It should be noted that the Mound Laboratory operations do not at this time result in measurable particulate discharges, and this measured level represents the ambient air levels surrounding the Laboratory.

Water - Radioactive

Water samples are collected twice per week along the bank of the Great Miami River, and two nearby ponds that are both northeast of the Laboratory. A sample of approximately 500 ml is taken at each of these nine sampling locations. These locations are shown in Figure 2. All samples are subjected to specific analyses for polonium-210, plutonium-238, and tritium oxide. Analysis of data obtained from these water samples during the second half of 1971 indicates that the average concentrations of polonium-210 detected were less than 1% of the RCG. The average concentrations for the entire year of 1971 were less than 2% of the RCG. These results are summarized in Table 6. Average concentrations of plutonium-238 measured during the second half of 1971 at all bi-weekly sampling locations were less than one-tenth of 1% of the RCG. The average concentrations for the entire year of 1971 were less than two-tenths of 1% of the RCG. These results are summarized in Table 7. Analysis of the tritium oxide data obtained from these bi-weekly water samples during the second half of 1971 indicates that the average concentration was less than 1% of the RCG. The average concentrations for the entire year of 1971 were less than 2.8% of the RCG. These results are summarized in Table 8.

Eight additional surface water locations such as ponds and streams are sampled monthly. These locations are shown in Figure 2. A sample of approximately four liters is collected at each location and analyzed for polonium-210, plutonium-238 and tritium oxide. The average concentrations of polonium-210 measured at the surface water locations during 1971 were less than 1/10 of 1% of the RCG. The average concentrations of plutonium-238 measured at these locations during 1971 were less than 1/100 of 1% of the RCG. The average concentrations of tritium oxide measured at these locations were less than 9/10 of 1% of the RCG. The results of the surface water monitoring program are summarized in Table 9.

Drinking water from communities in the surrounding area is sampled quarterly. These communities are shown in Figure 1. A sample of approximately four liters is collected and analyzed for polonium-210, plutonium-238, and tritium oxide. The concentrations of polonium-210, plutonium-238 and tritium oxide were found to be less than 5/100 of 1%, 1/100 of 1% and 2% of their RCG's, respectively. The results of the community drinking water sampling program are summarized in Table 10.

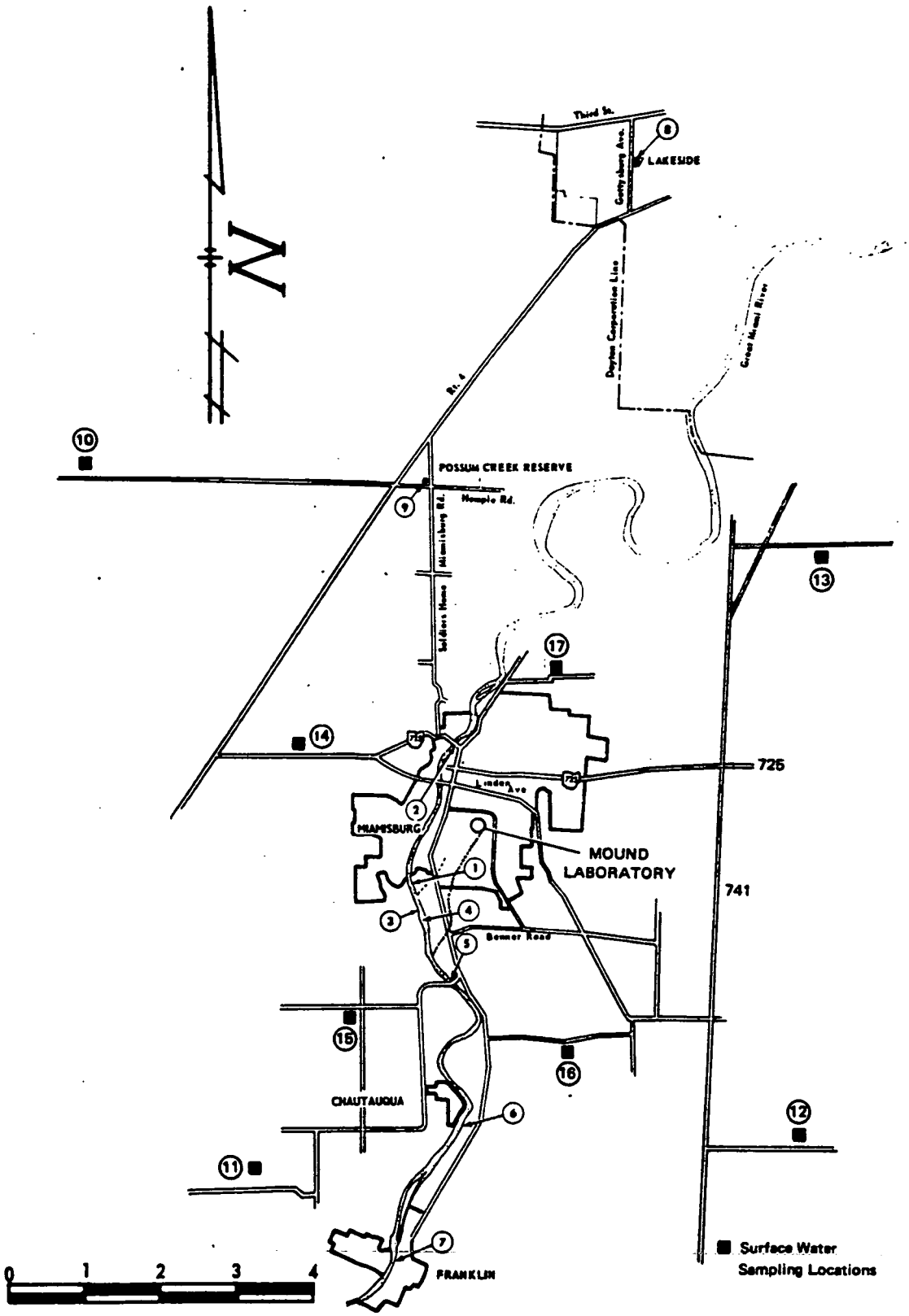

FIGURE 2 - Off-site water sampling locations.

Water - Non-radioactive

It is difficult to measure the levels of non-radioactive pollutants in the Great Miami River resulting from Mound Laboratory's water effluent because of the relatively high level of these pollutants already present in the river upstream from the outfalls. Therefore, a composite sample of both water effluent streams leaving the Laboratory is automatically collected and analyzed for various water quality parameters as reported below. The sample volume is proportionate to the flow in the stream. The composite effluent water samples are analyzed for the listed water quality parameters according to standard techniques[3] for waste water analysis accepted by the Office of Water Programs of the Environmental Protection Agency. Concentrations of non-radioactive pollutants in the effluent stream are compared to the Surface Water Criteria for Public Water Supplies since there are no effluent standards now in effect. The results of the effluent stream analyses are summarized in Table 11. Analysis of the data indicate that the effluent water leaving Mound Laboratory meets the more restrictive Surface Water Criteria for Public Water Supplies in all cases except chlorides and total solids. These exceptions occur because the extremely hard water supply is softened and the effluent from the softening process is discharged via the effluent stream to the Great Miami River. A study is under way to solve this problem either by means of a different softening process or a reduction in the use of softened water. These would not be exceptions if dilution by the receiving stream were taken into consideration.

Foodstuffs and Vegetation - Radioactive

Various locally grown foodstuff and vegetation samples are collected from the surrounding area. The samples collected include milk, eggs, garden vegetables, grass and aquatic life. The intent of this portion of the Environmental Monitoring Program is to determine if there is any uptake and concentration of radionuclides by plant or animal life. The polonium-210 and plutonium-238 content of the foodstuff and vegetation samples is determined by slowly evaporating the sample to dryness and then proceeding with the same techniques used for polonium-210 and plutonium-238 analyses of air samples. These samples are analyzed for tritium oxide by distilling the water fraction from an aliquot of the entire sample. The tritium content of the distillate is then determined in the same manner as the water samples previously discussed in this report. The results of the foodstuff and vegetation analyses are summarized in Table 12. The concentration is given in terms of the sample weight before evaporation to dryness. The only foodstuff samples analyzed for tritium are milk since Rosenthal and Stewart[4] in their study on tritium transfer in simple aquatic food chains concluded that equilibrium between tritium in aquatic life and its environment is rapid and that a biological sink does not exist. Therefore, if the environment, i.e., air and water, are monitored the levels found there would be indicative of the levels present in the plant and animal life growing therein. In addition to monitoring air and water for tritium, milk is also analyzed for tritium content since it is consumed in relatively large quantities by young children and babies.

The vegetables analyzed included green beans, onions, corn and tomatoes. The samples of aquatic life analyzed included only the edible fleshy portions. There appears to be a very small amount of polonium-210 in the aquatic life samples. Since the foodstuff sampling program has been in operation for only slightly more than a year and polonium-210 does appear naturally in the earth's crust, no conclusions can be drawn. More data must be accumulated before any conclusion can be reached as to the source of the polonium-210 found in these types of samples. No other indication has been found that there is any significant uptake and concentration by plant or animal life of the three radionuclides handled at Mound Laboratory.

Soil and Silt - Radioactive

Two types of soil samples from areas surrounding the Laboratory have been analyzed for plutonium-238. One type of sample is used to evaluate the resuspendible amounts of plutonium-238 in the soil surrounding Mound Laboratory. Surface scrapings (approximately 1/8 inch deep) of undisturbed soil were collected for this evaluation. Surface scraping samples were taken from twenty sectors surrounding Mound Laboratory to a distance of ten miles. These sectors are shown in Figure 3. In addition, surface scrapings were taken fifty miles northeast, southeast, southwest and northwest of the Laboratory to serve as background control samples. Twenty-five scrapings are composited to form a sample for each sector. Soil samples are digested with an acid mixture to extract the plutonium. The solution is then passed over an ion exchange column specific for plutonium and analyzed in the same manner as the particulate air samples previously discussed in this report. This leach method has been compared with a fusion method for soil analysis.[5] Good agreement was obtained between the two methods of analysis. The leach method was chosen for the soil analysis because larger samples, which minimize sampling and aliquoting errors, and increase sensitivity can be handled with this method.

The results of the soil surface scraping study for 1971 are shown in Table 13. The highest concentration of plutonium-238 found in 1971 was approximately 2% of the most restrictive levels suggested by Kathren[6] for urban areas.

The second type of sample is used to determine the inventory amounts of plutonium-238 in the soil surrounding Mound Laboratory. A 3-1/2 inch diameter core of soil approximately 1-1/2 inches deep is taken for this determination. The site selection and sampling techniques used in core sampling were basically those suggested by the criteria given for "Soil Sampling for Plutonium Analysis" as distributed by the AEC Division of Operational Safety. Core samples were collected from various locations within approximately one mile from the Laboratory. Five cores were collected from a twenty foot square area at each location and composited to form one core sample. Additional core samples for background control data were taken from locations fifty miles from the laboratory. The background control core samples consisted of twenty cores, four cores

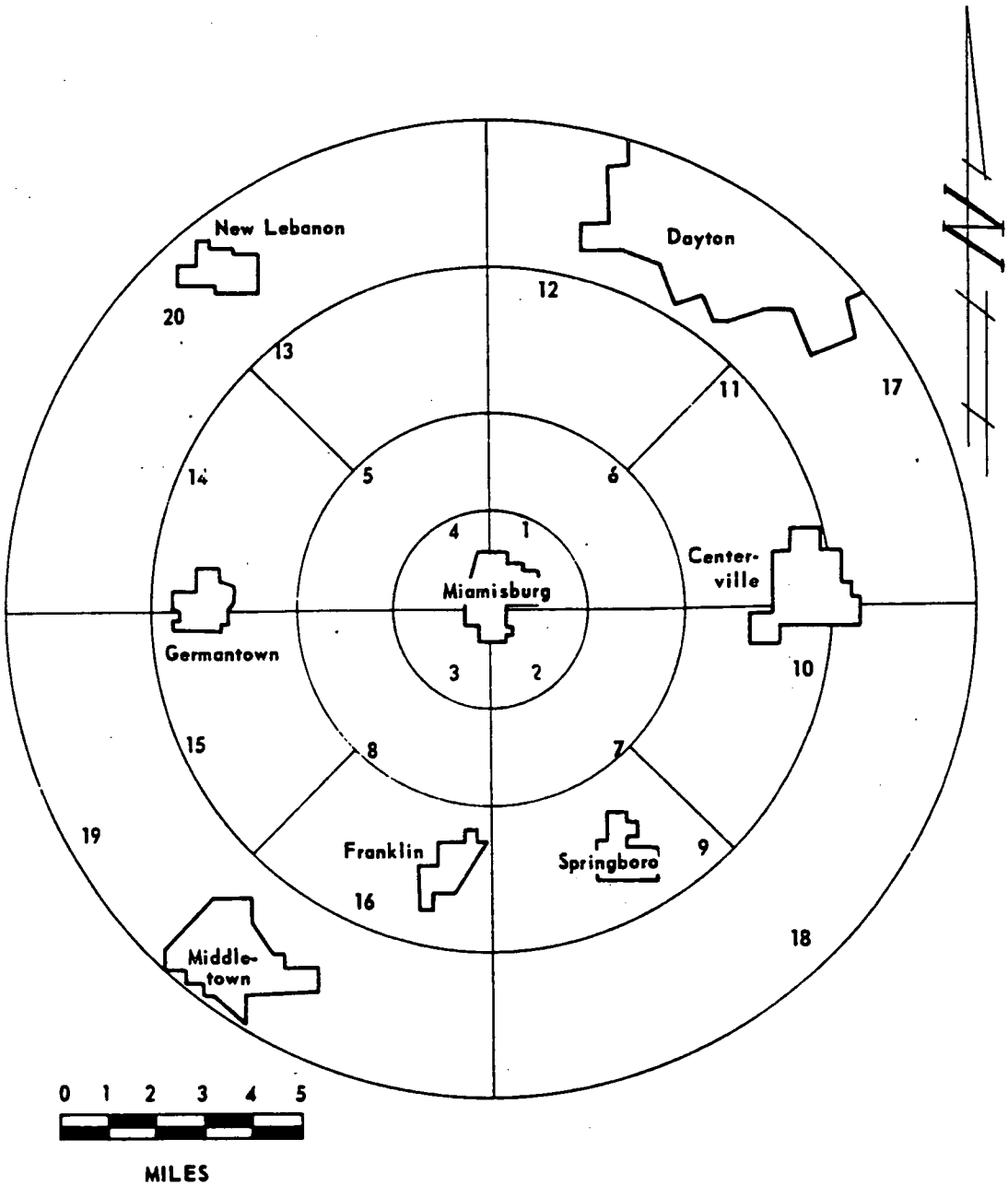

FIGURE 3 - Soil sampling sectors.

from each of five locations. The results of the core sampling program are summarized in Table 14. The sectors referred to are those shown on Figure 3. As mentioned in the appendix of this report, no standards have been established for radioactive species in soil. Additional sample analyses are necessary before a total inventory can be calculated and these are continuing as part of Mound Laboratory's comprehensive Environmental Control Program.

Silt samples are collected quarterly from four locations on the Great Miami River. These samples are taken at four of the same locations that water samples are taken from and are identified by the same numbers shown in Figure 2. Additional silt samples are collected annually from the same surface water locations which are sampled monthly. The silt samples are analyzed in the same manner as the soil samples. The results of Great Miami River silt sampling for 1971 are summarized in Table 15. The results of the silt sampling from the area ponds are summarized in Table 16. There appears to be a very slight accumulation of plutonium-238 in river silt from the very small amounts of plutonium-238 which are discharged to the river. However, as mentioned previously, there does not appear to be any reentrainment of plutonium-238 by plant or animal life in the river nor by the river itself. No significant accumulation is indicated, however, by the pond silt data. As mentioned in the appendix of this report, there are no standards for radioactive species in soil or silt.

SUMMARY

The average concentrations of polonium-210, plutonium-238 and tritium detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, are presented for the second half of 1971 and for the entire year. The average concentrations of these radioisotopes were well within the stringent standards adopted by the Atomic Energy Commission.

Atmospheric monitoring for radioactive species found the highest average concentrations of plutonium and tritium in air during 1971 to be 1% and 4% of their respective RCG's. These concentrations are 10% and 26% lower, respectively, than those detected during 1970. The average concentrations of polonium in air detected during 1971 were approximately 0.2% of the RCG which is approximately the same as detected during 1970.

Atmospheric monitoring for non-radioactive species was conducted to establish background levels for particulates.

Water monitoring for radioactive species found the highest average concentration of plutonium at any of the water sampling locations during 1971 to be only 0.2% of the RCG which is 40% of the highest average concentration reported during 1970. The highest average concentrations of polonium and tritium in water during 1971 were 1.8% and 2.8% of their respective RCG's. These concentrations are approximately the same as reported during 1970.

Water monitoring for non-radioactive species was conducted.

Additionally, data concerning radioactive species in surface water, community drinking water, foodstuffs and silt are presented for the first time. No significant uptake of radioactive species from air or water by plant or animal life has been observed. No reentrainment of radioactive species from soil or silt is indicated at this time. The highest level of plutonium-238 found during 1971 in soil surface scrapings was approximately 2% of the most restrictive levels suggested for urban areas. Soil core sample analyses will continue to establish a plutonium soil inventory as part of the total program to assess the impact of the Laboratory's operations on the environment.

These data indicate that the operation of the Laboratory has negligible effect on the environment.

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3. Standard Methods for the Examination of Water and Waste Water, M. J. Taras et al. (ed.), Thirteenth edition, American Public Health Association, Washington, D. C., 1971, 874 pp.

4. G. M. Rosenthal, Jr., M. L. Stewart, "Tritium Incorporation in Algae and Transfer in Simple Aquatic Food Chains," presented at Symposium on Radioecology, Oak Ridge, Tennessee, May 10-12, 1971, CONF-710501-24.

5. C. T. Bishop, W. E. Sheehan, R. K. Gillette, and B. Robinson, "Comparison of a Leaching Method and a Fusion Method for the Determination of Plutonium-238 in Soil," presented at a meeting on "Distribution and Measurement of Plutonium in the Environment," at Los Alamos Scientific Laboratory, August 4-5, 1971.

6. R. L. Kathren, Towards Interim Acceptable Surface Contamination Levels for Environmental PuO_2, BNWL-SA-1510, Battelle Memorial Institute, Pacific Northwest Laboratory, Richland, Washington (Mar. 14, 1968), p. 10.

APPENDIX.

ADDITIVE LEVELS DUE TO RADIONUCLIDE MIXTURE

The Standards for Radiation Protection (AEC Chapter 0524) states that a radionuclide should not be considered part of the mixture if the ratio of the concentration of the radionuclide to its RCG is not greater than 1/10. Furthermore the sum of all such excluded ratios cannot exceed 1/4. The sum of the ratios of the concentration of radionuclides to their respective RCG's for both the second half of 1971 and the entire year 1971 are listed below. The sum is presented for the maximum levels detected in both air and water.

	Air		Water	
	July-Dec.	Jan.-Dec.	July-Dec.	Jan.-Dec.
Concentration of ^{210}Po/RCG for ^{210}Po	0.003	0.002	0.009	0.018
Concentration of ^{238}Pu/RCG for ^{238}Pu	0.019	0.010	0.001	0.002
Concentration of tritium oxide/RCG for tritium oxide	0.062	0.041	0.008	0.028
Sum	0.084	0.053	0.018	0.048

The data indicate that for purposes of AEC Manual Chapter 0524 a mixture of radionuclides did not occur during 1971.

APPLICABLE STANDARDS

RADIOACTIVE STANDARDS

Concentrations of radioactive species in air and water are compared with the Radioactivity Concentration Guide (RCG) values as promulgated by the Office of Radiation Programs of the Environmental Protection Agency. The RCG value can be interpreted as the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The RCG values, as defined in AEC Manual Chapter 0524, for the various types of samples are listed below.

General Population

Air

Polonium-210: 7×10^{-12} microcuries per milliliter (μCi/ml)
Plutonium-238: 3×10^{-13} microcuries per milliliter (μCi/ml)
Tritium: 7×10^{-8} microcuries per milliliter (μCi/ml)

Water

Polonium-210: 2×10^{-7} microcuries per milliliter (μCi/ml)
Plutonium-238: 2×10^{-6} microcuries per milliliter (μCi/ml)
Tritium: 1×10^{-3} microcuries per milliliter (μCi/ml)

Uncontrolled Area

Air

Polonium-210: 2×10^{-11} microcuries per milliliter (μCi/ml)
Plutonium-238: 1×10^{-12} microcuries per milliliter (μCi/ml)
Tritium: 2×10^{-7} microcuries per milliliter (μCi/ml)

Mixture

In addition to the RCG values for the individual radionuclides, the Standards for Radiation Protection (AEC Chapter 0524), indicate that if a mixture of more than one radionuclide occurs in air or water, the following guidelines shall be used. The ratio between the concentration of each radionuclide present in the mixture and its respective RCG shall be determined. The sum of these ratios for all the radionuclides in the mixture should not exceed "unity." A radionuclide should not be considered part of the mixture if the ratio of the concentration of the radionuclide to its RCG is not greater than 1/10 provided that the sum of all such excluded ratios does not exceed 1/4.

Foodstuffs

There are no RCG values specified for foodstuffs as such since the water content of food was taken into account in the determination of RCG values for water. Consideration of radionuclides in food is necessary only in case of concentration in food during processing or in case it enters the food from other sources. In this event the recommendation is to use the RCG for water converted to microcuries per gram. For comparison purposes the recommendation is followed in this report.

Soil

There are no guidelines established for radioactive species in soil. There have been several studies published which suggest maximum surface contamination levels only. Of these, the levels suggested by Kathren[6] are the most restrictive. Kathren gives the following as acceptable levels of surface contamination for occupancy by the general public:

	Average Concentration	Maximum Concentration
Urban Areas	10 d/m/cm^2	100 d/m/cm^2 (for ≤10% of area)
Rural Areas	100 d/m/cm^2	

There are no authoritative studies published on proposed standards for soil, mud or silt cores. It is felt that the health significance associated with radioactive species found in these type samples is in the reentrainment of these species into air or foodstuffs either by means of water run-off or uptake by plant life. Therefore, monitoring of air, water and foodstuffs is considered a better indicator than monitoring of soil and silt.

NON-RADIOACTIVE STANDARDS

Concentrations of non-radioactive species in air and water are compared with standards promulgated by the Offices of Air and Water Programs of the Environmental Protection Agency. If a local standard which is more restrictive than the national standard is in effect it will be used for comparison. The following air and water standards are ambient standards since emission or effluent standards do not exist at this time for the State of Ohio. Ambient standards are more restrictive since dilution by the environment is taken into account and no further dilution is expected.

Air

The State of Ohio Ambient Air Quality Standards should be used for comparison since they are more restrictive than the National Ambient Air Quality Standards. The State of Ohio standards are:

Particulate Matter	65 micrograms/cubic meter ($\mu g/m^3$)
Sulfur Dioxide	40 micrograms/cubic meter ($\mu g/m^3$)
Carbon Monoxide	10 milligrams/cubic meter (mg/m^3)
Photochemical Oxidants	40 micrograms/cubic meter ($\mu g/m^3$)
Hydrocarbons	126 micrograms/cubic meter ($\mu g/m^3$)

Water

The Surface Water Criteria for Public Water Supplies adopted by the Environmental Protection Agency should be used for comparison of concentrations of non-radioactive pollutants in water. The Criteria are:

Constituent	Criteria (mg/L)
Heavy Metals	
Arsenic	0.05
Barium	1.0
Boron	1.0
Cadmium	0.01
Chromium, hexavalent	0.05
Copper	1.0
Iron	

Constituent	Criteria (mg/L)
Lead	0.05
Manganese	0.05
Mercury	0.05
Selenium	0.01
Silver	0.05
Uranyl Ion	5.0
Zinc	5.0
Other Inorganics	
Chlorides	250
Sulfates	250
Nitrates	10
pH	6.0 - 8.5
Total dissolved solids	500
Dissolved Oxygen	$\geq$ 4
Organic	
BOD	-
Cyanide	0.20
ABS	0.5
Phenol	0.001
Oil & Grease	Virtually absent
Physical Properties	
Suspended Solids	20*
Turbidity	-
Biological	
Total Coliforn	10,000/100 ml
Fecal Coliform	2,000/100 ml

*Treatment plant criteria

Table 1

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JULY-DECEMBER 1971, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/ml)	Percent of RCG**
0 - 3 (upwind)	64	0.014 ± 0.008	0.2
0 - 3 (downwind)	64	0.013 ± 0.005	0.2
3 - 5 (downwind)	64	0.014 ± 0.008	0.2
5 - 10 (downwind)	64	0.019 ± 0.009	0.3
10 - 15 (downwind)	64	0.018 ± 0.009	0.3
15 - 20 (downwind)	64	0.010 ± 0.009	0.1

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JANUARY-DECEMBER 1971, ALL ZONES

0 - 3 (upwind)	134	0.012 ± 0.008	0.2
0 - 3 (downwind)	134	0.010 ± 0.006	0.1
3 - 5 (downwind)	134	0.010 ± 0.007	0.1
5 - 10 (downwind)	134	0.014 ± 0.008	0.2
10 - 15 (downwind)	134	0.013 ± 0.008	0.2
15 - 20 (downwind)	134	0.009 ± 0.005	0.1

*Lowest detectable limit (LDL) for polonium in air is 0.002×10^{-12} microcurie/ml. The LDL = 0.03 percent of the RCG.

**RCG - Radioactivity Concentration Guide = 7×10^{-12} microcurie/ml.

Table 2

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1971, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-13} microcurie/ml)	Percent of RCG**
0 - 3 (upwind)	44	0.0319 ± 0.0047	1.1
0 - 3 (downwind)	44	0.0558 ± 0.0051	1.9
3 - 5 (downwind)	44	0.0208 ± 0.0038	0.7
5 - 10 (downwind)	44	0.0204 ± 0.0038	0.7
10 - 15 (downwind)	44	0.0145 ± 0.0032	0.5
15 - 20 (downwind)	44	0.0281 ± 0.0036	0.9

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JANUARY-DECEMBER 1971, ALL ZONES

0 - 3 (upwind)	116	0.0227 ± 0.0039	0.8
0 - 3 (downwind)	116	0.0296 ± 0.0037	1.0
3 - 5 (downwind)	115	0.0154 ± 0.0033	0.5
5 - 10 (downwind)	110	0.0163 ± 0.0034	0.5
10 - 15 (downwind)	112	0.0137 ± 0.0031	0.5
15 - 20 (downwind)	108	0.0193 ± 0.0030	0.6

*Lowest detectable limit (LDL) for plutonium in air is 0.0003 x 10^{-13} microcuries/ml. The LDL = 0.01 percent of the RCG.

**RCG - Radioactivity Concentration Guide = 3 x 10^{-13} microcurie/ml.

Table 3

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1971, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-8} microcuries/ml)	Percent of RCG**
0 - 3 (upwind)	65	0.084 ± 0.012	1.2
0 - 3 (downwind)	65	0.433 ± 0.019	6.2
3 - 5 (downwind)	65	0.107 ± 0.012	1.5
5 - 10 (downwind)	65	0.045 ± 0.011	0.6
10 - 15 (downwind)	65	0.036 ± 0.011	0.5
15 - 20 (downwind)	65	0.048 ± 0.011	0.7

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-DECEMBER 1971, ALL ZONES

0 - 3 (upwind)	136	0.061 ± 0.011	0.9
0 - 3 (downwind)	136	0.288 ± 0.016	4.1
3 - 5 (downwind)	136	0.076 ± 0.012	1.1
5 - 10 (downwind)	136	0.041 ± 0.011	0.6
10 - 15 (downwind)	136	0.036 ± 0.011	0.5
15 - 20 (downwind)	136	0.045 ± 0.011	0.6

*Lowest detectable limit for tritium in air is 0.004×10^{-8} microcuries/ml = 0.06 percent of RCG.

**RCG - Radioactivity Concentration Guide = 7×10^{-8} microcurie/ml.

Table 4

SUMMARY OF MONTGOMERY COUNTY COMBINED GENERAL HEALTH DISTRICT AIR MONITORING DATA FOR POLONIUM-210

JANUARY-DECEMBER 1971

Location	Average Concentration ($\mu Ci/cc \times 10^{15}$)	Percent RCG**
201	4.61 ± 0.46	0.07
202	3.83 ± 0.39	0.05
203	4.57 ± 0.46	0.07
204	4.90 ± 0.47	0.07
205	5.18 ± 0.47	0.07
206	5.72 ± 0.50	0.08
207	8.14 ± 0.71	0.12
208	5.38 ± 0.47	0.08
209	4.84 ± 0.45	0.07
210	5.09 ± 0.45	0.07
211	4.90 ± 0.46	0.07
Piqua, Ohio*	7.84 ± 0.67	0.11
Troy, Ohio*	7.80 ± 0.71	0.11
Springfield, Ohio*	7.47 ± 0.66	0.11
Springfield, Ohio*	7.47 ± 0.68	0.11
Springfield, Ohio*	7.18 ± 0.64	0.10
Fairborn, Ohio*	7.97 ± 0.70	0.11
Xenia, Ohio*	8.04 ± 0.72	0.11

*Stations Outside Montgomery County.

**RCG - Radioactivity Concentration Guide = 7×10^{-12} microcurie/ml. Lowest detectable limit (LDL) for polonium in air for MCCGHD samples is 0.01×10^{-15} microcurie/ml. The LDL = 0.0001 percent of the RCG.

Table 5

SUMMARY OF MONTGOMERY COUNTY COMBINED GENERAL HEALTH DISTRICT AIR MONITORING DATA FOR PLUTONIUM-238

JANUARY-DECEMBER 1971

Location	Average Concentration ($\mu Ci/cc \times 10^{17}$)	Percent RCG**
201	2.65 ± 0.64	0.009
202	1.87 ± 0.49	0.006
203	8.19 ± 1.12	0.027
204	1.91 ± 0.53	0.006
205	7.76 ± 1.05	0.026
206	14.09 ± 1.43	0.047
207	4.01 ± 0.91	0.013
208	1.96 ± 0.53	0.007
209	11.77 ± 1.33	0.039
210	4.88 ± 0.82	0.016
211	5.38 ± 0.88	0.018
Piqua, Ohio*	3.27 ± 0.79	0.011
Troy, Ohio*	2.52 ± 0.74	0.008
Springfield, Ohio*	2.18 ± 0.64	0.007
Springfield, Ohio*	1.89 ± 0.62	0.006
Springfield, Ohio*	3.33 ± 0.80	0.011
Fairborn, Ohio*	1.44 ± 0.54	0.005
Xenia, Ohio*	4.25 ± 1.00	0.014

*Stations outside Montgomery County.

**RCG - Radioactivity Concentration Guide = 3×10^{-13} microcurie/ml. Lowest detectable limit (LDL) for plutonium in air for MCCGHD samples is 0.19×10^{-17} microcurie/ml. The LDL = 0.0006 percent of the RCG.

Table 6

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM-210

JULY-DECEMBER 1971

Sample Location	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/ml)	Percent of RCG**
The river, 25 yd upstream from Mound Lab Effluent (location No. 1 on map)	49	0.007 ± 0.004	0.3
Sycamore St. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	49	0.007 ± 0.004	0.3
The river, 10 ft downstream from Mound Lab Effluent (location No. 3 on map)	49	0.019 ± 0.006	0.9
250 yd downstream from Mound Lab Effluent (location No. 4 on map)	49	0.007 ± 0.004	0.3
Chautauqua Road Bridge (location No. 5 on map)	49	0.008 ± 0.004	0.4
Chautauqua Dam (location No. 6 on map)	49	0.008 ± 0.004	0.4
Franklin, Ohio (location No. 7 on map)	48	0.007 ± 0.004	0.3
Pond-opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, Location 8 on map)	49	0.007 ± 0.004	0.3
Pond-Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, Location 9 on map)	33	0.008 ± 0.004	0.4

*Lowest detectable limit for polonium in water is 0.0013 x 10^{-7} microcurie/ml. The LDL = 0.07 percent of the RCG.

**RCG - Radioactivity concentration guide = 2 x 10^{-7} microcurie/ml.

Table 6 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM-210

JANUARY-DECEMBER 1971

Sample Location	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/ml)	Percent of RCG**
The river, 25 yd upstream from Mound Lab Effluent (location No. 1 on map)	99	0.009 ± 0.005	0.4
Sycamore St. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	99	0.005 ± 0.004	0.2
The river, 10 ft downstream from Mound Lab Effluent (location No. 3 on map)	99	0.036 ± 0.008	1.8
250 yd downstream from Mound Lab Effluent (location No. 4 on map)	99	0.032 ± 0.007	1.6
Chautauqua Road Bridge (location No. 5 on map)	99	0.007 ± 0.004	0.3
Chautauqua Dam (location No. 6 on map)	99	0.006 ± 0.004	0.3
Franklin, Ohio (location No. 7 on map)	98	0.006 ± 0.004	0.3
Pond-opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, Location 8 on map)	99	0.005 ± 0.004	0.2
Pond-Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, Location 9 on map)	83	0.006 ± 0.004	0.3

*Lowest detectable limit for polonium in water is 0.0013×10^{-7} microcurie/ml. The LDL = 0.07 percent of the RCG.

**RCG - Radioactivity concentration guide = 2×10^{-7} microcurie/ml.

Table 7

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1971

Sample Location	Number of Samples Collected	Average Concentration* (10^{-6} microcurie/ml)	Percent of RCG**
The river, 25 yd upstream from Mound Lab Effluent (location No. 1 on map)	49	0.0013 ± 0.0005	0.07
Sycamore St. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	49	0.0010 ± 0.0005	0.05
The river, 10 ft downstream from Mound Lab Effluent (location No. 3 on map)	49	0.0015 ± 0.0005	0.08
250 yd downstream from Mound Lab Effluent (location No. 4 on map)	49	0.0013 ± 0.0005	0.07
Chautauqua Road Bridge (location No. 5 on map)	49	0.0011 ± 0.0005	0.06
Chautauqua Dam (location No. 6 on map)	49	0.0010 ± 0.0005	0.05
Franklin, Ohio (location No. 7 on map)	48	0.0008 ± 0.0004	0.04
Pond-opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, Location 8 on map)	49	0.0009 ± 0.0005	0.05
Pond-Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, Location 9 on map)	33	0.0008 ± 0.0004	0.04

*Lowest detectable limit for plutonium in water is 0.00013 x 10^{-6} microcurie/ml. The LDL = 0.007 percent of the RCG.

**RCG - Radioactivity Concentration Guide = 2 x 10^{-6} microcurie/ml.

Table 7 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM-238

JANUARY-DECEMBER 1971

Sample Location	Number of Samples Collected	Average Concentration* (10^{-6} microcurie/ml)	Percent of RCG**
The river, 25 yd upstream from Mound Lab Effluent (location No. 1 on map)	99	0.0015 ± 0.0005	0.08
Sycamore St. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	99	0.0011 ± 0.0005	0.06
The river, 10 ft downstream from Mound Lab Effluent (location No. 3 on map)	99	0.0034 ± 0.0008	0.17
250 yd downstream from Mound Lab Effluent (location No. 4 on map)	99	0.0025 ± 0.0006	0.13
Chautauqua Road Bridge (location No. 5 on map)	99	0.0013 ± 0.0005	0.07
Chautauqua Dam (location No. 6 on map)	99	0.0012 ± 0.0005	0.06
Franklin, Ohio (location No. 7 on map)	98	0.0012 ± 0.0005	0.06
Pond-opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, Location 8 on map)	99	0.0010 ± 0.0005	0.05
Pond-Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, Location 9 on map)	83	0.0008 ± 0.0004	0.04

*Lowest detectable limit for plutonium in water is 0.00013 x 10^{-6} microcurie/ml. The LDL = 0.007 percent of the RCG.

**RCG - Radioactivity Concentration Guide = 2 x 10^{-6} microcurie/ml.

Table 8

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JULY-DECEMBER 1971

Sample Location	Number of Samples Collected	Average Concentration* (10^{-3} microcurie/ml)	Percent of RCG**
The river, 25 yd upstream from Mound Lab Effluent (location No. 1 on map)	49	0.0055 ± 0.0003	0.55
Sycamore St. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	49	0.0013 ± 0.0002	0.13
The river, 10 ft downstream from Mound Lab Effluent (location No. 3 on map)	49	0.0081 ± 0.0004	0.81
250 yd downstream from Mound Lab Effluent (location No. 4 on map)	49	0.0035 ± 0.0003	0.35
Chautauqua Road Bridge (location No. 5 on map)	49	0.0019 ± 0.0002	0.19
Chautauqua Dam (location No. 6 on map)	49	0.0017 ± 0.0002	0.17
Franklin, Ohio (location No. 7 on map)	48	0.0017 ± 0.0002	0.17
Pond-opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, Location 8 on map)	41	0.0025 ± 0.0002	0.25
Pond-Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, Location 9 on map)	33	0.0045 ± 0.0003	0.45

*Lowest detectable limit for tritium in water is 0.0002×10^{-3} microcurie/ml. The LDL = 0.02 percent of the RCG.

**RCG - Radioactivity Concentration Guide = 1×10^{-3} microcurie/ml.

Table 8 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JANUARY-DECEMBER 1971

Sample Location	Number of Samples Collected	Average Concentration* (10^{-3} microcurie/ml)	Percent of RCG**
The river, 25 yd upstream from Mound Lab Effluent (location No. 1 on map)	99	0.0120 ± 0.0005	1.20
Sycamore St. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	99	0.0038 ± .0003	0.38
The river, 10 ft downstream from Mound Lab Effluent (location No. 3 on map)	99	0.0279 ± 0.0007	2.79
250 yd downstream from Mound Lab Effluent (location No. 4 on map)	99	0.0155 ± 0.0006	1.55
Chautauqua Road Bridge (location No. 5 on map)	99	0.0033 ± 0.0003	0.33
Chautauqua Dam (location No. 6 on map)	99	0.0024 ± 0.0002	0.24
Franklin, Ohio (location No. 7 on map)	98	0.0023 ± 0.0002	0.23
Pond-opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, Location 8 on map)	91	0.0041 ± 0.0003	0.41
Pond-Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, Location 9 on map)	83	0.0072 ± 0.0004	0.72

*Lowest detectable limit for tritium in water is 0.0002×10^{-3} microcurie/ml. The LDL = 0.02 percent of the RCG.

**RCG - Radioactivity Concentration Guide = 1×10^{-3} microcurie/ml.

Table 9

SUMMARY OF SURFACE WATER MONITORING

JANUARY-DECEMBER 1971

LOCATION	AVG. CONC. ^{210}Po ($10^{-7}\mu Ci/ml$)	PERCENT OF RCG*	AVG. CONC. ^{238}Pu ($10^{-6}\mu Ci/ml$)	PERCENT OF RCG**	AVG. CONC. ^{3}H Oxide ($10^{-3}\mu Ci/ml$)	PERCENT OF RCG***
10	0.0011±0.00017	0.05	0.00004±0.0000034	0.002	0.0027±0.00010	0.27
11	0.0009±0.00015	0.05	0.00011±0.0000056	0.005	0.0042±0.00013	0.42
12	0.0013±0.00018	0.07	0.00001±0.0000017	0.001	0.0025±0.00010	0.25
13	0.0005±0.00011	0.03	0.00005±0.0000037	0.003	0.0018±0.00008	0.18
14	0.0011±0.00017	0.05	0.00007±0.0000045	0.003	0.0086±0.00018	0.86
15	0.0011±0.00017	0.05	0.00010±0.0000053	0.005	0.0063±0.00015	0.63
16	0.0013±0.00018	0.07	0.00005±0.0000037	0.003	0.0031±0.00011	0.31
17	0.0022±0.00023	0.11	0.00021±0.0000077	0.010	0.0071±0.00016	0.71

*RCG - Radioactivity Concentration Guide for ^{210}Po in water = 2×10^{-7} microcurie/ml.

**RCG - Radioactivity Concentration Guide for ^{238}Pu in water = 2×10^{-6} microcurie/ml.

***RCG - Radioactivity Concentration Guide for ^{3}H Oxide in water = 1×10^{-3} microcurie/ml.

Lowest detectable limit (LDL) for polonium-210 in water is 0.0003×10^{-7} microcurie/ml. The LDL = 0.01 percent of the RCG.

LDL for plutonium-238 in water is 0.00004×10^{-6} microcurie/ml. The LDL = 0.002 percent of the RCG.

LDL for tritium in water is 0.0004 microcurie/ml. The LDL = 0.04 percent of the RCG.

Table 10

SUMMARY OF COMMUNITY DRINKING WATER

RESULTS FOR 1971

LOCATION	AVG.CONC. ^{210}Po ($10^{-7}\mu Ci/ml$)	PERCENT OF RCG*	AVG.CONC. ^{238}Pu ($10^{-6}\mu Ci/ml$)	PERCENT OF RCG**	AVG.CONC. ^{3}H Oxide ($10^{-3}\mu Ci/ml$)	PERCENT OF RCG***
Bellbrook	< 0.0002±.00007	< 0.01	0.00002±.000008	0.001	0.0013±.000034	0.13
Camden	< 0.0002±.00007	< 0.01	0.00005±.000012	0.003	0.0009±.000028	0.09
Centerville	< 0.0002±.00007	< 0.01	0.00004±.000011	0.002	0.0015±.000037	0.15
Dayton	0.0005±.00011	0.03	0.00002±.000008	0.001	0.0003±.000016	0.03
Eaton	0.0004±.00010	0.02	0.00002±.000008	0.001	0.0018±.000040	0.18
Franklin	0.0003±.00008	0.01	0.00002±.000008	0.001	0.0011±.000031	0.11
Germantown	< 0.0002±.00007	< 0.01	0.00004±.000011	0.002	0.0019±.000041	0.19
Kettering	< 0.0002±.00007	< 0.01	0.00002±.000008	0.001	0.0006±.000023	0.06
Lebanon	< 0.0002±.00007	< 0.01	0.00004±.000011	0.002	0.0003±.000016	0.03
Mason	< 0.0002±.00007	< 0.01	0.00002±.000008	0.001	< 0.0003±.000016	< 0.03
Miamisburg	0.0004±.00010	0.02	0.00025±.000028	0.013	0.0197±.000133	1.97
Middletown	< 0.0002±.00007	< 0.01	0.00002±.000008	0.001	0.0010±.000030	0.10
Moraine	< 0.0002±.00007	< 0.01	-	-	0.0028±.000050	0.28
Springboro	< 0.0002±.00007	< 0.01	-	-	0.0028±.000050	0.28
Waynesville	< 0.0002±.00007	< 0.01	-	-	0.0043±.000062	0.43
West Carrollton	0.0003±.00008	0.01	0.00002±.000008	0.001	0.0010±.000030	0.10

*RCG - Radioactivity Concentration Guide for ^{210}Po in water = 2×10^{-7} microcurie/ml.

**RCG - Radioactivity Concentration Guide for ^{238}Pu in water = 2×10^{-8} microcurie/ml.

***RCG - Radioactivity Concentration Guide for ^{3}H Oxide in water = 1×10^{-3} microcurie/ml.

Lowest detectable limit (LDL) for ^{210}Po in drinking water is $0.00017 \times 10^{-7}\mu Ci/ml$. The LDL is 0.008 percent of the RCG.

LDL for ^{238}Pu in drinking water is 0.000018×10^{-6} $\mu Ci/ml$. The LDL is 0.0009 percent of the RCG.

LDL for tritium oxide is 0.00026×10^{-3} $\mu Ci/ml$. The LDL is 0.026 percent of the RCG.

Table 11

SUMMARY OF EFFLUENT WATER MONITORING FOR NON-RADIOACTIVE CONSTITUENTS

Constituent	Average Value (mg/L)
Heavy Metals	
Arsenic	< 0.03
Barium	0.08
Boron	0.4
Cadmium	0.005
Chromium, hexavalent	0.01
Copper	0.03
Iron	0.1
Lead	0.01
Manganese	< 0.01
Mercury	< 0.001
Selenium	0.003
Silver	< 0.01
Uranyl Ion	< 0.175
Zinc	0.07
Other Inorganics	
Chlorides	902
Sulfates	81
Nitrates	2
pH	8.1
Total dissolved solids	2092
Dissolved Oxygen	9.5
Organic	
BOD	8.6
Cyanide	< 0.007
ABS	0.06
Phenol	< 0.004*
Oil & Grease	1.7
Physical Properties	
Suspended Solids	5.7
Turbidity	< 25 JTU**
Biological	
Total Coliform	14,870/100 ml
Fecal Coliform	460/100 ml

*The phenol concentration appears to exceed the criteria but there is no known analytical procedure with sensitivity to detect the concentration at the criteria level.

**JTU - Jackson Turbidity Units - a standard unit used to describe turbidity. This value is at the limit of sensitivity of the instrument used and basically indicates absence of any turbidity.

Table 12

SUMMARY OF FOODSTUFFS AND VEGETATION ANALYSIS FOR 1971

TYPE OF SAMPLE	AVE.CONC. ^{210}Po ($10^{-7}\mu Ci/g$)	PERCENT OF RCG*	AVE.CONC. ^{238}Pu ($10^{-6}\mu Ci/g$)	PERCENT OF RCG**	AVE.CONC. ^{3}H Oxide ($10^{-3}\mu Ci/g$)	PERCENT OF RCG***
Milk	0.0279	1.41	0.00014	0.007	0.0024	0.24
Eggs	-	-	0.00031	0.015	-	-
Vegetables	0.0078	0.39	0.00031	0.015	-	-
Grass	0.1462	7.3	0.00165	0.083	-	-
Aquatic Life	0.1540	7.7	0.0024	0.12	-	-

*RCG - Radioactivity Concentration Guide for $^{210}Po = 2 \times 10^{-7}$microcurie/g.

**RCG - Radioactivity Concentration Guide for $^{238}Pu = 2 \times 10^{-6}$microcurie/g.

***RCG - Radioactivity Concentration Guide for ^{3}H Oxide = 1×10^{-3}microcurie/g.

Table 13

RESUSPENDIBLE PLUTONIUM-238 LEVELS DETERMINED FORM 1/8 IN. SOIL SURFACE SCRAPINGS

Sector	^{238}Pu ($d/m/cm^2$)†
1	0.118 ± 0.0065
2	0.013 ± 0.0021
3	0.174 ± 0.0078
4	0.025 ± 0.0029
5	0.003 ± 0.0010
6	0.008 ± 0.0017
7	0.004 ± 0.0012
8	0.006 ± 0.0015
9	0.003 ± 0.0010
10	0.003 ± 0.0010
11	0.001 ± 0.0005
12	0.002 ± 0.0008
13	0.004 ± 0.0012
14	0.004 ± 0.0012
15	0.003 ± 0.0010
16	0.037 ± 0.0036
17	0.004 ± 0.0012
18	0.003 ± 0.0010
19	0.003 ± 0.0010
20	0.001 ± 0.0005
(50 mi-NE)*	0.002 ± 0.0008
(50 mi-SE)*	0.002 ± 0.0008
(50 mi-SW)*	0.003 ± 0.0010
(50 mi-NW)*	0.001 ± 0.0005
Reagent Blanks	< 0.001 - 0.003

*Mound Laboratory Background Control Data Scrapings were taken at 50 miles.

†$d/m/cm^2$ = Disintegration per minute per square centimeter of sample surface.

Lowest detectable limit for plutonium-238 in soil surface scrapings is 0.0004 $d/m/cm^2$.

Table 14

PLUTONIUM-238 RESULTS IN SOIL SAMPLES AT CORE LOCATIONS

Location (Sector)	^{238}Pu* (d/m/g)†	^{238}Pu* (d/m/cm²)‡
1	4.68 ± 0.03	16.31 ± 0.10
2	2.19 ± 0.02	6.31 ± 0.06
3	0.07 ± 0.004	0.30 ± 0.01
4	0.12 ± 0.005	0.46 ± 0.02
Irwin, Ohio (Northeast-50 mi.)	0.005 ± 0.001	0.016 ± 0.003
Sardinia, Ohio (Southeast-50 mi.)	0.005 ± 0.001	0.014 ± 0.003
Aurora, Indiana (Southwest-50 mi.)	0.003 ± 0.001	0.008 ± 0.002
Winchester, Indiana (Northwest-50 mi.)	0.003 ± 0.001	0.010 ± 0.002
Reagent Blank	< 0.001 ± 0.001	0.002 ± 0.001

*The levels of plutonium in soil as a result of nuclear testing fallout reported by Health and Safety Laboratory for the southern Ohio area range from 0.248 to 0.416 d/m/cm².

†d/m/g = Disintegration per minute per gram of sample.

‡d/m/cm² = Disintegration per minute per square centimeter of sample surface.

Lowest detectable limit for plutonium-238 in soil core samples is 0.0003 d/m/g or 0.0008 d/m/cm².

Table 15

SUMMARY OF GREAT MIAMI RIVER SILT SAMPLES FOR 1971

Location	^{238}Pu (d/m/g)*
2	0.431 ± 0.021
4	0.408 ± 0.021
6	0.947 ± 0.032
7	0.865 ± 0.030

*d/m/g = Disintegration per minute per gram of sample.

Lowest detectable limit for plutonium-238 in silt samples is 0.001 d/m/g.

Table 16

SUMMARY OF POND SILT SAMPLES FOR 1971

Location	^{238}Pu (d/m/g)*
10	0.017 ± 0.004
11	0.027 ± 0.005
12	0.023 ± 0.005
13	0.062 ± 0.008
14	0.017 ± 0.004
15	0.011 ± 0.003
16	0.012 ± 0.004
17	0.038 ± 0.006

*d/m/g = Disintegration per minute per gram of sample.

Lowest detectable limit for plutonium-238 in silt samples is 0.001 d/m/g.

ENVIRONMENTAL MONITORING REPORT

1970

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

1970

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Environmental Monitoring Report: January-June 1970

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ABSTRACT

The average concentrations of polonium-210, plutonium-238 and tritium detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, are presented for the first half of 1970. The average concentrations of these radioisotopes in the Great Miami River and at the air sampling stations were well within the stringent standards adopted by the Atomic Energy Commission.

INTRODUCTION

Mound Laboratory is situated on 180 acres of land in Miamisburg, Ohio. This location is 12 miles southwest of Dayton. The Laboratory began operation in 1949. Its mission currently includes research, development, engineering, and production of components for the AEC weapons program; separation, purification, and sale of stable isotopes of the noble gases; and development, design, and fabrication of radioisotopic heat sources for medical application and space exploration.

Interest in the health and safety of employes and the public is manifested by the fact that Laboratory operations have as a fundamental objective the containment of radioactive waste as a part of its environmental control program. Any releases of low-level gaseous and liquid wastes to the environment are carefully controlled and dispersed to ensure that concentrations are well within recommended standards.

An Environmental Control and Monitoring Program has been in existence continuously during the Laboratory's history. As part of the Program's control function, all effluents containing radioisotopes are controlled at each operating step. Radioisotopes are removed from air effluents by passing through high-efficiency particulate absolute (HEPA) filters. Radioisotopes are removed from liquid effluent by chemical processing. As part of the Program's monitoring function, air and water samples are collected in a 1,250 square mile area to determine the concentrations of radioactive materials. The sampling techniques and counting methods are those best suited for the detection and measurement of the radioactive materials involved.

Concentrations of radionuclides in air and water are compared with the Radioactivity Concentration Guides (RCG) values as promulgated by the Federal Government. These RCG's are based on recommendations of the International Commission on Radiological Protection and of the Federal Radiation Council and can be interpreted as the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The RCG values for these radioisotopes are:

Polonium-210

Air: 2×10^{-11} microcuries per cubic centimeter (μCi/cc)
Water: 7×10^{-7} microcuries per cubic centimeter (μCi/cc)

Plutonium-238

Air: 1×10^{-12} microcuries per cubic centimeter (μCi/cc)
Water: 5×10^{-6} microcuries per cubic centimeter (μCi/cc)

Tritium

Air: 2×10^{-7} microcuries per cubic centimeter (μCi/cc)
Water: 3×10^{-3} microcuries per cubic centimeter (μCi/cc)

Office of the Environmental Protection Agency

OFF-SITE AIR SAMPLING

Air samples are collected weekly to a distance of 20 miles from the Laboratory--an area of 1250 square miles--with sampling equipment. Analysis of these samples is performed using equipment which is capable of detecting traces of radioactivity significantly less than the concentration standards that have been adopted by Federal agencies. These standards are called Radioactivity Concentration Guides and are abbreviated as RCG. Weekly samples are collected upwind and downwind from the Laboratory. Figure 1 shows the zones routinely sampled.

AIRBORNE SAMPLE HANDLING AND RESULTS

Polonium-210 and Plutonium-238 Samples are collected using a high volume air sampler. Particulates are collected on Whatman No. 41 filter paper through which air is passed at a rate of 20 ft^3/min (5.7×10^5 cc/min). The sampling port is atop a mobile unit, in which the apparatus is contained. This mobile unit--a truck--is parked safely off the road while the sample is taken. A 2-in. diam circle cut from the center of the filter paper is processed and analyzed for polonium-210, while plutonium-238, due to its lower specific activity, is analyzed using the remaining filter paper.

Polonium-210 Analysis A 2-in. diam circle is cut from the center of the filter paper and digested by heating with 5.8 M hydrochloric acid. After cooling, the solution is transferred quantitatively to a plastic plating cell that accommodates a 1 7/8-in. diam stainless steel disc. The solution in the cell is made approximately 1 M in hydrochloric acid. The solution is then stirred for 2 hr and the polonium-210 is spontaneously plated by simple replacement onto the stainless steel disc. The disc is then removed from the cell, rinsed, dried and alpha counted in a low background, gas flow proportional counter.

Results Analysis of the monitoring data shows that the average concentration of polonium-210 measured at all locations upwind and downwind in all zones was only slightly above the limit of detection. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling areas were well below that level. The highest average concentration was 8/100 of 1% of the RCG in the 5-to-10 mile range downwind. Results are shown in Figure 2.

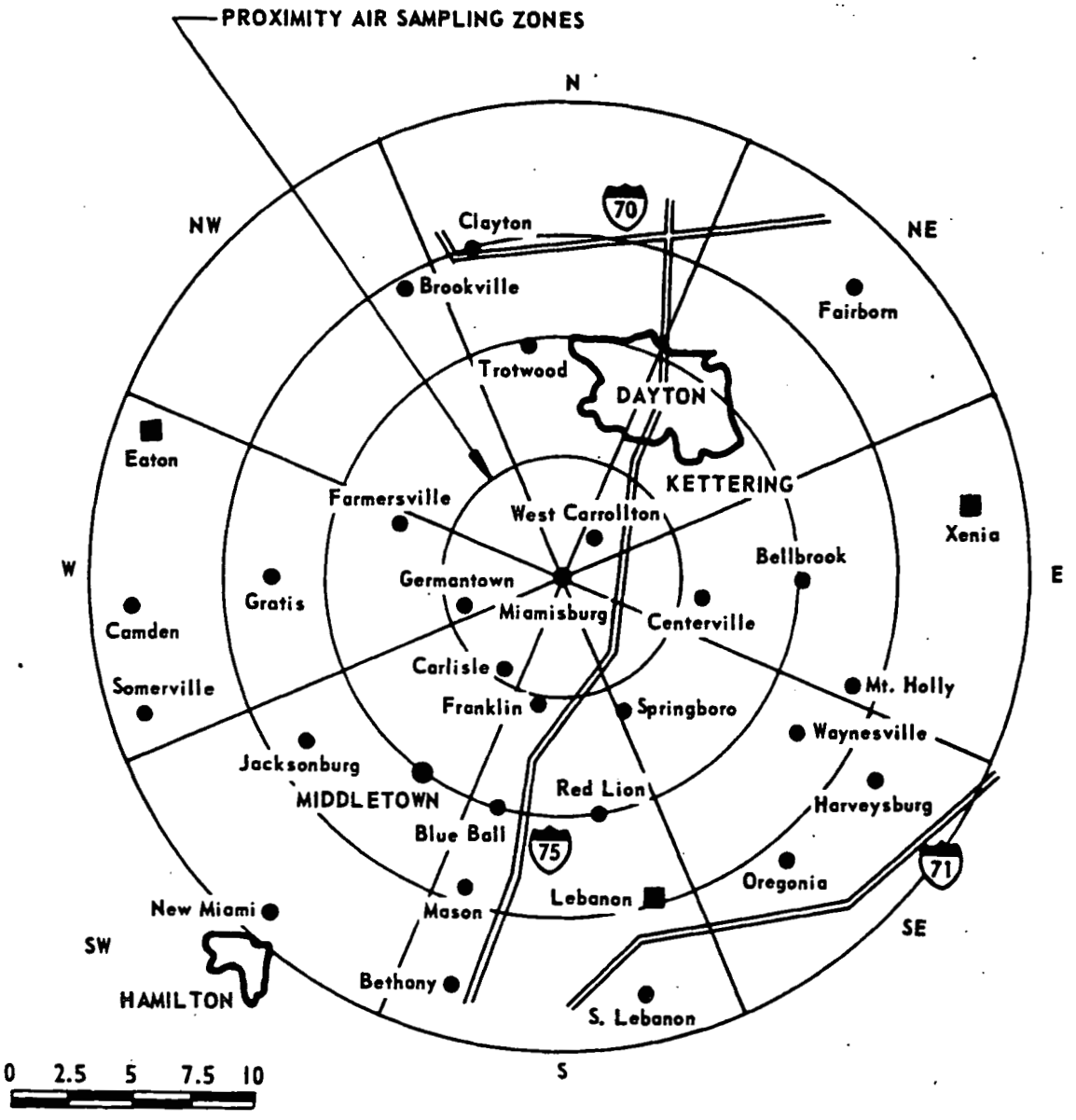

FIGURE 1 - Off-site air sampling zones.

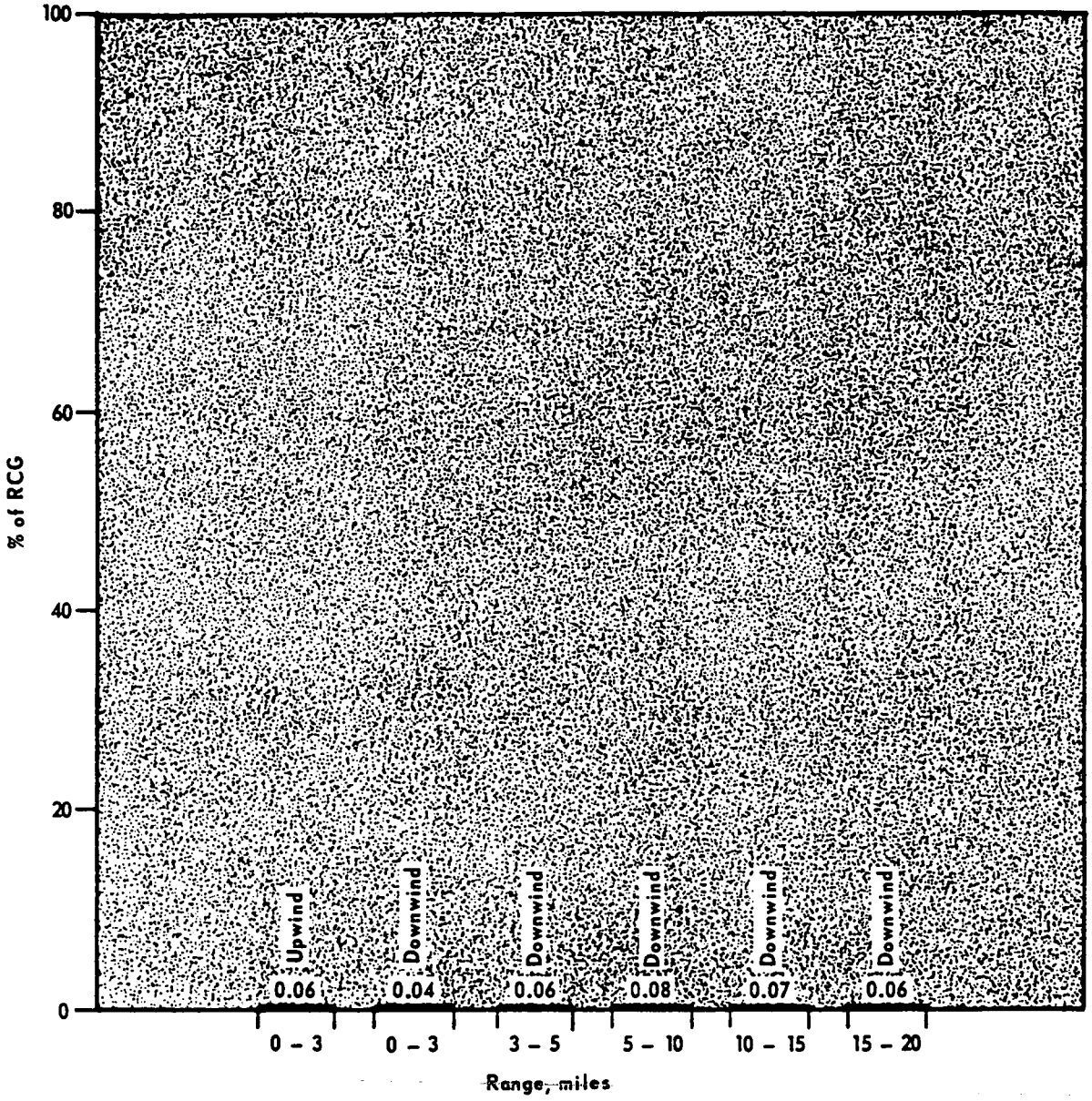

FIGURE 2 - Off-site air monitoring data for polonium-210.

Plutonium-238 Analysis The remaining filter paper, after a 2-in. diam circle is removed for the polonium-210 analysis, is charred at 800°C for a minimum of 2 hr in a muffle furnace. A solution of concentrated nitric and 0.1 M hydrofluoric acid is added (20 ml total), and this solution is then evaporated to a low volume. The sample is transferred quantitatively to a 50-ml capacity centrifuge tube containing 1 ml of concentrated nitric acid, 2 mg of radiochemically pure cerium carrier, and 1 drop of concentrated phosphoric acid. Plutonium-238 is coprecipitated from this solution with cerium phosphate. The cerium phosphate precipitate is then dissolved in dilute hydrochloric acid and reprecipitated as cerium fluoride with hydrofluoric acid. The cerium fluoride precipitate, which selectively coprecipitates the plutonium-238, is plancheted directly and dried under a heat lamp. The plancheted sample is then flamed and alpha counted in a low background, gas flow proportional counter for a minimum of 16 hr. When a positive result is obtained, the sample is counted with alpha pulse height equipment to confirm the possible presence of plutonium-238.

Results Plutonium-238 concentrations measured in all zones were less than 1% of the RCG with a maximum of 7/10 of 1% occurring in the 0-to-3 mile range downwind. As in the case of polonium-210, the measured average concentrations only approached the limit of detection. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling areas were well below that level. Results are shown in Figure 3.

Tritium Oxide Analysis Samples are collected (at the same time that particulate samples of plutonium-238 and polonium-210 are taken) by bubbling air through 100 ml of liquid scintillation solution at a rate of 0.35 ft^3/min (0.99×10^4 cc/min) with p-dioxane as the organic solvent. Tritium oxide is collected by the p-dioxane solution, and a 20 ml aliquot of the resulting solution is counted directly for 10 min in a liquid scintillation spectrometer. The analysis is directed to tritium oxide rather than the gas since the RCG for the oxide is 200 times more restrictive.

Results The highest average concentration of tritium oxide detected in the environment measured 1.6% of the RCG in the 0-to-3 mile range downwind. The concentration diminished to 3/10 of 1% in the 3-to-5 mile range downwind and only approached the limit of detection in all other zones. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling areas were well below that level. Results are shown in Figure 4.

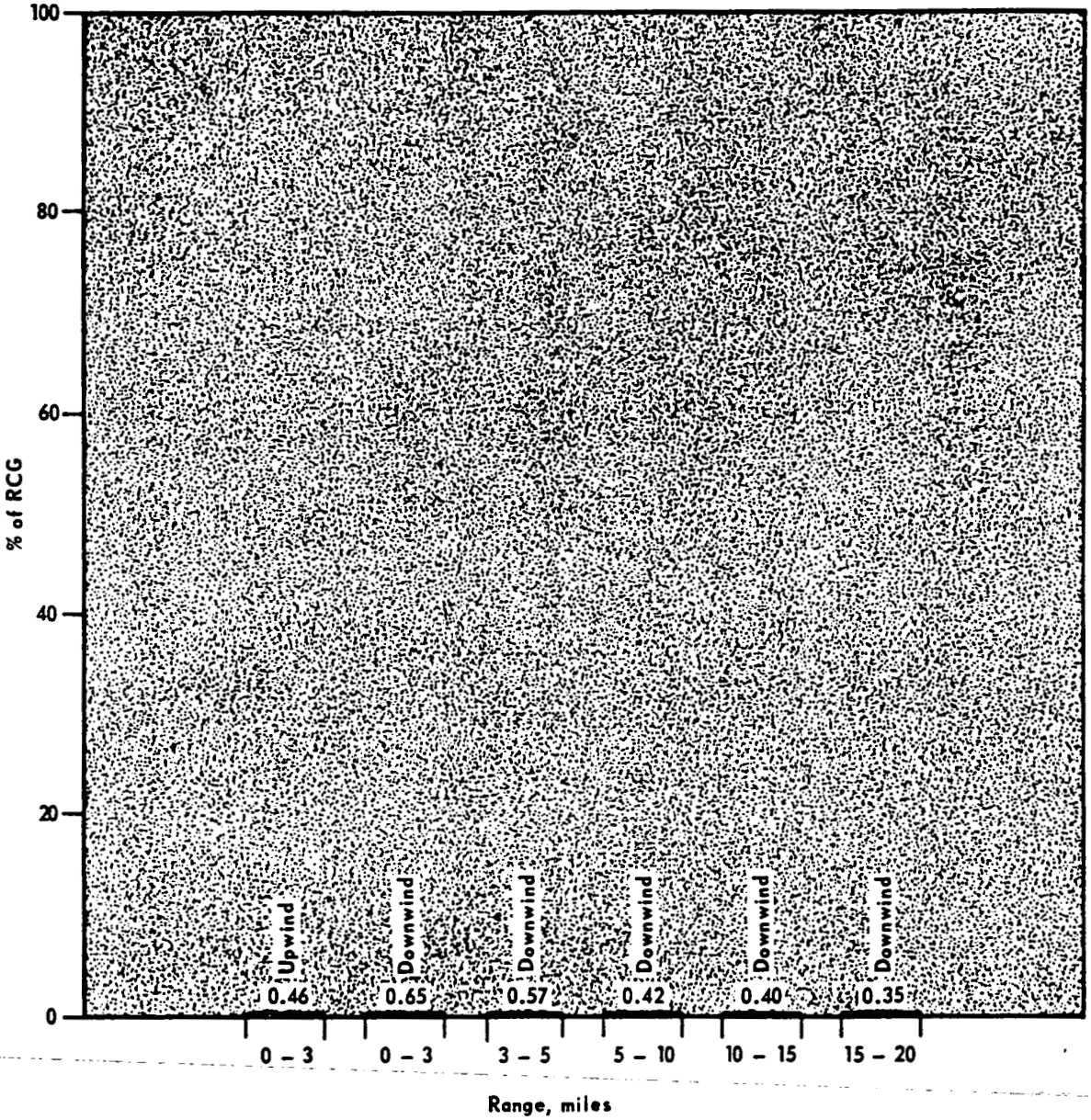

FIGURE 3 - Off-site air monitoring data for plutonium-238.

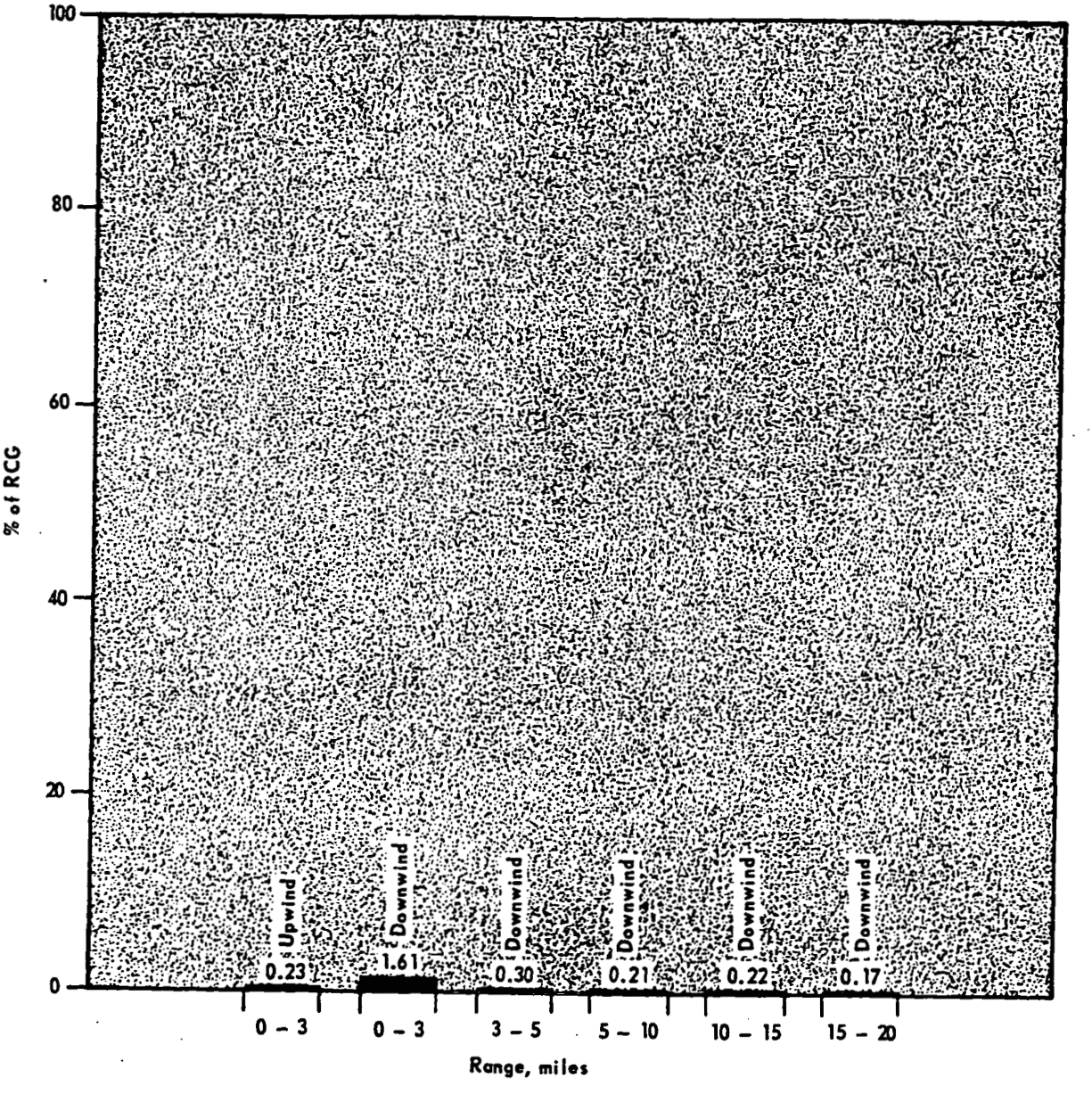

FIGURE 4 - Off-site air monitoring data for tritium oxide.

OFF-SITE WATER SAMPLING

Water samples are collected weekly along the bank of the Great Miami River, a drainage ditch running through Mound Laboratory, and two ponds northeast of the Laboratory. Analysis of these samples is performed using equipment which is capable of detecting traces of radioactivity far below the RCG. All samples are analyzed for polonium-210, plutonium-238, and tritium. A sample of approximately 200 ml is taken at each of 9 sampling locations. These locations are shown in Figure 5.

Polonium-210 Analysis A 100-ml aliquot from each water sample (representing a water sampling location) is quantitatively transferred to a plastic plating cell that accomodates a 1 7/8-in. diam stainless steel disc. The solution in the cell is made approximately 1 M in HCl. The solution is then stirred for 2 hr, and the polonium-210 is spontaneously plated by simple replacement onto the stainless steel disc. The disc is then removed from the cell, rinsed, dried, and alpha counted in a low background, gas flow proportional counter.

Results Figure 6 shows that the highest average concentration for polonium-210 at any sampling location was 13.28% of the RCG. This was at the point the Mound Laboratory effluent, enters the Great Miami River (location 3). The average concentration rapidly decreased to 0.67% of the RCG at location 4, 250 yd downstream, and diminished to the lower detectable limit atsampling point 5 and beyond. The RCG is the concentration of radioactivity in the environment which is determined to result in the whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling locations were well below that level.

Plutonium-238 Analysis A 25-ml aliquot from each water sample (representing a water sampling location) is transferred quantitatively to a 50-ml capacity centrifuge tube containing 1 ml of concentrated nitric acid, 2 mg of radiochemically pure cerium carrier, and 1 drop of concentrated phosphoric acid. Plutonium-238 is coprecipitated from this solution with cerium phosphate. The cerium phosphate precipitate is then dissolved in dilute hydrochloric acid and reprecipitated as cerium fluoride with hydrofluoric acid. The cerium fluoride precipitate, which selectively coprecipitates the plutonium-238, is plancheted directly and dried under a heat lamp. The plancheted sample is then flamed and alpha counted in a low background, gas flow proportional counter for a minimum of 4 hr. When a positive result is obtained, the sample is counted with alpha pulse height equipment to confirm the possible presence of plutonium-238.

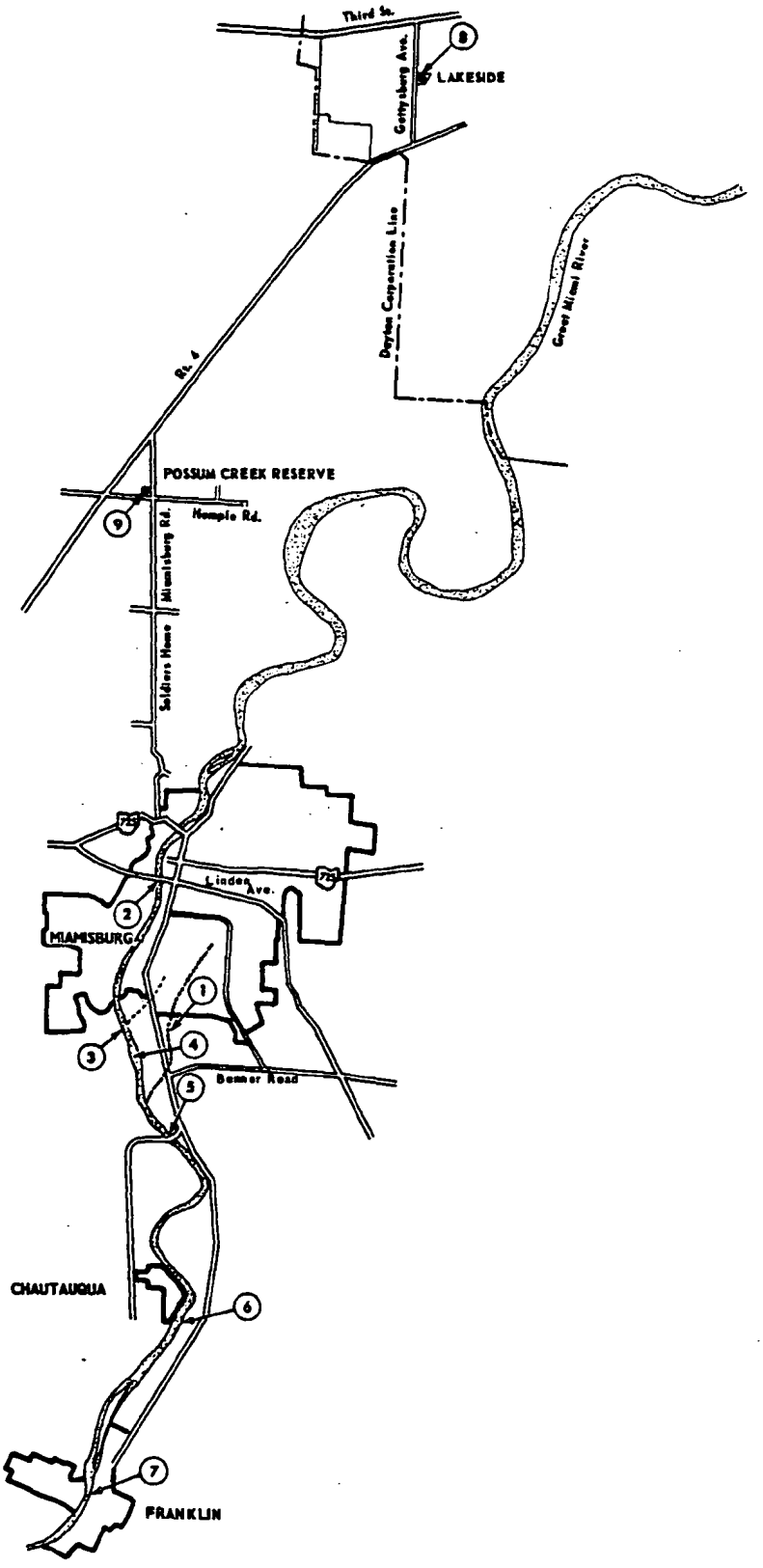

FIGURE 5 - Off-site water sampling locations.

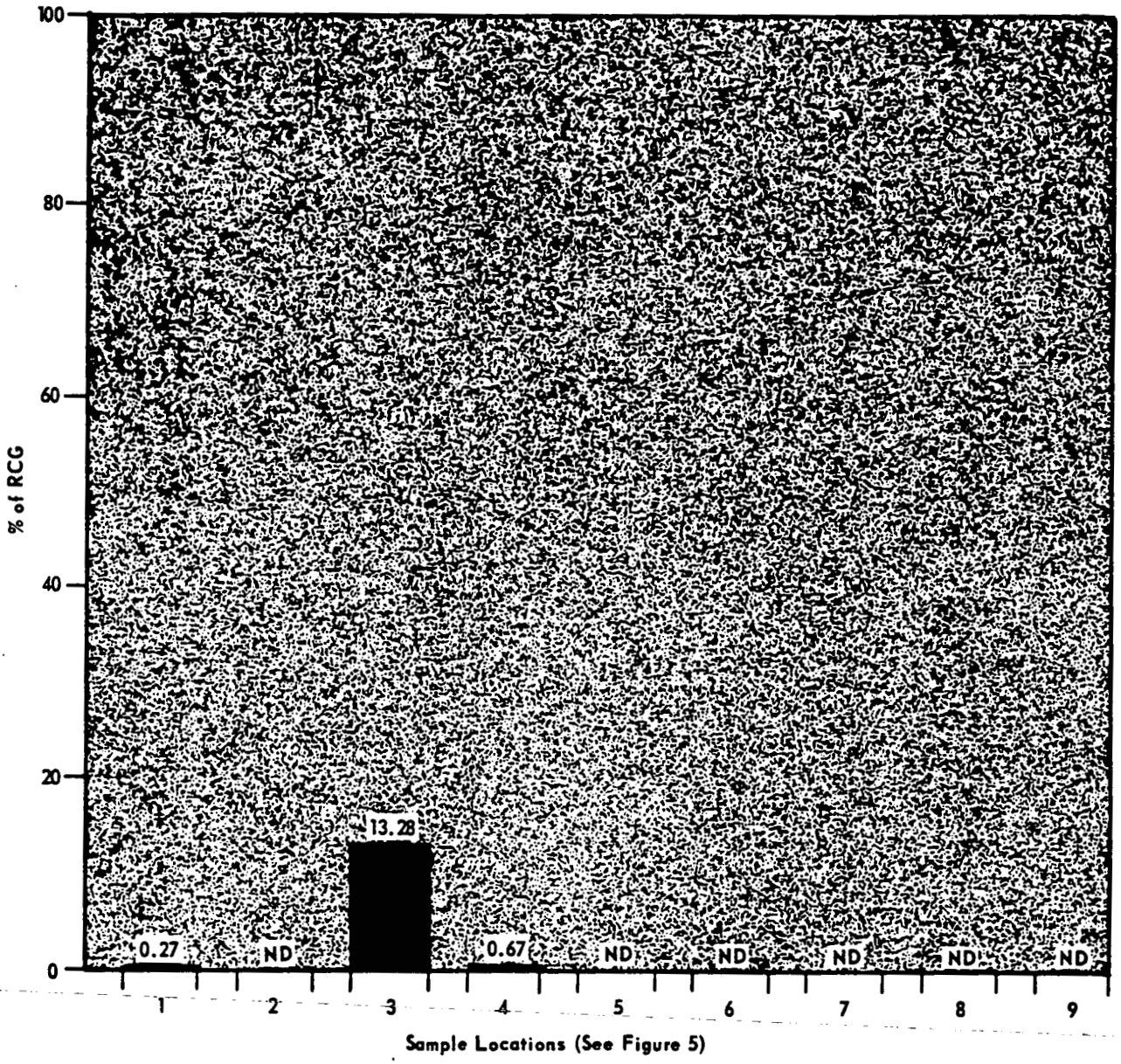

FIGURE 6 - Off-site water monitoring for polonium-210.

Results Figure 7 shows that the highest average concentration of plutonium-238 at any sampling location was 0.78% of the RCG. The average concentration at only one other location exceeded 0.25% of the RCG. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling locations were well below that level.

Tritium Oxide Analysis A 1-ml aliquot from each water sample is pipetted into a vial containing 17 ml of p-dioxane-based scintillation fluid. The vial is then placed in a liquid scintillation counter and counted 10 min for tritium.

Results Figure 8 shows that the highest average concentration of tritium oxide was 18.2% at location 1 in the Laboratory drainage ditch. The average concentration at location 3, where the Laboratory effluent enters the Great Miami River, was 11.2% of the RCG. The average concentration rapidly decreased to 0.50% of the RCG 250 yards downstream at location 4 and further downstream at location 5. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling locations were well below that level.

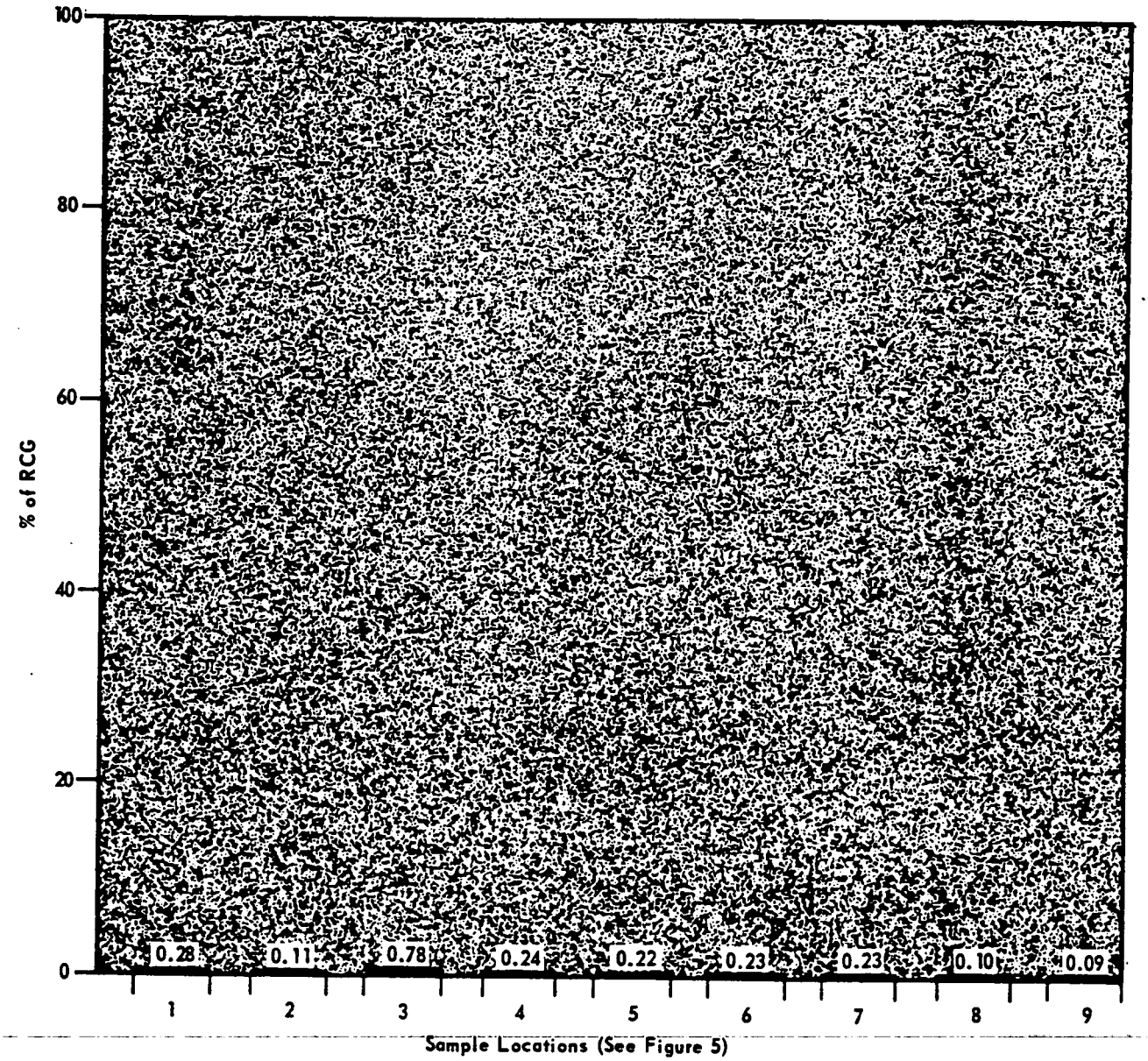

FIGURE 7 - Off-site water monitoring data for plutonium-238.

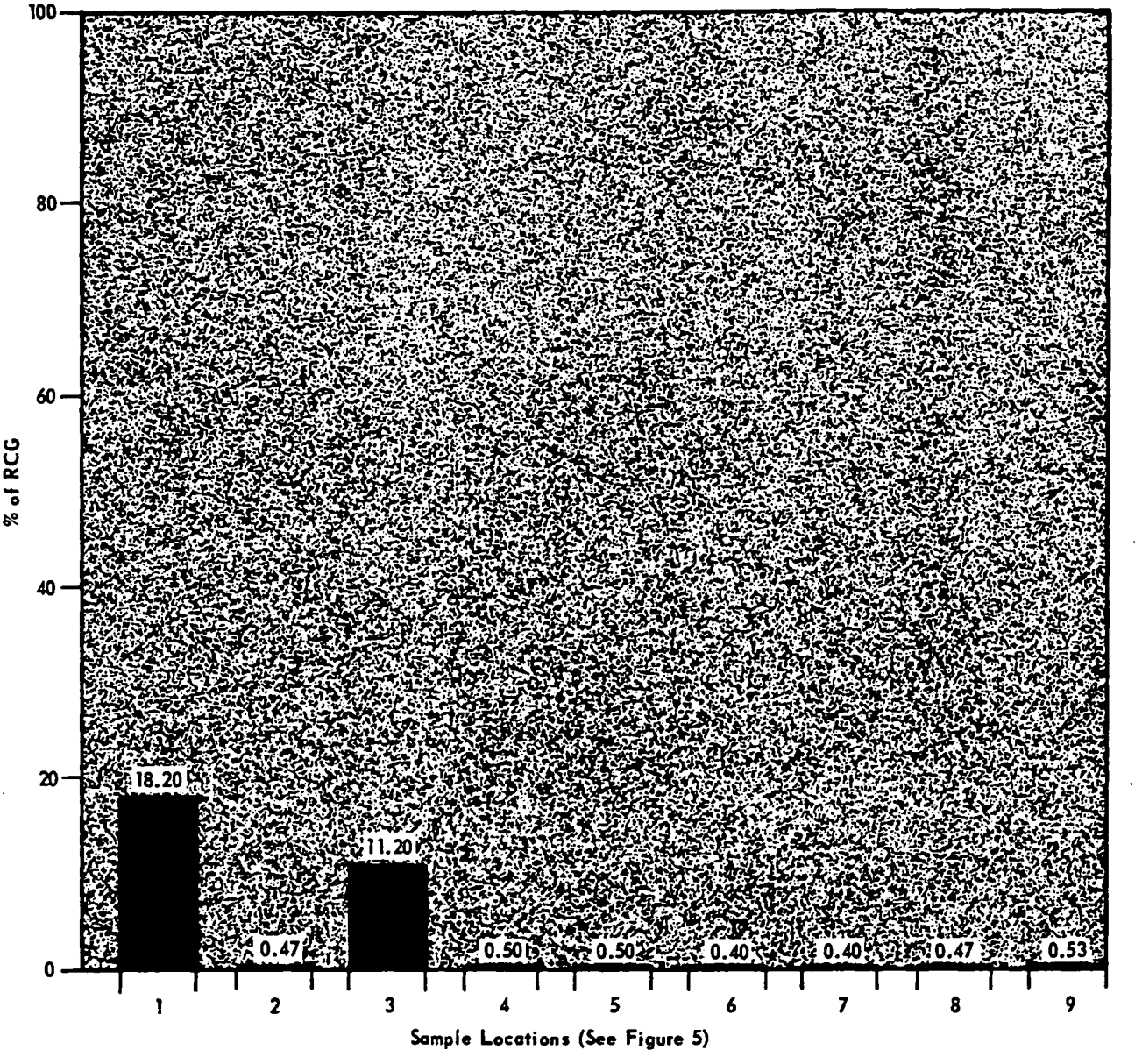

FIGURE 8 - Off-site water monitoring data for tritium oxide.

APPENDIX

Table 1

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM-210

JANUARY-JUNE 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No.1 on map)	24	0.0190	0.27
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	ND	ND
Mound Lab Effluent No. 1 (location No. 3 on map)	23	0.9300	13.28
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	23	0.0470	0.67
Chautauqua Road Bridge (location No. 5 on map)	23	ND	ND
Chautauqua Dam (location No. 6 on map)	23	ND	ND
Franklin, Ohio (location No. 7 on map)	23	ND	ND
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	23	ND	ND
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	24	ND	ND

*Lowest detectable limit for polonium in water is 0.018×10^{-7} microcurie/cc.

**RCG - Radioactivity concentration guide = 7×10^{-7} microcurie/cc.

ND - Less than the lowest detectable limit = Less than 0.26 percent of the RCG.

Table 2

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM-238

JANUARY-JUNE 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-6} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No.1 on map)	24	0.0142	0.28
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	0.0053	0.11
Mound Lab Effluent No. 1 (location No. 3 on map)	23	0.0391	0.78
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	23	0.0118	0.24
Chautauqua Road Bridge (location No. 5 on map)	23	0.0111	0.22
Chautauqua Dam (location No. 6 on map)	23	0.0116	0.23
Franklin, Ohio (location No. 7 on map)	23	0.0114	0.23
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	23	0.0050	0.10
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	24	0.0046	0.09

*Lowest detectable limit for plutonium in water is 0.0045×10^{-6} microcurie/cc.

**RCG - Radioactivity concentration guide = 5×10^{-6} microcurie/cc.

Table 3

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JANUARY-JUNE 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-3} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No.1 on map)	24	0.5460	18.20
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	0.0140	0.47
Mound Lab Effluent No. 1 (location No. 3 on map)	23	0.3360	11.20
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	23	0.0150	0.50
Chautauqua Road Bridge (location No. 5 on map)	23	0.0150	0.50
Chautauqua Dam (location No. 6 on map)	23	0.0120	0.40
Franklin, Ohio (location No. 7 on map)	23	0.0120	0.40
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	23	0.0140	0.47
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	24	0.0160	0.53

*Lowest detectable limit for tritium in water is 0.006×10^{-3} microcurie/cc.

**RCG - Radioactivity concentration guide = 3×10^{-3} microcurie/cc.

Table 4

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JANUARY-JUNE 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** for Average
0 - 3 (upwind)	25	0.0011	0.05
0 - 3 (downwind)	25	0.0008	0.04
3 - 5 (downwind)	25	0.0012	0.06
5 - 10 (downwind)	25	0.0015	0.07
10 - 15 (downwind)	25	0.0014	0.07
15 - 20 (downwind)	25	0.0012	0.06

*Lowest detectable limit (LDL) for polonium in air is 0.0008×10^{-11} microcurie/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.0005×10^{-11} microcurie/cc for samples collected 0-3 miles downwind and 15-20 miles downwind.

**RCG - Radioactivity concentration guide = 2×10^{-11} microcuries/cc.

Note: Two LDL's are expressed above for the ranges in which polonium-210 samples are collected. Air is sampled at three locations within the 0-3 and 15-20 mile downwind ranges, and the filter papers are combined to form one composite sample for each range. Air samples in other ranges are comprised of samples collected at the location within each range. Since the volume of air analyzed in the 0-3 and 15-20 mile downwind ranges is 33% greater than in the other ranges, the sensitivity expressed as LDL is proportionately lower.

Table 5

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JANUARY-JUNE 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	24	0.0046	0.46
0 - 3 (downwind)	24	0.0065	0.65
3 - 5 (downwind)	24	0.0057	0.57
5 - 10 (downwind)	24	0.0042	0.42
10 - 15 (downwind)	24	0.0040	0.40
15 - 20 (downwind)	24	0.0035	0.35

*Lowest detectable limit (LDL) for plutonium in air is 0.0013×10^{-12} microcurie/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.0009×10^{-12} microcurie/cc for samples collected 0-3 miles downwind and 15-20 miles downwind.

**RCG - Radioactivity concentration guide = 1×10^{-12} microcurie/cc.

Note: Two LDL's are expressed above for the ranges in which plutonium-238 samples are collected. Air is sampled at three locations within the 0-3 and 15-20 mile downwind ranges, and the filter papers are combined to form one composite sample for each range. Air samples in other ranges are comprised of samples collected at the location within each range. Since the volume of air analyzed in the 0-3 and 15-20 mile downwind ranges is 33% greater than in the other ranges, the sensitivity expressed as LDL is proportionately lower.

Table 6

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-JUNE 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	25	0.0044	0.22
0 - 3 (downwind)	25	0.0442	2.21
3 - 5 (downwind)	25	0.0049	0.24
5 - 10 (downwind)	25	0.0034	0.17
10 - 15 (downwind)	25	0.0040	0.20
15 - 20 (downwind)	25	0.0032	0.16

*Lowest detectable limit for tritium in air is 0.0020×10^{-7} microcurie/cc.

**RCG - Radioactivity concentration guide = 2×10^{-7} microcurie/cc.

Table 7

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JANUARY-JUNE 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** for Average
		North Zone	
0 - 3 (upwind)	3	ND	ND
0 - 3 (downwind)	3	0.0006	0.03
3 - 5 (downwind)	3	ND	ND
5 - 10 (downwind)	3	0.0010	0.05
10 - 15 (downwind)	3	0.0012	0.06
15 - 20 (downwind)	3	ND	ND
		Northeast Zone	
0 - 3 (upwind)	7	0.0012	0.06
0 - 3 (downwind)	7	0.0007	0.03
3 - 5 (downwind)	7	0.0013	0.06
5 - 10 (downwind)	7	0.0012	0.06
10 - 15 (downwind)	7	0.0011	0.06
15 - 20 (downwind)	7	0.0024	0.05

Table 7 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** for Average
		East Zone	
0 - 3 (upwind)	5	0.0008	0.04
0 - 3 (downwind)	5	0.0007	0.03
3 - 5 (downwind)	5	0.0009	0.04
5 - 10 (downwind)	5	0.0021	0.10
10 - 15 (downwind)	5	0.0021	0.10
15 - 20 (downwind)	5	0.0007	0.03
		Southeast Zone	
0 - 3 (upwind)	1	0.0020	0.10
0 - 3 (downwind)	1	0.0022	0.11
3 - 5 (downwind)	1	ND	ND
5 - 10 (downwind)	1	ND	ND
10 - 15 (downwind)	1	ND	ND
15 - 20 (downwind)	1	ND	ND

Table 7 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** for Average
		South Zone	
0 - 3 (upwind)	1	ND	ND
0 - 3 (downwind)	1	ND	ND
3 - 5 (downwind)	1	0.0026	0.13
5 - 10 (downwind)	1	ND	ND
10 - 15 (downwind)	1	0.0029	0.14
15 - 20 (downwind)	1	0.0006	0.03
		Southwest Zone	
0 - 3 (upwind)	2	0.0010	0.05
0 - 3 (downwind)	2	0.0012	0.06
3 - 5 (downwind)	2	0.0022	0.11
5 - 10 (downwind)	2	0.0024	0.12
10 - 15 (downwind)	2	0.0014	0.07
15 - 20 (downwind)	2	0.0021	0.10

Table 7 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** for Average
		West Zone	
0 - 3 (upwind)	2	0.0020	0.10
0 - 3 (downwind)	2	ND	ND
3 - 5 (downwind)	2	0.0008	0.04
5 - 10 (downwind)	2	0.0027	0.13
10 - 15 (downwind)	2	0.0019	0.09
15 - 20 (downwind)	2	ND	ND
		Northwest Zone	
0 - 3 (upwind)	4	0.0011	0.05
0 - 3 (downwind)	4	0.0006	0.03
3 - 5 (downwind)	4	0.0009	0.04
5 - 10 (downwind)	4	0.0012	0.06
10 - 15 (downwind)	4	0.0009	0.04
15 - 20 (downwind)	4	0.0006	0.03

*Lowest detectable limit (LDL) for polonium in air is 0.0008 x 10^{-11} microcurie/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.0005 x 10^{-11} microcurie/cc for samples collected 0-3 miles downwind and 15-20 miles downwind.

**RCG - Radioactivity concentration guide = 2 x 10^{-11} microcurie/cc.

ND - Less than lowest detectable limit = Less than 0.04 percent and 0.025 percent (see LDL above) of the RCG.

Note: Two LDL's are expressed above for the ranges in which polonium-210 samples are collected. Air is sampled at three locations within the 0-3 and 15-20 mile downwind ranges, and the filter papers are combined to form one composite sample for each range. Air samples in other ranges are comprised of samples collected at the location within each range. Since the volume of air analyzed in the 0-3 and 15-20 mile downwind ranges is 33% greater than in the other ranges, the sensitivity expressed as LDL is proportionately lower.

Table 8

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JANUARY-JUNE 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** for Average
		North Zone	
0 - 3 (upwind)	3	0.0026	0.26
0 - 3 (downwind)	3	0.0060	0.60
3 - 5 (downwind)	3	0.0031	0.31
5 - 10 (downwind)	3	ND	ND
10 - 15 (downwind)	3	0.0020	0.20
15 - 20 (downwind)	3	0.0016	0.16
		Northeast Zone	
0 - 3 (upwind)	7	0.0077	0.77
0 - 3 (downwind)	7	0.0045	0.45
3 - 5 (downwind)	7	0.0086	0.86
5 - 10 (downwind)	7	0.0056	0.56
10 - 15 (downwind)	7	0.0051	0.51
15 - 20 (downwind)	7	0.0053	0.53

Table 8 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** for Average
		East Zone	
0 - 3 (upwind)	5	0.0045	0.45
0 - 3 (downwind)	5	0.0142	1.42
3 - 5 (downwind)	5	0.0053	0.53
5 - 10 (downwind)	5	0.0047	0.47
10 - 15 (downwind)	5	0.0066	0.66
15 - 20 (downwind)	5	0.0051	0.51
		Southeast Zone	
0 - 3 (upwind)	1	ND	ND
0 - 3 (downwind)	1	0.0153	1.53
3 - 5 (downwind)	1	0.0066	0.66
5 - 10 (downwind)	1	0.0053	0.53
10 - 15 (downwind)	1	0.0038	0.38
15 - 20 (downwind)	1	0.0027	0.27

Table 8 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** for Average
		South Zone	
0 - 3 (upwind)	1	ND	ND
0 - 3 (downwind)	1	ND	ND
3 - 5 (downwind)	1	0.0050	0.50
5 - 10 (downwind)	1	0.0091	0.91
10 - 15 (downwind)	1	ND	ND
15 - 20 (downwind)	1	ND	ND
		Southwest Zone	
0 - 3 (upwind)	2	0.0043	0.43
0 - 3 (downwind)	2	0.0047	0.47
3 - 5 (downwind)	2	0.0028	0.28
5 - 10 (downwind)	2	0.0040	0.40
10 - 15 (downwind)	2	ND	ND
15 - 20 (downwind)	2	ND	ND

Table 8 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** for Average
		West Zone	
0 - 3 (upwind)	1	ND	ND
0 - 3 (downwind)	1	ND	ND
3 - 5 (downwind)	1	ND	ND
5 - 10 (downwind)	1	ND	ND
10 - 15 (downwind)	1	ND	ND
15 - 20 (downwind)	1	0.0029	0.29
		Northwest Zone	
0 - 3 (upwind)	4	0.0037	0.37
0 - 3 (downwind)	4	0.0024	0.24
3 - 5 (downwind)	4	0.0055	0.55
5 - 10 (downwind)	4	0.0026	0.26
10 - 15 (downwind)	4	0.0029	0.29
15 - 20 (downwind)	4	0.0018	0.18

*Lowest detectable limit (LDL) for plutonium in air is 0.0013×10^{-12} microcurie/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.0009×10^{-12} microcurie/cc for samples collected 0-3 miles downwind and 15-20 miles downwind.

**RCG - Radioactivity concentration guide = 1×10^{-12} microcurie/cc.

ND = Less than lowest detectable limit = Less than 0.13 percent and 0.09 percent (see LDL above) of the RCG.

Note: Two LDL's are expressed above for the ranges in which plutonium-238 samples are collected. Air is sampled at three locations within the 0-3 and 15-20 mile downwind ranges, and the filter papers are combined to form one composite sample for each range. Air samples in other ranges are comprised of samples collected at the location within each range. Since the volume of air analyzed in the 0-3 and 15-20 mile downwind ranges is 33% greater than in the other ranges, the sensitivity expressed as LDL is proportionately lower.

Table 9

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-JUNE 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** for Average
		North Zone	
0 - 3 (upwind)	3	0.0036	0.18
0 - 3 (downwind)	3	0.0087	0.43
3 - 5 (downwind)	3	0.0072	0.36
5 - 10 (downwind)	3	0.0041	0.20
10 - 15 (downwind)	3	ND	ND
15 - 20 (downwind)	3	ND	ND
		Northeast Zone	
0 - 3 (upwind)	6	0.0041	0.20
0 - 3 (downwind)	6	0.0179	0.89
3 - 5 (downwind)	6	0.0031	0.15
5 - 10 (downwind)	6	0.0023	0.11
10 - 15 (downwind)	6	0.0030	0.15
15 - 20 (downwind)	6	0.0034	0.17

Table 9 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** for Average
		East Zone	
0 - 3 (upwind)	6	0.0079	0.39
0 - 3 (downwind)	6	0.0349	1.74
3 - 5 (downwind)	6	0.0116	0.58
5 - 10 (downwind)	6	0.0093	0.46
10 - 15 (downwind)	6	0.0075	0.37
15 - 20 (downwind)	6	0.0042	0.21
		Southeast Zone	
0 - 3 (upwind)	1	0.0074	0.37
0 - 3 (downwind)	1	0.0781	3.90
3 - 5 (downwind)	1	ND	ND
5 - 10 (downwind)	1	ND	ND
10 - 15 (downwind)	1	ND	ND
15 - 20 (downwind)	1	ND	ND

Table 9 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** for Average
		South Zone	
0 - 3 (upwind)	1	ND	ND
0 - 3 (downwind)	1	0.0686	3.43
3 - 5 (downwind)	1	ND	ND
5 - 10 (downwind)	1	ND	ND
10 - 15 (downwind)	1	ND	ND
15 - 20	1	ND	ND
		Southwest Zone	
0 - 3 (upwind)	2	0.0039	0.19
0 - 3 (downwind)	2	0.0053	0.26
3 - 5 (downwind)	2	0.0026	0.13
5 - 10 (downwind)	2	0.0028	0.14
10 - 15 (downwind)	2	0.0030	0.15
15 - 20 (downwind)	2	0.0037	0.18

Table 9 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** for Average
		West Zone	
0 - 3 (upwind)	2	0.0038	0.19
0 - 3 (downwind)	2	0.1269	6.34
3 - 5 (downwind)	2	0.0063	0.31
5 - 10 (downwind)	2	ND	ND
10 - 15 (downwind)	2	0.0086	0.43
15 - 20 (downwind)	2	0.0057	0.28
		Northwest Zone	
0 - 3 (upwind)	4	0.0028	0.14
0 - 3 (downwind)	4	0.0132	0.66
3 - 5 (downwind)	4	0.0046	0.23
5 - 10 (downwind)	4	0.0030	0.15
10 - 15 (downwind)	4	0.0041	0.20
15 - 20 (downwind)	4	0.0033	0.16

*Lowest detectable limit for tritium in air is 0.0020×10^{-7} microcurie/cc.

**RCG - Radioactivity concentration guide = 2×10^{-7} microcurie/cc.

ND - Less than lowest detectable limit = Less than 0.1 percent of RCG.

MLM-1795

MLM-1795

Environmental Monitoring Report: July-December 1970 and 1970 Summary

April 15, 1971

AEC Research and Development Report

MOUND LABORATORY
Miamisburg, Ohio
operated by

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MONSANTO RESEARCH CORPORATION
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for the

U. S. ATOMIC ENERGY COMMISSION

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Environmental Monitoring Report: July-December 1970 and 1970 Summary

Issued: April 15, 1971

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ABSTRACT

The average concentrations of polonium-210, plutonium-238 and tritium detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, are presented for the second half of 1970 and for the entire year. (The data for the first half of 1970 were presented in Mound Laboratory document MLM-1784.) The average concentrations of these radioisotopes in the Great Miami River and at the air sampling stations were well within the stringent standards adopted by the Atomic Energy Commission. The highest average concentration of these radioisotopes at any of the water sampling stations during the second half of 1970 was less than during the first half of 1970 by as much as 36%. The highest average concentration of polonium-210 at the air sampling stations during the second half of 1970 was 14% more than during the first half of 1970 (0.08% of RCG vs. 0.07% of RCG), however, the highest average concentration of the other two radioisotopes was less by as much as 57%.

INTRODUCTION

Mound Laboratory is situated on 180 acres of land in Miamisburg, Ohio. This location is 12 miles southwest of Dayton. The Laboratory began operation in 1949. Its mission currently includes research, development, engineering, and production of components for the AEC weapons program; separation, purification, and sale of stable isotopes of the noble gases; and development, design, and fabrication of radioisotopic heat sources for medical application and space exploration.

Interest in the health and safety of employes and the public is manifested by the fact that Laboratory operations have as a fundamental objective the containment of radioactive waste as a part of its environmental control program. Any releases of low-level gaseous and liquid wastes to the environment are carefully controlled and dispersed to ensure that concentrations are well within recommended standards.

An Environmental Control and Monitoring Program has been in existence continuously during the Laboratory's history. As part of the Program's control function, all effluents containing radioisotopes are controlled at each operating step. Radioisotopes are removed from air effluents by the use of high-efficiency particulate absolute (HEPA) filters. Radioisotopes are removed from liquid effluent by chemical processing. As part of the Program's monitoring function, air and water samples are collected in a 1,250 square mile area to determine the concentrations of radioactive materials. The sampling techniques and counting methods are those best suited for the detection and measurement of the radioactive materials involved.

Concentrations of radionuclides in air and water are compared with the Radioactivity Concentration Guide (RCG) values as promulgated by the Radiation Office of the Environmental Protection Agency and can be interpreted as the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The RCG values for these radioisotopes are:

Polonium-210

Air: 2×10^{-11} microcuries per cubic centimeter (μCi/cc)
Water: 7×10^{-7} microcuries per cubic centimeter (μCi/cc)

Plutonium-238

Air 1×10^{-12} microcuries per cubic centimeter (μCi/cc)
Water: 5×10^{-6} microcuries per cubic centimeter (μCi/cc)

Tritium

Air: 2×10^{-7} microcuries per cubic centimeter (μCi/cc)
Water: 3×10^{-3} microcuries per cubic centimeter (μCi/cc)

OFF-SITE AIR SAMPLING

Air samples are collected weekly to a distance of 20 miles from the Laboratory--an area of 1250 square miles--with sampling equipment. In August 1970, the sampling frequency was increased from once per week to three times per week. Analysis of these samples is performed using equipment which is capable of detecting traces of radioactivity significantly less than the concentration standards that have been adopted by Federal agencies. These standards are called Radioactivity Concentration Guides and are abbreviated as RCG. Weekly samples are collected upwind and downwind from the Laboratory. Figure 1 shows the zones routinely sampled.

AIRBORNE SAMPLE HANDLING AND RESULTS

Polonium-210 and Plutonium-238 Samples are collected using a high volume air sampler. Particulates are collected on 4-in. diam Whatman No. 41 filter paper through which air is passed at a rate of 20 ft^3/min (5.7×10^5 cc/min). The sampling port is atop a mobile unit, in which the apparatus is contained. This mobile unit--a truck--is parked safely off the road while the sample is taken. A 2-in. diam circle cut from the center of the filter paper is processed and analyzed for polonium-210, while plutonium-238, due to its lower specific activity, is analyzed using the remaining filter paper.

Polonium-210 Analysis A 2-in. diam circle is cut from the center of the filter paper and digested by heating with 5.8 M hydrochloric acid. After cooling, the solution is transferred quantitatively to a plastic plating cell that accommodates a 1 7/8-in. diam stainless steel disc. The solution in the cell is made approximately 1 M in hydrochloric acid. The solution is then stirred for 2 hr and the polonium-210 is spontaneously plated by simple replacement onto the stainless steel disc. The disc is then removed from the cell, rinsed, dried and alpha counted in a low background, gas flow proportional counter.

Results Analysis of the monitoring data shows that the average concentration of polonium-210 measured at all locations upwind and downwind in all zones was only slightly above the limit of detection. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling areas were well below that level. The highest average concentration for the second half of 1970 was 8/100 of 1% of the RCG in the 0-to-3 mile range upwind. Results are shown in Figure 2. The highest average concentration for the year 1970 was 7/100 of 1% of the RCG in the 0-to-3 mile range upwind. Results for the entire year are shown in Figure 3.

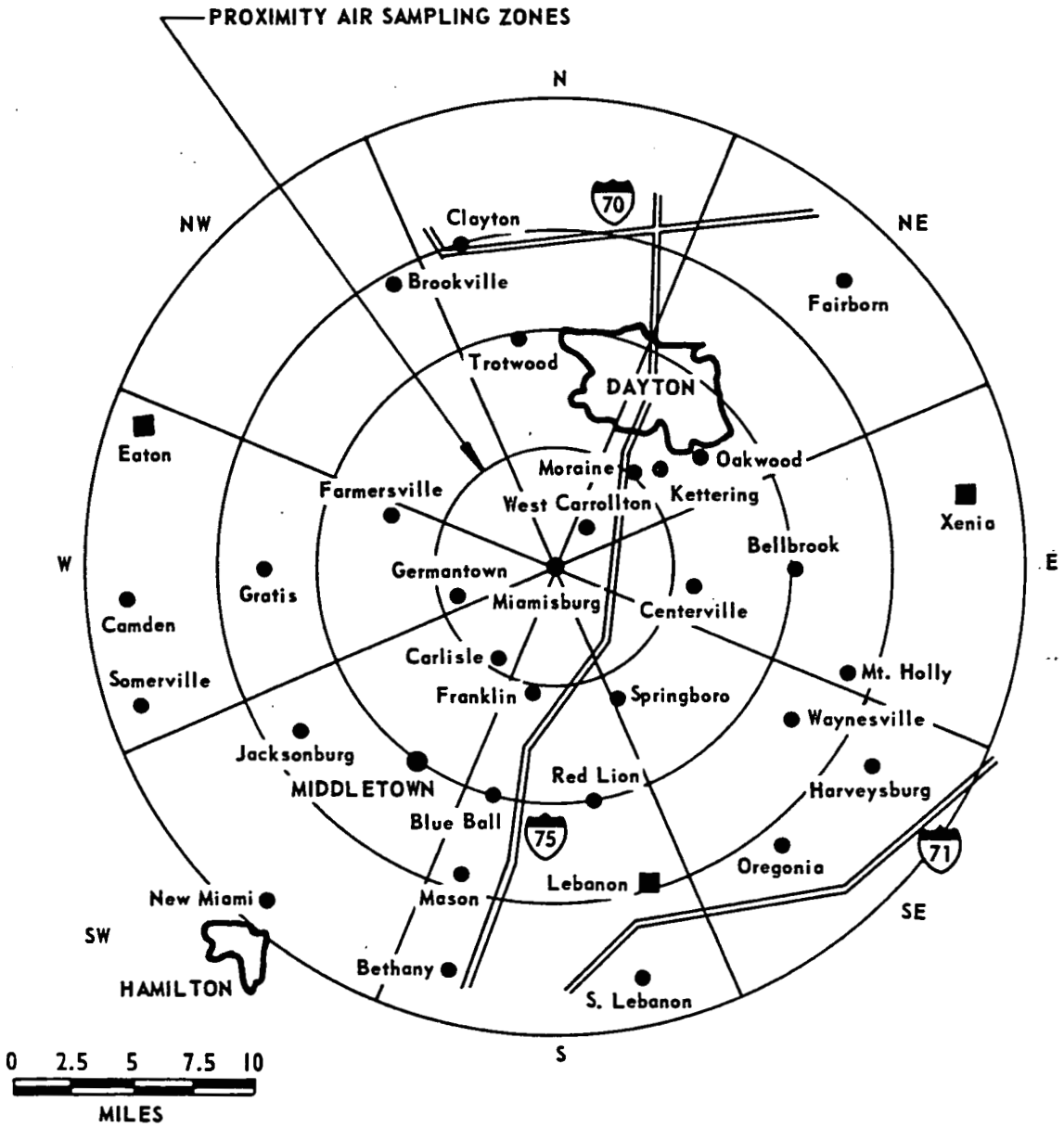

FIGURE 1 - Off-site air sampling zones.

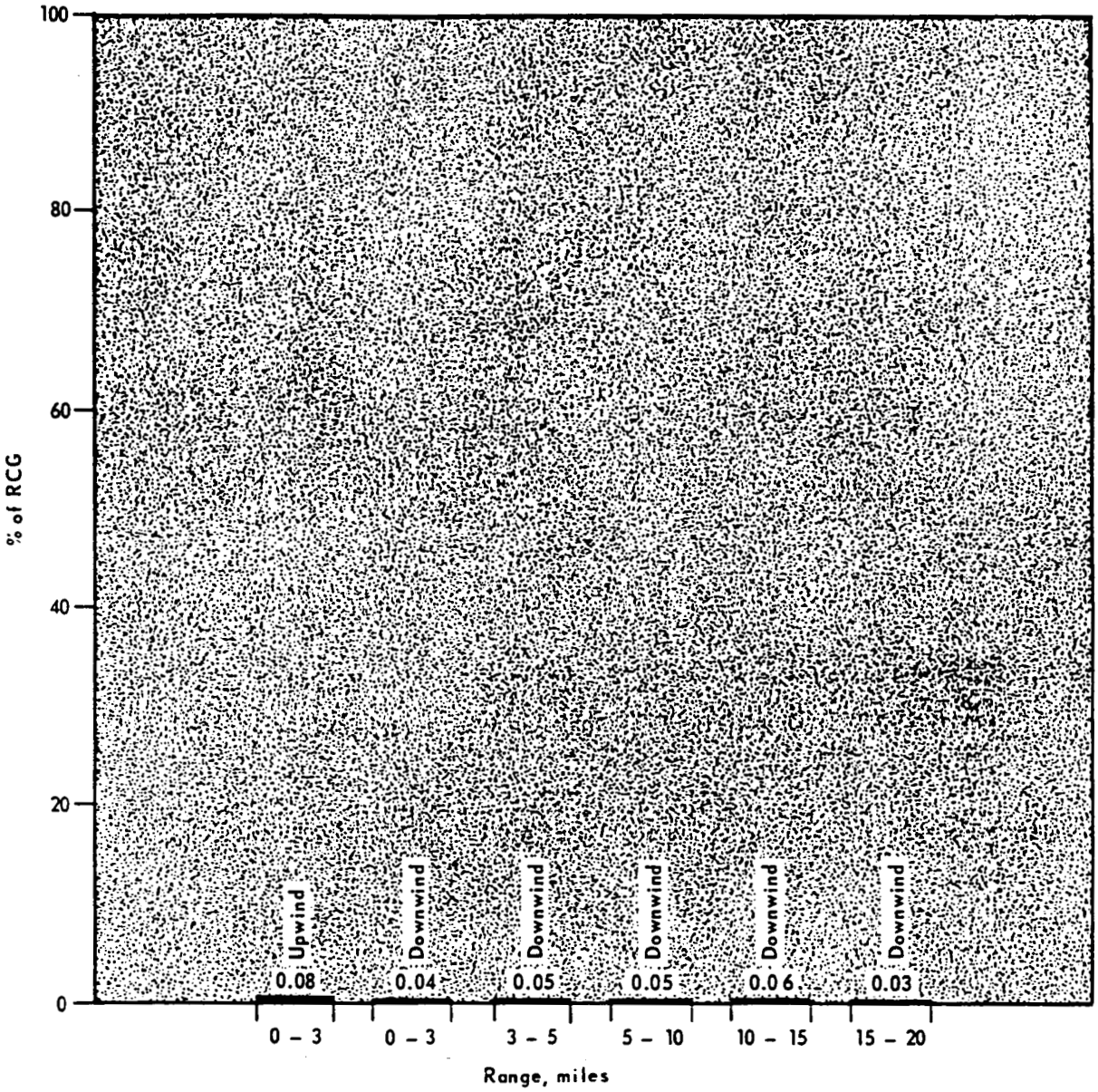

FIGURE 2 - Off-site air monitoring data for polonium-210--July-December 1970.

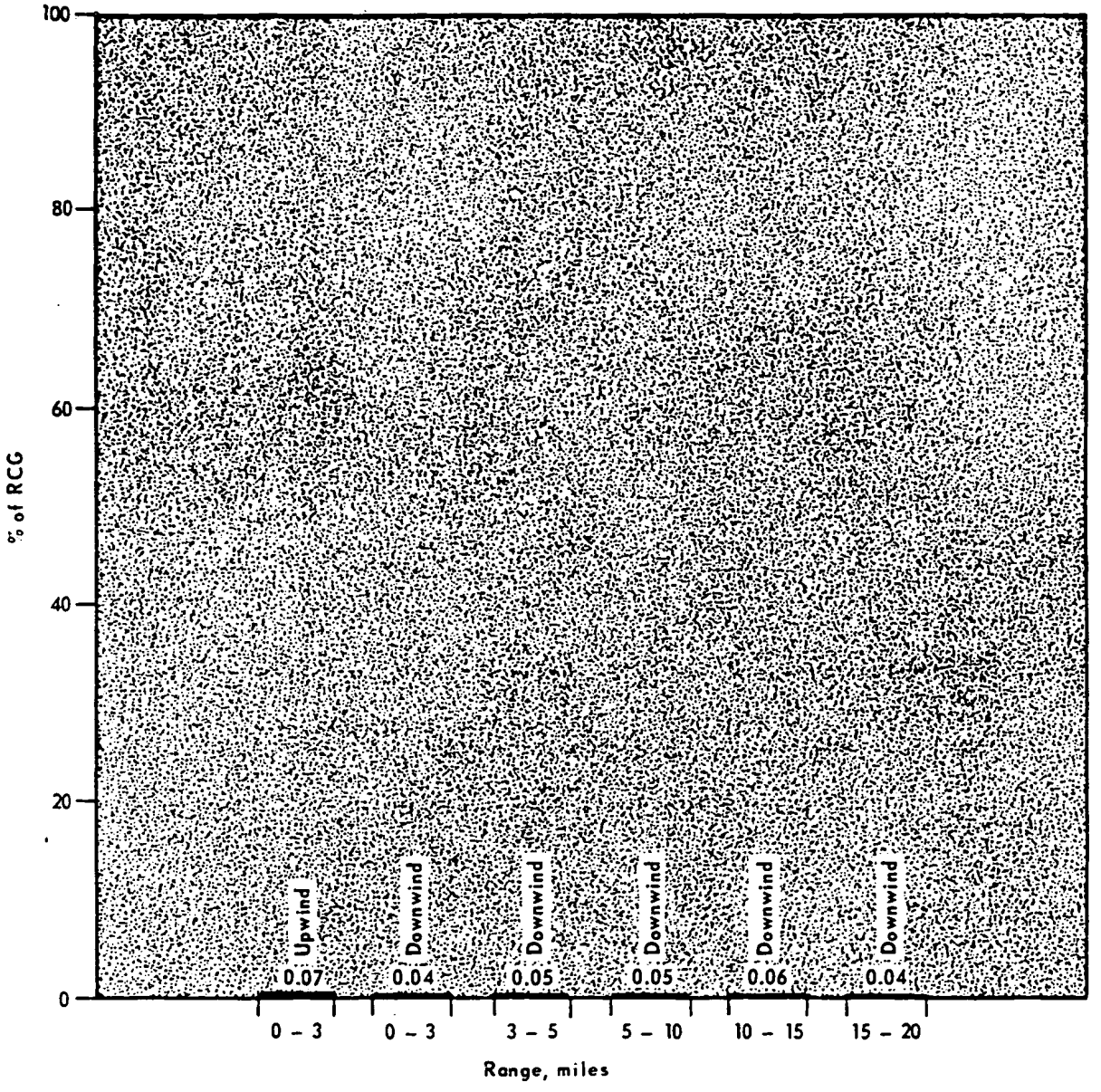

FIGURE 3 - Off-site air monitoring data for polonium-210--January-December 1970.

Plutonium-238 Analysis The remaining filter paper, after a 2-in. diam circle is removed for the polonium-210 analysis, is charred at 800°C for a minimum of 2 hr in a muffle furnace. A solution of concentrated nitric and 0.1 M hydrofluoric acid is added (20 ml total), and this solution is then evaporated to a low volume. The sample is transferred quantitatively to a 50-ml capacity centrifuge tube containing 1 ml of concentrated nitric acid, 2 mg of radiochemically pure cerium carrier, and 1 drop of concentrated phosphoric acid. Plutonium-238 is coprecipitated from this solution with cerium phosphate. The cerium phosphate precipitate is then dissolved in dilute hydrochloric acid and reprecipitated as cerium fluoride with hydrofluoric acid. The cerium fluoride precipitate, which selectively coprecipitates the plutonium-238, is plancheted directly and dried under a heat lamp. The plancheted sample is then flamed and alpha counted in a low background, gas flow proportional counter for a minimum of 16 hr. When a positive result is obtained, the sample is counted with alpha pulse height equipment to confirm the possible presence of plutonium-238.

Results Plutonium-238 concentrations measured in all zones, both for the second half of 1970 and for the year, were less than 1% of the RCG with a maximum of 3/10 of 1% occurring in the 0-to-3 mile range upwind. As in the case of polonium-210, the measured average concentrations only approached the limit of detection. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling areas were well below that level. Results are shown in Figures 4 and 5 for the second half of 1970 and the entire year, respectively.

Tritium Oxide Analysis Samples are collected (at the same time that particulate samples of plutonium-238 and polonium-210 are taken) by bubbling air through 100 ml of p-dioxane-based scintillation fluid at a rate of 0.35 ft^3/min (0.99×10^4 cc/min). Tritium oxide is collected by the p-dioxane solution, and a 20 ml aliquot of the resulting solution is counted directly for 10 min in a liquid scintillation spectrometer. The analysis is directed to tritium oxide rather than the gas since the RCG for the oxide is 200 times more restrictive.

Results The highest average concentration of tritium oxide detected during the second half of 1970 in the environment measured 1.70% of the RCG in the 0-to-3 mile range downwind. The concentration diminished to 4/10 of 1% in the 3-to-5 mile range downwind. The highest average concentration of tritium oxide for the entire year was 1.95% of the RCG measured in the 0-to-3 mile range downwind. The concentration diminished to 3/10 of 1% in the 3-to-5 mile range downwind. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling areas were well below that level. Results are shown in Figures 6 and 7 for the second half of 1970 and the entire year, respectively.

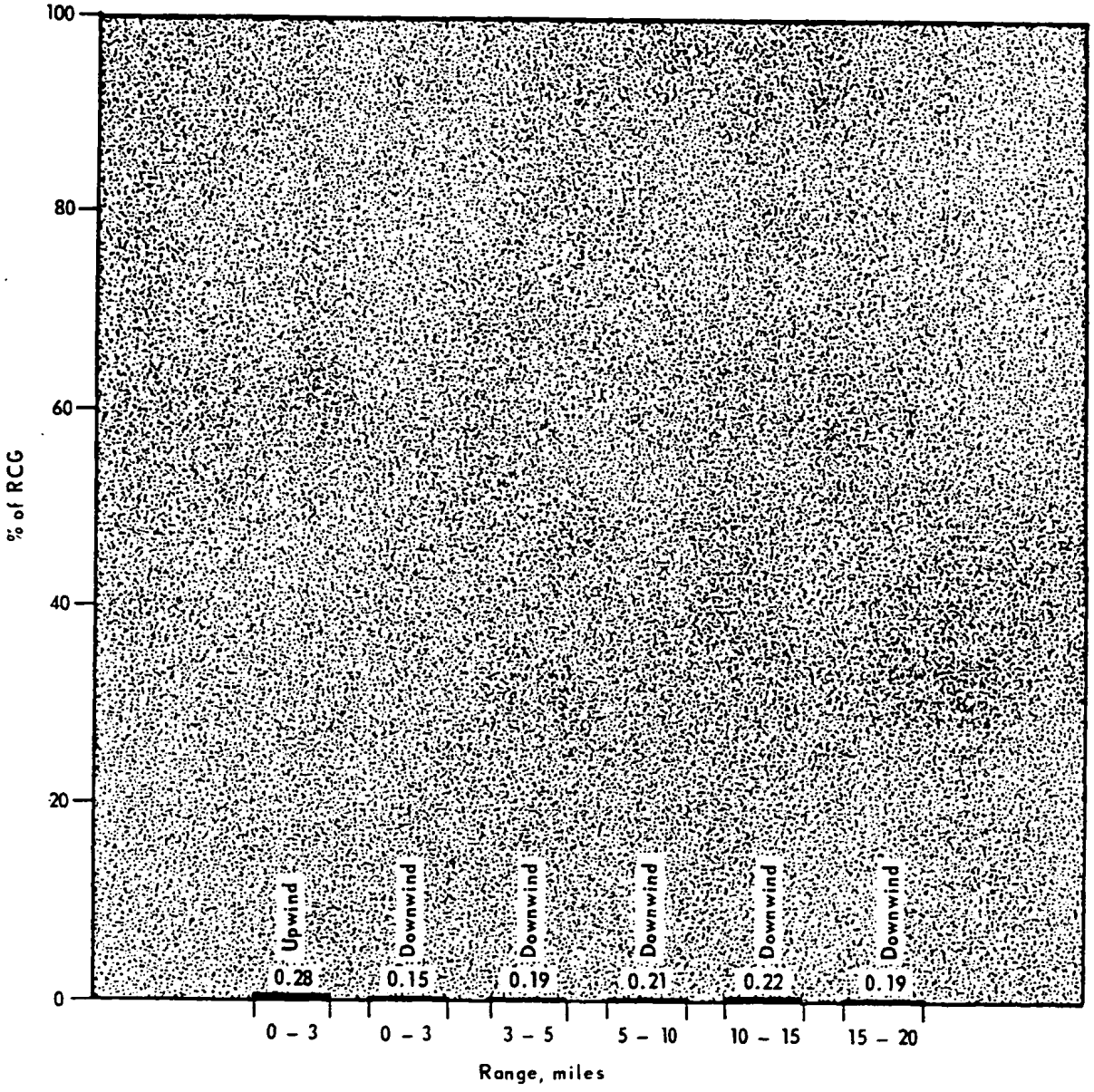

FIGURE 4 - Off-site air monitoring data for plutonium-238--July-December 1970.

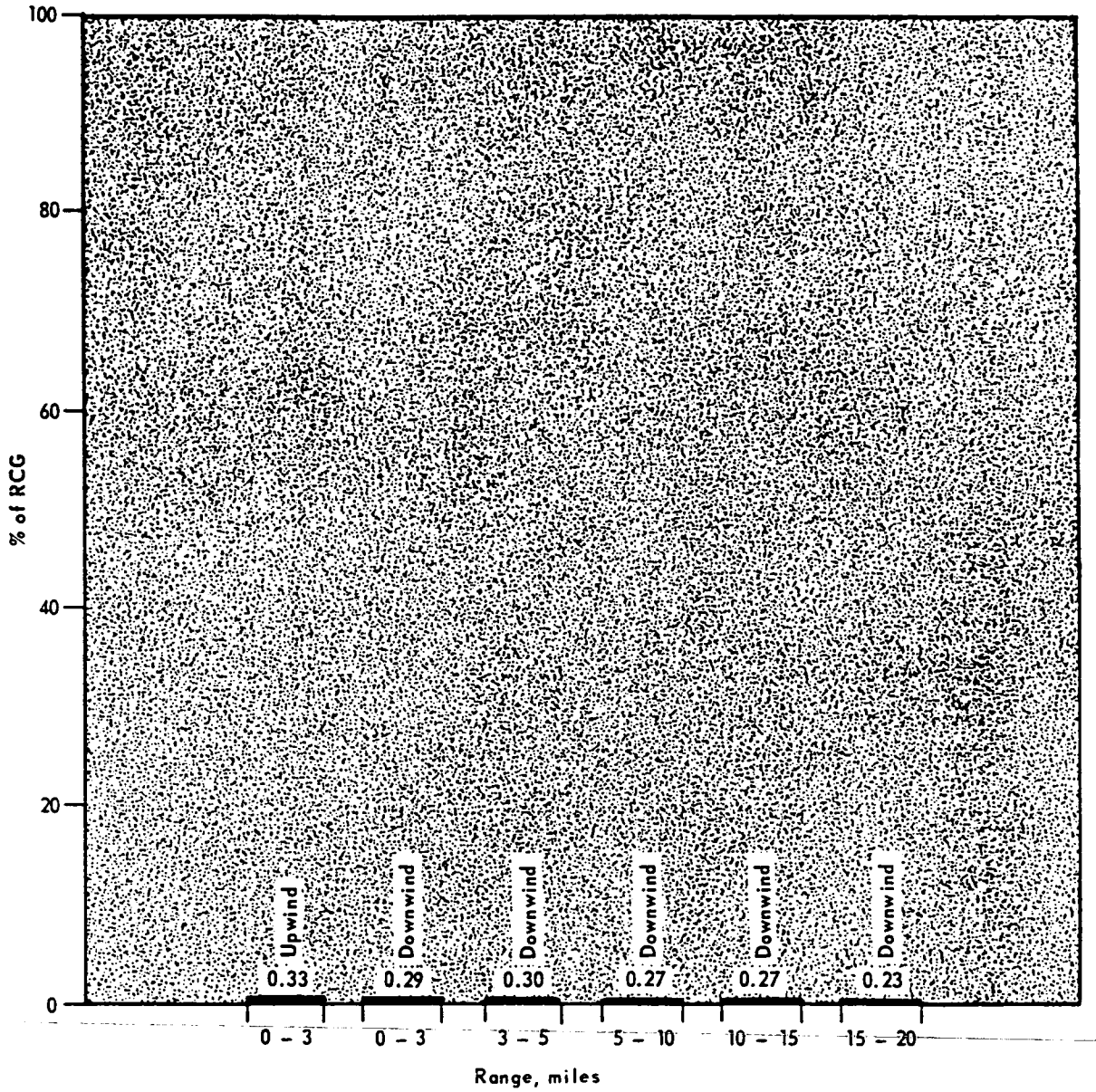

FIGURE 5 - Off-site air monitoring data for plutonium-238--January-December 1970.

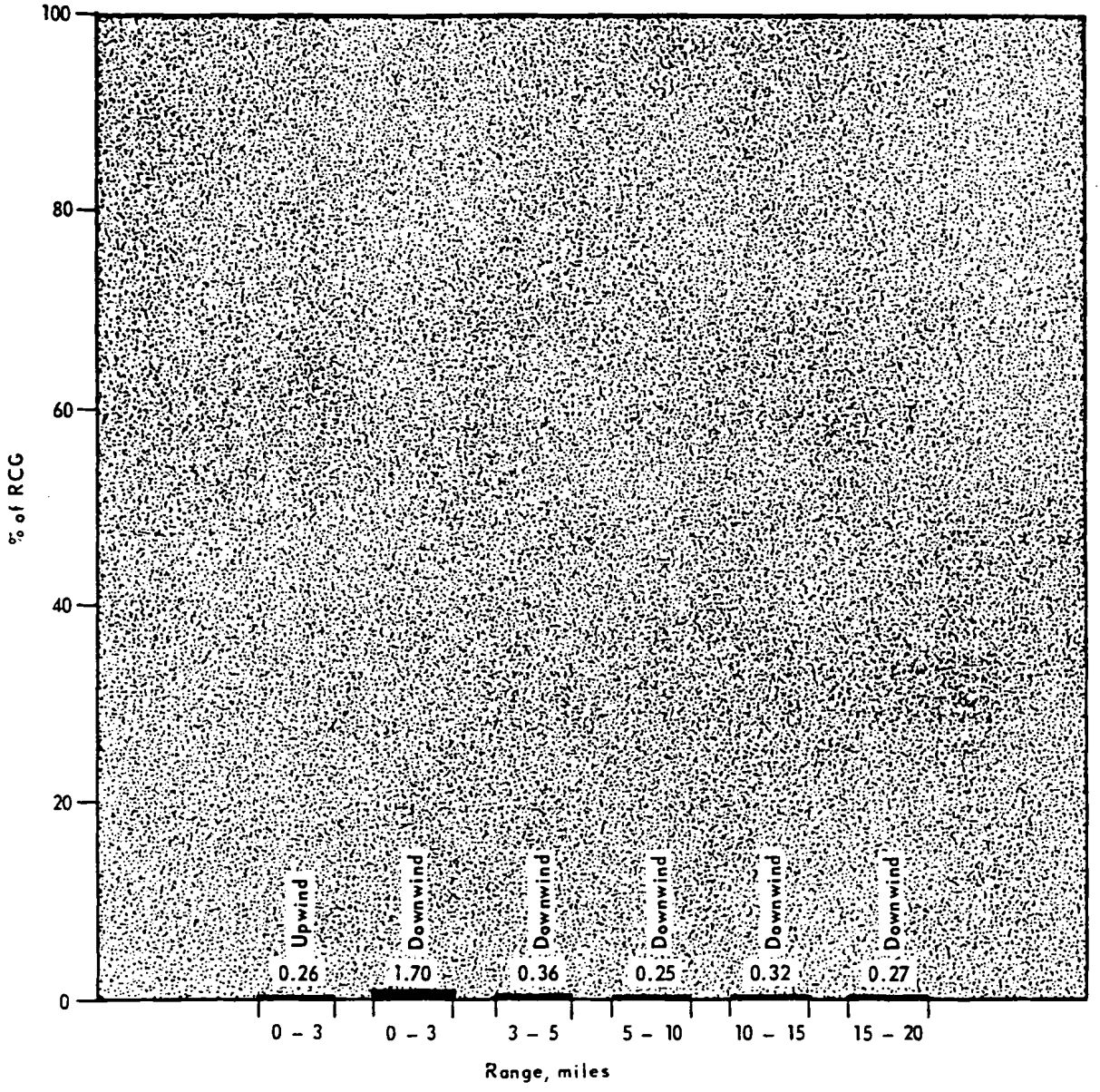

FIGURE 6 - Off-site air monitoring data for tritium oxide - July-December 1970.

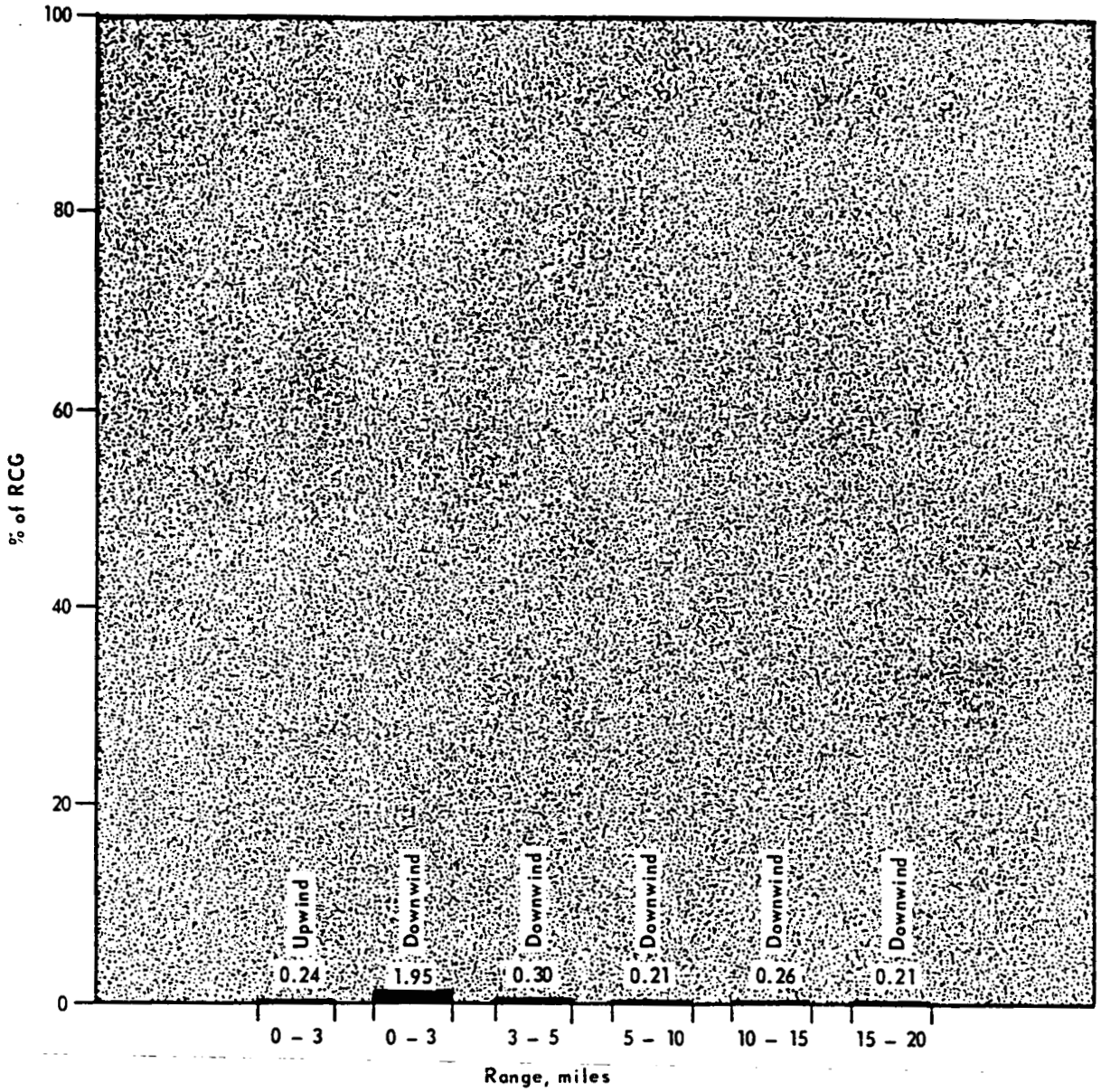

FIGURE 7 - Off-site air monitoring data for tritium oxide - January-December 1970.

OFF-SITE WATER SAMPLING

Water samples are collected weekly along the bank of the Great Miami River, a drainage ditch running through Mound Laboratory, and two ponds northeast of the Laboratory. In August 1970, the sampling frequency was increased from once per week to twice per week. Analysis of these samples is performed using equipment which is capable of detecting traces of radioactivity far below the RCG. All samples are analyzed for polonium-210, plutonium-238, and tritium. A sample of approximately 200 ml is taken at each of 9 sampling locations. These locations are shown in Figure 8.

Polonium-210 Analysis A 100-ml aliquot from each water sample (representing a water sampling location) is quantitatively transferred to a plastic plating cell that accommodates a 1 7/8-in. diam stainless steel disc. The solution in the cell is made approximately 1 M in hydrochloric acid. The solution is then stirred for 2 hr, and the polonium-210 is spontaneously plated by simple replacement onto the stainless steel disc. The disc is then removed from the cell, rinsed, dried, and alpha counted in a low background, gas flow proportional counter.

Results Figure 9 shows that the highest average concentration for the second half of 1970 for polonium-210 at any sampling location was 7.41% of the RCG. This was at the point the Mound Laboratory effluent enters the Great Miami River (location 3 in Figure 8). The average concentration rapidly decreased to 3/10 of 1% of the RCG at location 4, 250 yd downstream. The highest average concentration of polonium-210 for the year 1970 was 9.63% of the RCG, also at location 3. The average concentrations for the year 1970 for all locations are shown in Figure 10. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling locations were well below that level.

Plutonium-238 Analysis A 25-ml aliquot from each water sample (representing a water sampling location) is transferred quantitatively to a 50-ml capacity centrifuge tube containing 1 ml of concentrated nitric acid, 2 mg of radiochemically pure cerium carrier, and 1 drop of concentrated phosphoric acid. Plutonium-238 is coprecipitated from this solution with cerium phosphate. The cerium phosphate precipitate is then dissolved in dilute hydrochloric acid and reprecipitated as cerium fluoride with hydrofluoric acid. The cerium fluoride precipitate, which selectively coprecipitates the plutonium-238, is plancheted directly and dried under a heat lamp. The plancheted sample is then flamed and alpha counted in a low background, gas flow proportional counter for a minimum of 4 hr. When a positive result is obtained, the sample is counted with alpha pulse height equipment to confirm the possible presence of plutonium-238.

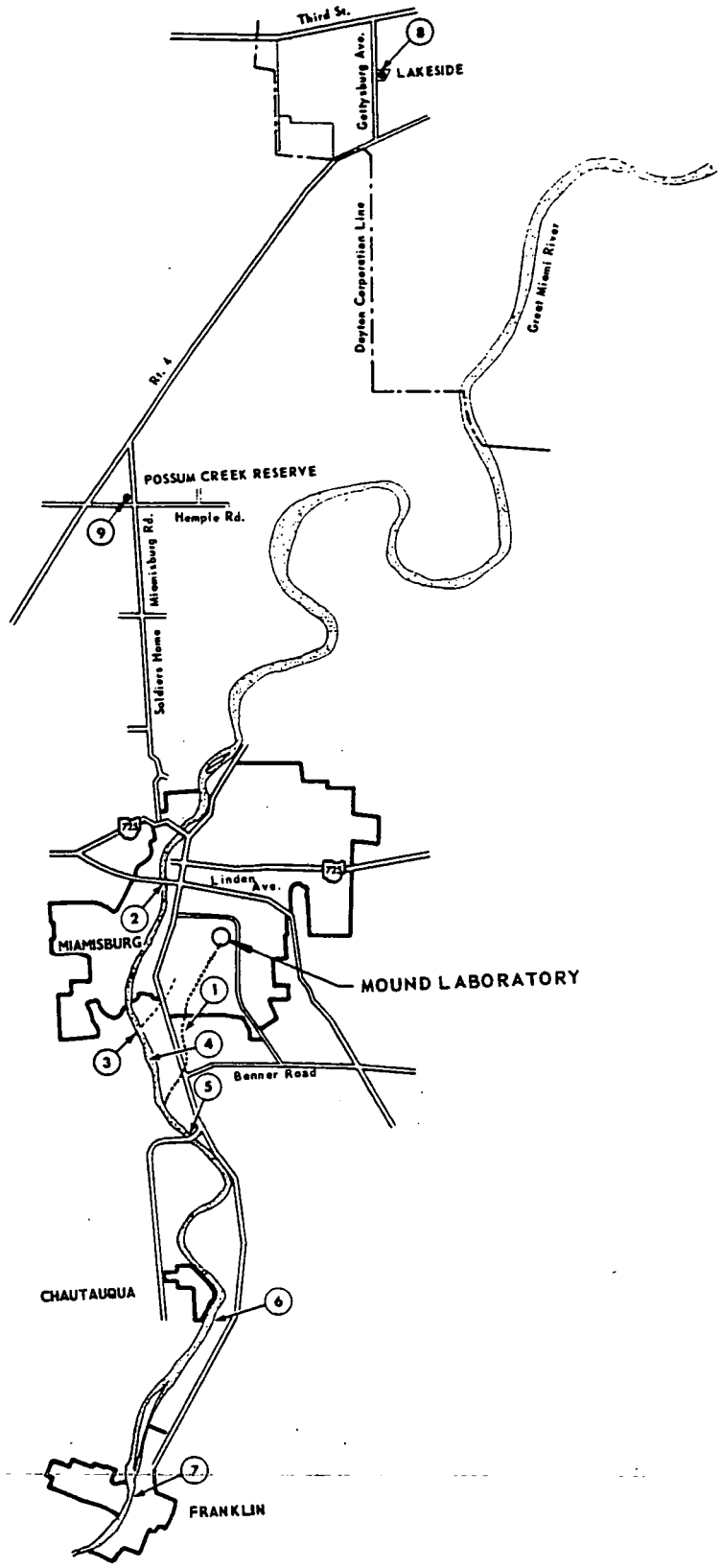

FIGURE 8 - Off-site water sampling locations.

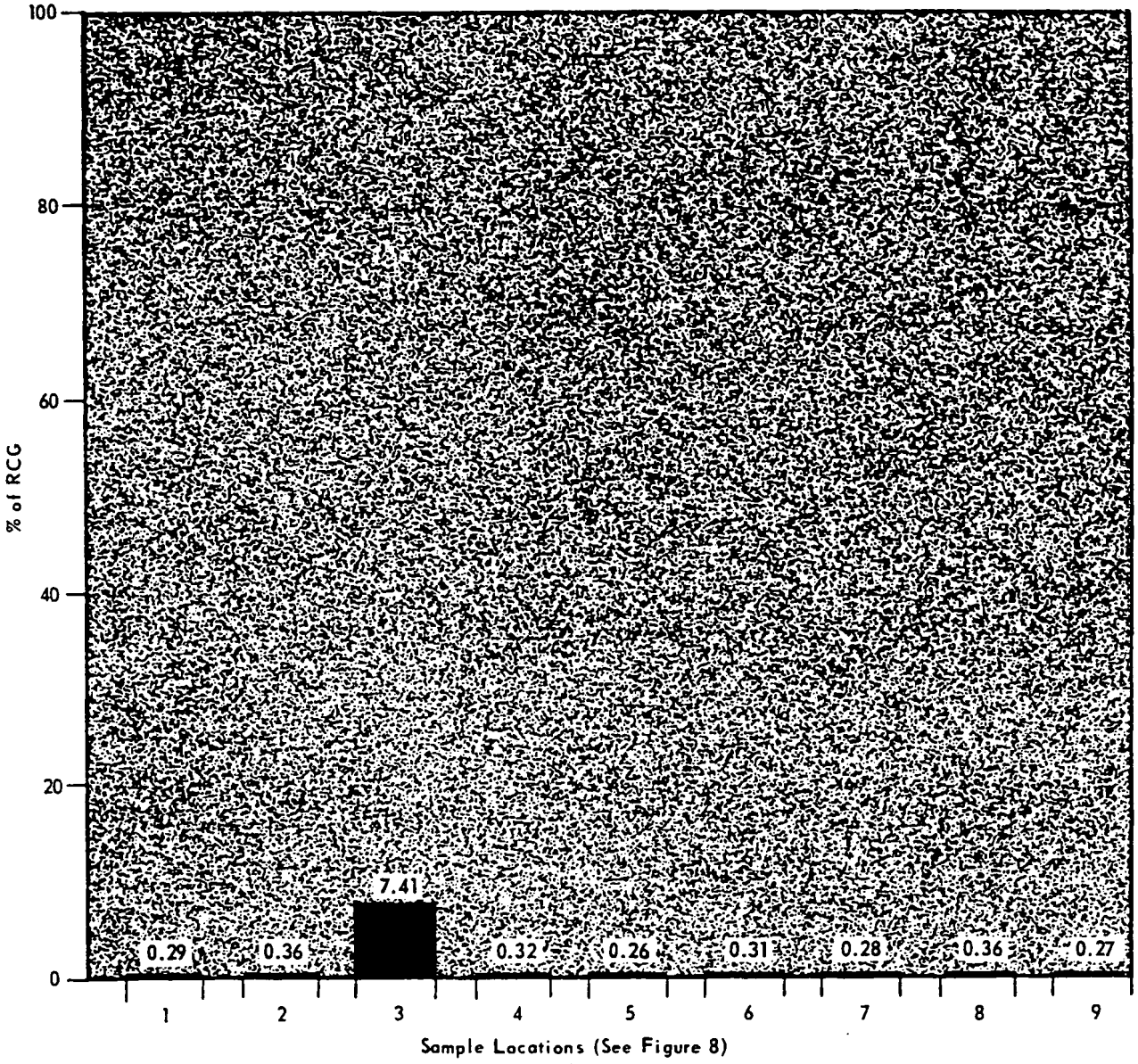

FIGURE 9 - Off-site water monitoring data for polonium-210--July-December 1970.

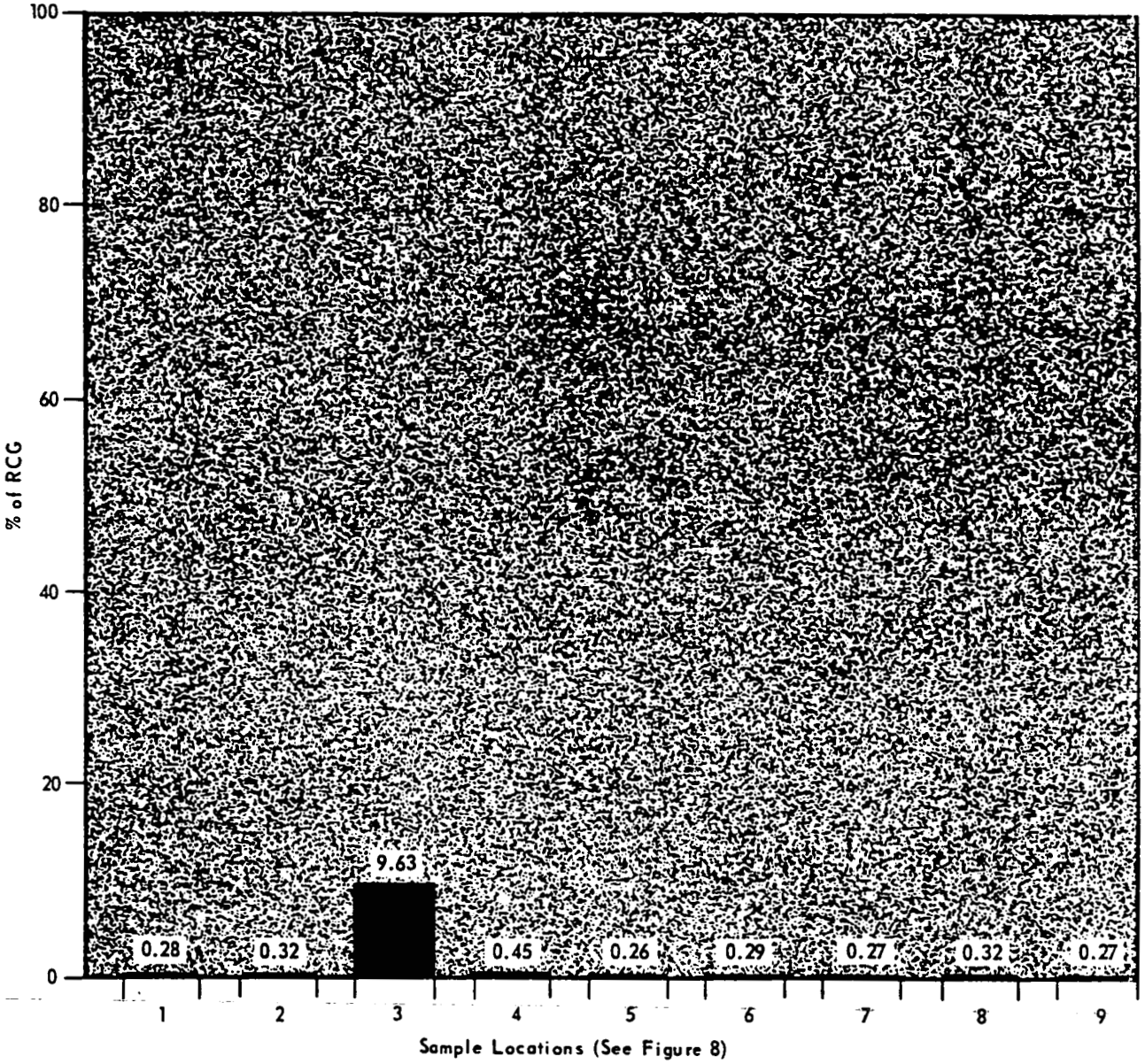

FIGURE 10 - Off-site water monitoring data for polonium-210--January-December 1970.

Results Figure 11 shows that the highest average concentration of plutonium-238 at any sampling location was 7/10 of 1% of the RCG for the second half of 1970. The next highest average concentration at any sampling site was 2/10 of 1% of the RCG. The highest average concentration of plutonium-238 at any sampling location for the entire year was 5/10 of 1% of the RCG. This concentration was detected in the Laboratory drainage ditch (location 1 in Figure 8). The highest average concentration in the Great Miami River for the year 1970 was 2/10 of 1% of the RCG at Chautauqua Dam (location 6 in Figure 8). The average concentrations for the entire year for all sampling sites are shown in Figure 12. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling locations were well below that level.

Tritium Oxide Analysis A 1-ml aliquot from each water sample is pipetted into a vial containing 17 ml of p-dioxane-based scintillation fluid. The vial is then placed in a liquid scintillation counter and counted 10 min for tritium.

Results Figure 13 shows that the highest average concentration of tritium oxide for the second half of 1970 was 11.73% of the RCG at location 1 in the Laboratory drainage ditch. The average concentration at location 3, where the Laboratory effluent enters the Great Miami River, was 5.90% of the RCG. The average concentration rapidly decreased to 3/10 of 1% of the RCG 250 yards downstream at location 4 and further downstream at location 5. The highest average concentration of tritium oxide for the year 1970 was 14.23% of the RCG at location 1. The next highest average concentration was detected at location 3 and was 7.9% of the RCG. The highest average concentration in the Great Miami River for the year 1970 was 4/10 of 1% of the RCG 250 yards downstream at location 4. The average concentrations for all sampling locations are shown in Figure 14. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling locations were well below that level.

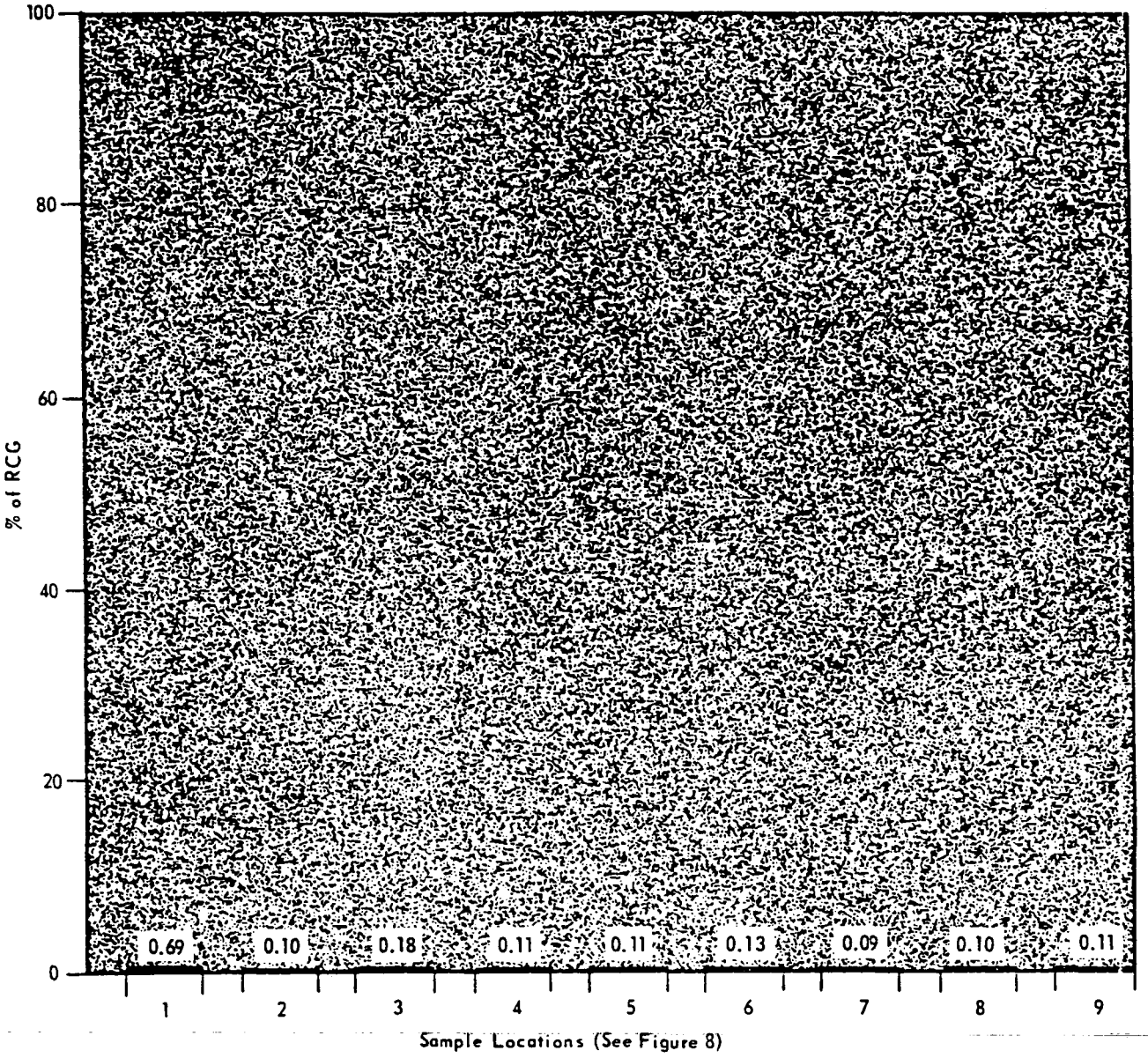

FIGURE 11 - Off-site water monitoring data for plutonium-238--July-December 1970.

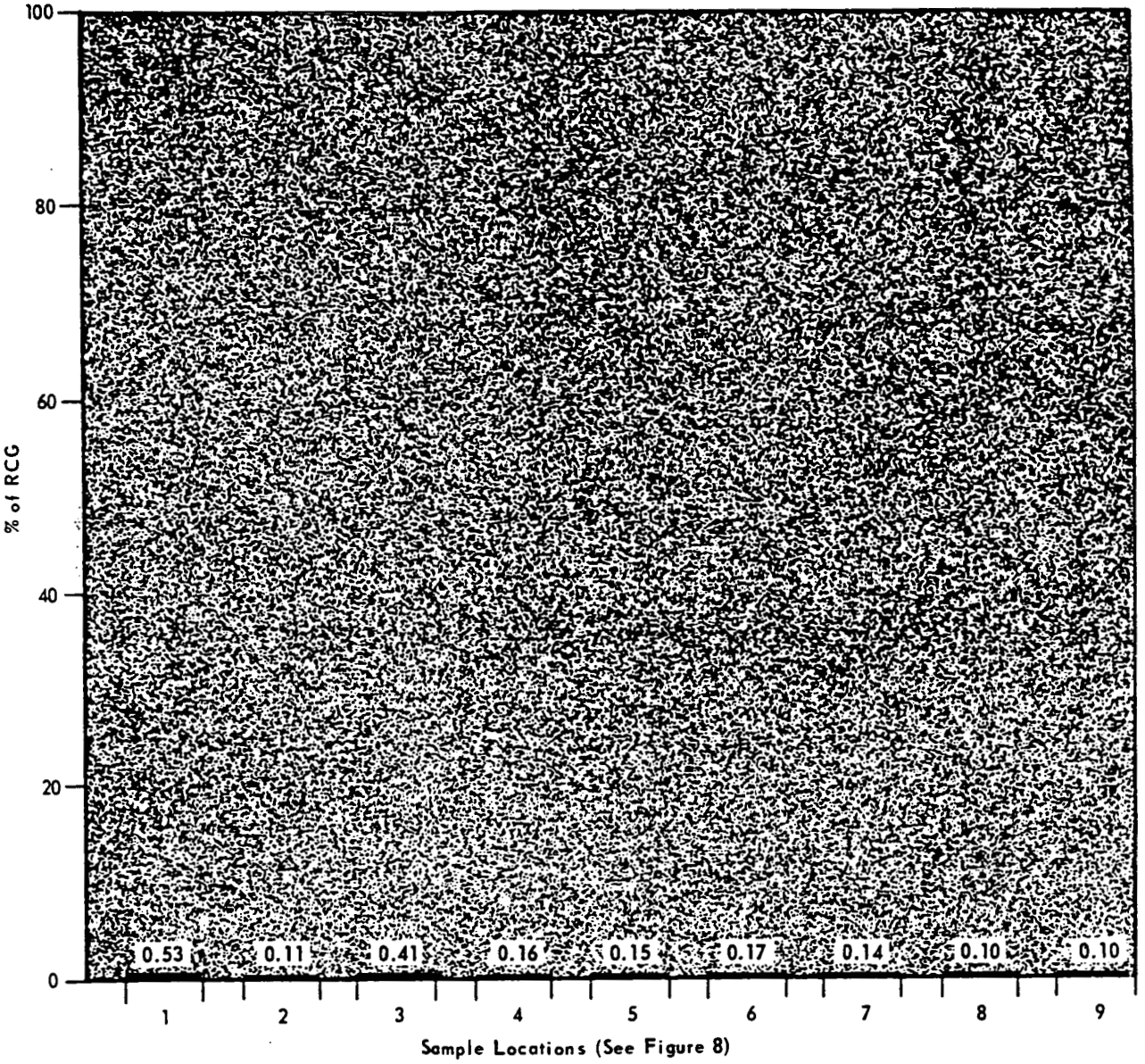

FIGURE 12 - Off-site water monitoring data for plutonium-238--January-December 1970.

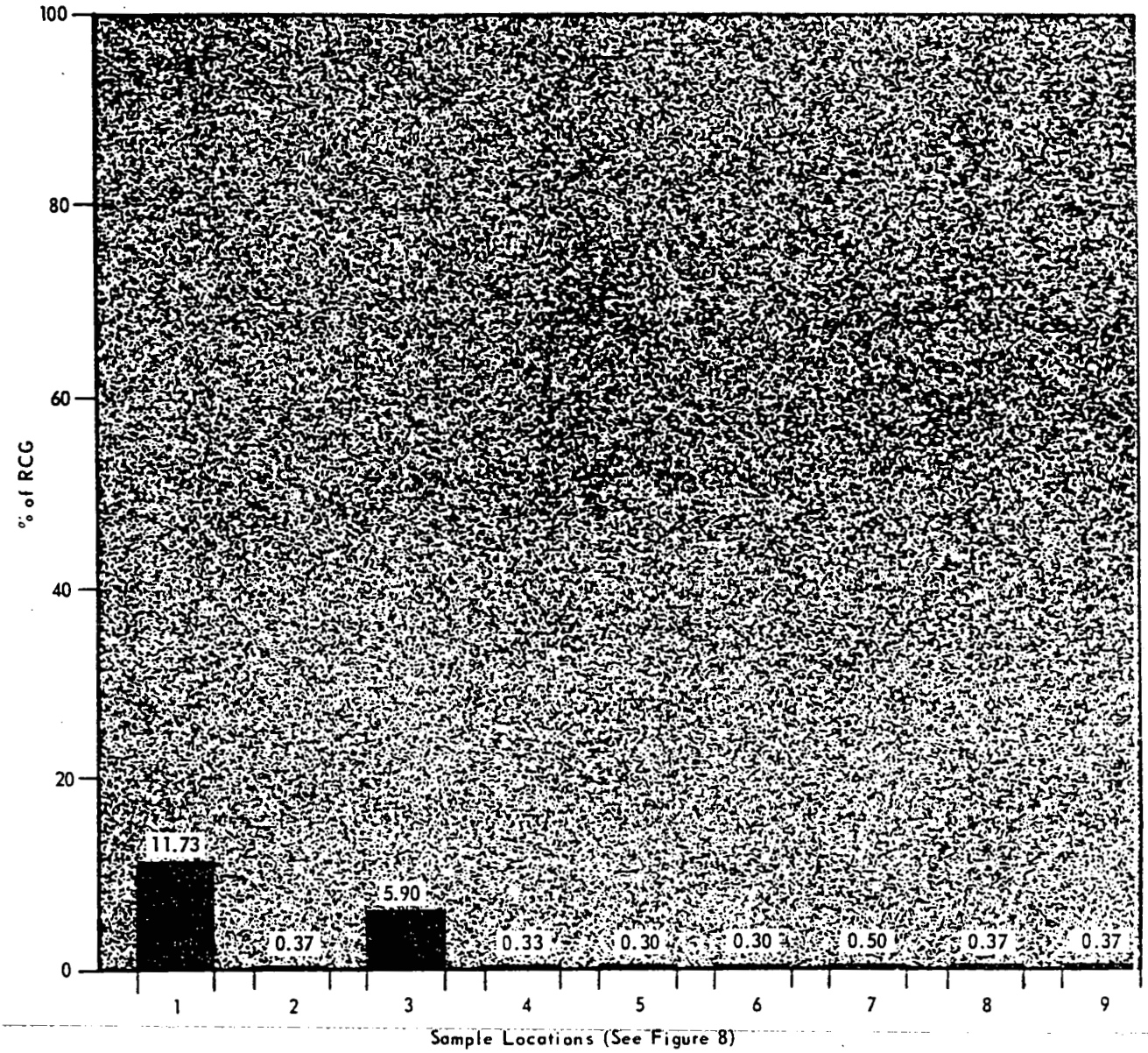

FIGURE 13 - Off-site water monitoring data for tritium oxide - July-December 1970.

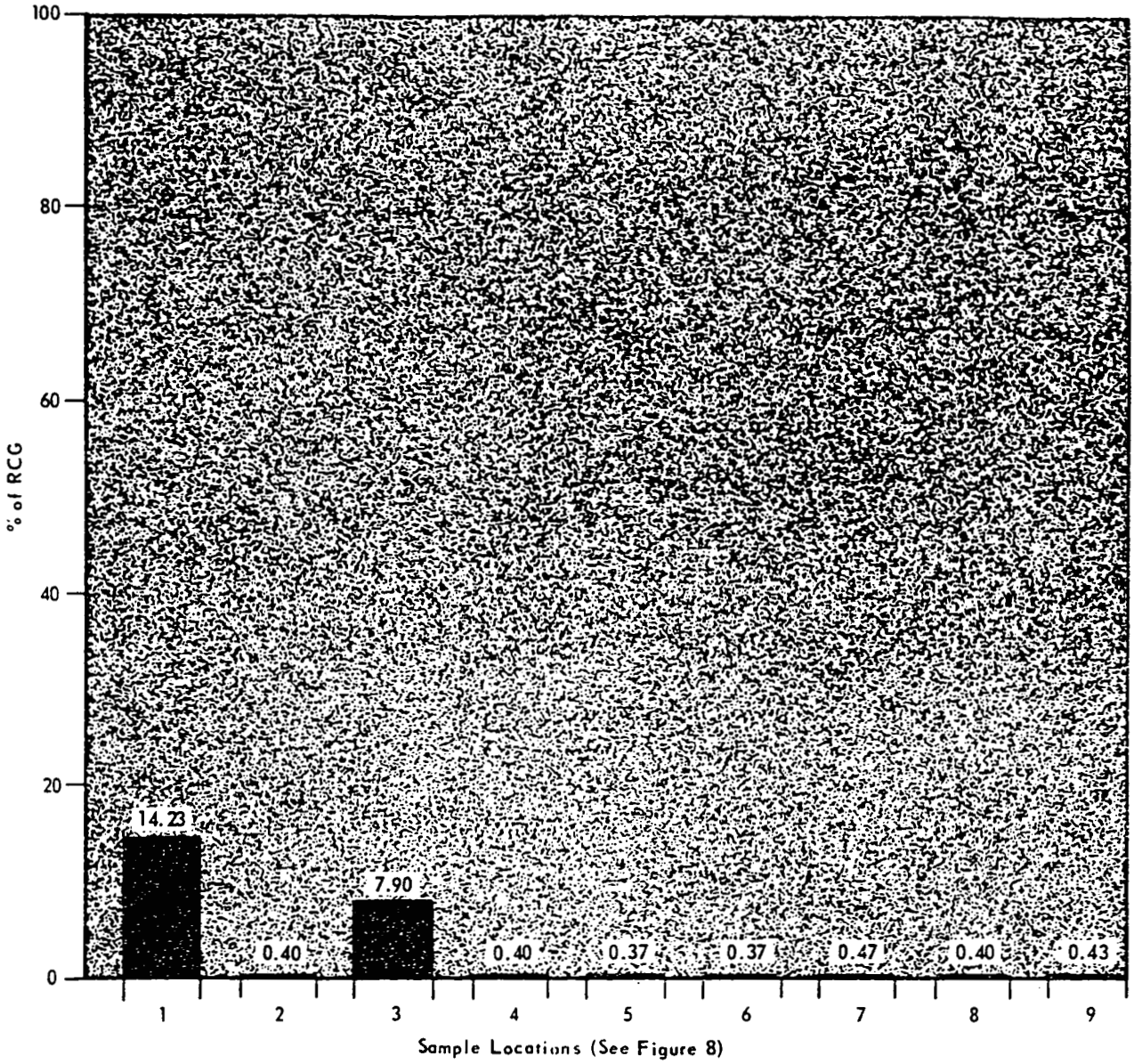

FIGURE 14 - Off-site water monitoring data for tritium oxide - January-December 1970.

APPENDIX

Table 1

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JANUARY-JUNE 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** for Average
0 - 3 (upwind)	25	0.0011	0.05
0 - 3 (downwind)	25	0.0008	0.04
3 - 5 (downwind)	25	0.0012	0.06
5 - 10 (downwind)	25	0.0015	0.07
10 - 15 (downwind)	25	0.0014	0.07
15 - 20 (downwind)	25	0.0012	0.06

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	59	0.0015	0.08
0 - 3 (downwind)	59	0.0008	0.04
3 - 5 (downwind)	58	0.0010	0.05
5 - 10 (downwind)	59	0.0009	0.05
10 - 15 (downwind)	59	0.0011	0.06
15 - 20 (downwind)	59	0.0006	0.03

Table 1 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JANUARY-DECEMBER 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	84	0.0014	0.07
0 - 3 (downwind)	84	0.0008	0.04
3 - 5 (downwind)	83	0.0010	0.05
5 - 10 (downwind)	84	0.0011	0.05
10 - 15 (downwind)	84	0.0012	0.06
15 - 20 (downwind)	84	0.0008	0.04

*Lowest detectable limit (LDL) for polonium in air is 0.0008×10^{-11} microcurie/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.0005×10^{-11} microcurie/cc for samples collected 0-3 miles downwind and 15-20 miles downwind.

**RCG - Radioactivity concentration guide = 2×10^{-11} microcurie/cc.

Note: Two LDL's are expressed above for the ranges in which polonium-210 samples are collected. Air is sampled at three locations within the 0-3 and 15-20 mile downwind ranges, and the filter papers are combined to form one composite sample for each range. Air samples in other ranges are comprised of samples collected at two locations within each range. Since the volume of air analyzed in the 0-3 and 15-20 mile downwind ranges is 33% greater than in the other ranges, the sensitivity expressed as LDL is proportionately lower.

Table 2

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JANUARY-JUNE 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	24	0.0046	0.46
0 - 3 (downwind)	24	0.0065	0.65
3 - 5 (downwind)	24	0.0057	0.57
5 - 10 (downwind)	24	0.0042	0.42
10 - 15 (downwind)	24	0.0040	0.40
15 - 20 (downwind)	24	0.0035	0.35

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	57	0.0028	0.28
0 - 3 (downwind)	57	0.0015	0.15
3 - 5 (downwind)	57	0.0019	0.19
5 - 10 (downwind)	57	0.0021	0.21
10 - 15 (downwind)	57	0.0022	0.22
15 - 20 (downwind)	57	0.0019	0.19

Table 2 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JANUARY-DECEMBER 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	81	0.0033	0.33
0 - 3 (downwind)	81	0.0029	0.29
3 - 5 (downwind)	81	0.0030	0.30
5 - 10 (downwind)	81	0.0027	0.27
10 - 15 (downwind)	81	0.0027	0.27
15 - 20 (downwind)	81	0.0023	0.23

*Lowest detectable limit (LDL) for plutonium in air is 0.0013×10^{-12} microcurie/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.0009×10^{-12} microcurie/cc for samples collected 0-3 miles downwind and 15-20 miles downwind.

**RCG - Radioactivity concentration guide = 1×10^{-12} microcurie/cc.

Note: Two LDL's are expressed above for the ranges in which plutonium-238 samples are collected. Air is sampled at three locations within the 0-3 and 15-20 mile downwind ranges, and the filter papers are combined to form one composite sample for each range. Air samples in other ranges are comprised of samples collected at two locations within each range. Since the volume of air analyzed in the 0-3 and 15-20 mile downwind ranges is 33% greater than in the other ranges, the sensitivity expressed as LDL is proportionately lower.

Table 3

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-JUNE 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	25	0.0044	0.22
0 - 3 (downwind)	25	0.0442	2.21
3 - 5 (downwind)	25	0.0049	0.24
5 - 10 (downwind)	25	0.0034	0.17
10 - 15 (downwind)	25	0.0040	0.20
15 - 20 (downwind)	25	0.0032	0.16

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	57	0.0053	0.26
0 - 3 (downwind)	58	0.0340	1.70
3 - 5 (downwind)	58	0.0073	0.36
5 - 10 (downwind)	59	0.0050	0.25
10 - 15 (downwind)	59	0.0064	0.32
15 - 20 (downwind)	59	0.0054	0.27

Table 3 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-DECEMBER 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	82	0.0048	0.24
0 - 3 (downwind)	83	0.0391	1.95
3 - 5 (downwind)	83	0.0061	0.30
5 - 10 (downwind)	84	0.0042	0.21
10 - 15 (downwind)	84	0.0052	0.26
15 - 20 (downwind)	84	0.0043	0.21

*Lowest detectable limit for tritium in air is 0.0020×10^{-7} microcuries/cc.

**RCG - Radioactivity concentration guide = 2×10^{-7} microcurie/cc.

Table 4

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** For Average
		North Zone	
0 - 3 (upwind)	15	0.0012	0.06
0 - 3 (downwind)	15	0.0006	0.03
3 - 5 (downwind)	15	0.0009	0.04
5 - 10 (downwind)	15	0.0009	0.04
10 - 15 (downwind)	15	0.0012	0.06
15 - 20 (downwind)	15	0.0006	0.03
		Northeast Zone	
0 - 3 (upwind)	9	0.0011	0.06
0 - 3 (downwind)	9	0.0009	0.04
3 - 5 (downwind)	9	0.0009	0.04
5 - 10 (downwind)	9	ND	ND
10 - 15 (downwind)	9	ND	ND
15 - 20 (downwind)	9	0.0006	0.03

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** For Average
		East Zone	
0 - 3 (upwind)	9	0.0009	0.04
0 - 3 (downwind)	9	ND	ND
3 - 5 (downwind)	9	0.0009	0.04
5 - 10 (downwind)	9	0.0011	0.05
10 - 15 (downwind)	9	0.0011	0.05
15 - 20 (downwind)	9	ND	ND
		Southeast Zone	
0 - 3 (upwind)	4	0.0047	0.23
0 - 3 (downwind)	4	0.0019	0.09
3 - 5 (downwind)	4	0.0018	0.09
5 - 10 (downwind)	4	0.0010	0.05
10 - 15 (downwind)	4	0.0030	0.15
15 - 20 (downwind)	4	0.0006	0.03

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** For Average
		South Zone	
0 - 3 (upwind)	3	ND	ND
0 - 3 (downwind)	3	0.0006	0.03
3 - 5 (downwind)	3	0.0020	0.10
5 - 10 (downwind)	3	ND	ND
10 - 15 (downwind)	3	ND	ND
15 - 20 (downwind)	3	ND	ND
		Southwest Zone	
0 - 3 (upwind)	1	0.0033	0.17
0 - 3 (downwind)	1	ND	ND
3 - 5 (downwind)	1	ND	ND
5 - 10 (downwind)	1	ND	ND
10 - 15 (downwind)	1	0.0014	0.07
15 - 20 (downwind)	1	ND	ND

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** For Average
		West Zone	
0 - 3 (upwind)	6	0.0015	0.08
0 - 3 (downwind)	6	ND	ND
3 - 5 (downwind)	6	0.0009	0.04
5 - 10 (downwind)	6	0.0009	0.04
10 - 15 (downwind)	6	0.0010	0.05
15 - 20 (downwind)	6	ND	ND
		Northwest Zone	
0 - 3 (upwind)	12	0.0017	0.09
0 - 3 (downwind)	12	0.0009	0.04
3 - 5 (downwind)	11	0.0010	0.05
5 - 10 (downwind)	12	0.0009	0.04
10 - 15 (downwind)	12	ND	ND
15 - 20 (downwind)	12	0.0006	0.03

*Lowest detectable limit (LDL) for polonium in air is 0.0008×10^{-11} microcurie/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.0005×10^{-11} microcurie/cc for samples collected 0-3 miles downwind and 15-20 miles downwind.

**RCG - Radioactivity concentration guide = 2×10^{-11} microcurie/cc.

ND - Less than lowest detectable limit = Less than 0.04 percent and 0.025 percent (see LDL above) of the RCG.

Note: Two LDL's are expressed above for the ranges in which polonium-210 samples are collected. Air is sampled at three locations within the 0-3 and 15-20 mile downwind ranges, and the filter papers are combined to form one composite sample for each range. Air samples in other ranges are comprised of samples collected at two locations within each range. Since the volume of air analyzed in the 0-3 and 15-20 mile downwind ranges is 33% greater than in the other ranges, the sensitivity expressed as LDL is proportionately lower.

Table 5

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
		North Zone	
0 - 3 (upwind)	14	0.0017	0.17
0 - 3 (downwind)	14	0.0011	0.11
3 - 5 (downwind)	14	0.0019	0.19
5 - 10 (downwind)	14	0.0016	0.16
10 - 15 (downwind)	14	0.0021	0.21
15 - 20 (downwind)	14	0.0012	0.12
		Northeast Zone	
0 - 3 (upwind)	10	0.0060	0.60
0 - 3 (downwind)	10	0.0025	0.25
3 - 5 (downwind)	10	0.0025	0.25
5 - 10 (downwind)	10	0.0023	0.23
10 - 15 (downwind)	10	0.0027	0.27
15 - 20 (downwind)	10	0.0022	0.22

Table 5 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
		East Zone	
0 - 3 (upwind)	8	0.0019	0.19
0 - 3 (downwind)	8	0.0013	0.13
3 - 5 (downwind)	8	0.0011	0.11
5 - 10 (downwind)	8	0.0014	0.14
10 - 15 (downwind)	8	0.0019	0.19
15 - 20 (downwind)	8	0.0052	0.52
		Southeast Zone	
0 - 3 (upwind)	4	0.0029	0.29
0 - 3 (downwind)	4	0.0021	0.21
3 - 5 (downwind)	4	0.0022	0.22
5 - 10 (downwind)	4	0.0058	0.58
10 - 15 (downwind)	4	0.0030	0.30
15 - 20 (downwind)	4	0.0019	0.19

Table 5 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
		South Zone	
0 - 3 (upwind)	3	0.0025	0.25
0 - 3 (downwind)	3	0.0017	0.17
3 - 5 (downwind)	3	0.0016	0.16
5 - 10 (downwind)	3	ND	ND
10 - 15 (downwind)	3	0.0033	0.33
15 - 20 (downwind)	3	0.0013	0.13
		Southwest Zone	
0 - 3 (upwind)	1	0.0071	0.71
0 - 3 (downwind)	1	ND	ND
3 - 5 (downwind)	1	ND	ND
5 - 10 (downwind)	1	0.0038	0.38
10 - 15 (downwind)	1	ND	ND
15 - 20 (downwind)	1	ND	ND

Table 5 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
		West Zone	
0 - 3 (upwind)	6	0.0019	0.19
0 - 3 (downwind)	6	0.0013	0.13
3 - 5 (downwind)	6	0.0023	0.23
5 - 10 (downwind)	6	0.0017	0.17
10 - 15 (downwind)	6	0.0028	0.28
15 - 20 (downwind)	6	0.0013	0.13
		Northwest Zone	
0 - 3 (upwind)	11	0.0019	0.19
0 - 3 (downwind)	11	0.0011	0.11
3 - 5 (downwind)	11	0.0017	0.17
5 - 10 (downwind)	11	0.0019	0.19
10 - 15 (downwind)	11	0.0014	0.14
15 - 20 (downwind)	11	0.0010	0.10

*Lowest detectable limit (LDL) for plutonium in air is 0.0013×10^{-12} microcurie/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.0009×10^{-12} microcurie/cc for samples collected 0-3 miles downwind and 15-20 miles downwind.

**RCG - Radioactivity concentration guide = 1×10^{-12} microcurie/cc.

ND - Less than lowest detectable limit = Less than 0.13 percent and 0.09 percent (see LDL above) of the RCG.

Note: Two LDL's are expressed above for the ranges in which polonium-210 samples are collected. Air is sampled at three locations within the 0-3 and 15-20 mile downwind ranges, and the filter papers are combined to form one composite sample for each range. Air samples in other ranges are comprised of samples collected at two locations within each range. Since the volume of air analyzed in the 0-3 and 15-20 mile downwind ranges is 33% greater than in the other ranges, the sensitivity expressed as LDL is proportionately lower.

Table 6

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
		North Zone	
0 - 3 (upwind)	15	0.0086	0.43
0 - 3 (downwind)	15	0.0542	2.71
3 - 5 (downwind)	15	0.0184	0.92
5 - 10 (downwind)	15	0.0046	0.23
10 - 15 (downwind)	15	0.0039	0.19
15 - 20 (downwind)	15	0.0036	0.18
		Northeast Zone	
0 - 3 (upwind)	9	0.0085	0.42
0 - 3 (downwind)	8	0.0180	0.90
3 - 5 (downwind)	9	0.0139	0.69
5 - 10 (downwind)	9	0.0048	0.24
10 - 15 (downwind)	9	0.0048	0.24
15 - 20 (downwind)	9	0.0055	0.27

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
		East Zone	
0 - 3 (upwind)	6	0.0035	0.17
0 - 3 (downwind)	8	0.0116	0.58
3 - 5 (downwind)	8	0.0067	0.33
5 - 10 (downwind)	8	0.0098	0.49
10 - 15 (downwind)	8	0.0052	0.26
15 - 20 (downwind)	8	0.0117	0.58
		Southeast Zone	
0 - 3 (upwind)	4	0.0028	0.14
0 - 3 (downwind)	4	0.0165	0.82
3 - 5 (downwind)	4	0.0033	0.16
5 - 10 (downwind)	4	0.0032	0.16
10 - 15 (downwind)	4	0.0186	0.93
15 - 20 (downwind)	4	0.0028	0.14

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
		South Zone	
0 - 3 (upwind)	4	0.0046	0.23
0 - 3 (downwind)	4	0.0444	2.22
3 - 5 (downwind)	4	0.0058	0.29
5 - 10 (downwind)	4	0.0052	0.26
10 - 15 (downwind)	4	0.0049	0.24
15 - 20 (downwind)	4	0.0042	0.21
		Southwest Zone	
0 - 3 (upwind)	1	0.0046	0.23
0 - 3 (downwind)	1	0.0777	3.88
3 - 5 (downwind)	1	ND	ND
5 - 10 (downwind)	1	ND	ND
10 - 15 (downwind)	1	ND	ND
15 - 20 (downwind)	1	ND	ND

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
		West Zone	
0 - 3 (upwind)	6	0.0081	0.40
0 - 3 (downwind)	6	0.0205	1.02
3 - 5 (downwind)	6	0.0025	0.12
5 - 10 (downwind)	6	0.0073	0.36
10 - 15 (downwind)	6	0.0021	0.10
15 - 20 (downwind)	6	0.0063	0.31
		Northwest Zone	
0 - 3 (upwind)	12	ND	ND
0 - 3 (downwind)	12	0.0290	1.45
3 - 5 (downwind)	11	0.0059	0.29
5 - 10 (downwind)	12	0.0037	0.18
10 - 15 (downwind)	12	0.0095	0.47
15 - 20 (downwind)	12	0.0068	0.34

*Lowest detectable limit for tritium in air is 0.0020×10^{-7} microcurie/cc.

**RCG - Radioactivity concentration guide = 2×10^{-7} microcurie/cc.

ND - Less than lowest detectable limit = less than 0.1 percent of RCG.

Table 7

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM-210

JANUARY-JUNE 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No.1 on map)	24	0.0190	0.27
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	ND	ND
Mound Lab Effluent No. 1 (location No. 3 on map)	23	0.9300	13.28
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	23	0.0470	0.67
Chautauqua Road Bridge (location No. 5 on map)	23	ND	ND
Chautauqua Dam (location No. 6 on map)	23	ND	ND
Franklin, Ohio (location No. 7 on map)	23	ND	ND
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	23	ND	ND
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	24	ND	ND

*Lowest detectable limit for polonium in water is 0.0180×10^{-7} microcurie/cc.

**RCG - Radioactivity concentration guide = 7×10^{-7} microcurie/cc.

ND - Less than the lowest detectable limit = Less than 0.26 percent of the RCG.

Table 7 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	38	0.0201	0.29
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	38	0.0251	0.36
Mound Lab Effluent No. 1 (location No. 3 on map)	38	0.5190	7.41
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	38	0.0225	0.32
Chautauqua Road Bridge (location No. 5 on map)	38	0.0185	0.26
Chautauqua Dam (location No. 6 on map)	38	0.0218	0.31
Franklin, Ohio (location No. 7 on map)	38	0.0194	0.28
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	38	0.0254	0.36
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	38	0.0192	0.27

*Lowest detectable limit for polonium in water is 0.0180×10^{-7} microcurie/cc.

**RCG - Radioactivity concentration guide = 7×10^{-7} microcurie/cc.

Table 7 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM-210

JANUARY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	62	0.0196	0.28
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	61	0.0224	0.32
Mound Lab Effluent No. 1 (location No. 3 on map)	61	0.6739	9.63
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	61	0.0317	0.45
Chautauqua Road Bridge (location No. 5 on map)	61	0.0183	0.26
Chautauqua Dam (location No. 6 on map)	61	0.0204	0.29
Franklin, Ohio (location No. 7 on map)	61	0.0189	0.27
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	61	0.0227	0.32
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	62	0.0187	0.27

*Lowest detectable limit for polonium in water is 0.0180×10^{-7} microcurie/cc.

**RCG - Radioactivity concentration guide = 7×10^{-7} microcurie/cc.

Table 8

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM-238

JANUARY-JUNE 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-6} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No.1 on map)	24	0.0142	0.28
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	0.0053	0.11
Mound Lab Effluent No. 1 (location No. 3 on map)	23	0.0391	0.78
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	23	0.0118	0.24
Chautauqua Road Bridge (location No. 5 on map)	23	0.0111	0.22
Chautauqua Dam (location No. 6 on map)	23	0.0116	0.23
Franklin, Ohio (location No. 7 on map)	23	0.0114	0.23
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	23	0.0050	0.10
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	24	0.0046	0.09

*Lowest detectable limit for plutonium in water is 0.0045×10^{-6} microcurie/cc.

**RCG - Radioactivity concentration guide = 5×10^{-6} microcurie/cc.

Table 8 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-6} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	37	0.0344	0.69
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	37	0.0052	0.10
Mound Lab Effluent No. 1 (location No. 3 on map)	37	0.0092	0.18
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	38	0.0054	0.11
Chautauqua Road Bridge (location No. 5 on map)	36	0.0053	0.11
Chautauqua Dam (location No. 6 on map)	38	0.0064	0.13
Franklin, Ohio (location No. 7 on map)	38	0.0046	0.09
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	38	0.0051	0.10
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	37	0.0057	0.11

*Lowest detectable limit for plutonium in water is 0.0045×10^{-6} microcurie/cc.

**RCG - Radioactivity concentration guide = 5×10^{-6} microcurie/cc.

Table 8 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM-238

JANUARY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-6} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	61	0.0265	0.53
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	60	0.0053	0.11
Mound Lab Effluent No. 1 (location No. 3 on map)	60	0.0207	0.41
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	61	0.0078	0.16
Chautauqua Road Bridge (location No. 5 on map)	59	0.0076	0.15
Chautauqua Dam (location No. 6 on map)	61	0.0084	0.17
Franklin, Ohio (location No. 7 on map)	61	0.0072	0.14
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	61	0.0050	0.10
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	61	0.0052	0.10

*Lowest detectable limit for plutonium in water is 0.0045×10^{-6} microcurie/cc.

**RCG - Radioactivity concentration guide = 5×10^{-6} microcurie/cc.

Table 9

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JANUARY-JUNE 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-3} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No.1 on map)	24	0.5460	18.20
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	0.0140	0.47
Mound Lab Effluent No. 1 (location No. 3 on map)	23	0.3360	11.20
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	23	0.0150	0.50
Chautauqua Road Bridge (location No. 5 on map)	23	0.0150	0.50
Chautauqua Dam (location No. 6 on map)	23	0.0120	0.40
Franklin, Ohio (location No. 7 on map)	23	0.0120	0.40
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	23	0.0140	0.47
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	24	0.0160	0.53

*Lowest detectable limit for tritium in water is 0.0060×10^{-3} microcurie/cc.

**RCG - Radioactivity concentration guide = 3×10^{-3} microcurie/cc.

Table 9 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JULY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-3} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	38	0.3520	11.73
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	38	0.0110	0.37
Mound Lab Effluent No. 1 (location No. 3 on map)	38	0.1770	5.90
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	38	0.0100	0.33
Chautauqua Road Bridge (location No. 5 on map)	38	0.0090	0.30
Chautauqua Dam (location No. 6 on map)	38	0.0090	0.30
Franklin, Ohio (location No. 7 on map)	38	0.0150	0.50
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	38	0.0110	0.37
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	38	0.0110	0.37

*Lowest detectable limit for tritium in water is 0.0060×10^{-3} microcurie/cc.

**RCG - Radioactivity concentration guide = 3×10^{-3} microcurie/cc.

Table 9 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JANUARY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-3} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	62	0.4270	14.23
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	61	0.0120	0.40
Mound Lab Effluent No. 1 (location No. 3 on map)	61	0.2370	7.90
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	61	0.0120	0.40
Chautauqua Road Bridge (location No. 5 on map)	61	0.0110	0.37
Chautauqua Dam (location No. 6 on map)	61	0.0110	0.37
Franklin, Ohio (location No. 7 on map)	61	0.0140	0.47
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	61	0.0120	0.40
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	62	0.0130	0.43

*Lowest detectable limit for tritium in water is 0.0060×10^{-3} microcurie/cc.

**RCG - Radioactivity concentration guide = 3×10^{-3} microcurie/cc.

ENVIRONMENTAL MONITORING REPORT

1969

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

1969

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ENVIRONMENTAL MONITORING REPORT: JANUARY–JUNE 1969

H. F. Anderson and W. E. Sheehan

AEC Research and Development REPORT

MONSANTO RESEARCH CORPORATION

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ABSTRACT

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, is presented for the first half of 1969. The average concentration of radionuclides from Mound Laboratory in the Great Miami River and in the environmental air was within the stringent standards of safety specified by the Atomic Energy Commission.

INTRODUCTION

This report is a summary of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program considers all of the projects at Mound Laboratory and all of the radioisotopes which could be released into the environment. The monitoring procedures and counting techniques are those best suited for the detection and measurement of these radioactive materials.

The Radioactivity Concentration Guide (RCG) values in air and in water for the radionuclides in use at Mound Laboratory are taken from the USAEC Manual, Chapter 0524. The Radioactivity Concentration Guides for environmental air and water for the materials used at Mound Laboratory are:

Polonium-210

Air: 2×10^{-11} microcuries per cubic centimeter (μCi/cc)
Water: 7×10^{-7} microcuries per cubic centimeter (μCi/cc)

Plutonium-238

Air: 1×10^{-12} microcuries per cubic centimeter (μCi/cc)
Water: 5×10^{-6} microcuries per cubic centimeter (μCi/cc)

Hydrogen-3 (Tritium)

Air: 2×10^{-7} microcuries per cubic centimeter (μCi/cc)
Water: 3×10^{-3} microcuries per cubic centimeter (μCi/cc)

The data in Tables 1 through 9 were generated by an IBM Systems/360, Model 50H computer at Mound Laboratory. Consequently, powers of ten for the maximum and average concentrations (μCi/cc) in these tables are expressed in conventional computer notation. For example:

0.80×10^{-14} = 0.80 x E-14
1.80×10^{-9} = 1.80 x E-9
0.05×10^{-13} = 0.05 x E-3

LIQUID CONTAMINATION

Polonium-Plutonium Liquid radioactive wastes from polonium and plutonium work at the Laboratory are processed separately to reduce the concentration of these radionuclides to a level at which they may be discharged to the environment. Treated polonium liquid waste is discharged to the Great Miami River via a closed sewer line which also carries the treated plant sewage. The treated plutonium waste is discharged to a drainage ditch which runs through the plant site and eventually reaches the river.

Tritium Helium-3 being purified at Mound Laboratory contains small quantities of tritium. In addition, tritium is being recovered from various AEC tritium-contaminated wastes. Liquid waste generated by these operations is treated (diluted with water when necessary) and is discharged to the drainage ditch. Some tritium-contaminated liquid wastes are discharged to the closed sewer line.

Water Sampling Water samples are collected weekly from the Great Miami River, the drainage ditch and two ponds NE of Mound Laboratory. All samples are analyzed for polonium, plutonium and tritium.

Map 1 shows the location of weekly water sampling points on the Great Miami River.

The results of the water sampling program are presented in Tables 1, 2 and 3. The data listed in these tables indicate that the average concentrations of polonium, plutonium and tritium in water discharged to the environment were well below the Radioactivity Concentration Guides.

AIRBORNE CONTAMINATION

Polonium-Plutonium Air which is contaminated with polonium and plutonium particulates is treated by passing it through absolute filters before it is discharged to the environment via several building stacks.

Tritium Air which might be contaminated with gaseous tritium is discharged to the environment via stacks.

Off-Site Air Sampling All environmental air samples are collected weekly to a distance of 20 miles with sampling equipment mounted in a one-ton panel truck. Samples are collected upwind and downwind from the plant according to routes drawn for the different wind directions. The selection of the air sampling zone depends on the wind direction on the days that samples are collected. Since the sampling zone is dependent on the wind direction it is possible that air samples from all zones will not be collected during the reporting period. Maps 2 and 3 show the zones routinely sampled. Results of the air sampling program are presented in Tables 4 to 9. Table 10 lists the specific location of sampling sites by zone for the polonium and plutonium monitoring program. Table 11 lists the specific location of sampling sites by zone for the tritium monitoring program.

Airborne polonium and plutonium particulates are collected with a high volume air sampler. One-fourth of each filter paper is processed by spontaneous deposition to isolate polonium. The remaining three-fourths of each filter paper is processed chemically to remove polonium. The remaining alpha activity is interpreted as plutonium; however, some of this alpha activity is probably due to naturally occurring alpha emitters.

Airborne tritium is monitored by bubbling air through a liquid scintillation counting solution with p-dioxane as the organic solvent. The counting solution is counted directly in a liquid spectrometer.

TABLE 1

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

JANUARY-JUNE 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	24	36.04	4.99	0.71
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	24	2.70	1.84	0.26
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	24	2117.12	267.94	38.28
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	24	29.73	4.39	0.63
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	24	371.17	17.23	2.46
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	24	6.31	1.99	0.28
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	24	1.80	1.80	0.26
POND - OPPOSITE V.A. HOSPITAL, DAYTON, OHIO (8 MI. NE OF MOUND LAB)	23	1.80	1.80	0.26
POND - POSSUM CREEK RESERVE, DAYTON, OHIO (6 MI. NE OF MOUND LAB)	23	1.80	1.80	0.26

* LOWEST DETECTABLE LIMIT FOR POLONIUM IN WATER IS 1.80 X E-9 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 2

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

JANUARY-JUNE 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	24	472.71	65.01	[illegible]
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	24	6.98	4.65	[illegible]
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	25	519.14	68.60	1.57
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	25	8.93	5.56	0.11
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	25	48.65	6.86	0.14
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	25	6.19	4.76	0.10
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	24	7.17	4.88	0.10
PORC - OPPOSITE V.A. HOSPITAL, DAYTON, OHIO (8 MI. NE OF MOUND LAB)	23	6.34	4.63	0.09
PORC - POSSUM CREEK RESERVE, DAYTON, OHIO (6 MI. NE OF MOUND LAB)	23	10.32	5.14	0.10

* LOWEST DETECTABLE LIMIT FOR PLUTONIUM IN WATER IS 4.50 X E-9 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 3

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JANUARY-JUNE 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-3 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-3 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	24	22.97	2.47	82.33
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	24	0.88	0.13	4.33
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	24	15.97	1.64	54.67
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	24	0.72	0.09	3.00
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	24	3.67	0.22	7.33
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	24	0.38	0.08	2.67
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	24	1.74	0.17	5.67
POND - OPPOSITE V.A. HOSPITAL, DAYTON, OHIO (8 MI. NE OF MOUND LAB)	22	0.22	0.08	2.67
POND - POSSUM CREEK RESERVE, DAYTON, OHIO (6 MI. NE OF MOUND LAB)	23	0.77	0.10	3.33

* LOWEST DETECTABLE LIMIT FOR TRITIUM IN WATER IS 0.05 X E-3 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 4

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		NORTH ZONE		
0 - 3 (UPWIND)	2	2.52	2.01	[illegible]
0 - 3 (DOWNWIND)	2	1.22	0.99	[illegible]
3 - 5 (DOWNWIND)	2	2.41	1.93	0.10
5 - 10 (DOWNWIND)	2	2.61	2.30	0.12
10 - 15 (DOWNWIND)	2	3.03	2.10	0.11
15 - 20 (DOWNWIND)	2	0.53	0.53	0.03
		NORTHEAST ZONE		
0 - 3 (UPWIND)	7	3.95	1.70	0.09
0 - 3 (DOWNWIND)	7	3.58	1.10	0.06
3 - 5 (DOWNWIND)	7	3.89	1.30	0.07
5 - 10 (DOWNWIND)	7	2.87	1.53	0.08
10 - 15 (DOWNWIND)	7	2.72	1.72	0.09
15 - 20 (DOWNWIND)	7	2.20	1.05	0.05

TABLE 4 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		EAST ZONE		
0 - 3 (UPWIND)	3	1.77	1.21	0.06
0 - 3 (DOWNWIND)	3	1.64	0.96	0.05
3 - 5 (DOWNWIND)	3	2.47	1.64	0.08
5 - 10 (DOWNWIND)	3	0.95	0.88	0.04
10 - 15 (DOWNWIND)	3	2.91	2.01	0.10
15 - 20 (DOWNWIND)	3	3.05	1.60	0.08
		SOUTHEAST ZONE		
0 - 3 (UPWIND)	3	1.94	1.54	0.08
0 - 3 (DOWNWIND)	3	1.87	1.12	0.06
3 - 5 (DOWNWIND)	2	1.02	0.93	0.05
5 - 10 (DOWNWIND)	3	1.74	1.17	0.06
10 - 15 (DOWNWIND)	3	2.34	1.67	0.08
15 - 20 (DOWNWIND)	3	2.84	1.60	0.08

TABLE 4 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCL** FOR AVERAGE
		SOUTH ZONE		
0 - 3 (UPWIND)	3	3.27	1.62	0.08
0 - 3 (DOWNWIND)	3	0.53	0.55	0.03
3 - 5 (DOWNWIND)	3	3.38	1.72	0.09
5 - 10 (DOWNWIND)	3	0.80	0.80	0.04
10 - 15 (DOWNWIND)	4	1.24	1.02	0.05
15 - 20 (DOWNWIND)	3	3.57	1.54	0.08
		SOUTHWEST ZONE		
0 - 3 (UPWIND)	2	2.08	1.44	0.07
0 - 3 (DOWNWIND)	2	2.11	1.32	0.07
3 - 5 (DOWNWIND)	2	2.38	1.59	0.08
5 - 10 (DOWNWIND)	2	1.21	1.01	0.05
10 - 15 (DOWNWIND)	2	2.38	1.59	0.08
15 - 20 (DOWNWIND)	2	0.90	0.71	0.04

TABLE 4 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		WEST ZONE		
0 - 3 (UPWIND)	2	1.61	1.21	0.06
0 - 3 (DOWNWIND)	2	0.99	0.76	0.04
3 - 5 (DOWNWIND)	2	2.34	1.57	0.08
5 - 10 (DOWNWIND)	2	3.36	2.08	0.10
10 - 15 (DOWNWIND)	2	1.79	1.29	0.06
15 - 20 (DOWNWIND)	2	2.65	1.59	0.08
		NORTHWEST ZONE		
0 - 3 (UPWIND)	2	2.27	2.11	0.11
0 - 3 (DOWNWIND)	2	1.47	1.08	0.05
3 - 5 (DOWNWIND)	2	1.28	1.04	0.05
5 - 10 (DOWNWIND)	2	2.58	2.16	0.11
10 - 15 (DOWNWIND)	2	1.37	1.08	0.05
15 - 20 (DOWNWIND)	2	1.90	1.22	0.06

TABLE 4 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JANUARY-JUNE 1969

* LOWEST DETECTABLE LIMIT FOR POLONIUM IN AIR IS 0.80 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES UPWIND, 3-5 MILES DOWNWIND, 5-10 MILES DOWNWIND AND 10-15 MILES DOWNWIND. THE LDL IS 0.53 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES DOWNWIND AND 15-20 MILES DOWNWIND. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THESE VALUES WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 5

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JANUARY-JUNE 1969, ALL ZONES

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
0 - 3 (UPWIND)	24	3.95	1.62	0.08
0 - 3 (DOWNWIND)	24	3.58	0.99	0.05
3 - 5 (DOWNWIND)	23	3.89	1.45	0.07
5 - 10 (DOWNWIND)	24	3.36	1.44	0.07
10 - 15 (DOWNWIND)	25	3.03	1.58	0.08
15 - 20 (DOWNWIND)	24	3.57	1.24	0.06

* LOWEST DETECTABLE LIMIT FOR POLONIUM IN AIR IS 0.80 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES UPWIND, 3-5 MILES DOWNWIND, 5-10 MILES DOWNWIND AND 10-15 MILES DOWNWIND. THE LDL IS 0.53 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES DOWNWIND AND 15-20 MILES DOWNWIND. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THESE VALUES WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 6

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		WEST ZONE		
0 - 3 (UPWIND)	2	0.81	0.67	0.67
0 - 3 (DOWNWIND)	2	0.90	0.55	0.55
3 - 5 (DOWNWIND)	2	1.29	0.93	0.93
5 - 10 (DOWNWIND)	2	0.82	0.82	0.82
10 - 15 (DOWNWIND)	2	0.96	0.86	0.86
15 - 20 (DOWNWIND)	1	1.00	1.00	1.00
		NORTHEAST ZONE		
0 - 3 (UPWIND)	7	1.08	0.43	0.43
0 - 3 (DOWNWIND)	7	1.01	0.50	0.50
3 - 5 (DOWNWIND)	7	1.10	0.47	0.47
5 - 10 (DOWNWIND)	7	1.26	0.56	0.56
10 - 15 (DOWNWIND)	7	1.53	0.45	0.45
15 - 20 (DOWNWIND)	8	0.83	0.37	0.37

TABLE 6 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		EAST ZONE		
0 - 3 (UPWIND)	3	0.77	0.46	0.46
0 - 3 (DOWNWIND)	3	0.32	0.25	0.25
3 - 5 (DOWNWIND)	3	0.51	0.36	0.36
5 - 10 (DOWNWIND)	3	0.13	0.13	0.13
10 - 15 (DOWNWIND)	3	0.43	0.31	0.31
15 - 20 (DOWNWIND)	3	0.32	0.23	0.23
		SOUTHEAST ZONE		
0 - 3 (UPWIND)	3	0.39	0.22	0.22
0 - 3 (DOWNWIND)	3	0.57	0.38	0.38
3 - 5 (DOWNWIND)	3	0.73	0.33	0.33
5 - 10 (DOWNWIND)	2	0.80	0.47	0.47
10 - 15 (DOWNWIND)	3	0.54	0.27	0.27
15 - 20 (DOWNWIND)	3	0.27	0.15	0.15

TABLE 6 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		SOUTH ZONE		
0 - 3 (UPWIND)	3	0.68	0.54	0.54
0 - 3 (DOWNWIND)	3	6.11	2.36	2.36
3 - 5 (DOWNWIND)	3	0.58	0.37	0.37
5 - 10 (DOWNWIND)	3	0.35	0.26	0.26
10 - 15 (DOWNWIND)	3	0.83	0.47	0.47
15 - 20 (DOWNWIND)	3	0.40	0.28	0.28
		SOUTHWEST ZONE		
0 - 3 (UPWIND)	2	0.74	0.43	0.43
0 - 3 (DOWNWIND)	2	0.73	0.50	0.50
3 - 5 (DOWNWIND)	2	18.33	9.40	9.40
5 - 10 (DOWNWIND)	2	0.38	0.35	0.35
10 - 15 (DOWNWIND)	2	0.62	0.37	0.37
15 - 20 (DOWNWIND)	2	0.25	0.17	0.17

TABLE 6 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		WEST ZONE		
0 - 3 (UPWIND)	2	0.77	0.66	0.66
0 - 3 (DOWNWIND)	2	0.63	0.52	0.52
3 - 5 (DOWNWIND)	2	0.13	0.13	0.13
5 - 10 (DOWNWIND)	2	0.98	0.69	0.69
10 - 15 (DOWNWIND)	2	0.89	0.86	0.86
15 - 20 (DOWNWIND)	2	0.44	0.37	0.37
		NORTHWEST ZONE		
0 - 3 (UPWIND)	2	0.98	0.98	0.98
0 - 3 (DOWNWIND)	2	1.82	0.95	0.95
3 - 5 (DOWNWIND)	2	0.83	0.67	0.67
5 - 10 (DOWNWIND)	2	1.00	0.57	0.57
10 - 15 (DOWNWIND)	2	0.91	0.73	0.73
15 - 20 (DOWNWIND)	2	1.56	0.83	0.83

TABLE 6 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JANUARY-JUNE 1969

* LOWEST DETECTABLE LIMIT FOR PLUTONIUM IN AIR IS 0.13 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES UPWIND, 3-5 MILES DOWNWIND, 5-10 MILES DOWNWIND AND 10-15 MILES DOWNWIND. THE LDL IS 0.09 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES DOWNWIND AND 15-20 MILES DOWNWIND. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THESE VALUES WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 7

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JANUARY-JUNE 1969, ALL ZONES

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
0 - 3 (UPWIND)	24	1.08	0.51	0.51
0 - 3 (DOWNWIND)	24	6.11	0.73	0.73
3 - 5 (DOWNWIND)	24	18.33	1.20	1.20
5 - 10 (DOWNWIND)	23	1.26	0.47	0.47
10 - 15 (DOWNWIND)	24	1.53	0.50	0.50
15 - 20 (DOWNWIND)	24	1.56	0.36	0.36

* LOWEST DETECTABLE LIMIT FOR PLUTONIUM IN AIR IS 0.13 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES UPWIND, 3-5 MILES DOWNWIND, 5-10 MILES DOWNWIND AND 10-15 MILES DOWNWIND. THE LDL IS 0.09 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES DOWNWIND AND 15-20 MILES DOWNWIND. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THESE VALUES WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 8

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF MCC** FOR AVERAGE
		NORTH ZONE		
0 - 3 (UPWIND)	2	1.00	1.00	0.50
0 - 3 (DOWNWIND)	2	12.19	6.60	3.30
3 - 5 (DOWNWIND)	2	1.00	1.00	0.50
5 - 10 (DOWNWIND)	2	1.00	1.00	0.50
10 - 15 (DOWNWIND)	2	1.00	1.00	0.50
15 - 20 (DOWNWIND)	1	1.00	1.00	0.50
		NORTHEAST ZONE		
0 - 3 (UPWIND)	7	2.51	1.36	0.68
0 - 3 (DOWNWIND)	7	2.42	1.20	0.60
3 - 5 (DOWNWIND)	7	1.00	1.00	0.50
5 - 10 (DOWNWIND)	6	1.00	1.00	0.50
10 - 15 (DOWNWIND)	7	1.00	1.00	0.50
15 - 20 (DOWNWIND)	8	1.00	1.00	0.50

TABLE 8 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCC** FOR AVERAGE
		EAST ZONE		
0 - 3 (UPWIND)	2	1.00	1.00	0.50
0 - 3 (DOWNWIND)	2	1.00	1.00	0.50
3 - 5 (DOWNWIND)	2	1.00	1.00	0.50
5 - 10 (DOWNWIND)	2	1.00	1.00	0.50
10 - 15 (DOWNWIND)	2	1.00	1.00	0.50
15 - 20 (DOWNWIND)	2	1.55	1.28	0.64
		SOUTHEAST ZONE		
0 - 3 (UPWIND)	3	1.40	1.13	0.56
0 - 3 (DOWNWIND)	3	1.00	1.00	0.50
3 - 5 (DOWNWIND)	3	1.00	1.00	0.50
5 - 10 (DOWNWIND)	3	1.00	1.00	0.50
10 - 15 (DOWNWIND)	3	1.00	1.00	0.50
15 - 20 (DOWNWIND)	3	1.00	1.00	0.50

TABLE 8 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		SOUTH ZONE		
0 - 3 (UPWIND)	3	1.35	1.12	0.56
0 - 3 (DOWNWIND)	3	1.00	1.00	0.50
3 - 5 (DOWNWIND)	2	1.00	1.00	0.50
5 - 10 (DOWNWIND)	4	1.00	1.00	0.50
10 - 15 (DOWNWIND)	3	1.00	1.00	0.50
15 - 20 (DOWNWIND)	2	3.58	2.29	1.14
		SOUTHWEST ZONE		
0 - 3 (UPWIND)	1	1.00	1.00	0.50
0 - 3 (DOWNWIND)	1	1.00	1.00	0.50
3 - 5 (DOWNWIND)	1	1.00	1.00	0.50
5 - 10 (DOWNWIND)	1	1.00	1.00	0.50
10 - 15 (DOWNWIND)	1	1.00	1.00	0.50
15 - 20 (DOWNWIND)	1	1.00	1.00	0.50

TABLE 8 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-JUNE 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		WEST ZONE		
0 - 3 (UPWIND)	3	4.91	2.45	1.22
0 - 3 (DOWNWIND)	3	2.49	1.50	0.75
3 - 5 (DOWNWIND)	3	1.68	1.46	0.73
5 - 10 (DOWNWIND)	3	1.45	1.29	0.64
10 - 15 (DOWNWIND)	3	1.09	1.03	0.51
15 - 20 (DOWNWIND)	3	1.00	1.00	0.50
		NORTHWEST ZONE		
0 - 3 (UPWIND)	2	1.00	1.00	0.50
0 - 3 (DOWNWIND)	2	1.00	1.00	0.50
3 - 5 (DOWNWIND)	2	1.00	1.00	0.50
5 - 10 (DOWNWIND)	2	1.00	1.00	0.50
10 - 15 (DOWNWIND)	2	1.00	1.00	0.50
15 - 20 (DOWNWIND)	2	1.00	1.00	0.50

TABLE 8 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-JUNE 1989

* LOWEST DETECTABLE LIMIT FOR TRITIUM IN AIR IS 1.00 X E-9 MICRO-CURIE/CC. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 9

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-JUNE 1969, ALL ZONES

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
0 - 3 (UPWIND)	23	4.91	1.33	0.66
0 - 3 (DOWNWIND)	23	12.19	1.61	0.80
3 - 5 (DOWNWIND)	22	1.68	1.06	0.53
5 - 10 (DOWNWIND)	23	1.45	1.04	0.52
10 - 15 (DOWNWIND)	23	1.09	1.00	0.50
15 - 20 (DOWNWIND)	22	3.58	1.14	0.57

* LOWEST DETECTABLE LIMIT FOR TRITIUM IN AIR IS 1.00 X E-9 MICROCURIE/CC. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

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Table 10

SUMMARY OF AIR SAMPLING LOCATIONS
FOR POLONIUM AND PLUTONIUM

North Zone

Sample No.	Location	Range
1a	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
1b	Mound Rd. and Benner Rd. (Miamisburg, Ohio)	0-3 miles upwind
2a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Upper River Rd. and Soldiers Home-Miamisburg Rd.	0-3 miles downwind
2c	One mile north on Upper River Rd. from previous sample	0-3 miles downwind
3a	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
3b	Union Rd. and Farmersville-West Carrollton Rd.	3-5 miles downwind
4a	Dayton Speedway (near intersection of State Route 4 and Liberty Dayton Rd.)	5-10 miles downwind
4b	Union Rd. and Liberty Dayton Rd.	5-10 miles downwind
5a	Siebenthaler Ave. and North Dixie Dr. (Dayton, Ohio)	10-15 miles downwind
5b	Trotwood, Ohio	10-15 miles downwind
6a	North Dixie Dr. and Little York Dr. (Dayton, Ohio)	15-20 miles downwind
6b	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind
6c	State Route 49 at Clayton, Ohio	15-20 miles downwind

Table 10 (continued)

South Zone

Sample No.	Location	Range
1a	West off State Route 725 between river bridge and railroad (Miamisburg, Ohio)	0-3 miles upwind
1b	Municipal Parking Lot on Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
2a	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
2b	Chautauqua, Ohio	0-3 miles downwind
2c	Miami Drive-In Theater on Cincinnati-Dayton Pike	0-3 miles downwind
3a	State Route 73 and Interstate 75	3-5 miles downwind
3b	State Route 123 and Dayton-Oxford Rd.	3-5 miles downwind
4a	Red Lion, Ohio	5-10 miles downwind
4b	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5a	Lebanon, Ohio	10-15 miles downwind
5b	Monroe, Ohio	10-15 miles downwind
6a	Rt. 48 and Mason Rd.	15-20 miles downwind
6b	Bethany Rd. and Mason Montgomery Rd.	15-20 miles downwind
6c	Bethany, Ohio	15-20 miles downwind

East Zone

1a	Riverview Ave. and Lower Miamisburg Rd. (Miamisburg, Ohio)	0-3 miles upwind
1b	State Route 725 and Union Rd.	0-3 miles upwind
2a	Mound Park	0-3 miles downwind
2b	Benner Rd. and Byers Rd.	0-3 miles downwind

Table 10 (continued)

East Zone

Sample No.	Location	Range
2c	State Route 725 and Interstate 75	0-3 miles downwind
3a	Yankee St. and State Route 725	3-5 miles downwind
3b	Waldruhe Park on Springboro Pike	3-5 miles downwind
4a	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
4b	State Route 48 and Social Row Rd.	5-10 miles downwind
5a	Bellbrook, Ohio	10-15 miles downwind
5b	U.S. 42 and Spring Valley-Paintersville Rd.	10-15 miles downwind
6a	Xenia, Ohio	15-20 miles downwind
6b	Spring Valley-Paintersville Rd. and State Route 380	15-20 miles downwind
6c	Mt. Holly, Ohio	15-20 miles downwind

West Zone

1a	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
1b	Maue Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
2a	Miami Drive-In Theater on Cincinnati-Dayton Pike	0-3 miles downwind
2b	Riverview Rd. and Lower Miamisburg Rd.	0-3 miles downwind
2c	Lower Miamisburg Rd. and Jamaica Rd.	0-3 miles downwind
3a	State Route 725 and State Route 4	3-5 miles downwind
3b	Germantown, Ohio	3-5 miles downwind
4a	Manning Rd. and Anthony Rd.	5-10 miles downwind
4b	Oxford Rd. and Browns Run Rd.	5-10 miles downwind

Table 10 (continued)

West Zone

Sample No.	Location	Range
5a	Gratis, Ohio	10-15 miles downwind
5b	Greenbush Rd. and State Route 122	10-15 miles downwind
6a	Eaton, Ohio	15-20 miles downwind
6b	Camden, Ohio	15-20 miles downwind
6c	Somerville, Ohio	15-20 miles downwind

Northeast Zone

1a	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
1b	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles upwind
2a	Harmon Field (Miamisburg, Ohio)	0-3 miles downwind
2b	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
2c	Elm St. and Cincinnati-Dayton Pike (West Carrollton, Ohio)	0-3 miles downwind
3a	Woody's Market on Cincinnati-Dayton Pike (West Carrollton, Ohio)	3-5 miles downwind
3b	Mad River Rd. and Alexandersville-Bellbrook Rd.	3-5 miles downwind
4a	Dorothy Lane and Springboro Pike	5-10 miles downwind
4b	State Route 48 and Stroop Rd.- Town and Country Shopping Center (Kettering Ohio)	5-10 miles downwind
5a	Interstate 75 and Wagner-Ford Rd.	10-15 miles downwind
5b	Belmont Auto Theater, Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind

Table 10 (continued)

Northeast Zone

Sample No.		
6a	State Route 201 and Chambersburg Rd.	15-20 miles downwind
6b	State Route 235 (Fairborn, Ohio)	15-20 miles downwind
6c	New Germany-Trebein Rd. and Fairground Rd.- approximately 3 miles south of previous sample	15-20 miles downwind

Northwest Zone

1a	Mound Ave. and Benner Rd.	0-3 miles upwind
1b	Medlar Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
2a	Cincinnati-Dayton Pike and Mound Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Union Rd. and State Route 725	0-3 miles downwind
2c	State Route 725 and Jamaica Rd.	0-3 miles downwind
3a	Jamaica Rd. and State Route 4	3-5 miles downwind
3b	State Route 4 and Farmersville-West Carrollton Pike	3-5 miles downwind
4a	Diamond Mill Rd. and Mile Rd.	5-10 miles downwind
4b	Farmersville, Ohio	5-10 miles downwind
5a	Clayton Rd. and Providence Rd.	10-15 miles downwind
5b	Farmersville-West Alexandria Pike and DeChant Rd.	10-15 miles downwind
6a	Brookville, Ohio	15-20 miles downwind
6b	Lexington Salem Rd. and Preble County Line Rd.	15-20 miles downwind
6c	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind

Table 10 (continued)

Southeast Zone

Sample No.		
1a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
1b	Union Rd. and State Route 725	0-3 miles upwind
2a	Mound Ave. and Benner Rd.	0-3 miles downwind
2b	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
2c	Mound Park	0-3 miles downwind
3a	Wood Rd. and Pennyroyal Rd.	3-5 miles downwind
3b	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4a	Springboro, Ohio	5-10 miles downwind
4b	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5a	State Route 48 and State Route 73	10-15 miles downwind
5b	Waynesville, Ohio	10-15 miles downwind
6a	State Route 73, 1 mile east of State Route 42	15-20 miles downwind
6b	3 miles east of Harveysburg on State Route 73	15-20 miles downwind
6c	3 miles east of Harveysburg on State Route 73	15-20 miles downwind

Southwest Zone

1a	State Route 725 and Alexandersville Rd.	0-3 miles upwind
1b	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
2a	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles downwind

Table 10 (continued)

Southwest Zone

Sample No.	Location	Range
2b	Farmington Rd. and Chautauqua Rd.	0-3 miles downwind
2c	Farmington Rd. and Union Rd.	0-3 miles downwind
3a	Farmington Rd. and Butter St.	3-5 miles downwind
3b	Carlisle, Ohio	3-5 miles downwind
4a	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
4b	Post Town, Ohio	5-10 miles downwind
5a	State Route 4 and State Route 73	10-15 miles downwind
5b	Jacksonburg, Ohio	10-15 miles downwind
6a	State Route 4 and State Route 747	15-20 miles downwind
6b	New Miami, Ohio	15-20 miles downwind
6c	West Elkton Rd. and Tolbert Rd.	15-20 miles downwind

Table 11

SUMMARY OF AIR SAMPLING LOCATIONS FOR TRITIUM

North Zone

Sample No.	Location	Range
1	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
3	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
4	Dayton Speedway (near intersection of State Route 4 and Liberty-Dayton Rd.)	5-10 miles downwind
5	Trotwood, Ohio	10-15 miles downwind
6	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind

Northeast Zone

1	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
2	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
3	Mad River Rd. and Alexandersville-Bellbrook Rd.)	3-5 miles downwind
4	State Route 48 and Stroop Rd. - Town and Country Shopping Center (Kettering, Ohio)	5-10 miles downwind
5	Belmont Auto Theater - Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind
6	State Route 235 (Fairborn, Ohio)	15-20 miles downwind

East Zone

1	State Route 725 and Union Rd.	0-3 miles upwind
2	Mound Park	0-3 miles downwind

Table 11 (continued)

East Zone

Sample No.	Location	Range
3	Yankee St. and State Route 725	3-5 miles downwind
4	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
5	U. S. 42 and Spring Valley-Paintersville Rd.	10-15 miles downwind
6	Xenia, Ohio	15-20 miles downwind

Southeast Zone

1	Union Rd. and State Route 725	0-3 miles upwind
2	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
3	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5	State Route 48 and State Route 73	10-15 miles downwind
6	Harveysburg, Ohio	15-20 miles downwind

South Zone

1	Municipal Parking Lot on Central Ave.	0-3 miles upwind
2	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
3	State Route 73 and Interstate 75	3-5 miles downwind
4	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5	Monroe, Ohio	10-15 miles downwind
6	Bethany Rd. and Mason-Montgomery Rd.	15-20 miles downwind

Table 11 (continued)

Southwest Zone

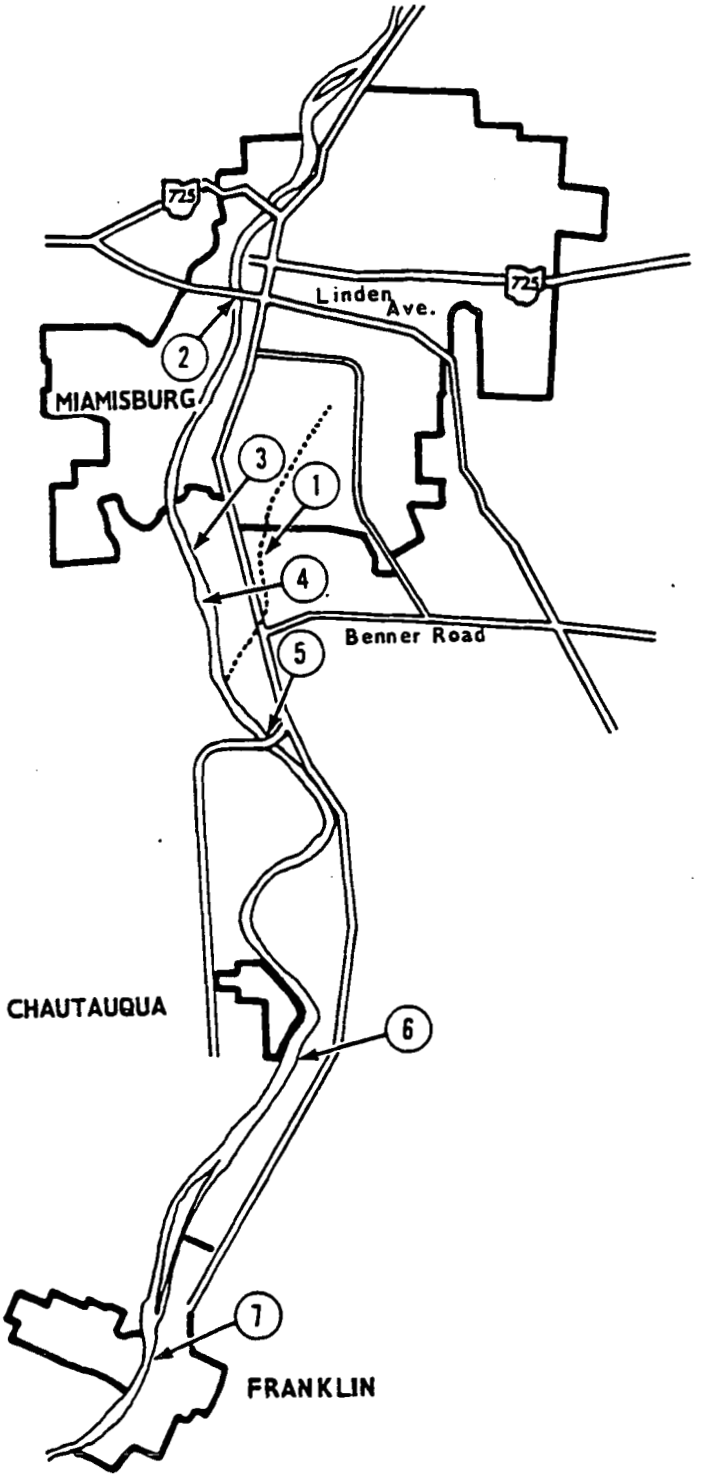
Sample No.	Location	Range
1	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Farmington Rd. and Union Rd.	0-3 miles downwind
3	Farmington Rd. and Butter St.	3-5 miles downwind
4	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
5	Jacksonburg, Ohio	10-15 miles downwind
6	New Miami, Ohio	15-20 miles downwind

West Zone

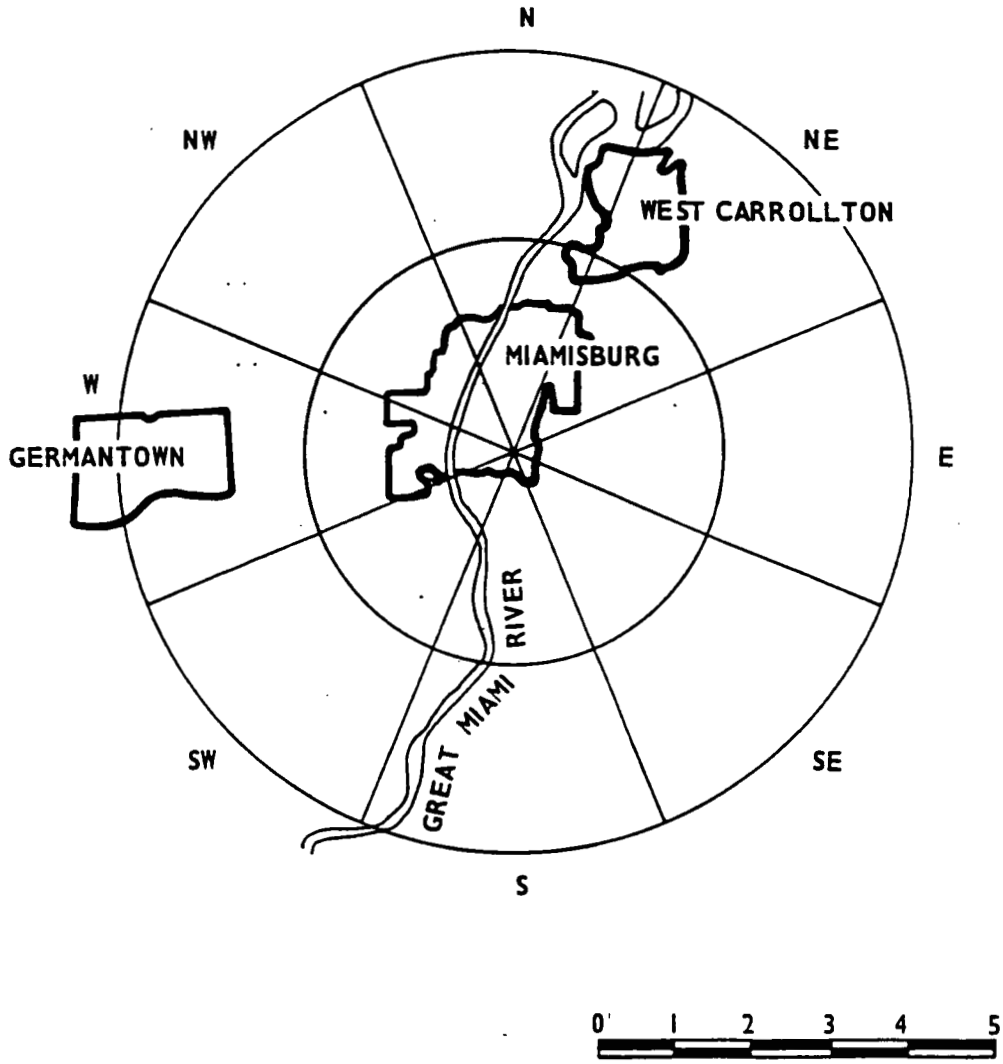
1	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
2	Riverview Rd. and Lower Miamisburg Rd.	0-3 miles downwind
3	Germantown, Ohio	3-5 miles downwind
4	Oxford Rd. and Browns Run Rd.	5-10 miles downwind
5	Gratis, Ohio	10-15 miles downwind
6	Camden, Ohio	15-20 miles downwind

Northwest Zone

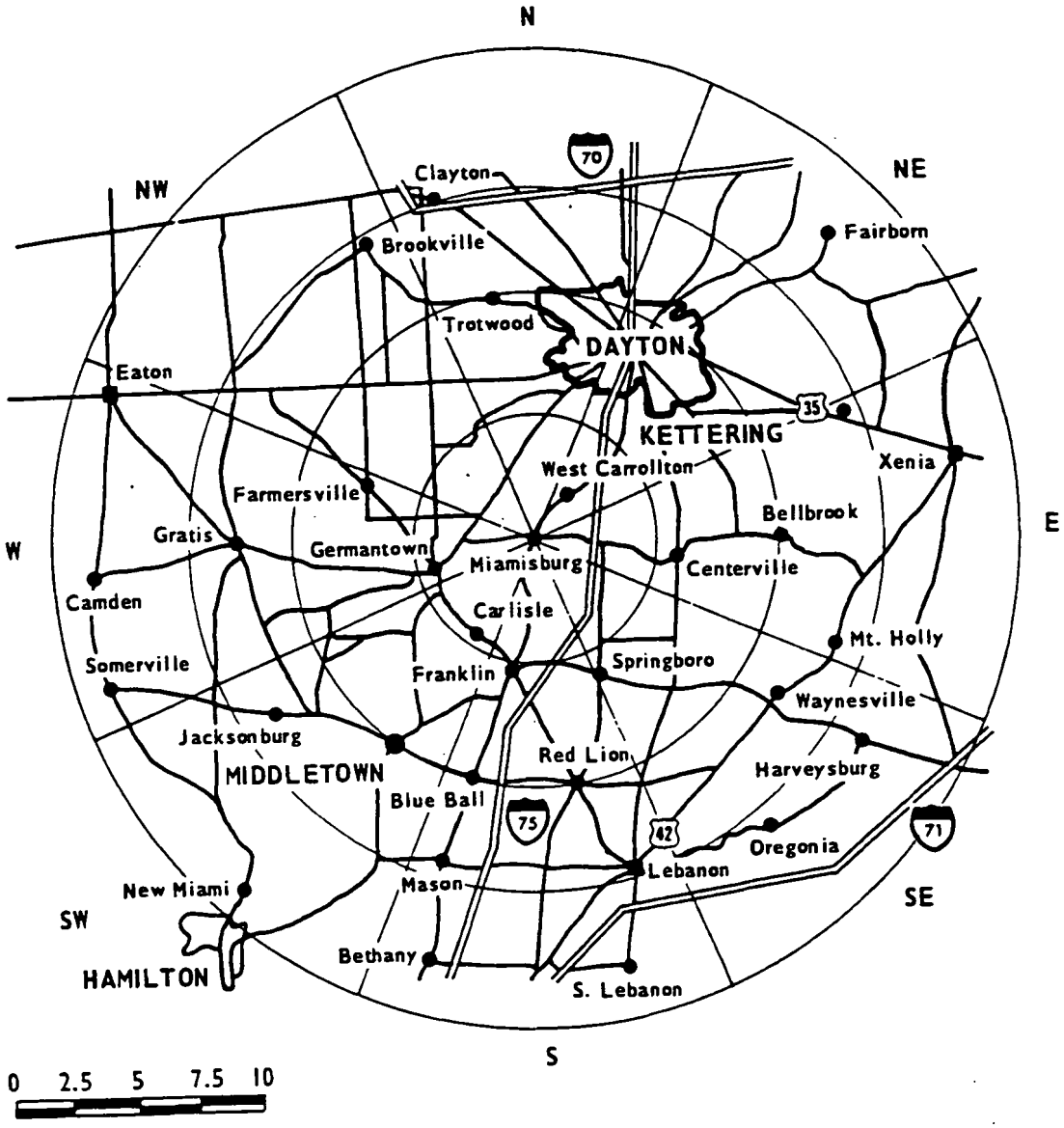
1	Mound Ave. and Benner Rd.	0-3 miles upwind
2	State Route 725 and Jamaica Rd.	0-3 miles downwind
3	Jamaica Rd. and State Route 4	3-5 miles downwind
4	Farmersville, Ohio	5-10 miles downwind
5	Clayton Rd. and Providence Rd.	10-15 miles downwind
6	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind



MAP 1 - Great Miami River sample locations.



MAP 2 - Proximity air sample zones.



MAP 3 - Distant air sample zones.

MLM-1616

MLM-MU-71-63-0045

MLM-1616

Environmental Monitoring Report: July-December 1969 and 1969 Summary

H. F. Anderson and W. E. Sheehan

AEC Research and Development Report

MOUND LABORATORY
operated by

Monsanto

MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company
for the

U. S. ATOMIC ENERGY COMMISSION

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Prepared by H. F. Anderson and W. E. Sheehan

Approved by H. E. Meyer

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A Subsidiary of Monsanto Company

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ABSTRACT

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, is presented for the second half of 1969, and a summary is presented for the entire year. The average concentration of radionuclides from Mound Laboratory in the Great Miami River and in the environmental air was within the stringent standards of safety specified by the Atomic Energy Commission.

INTRODUCTION

This report is a summary of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program considers all of the projects at Mound Laboratory and all of the radioisotopes which could be released into the environment. The monitoring procedures and counting techniques are those best suited for the detection and measurement of these radioactive materials.

The Radioactivity Concentration Guide (RCG) values in air and in water for the radionuclides in use at Mound Laboratory are taken from the USAEC Manual, Chapter 0524. The Radioactivity Concentration Guides for environmental air and water for the materials used at Mound Laboratory are:

Polonium-210

Air: 2×10^{-11} microcuries per cubic centimeter (μCi/cc)
Water: 7×10^{-7} microcuries per cubic centimeter (μCi/cc)

Plutonium-238

Air: 1×10^{-12} microcuries per cubic centimeter (μCi/cc)
Water: 5×10^{-6} microcuries per cubic centimeter (μCi/cc)

Hydrogen-3 (Tritium)

Air: 2×10^{-7} microcuries per cubic centimeter (μCi/cc)
Water: 3×10^{-3} microcuries per cubic centimeter (μCi/cc)

The data in Tables 1 through 9 were generated by an IBM Systems/360, Model 50H computer at Mound Laboratory. Consequently, powers of ten for the maximum and average concentrations (μCi/cc) in these tables are expressed in conventional computer notation, for example:

0.80×10^{-14} = 0.80 x E-14,
1.80×10^{-9} = 1.80 x E-9,
0.05×10^{-3} = 0.05 x E-3.

LIQUID CONTAMINATION

Polonium-Plutonium Liquid radioactive wastes from polonium and plutonium work at the Laboratory are processed separately to reduce the concentration of these radionuclides to a level at which they may be discharged to the environment. Treated polonium liquid waste is discharged to the Great Miami River via a closed sewer line which also carries the treated plant sewage. The treated plutonium waste is discharged to a drainage ditch which runs through the plant site and eventually reaches the river.

Tritium Helium-3 being purified at Mound Laboratory contains small quantities of tritium. In addition, tritium is being recovered from various AEC tritium-contaminated wastes. Liquid waste generated by these operations is treated (diluted with water when necessary) and is discharged to the drainage ditch. Some tritium-contaminated liquid wastes are discharged to the closed sewer line.

Water Sampling Water samples are collected weekly from the Great Miami River, the drainage ditch and two ponds NE of Mound Laboratory. All samples are analyzed for polonium, plutonium and tritium.

Map 1 shows the location of weekly water sampling points on the Great Miami River.

The results of the water sampling program are presented in Tables 1, 2 and 3. The data listed in these tables indicate that the average concentrations of polonium, plutonium and tritium in water discharged to the environment were well below the Radioactivity Concentration Guides.

AIRBORNE CONTAMINATION

Polonium-Plutonium Air which is contaminated with polonium and plutonium particulates is treated by passing it through absolute filters before it is discharged to the environment via several building stacks.

Tritium Air which might be contaminated with gaseous tritium is discharged to the environment via stacks.

Off-Site Air Sampling All environmental air samples are collected weekly to a distance of 20 miles with sampling equipment mounted in a one-ton panel truck. Samples are collected upwind and downwind from the plant according to routes drawn for the different wind directions. The selection of the air sampling zone depends on the wind direction on the days that samples are collected. Since the sampling zone is dependent on the wind direction it is possible that air samples from all zones will not be collected during the reporting period. Maps 2 and 3 show the zones routinely sampled. Results of the air sampling program are presented in Tables 4 to 9. The data listed in these tables indicate that the average concentration of polonium, plutonium and tritium in the environmental air is well below the Radioactivity Concentration Guides. Table 10 lists the specific location of sampling sites by zone for the polonium and plutoni-

um monitoring program. Table 11 lists the specific location of sampling sites by zone for the tritium monitoring program.

Airborne polonium and plutonium particulates are collected on filter paper with a high volume air sampler. One-fourth of each filter paper is processed and analyzed for polonium. Three-fourths of each filter paper is processed and analyzed for plutonium.

Airborne tritium is monitored by bubbling air through a liquid scintillation counting solution with p-dioxane as the organic solvent. The counting solution is counted directly in a liquid spectrometer.

TABLE 1

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

JANUARY-JUNE 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	24	36.04	4.99	0.71
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	24	2.70	1.84	0.26
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	24	2117.12	267.94	38.28
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	24	29.73	4.39	0.63
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	24	371.17	17.23	2.46
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	24	6.31	1.99	0.28
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	24	1.80	1.80	0.26
POND - OPPOSITE V.A. HOSPITAL, DAYTON, OHIO (8 MI. NE OF MOUND LAB)	23	1.80	1.80	0.26
POND - POSSUM CREEK RESERVE, DAYTON, OHIO (6 MI. NE OF MOUND LAB)	23	1.80	1.80	0.26

* LOWEST DETECTABLE LIMIT FOR POLONIUM IN WATER IS 1.80 X E-9 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

** RCG - RADIOACTIVITY CONCENTRATION GUIDE.

TABLE 1(CONTINUED)

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

JULY-DECEMBER 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	23	2.70	1.84	0.26
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	23	1.80	1.80	0.26
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	22	767.57	114.50	16.36
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	22	57.66	6.84	0.98
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	22	1.80	1.80	0.26
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	21	1.80	1.80	0.26
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	21	1.80	1.80	0.26
POND - OPPOSITE V.A. HOSPITAL, DAYTON, OHIO (8 MI. NE OF MOUND LAB)	23	1.80	1.80	0.26
POND - POSSUM CREEK RESERVE, DAYTON, OHIO (6 MI. NE OF MOUND LAB)	23	1.80	1.80	0.26

* LOWEST DETECTABLE LIMIT FOR POLONIUM IN WATER IS 1.80 X E-9 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

** RCG - RADIOACTIVITY CONCENTRATION GUIDE.

TABLE 1(CONTINUED)

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

JANUARY-DECEMBER 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	47	36.04	3.45	0.49
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	47	2.70	1.82	0.26
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	46	2117.12	194.55	27.79
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	46	57.66	5.56	0.79
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	46	371.17	9.85	1.41
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	45	6.31	1.90	0.27
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	45	1.80	1.80	0.26
POND - OPPOSITE V.A. HOSPITAL, DAYTON, OHIO (8 MI. NE OF MOUND LAB)	46	1.80	1.80	0.26
POND - POSSUM CREEK RESERVE, DAYTON, OHIO (6 MI. NE OF MOUND LAB)	46	1.80	1.80	0.26

* LOWEST DETECTABLE LIMIT FOR POLONIUM IN WATER IS 1.80 X E-9 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

** RCG - RADIOACTIVITY CONCENTRATION GUIDE.

TABLE 2

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

JANUARY-JUNE 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	24	472.71	65.01	1.30
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	24	6.98	4.65	0.09
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	23	519.14	68.60	1.37
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	25	8.93	5.38	0.11
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	25	48.65	6.86	0.14
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	25	6.19	4.76	0.10
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	24	7.17	4.88	0.10
POND - OPPOSITE V.A. HOSPITAL, DAYTON, OHIO (8 MI. NE OF MOUND LAB)	23	6.34	4.63	0.09
POND - POSSUM CREEK RESERVE, DAYTON, OHIO (6 MI. NE OF MOUND LAB)	23	10.32	5.14	0.10

* LOWEST DETECTABLE LIMIT FOR PLUTONIUM IN WATER IS 4.50 X E-9 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

** RCG - RADIOACTIVITY CONCENTRATION GUIDE.

TABLE 2(CONTINUED)

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

JULY-DECEMBER 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	23	40.63	12.29	0.25
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	23	11.30	5.32	0.11
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	22	314.19	28.94	0.58
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	22	8.71	5.38	0.11
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	22	11.30	5.73	0.11
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	21	10.36	5.39	0.11
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	21	10.25	5.09	0.10
POND - OPPOSITE V.A. HOSPITAL, DAYTON, OHIO (8 MI. NE OF MOUND LAB)	23	7.06	4.81	0.10
POND - POSSUM CREEK RESERVE, DAYTON, OHIO (6 MI. NE OF MOUND LAB)	24	95.68	9.14	0.18

* LOWEST DETECTABLE LIMIT FOR PLUTONIUM IN WATER IS 4.50 X E-9 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

** RCG - RADIOACTIVITY CONCENTRATION GUIDE.

TABLE 2(CONTINUED)

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

JANUARY-DECEMBER 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	47	472.71	39.21	0.78
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	47	11.30	4.98	0.10
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	45	519.14	49.21	0.98
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	47	8.93	5.38	0.11
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	47	48.65	6.33	0.13
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	46	10.36	5.05	0.10
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	45	10.25	4.98	0.10
POND - OPPOSITE V.A. HOSPITAL, DAYTON, OHIO (8 MI. NE OF MOUND LAB)	46	7.06	4.72	0.09
POND - POSSUM CREEK RESERVE, DAYTON, OHIO (6 MI. NE OF MOUND LAB)	47	95.68	7.18	0.14

* LOWEST DETECTABLE LIMIT FOR PLUTONIUM IN WATER IS 4.50 X E-9 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 3

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JANUARY-JUNE 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-3 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-3 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	24	22.97	2.47	82.33
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	24	0.88	0.13	4.33
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	24	15.97	1.64	54.67
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	24	0.72	0.09	3.00
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	24	3.67	0.22	7.33
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	24	0.38	0.08	2.67
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	24	1.74	0.17	5.67
POND - OPPOSITE V.A. HOSPITAL, DAYTON, OHIO (8 MI. NE OF MOUND LAB)	23	0.22	0.08	2.67
POND - POSSUM CREEK RESERVE, DAYTON, OHIO (6 MI. NE OF MOUND LAB)	23	0.77	0.10	3.33

* LOWEST DETECTABLE LIMIT FOR TRITIUM IN WATER IS 0.05 X E-3 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

** RCG - RADIOACTIVITY CONCENTRATION GUIDE.

TABLE 3(CONTINUED)

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JULY-DECEMBER 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-3 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-3 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	22	14.73	1.11	37.00
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	22	0.17	0.06	2.00
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	21	0.62	0.19	6.33
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	21	0.40	0.07	2.33
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	21	0.34	0.07	2.33
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	20	0.46	0.07	2.33
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	20	0.42	0.07	2.33
POND - OPPOSITE V.A. HOSPITAL, DAYTON,OHIO (8 MI. NE OF MOUND LAB)	22	0.43	0.07	2.33
POND - POSSUM CREEK RESERVE, DAYTON,OHIO (6 MI. NE OF MOUND LAB)	22	0.39	0.07	2.33

* LOWEST DETECTABLE LIMIT FOR TRITIUM IN WATER IS 0.05 X E-3 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 3(CONTINUED)

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JANUARY-DECEMBER 1969

SAMPLE LOCATION	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-3 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-3 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
MOUND LAB DRAINAGE DITCH (LOCATION NO. 1 ON MAP)	46	22.97	1.82	60.67
LINDEN AVE. BRIDGE, MIAMISBURG, OHIO (UPSTREAM-LOCATION NO. 2 ON MAP)	46	0.88	0.09	3.00
MOUND LAB EFFLUENT (LOCATION NO. 3 ON MAP)	45	15.97	0.96	32.00
250 YD. DOWNSTREAM FROM MOUND LAB EFFLUENT (LOCATION NO. 4 ON MAP)	45	0.72	0.08	2.67
CHAUTAUQUA ROAD BRIDGE (LOCATION NO. 5 ON MAP)	45	3.67	0.15	5.00
CHAUTAUQUA DAM (LOCATION NO. 6 ON MAP)	44	0.46	0.07	2.33
FRANKLIN, OHIO (LOCATION NO. 7 ON MAP)	44	1.74	0.12	4.00
POND - OPPOSITE V.A. HOSPITAL, DAYTON, OHIO (8 MI. NE OF MOUND LAB)	45	0.43	0.07	2.33
POND - POSSUM CREEK RESERVE, DAYTON, OHIO (6 MI. NE OF MOUND LAB)	45	0.77	0.09	3.00

* LOWEST DETECTABLE LIMIT FOR TRITIUM IN WATER IS 0.05 X E-3 MICROCURIE/CC. ALL SAMPLES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 4

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		NORTH ZONE		
0 - 3 (UPWIND)	1	2.30	2.30	0.12
0 - 3 (DOWNWIND)	1	0.53	0.53	0.03
3 - 5 (DOWNWIND)	1	0.80	0.80	0.04
5 - 10 (DOWNWIND)	1	0.80	0.80	0.04
10 - 15 (DOWNWIND)	1	1.39	1.39	0.07
15 - 20 (DOWNWIND)	1	0.72	0.72	0.04
		NORTHEAST ZONE		
0 - 3 (UPWIND)	4	2.05	1.48	0.07
0 - 3 (DOWNWIND)	4	1.56	1.05	0.05
3 - 5 (DOWNWIND)	4	1.28	0.92	0.05
5 - 10 (DOWNWIND)	4	2.67	1.27	0.06
10 - 15 (DOWNWIND)	4	2.80	1.30	0.07
15 - 20 (DOWNWIND)	4	1.44	0.76	0.04

TABLE 4 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		EAST ZONE		
0 - 3 (UPWIND)	1	2.21	2.21	0.11
0 - 3 (DOWNWIND)	1	1.37	1.37	0.07
3 - 5 (DOWNWIND)	1	2.96	2.96	0.15
5 - 10 (DOWNWIND)	1	2.94	2.94	0.15
10 - 15 (DOWNWIND)	1	1.08	1.08	0.05
15 - 20 (DOWNWIND)	1	0.62	0.62	0.03
		SOUTHEAST ZONE		
0 - 3 (UPWIND)	3	2.38	1.67	0.08
0 - 3 (DOWNWIND)	3	1.55	1.13	0.06
3 - 5 (DOWNWIND)	3	3.58	2.59	0.13
5 - 10 (DOWNWIND)	3	3.71	1.94	0.10
10 - 15 (DOWNWIND)	3	1.83	1.22	0.06
15 - 20 (DOWNWIND)	3	1.08	0.80	0.04

TABLE 4 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		SOUTH ZONE		
0 - 3 (UPWIND)	1	0.99	0.99	0.05
0 - 3 (DOWNWIND)	1	0.53	0.53	0.03
3 - 5 (DOWNWIND)	1	1.26	1.26	0.06
5 - 10 (DOWNWIND)	1	1.37	1.37	0.07
10 - 15 (DOWNWIND)	1	0.80	0.80	0.04
15 - 20 (DOWNWIND)	1	0.53	0.53	0.03
		SOUTHWEST ZONE		
0 - 3 (UPWIND)	1	0.80	0.80	0.04
0 - 3 (DOWNWIND)	1	0.53	0.53	0.03
3 - 5 (DOWNWIND)	1	0.80	0.80	0.04
5 - 10 (DOWNWIND)	1	0.80	0.80	0.04
10 - 15 (DOWNWIND)	1	0.80	0.80	0.04
15 - 20 (DOWNWIND)	1	0.53	0.53	0.03

TABLE 4 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		WEST ZONE		
0 - 3 (UPWIND)	1	0.80	0.80	0.04
0 - 3 (DOWNWIND)	2	0.53	0.53	0.03
3 - 5 (DOWNWIND)	2	1.63	1.22	0.06
5 - 10 (DOWNWIND)	2	6.49	3.65	0.18
10 - 15 (DOWNWIND)	2	1.57	1.27	0.06
15 - 20 (DOWNWIND)	1	0.53	0.53	0.03
		NORTHWEST ZONE		
0 - 3 (UPWIND)	1	0.80	0.80	0.04
0 - 3 (DOWNWIND)	1	0.53	0.53	0.03
3 - 5 (DOWNWIND)	1	0.80	0.80	0.04
5 - 10 (DOWNWIND)	1	0.80	0.80	0.04
10 - 15 (DOWNWIND)	1	1.35	1.35	0.07
15 - 20 (DOWNWIND)	1	0.53	0.53	0.03

TABLE 4 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JULY-DECEMBER 1969

* LOWEST DETECTABLE LIMIT FOR POLONIUM IN AIR IS 0.80 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES UPWIND, 3-5 MILES DOWNWIND, 5-10 MILES DOWNWIND AND 10-15 MILES DOWNWIND. THE LDL IS 0.53 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES DOWNWIND AND 15-20 MILES DOWNWIND. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THESE VALUES WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 5

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JANUARY-JUNE 1969, ALL ZONES

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
0 - 3 (UPWIND)	24	3.95	1.62	0.08
0 - 3 (DOWNWIND)	24	3.58	0.99	0.05
3 - 5 (DOWNWIND)	23	3.89	1.45	0.07
5 - 10 (DOWNWIND)	24	3.36	1.44	0.07
10 - 15 (DOWNWIND)	25	3.03	1.58	0.08
15 - 20 (DOWNWIND)	24	3.57	1.24	0.06

JULY-DECEMBER 1969, ALL ZONES

0 - 3 (UPWIND)	13	2.38	1.45	0.07
0 - 3 (DOWNWIND)	14	1.56	0.87	0.04
3 - 5 (DOWNWIND)	14	3.58	1.46	0.07
5 - 10 (DOWNWIND)	14	6.49	1.78	0.09
10 - 15 (DOWNWIND)	14	2.80	1.20	0.06
15 - 20 (DOWNWIND)	13	1.44	0.68	0.03

TABLE 5 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

JANUARY-DECEMBER 1969, ALL ZONES

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
0 - 3 (UPWIND)	37	3.95	1.56	0.08
0 - 3 (DOWNWIND)	38	3.58	0.94	0.05
3 - 5 (DOWNWIND)	37	3.89	1.45	0.07
5 - 10 (DOWNWIND)	38	6.49	1.56	0.08
10 - 15 (DOWNWIND)	39	3.03	1.44	0.07
15 - 20 (DOWNWIND)	37	3.57	1.04	0.05

* LOWEST DETECTABLE LIMIT FOR POLONIUM IN AIR IS 0.80 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES UPWIND, 3-5 MILES DOWNWIND, 5-10 MILES DOWNWIND AND 10-15 MILES DOWNWIND. THE LDL IS 0.53 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES DOWNWIND AND 15-20 MILES DOWNWIND. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THESE VALUES WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 6

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		NORTH ZONE		
0 - 3 (UPWIND)	1	0.48	0.48	0.48
0 - 3 (DOWNWIND)	1	0.70	0.70	0.70
3 - 5 (DOWNWIND)	1	0.54	0.54	0.54
5 - 10 (DOWNWIND)	1	0.99	0.99	0.99
10 - 15 (DOWNWIND)	1	0.65	0.65	0.65
15 - 20 (DOWNWIND)	1	0.56	0.56	0.56
		NORTHEAST ZONE		
0 - 3 (UPWIND)	4	0.84	0.70	0.70
0 - 3 (DOWNWIND)	4	0.91	0.69	0.69
3 - 5 (DOWNWIND)	4	1.46	1.02	1.02
5 - 10 (DOWNWIND)	4	1.48	1.19	1.19
10 - 15 (DOWNWIND)	4	1.01	0.63	0.63
15 - 20 (DOWNWIND)	4	0.55	0.50	0.50

TABLE 6 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		EAST ZONE		
0 - 3 (UPWIND)	1	1.27	1.27	1.27
0 - 3 (DOWNWIND)	1	0.74	0.74	0.74
3 - 5 (DOWNWIND)	1	1.52	1.52	1.52
5 - 10 (DOWNWIND)	1	1.32	1.32	1.32
10 - 15 (DOWNWIND)	1	1.97	1.97	1.97
15 - 20 (DOWNWIND)	1	1.22	1.22	1.22
		SOUTHEAST ZONE		
0 - 3 (UPWIND)	3	0.83	0.59	0.59
0 - 3 (DOWNWIND)	3	0.67	0.39	0.39
3 - 5 (DOWNWIND)	3	1.02	0.96	0.96
5 - 10 (DOWNWIND)	3	1.60	1.22	1.22
10 - 15 (DOWNWIND)	3	1.18	0.98	0.98
15 - 20 (DOWNWIND)	3	1.05	0.62	0.62

TABLE 6 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		SOUTH ZONE		
0 - 3 (UPWIND)	1	0.91	0.91	0.91
0 - 3 (DOWNWIND)	1	0.85	0.85	0.85
3 - 5 (DOWNWIND)	1	0.61	0.61	0.61
5 - 10 (DOWNWIND)	1	0.57	0.57	0.57
10 - 15 (DOWNWIND)	1	0.96	0.96	0.96
15 - 20 (DOWNWIND)	1	0.71	0.71	0.71
		SOUTHWEST ZONE		
0 - 3 (UPWIND)	1	0.13	0.13	0.13
0 - 3 (DOWNWIND)	1	0.09	0.09	0.09
3 - 5 (DOWNWIND)	1	0.48	0.48	0.48
5 - 10 (DOWNWIND)	1	0.13	0.13	0.13
10 - 15 (DOWNWIND)	1	0.45	0.45	0.45
15 - 20 (DOWNWIND)	1	0.20	0.20	0.20

TABLE 6 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		WEST ZONE		
0 - 3 (UPWIND)	1	0.13	0.13	0.13
0 - 3 (DOWNWIND)	2	1.93	1.01	1.01
3 - 5 (DOWNWIND)	2	0.13	0.13	0.13
5 - 10 (DOWNWIND)	2	0.69	0.58	0.58
10 - 15 (DOWNWIND)	2	0.46	0.30	0.30
15 - 20 (DOWNWIND)	1	0.30	0.30	0.30
		NORTHWEST ZONE		
0 - 3 (UPWIND)	1	0.43	0.43	0.43
0 - 3 (DOWNWIND)	1	0.28	0.28	0.28
3 - 5 (DOWNWIND)	1	0.79	0.79	0.79
5 - 10 (DOWNWIND)	1	0.13	0.13	0.13
10 - 15 (DOWNWIND)	1	0.40	0.40	0.40
15 - 20 (DOWNWIND)	1	0.36	0.36	0.36

TABLE 6 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JULY-DECEMBER 1969

* LOWEST DETECTABLE LIMIT FOR PLUTONIUM IN AIR IS 0.13 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES UPWIND, 3-5 MILES DOWNWIND, 5-10 MILES DOWNWIND AND 10-15 MILES DOWNWIND. THE LDL IS 0.09 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES DOWNWIND AND 15-20 MILES DOWNWIND. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THESE VALUES WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 7

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JANUARY-JUNE 1969, ALL ZONES

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
0 - 3 (UPWIND)	24	1.08	0.51	0.51
0 - 3 (DOWNWIND)	24	6.11	0.73	0.73
3 - 5 (DOWNWIND)	24	18.33	1.20	1.20
5 - 10 (DOWNWIND)	23	1.26	0.47	0.47
10 - 15 (DOWNWIND)	24	1.53	0.50	0.50
15 - 20 (DOWNWIND)	24	1.56	0.36	0.36

JULY-DECEMBER 1969, ALL ZONES

0 - 3 (UPWIND)	13	1.27	0.61	0.61
0 - 3 (DOWNWIND)	14	1.93	0.62	0.62
3 - 5 (DOWNWIND)	14	1.52	0.80	0.80
5 - 10 (DOWNWIND)	14	1.60	0.91	0.91
10 - 15 (DOWNWIND)	14	1.97	0.75	0.75
15 - 20 (DOWNWIND)	13	1.22	0.55	0.55

TABLE 7 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

JANUARY-DECEMBER 1969, ALL ZONES

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-14 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-14 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
0 - 3 (UPWIND)	37	1.27	0.54	0.54
0 - 3 (DOWNWIND)	38	6.11	0.68	0.68
3 - 5 (DOWNWIND)	38	18.33	1.05	1.05
5 - 10 (DOWNWIND)	37	1.60	0.63	0.63
10 - 15 (DOWNWIND)	38	1.97	0.59	0.59
15 - 20 (DOWNWIND)	37	1.56	0.42	0.42

* LOWEST DETECTABLE LIMIT FOR PLUTONIUM IN AIR IS 0.13 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES UPWIND, 3-5 MILES DOWNWIND, 5-10 MILES DOWNWIND AND 10-15 MILES DOWNWIND. THE LDL IS 0.09 X E-14 MICROCURIE/CC FOR SAMPLES COLLECTED 0-3 MILES DOWNWIND AND 15-20 MILES DOWNWIND. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THESE VALUES WHEN AVERAGE VALUES WERE CALCULATED.

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TABLE 8

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		NORTH ZONE		
0 - 3 (UPWIND)	1	5.48	5.48	2.74
0 - 3 (DOWNWIND)	1	1.00	1.00	0.50
3 - 5 (DOWNWIND)	1	3.99	3.99	1.99
5 - 10 (DOWNWIND)	1	1.00	1.00	0.50
10 - 15 (DOWNWIND)	1	1.00	1.00	0.50
15 - 20 (DOWNWIND)	1	1.00	1.00	0.50
		NORTHEAST ZONE		
0 - 3 (UPWIND)	3	1.26	1.16	0.58
0 - 3 (DOWNWIND)	3	1.00	1.00	0.50
3 - 5 (DOWNWIND)	3	1.00	1.00	0.50
5 - 10 (DOWNWIND)	3	1.00	1.00	0.50
10 - 15 (DOWNWIND)	3	1.00	1.00	0.50
15 - 20 (DOWNWIND)	3	1.00	1.00	0.50

TABLE 8 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		EAST ZONE		
0 - 3 (UPWIND)	1	1.00	1.00	0.50
0 - 3 (DOWNWIND)	1	1.00	1.00	0.50
3 - 5 (DOWNWIND)	1	1.00	1.00	0.50
5 - 10 (DOWNWIND)	1	1.00	1.00	0.50
10 - 15 (DOWNWIND)	1	1.00	1.00	0.50
15 - 20 (DOWNWIND)	1	1.00	1.00	0.50
		SOUTHEAST ZONE		
0 - 3 (UPWIND)	3	1.69	1.23	0.61
0 - 3 (DOWNWIND)	3	1.00	1.00	0.50
3 - 5 (DOWNWIND)	3	1.00	1.00	0.50
5 - 10 (DOWNWIND)	3	2.39	1.46	0.73
10 - 15 (DOWNWIND)	3	1.51	1.23	0.61
15 - 20 (DOWNWIND)	3	1.51	1.17	0.58

TABLE 8 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		SOUTH ZONE		
0 - 3 (UPWIND)	0			
0 - 3 (DOWNWIND)	0			
3 - 5 (DOWNWIND)	0	NO SAMPLES WERE OBTAINED IN THIS ZONE BECAUSE THE PREVAILING WINDS WERE NOT IN THIS DIRECTION ON DAYS SAMPLES WERE COLLECTED.		
5 - 10 (DOWNWIND)	0			
10 - 15 (DOWNWIND)	0			
15 - 20 (DOWNWIND)	0			
		SOUTHWEST ZONE		
0 - 3 (UPWIND)	1	1.00	1.00	0.50
0 - 3 (DOWNWIND)	1	1.00	1.00	0.50
3 - 5 (DOWNWIND)	1	1.00	1.00	0.50
5 - 10 (DOWNWIND)	1	1.00	1.00	0.50
10 - 15 (DOWNWIND)	1	1.00	1.00	0.50
15 - 20 (DOWNWIND)	1	1.00	1.00	0.50

TABLE 8 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1969

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
		WEST ZONE		
0 - 3 (UPWIND)	1	1.00	1.00	0.50
0 - 3 (DOWNWIND)	1	1.00	1.00	0.50
3 - 5 (DOWNWIND)	1	1.00	1.00	0.50
5 - 10 (DOWNWIND)	0			
10 - 15 (DOWNWIND)	0			
15 - 20 (DOWNWIND)	0			
		NORTHWEST ZONE		
0 - 3 (UPWIND)	2	1.45	1.22	0.61
0 - 3 (DOWNWIND)	2	1.00	1.00	0.50
3 - 5 (DOWNWIND)	2	1.03	1.01	0.50
5 - 10 (DOWNWIND)	2	1.00	1.00	0.50
10 - 15 (DOWNWIND)	2	1.00	1.00	0.50
15 - 20 (DOWNWIND)	2	1.16	1.08	0.54

TABLE A (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1969

* LOWEST DETECTABLE LIMIT FOR TRITIUM IN AIR IS 1.00 x E-9 MICRO-CURIE/CC. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

** RCG - RADIOACTIVITY CONCENTRATION GUIDE.

TABLE 9

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-JUNE 1969, ALL ZONES

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
0 - 3 (UPWIND)	23	4.91	1.33	0.66
0 - 3 (DOWNWIND)	23	12.19	1.61	0.80
3 - 5 (DOWNWIND)	22	1.68	1.06	0.53
5 - 10 (DOWNWIND)	23	1.45	1.04	0.52
10 - 15 (DOWNWIND)	23	1.09	1.00	0.50
15 - 20 (DOWNWIND)	22	3.59	1.14	0.57

JULY-DECEMBER 1969, ALL ZONES

0 - 3 (UPWIND)	12	5.48	1.51	0.75
0 - 3 (DOWNWIND)	12	1.00	1.00	0.50
3 - 5 (DOWNWIND)	12	3.59	1.25	0.62
5 - 10 (DOWNWIND)	11	2.39	1.13	0.56
10 - 15 (DOWNWIND)	11	1.51	1.06	0.53
15 - 20 (DOWNWIND)	11	1.51	1.06	0.53

TABLE 9 (CONTINUED)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-DECEMBER 1969, ALL ZONES

RANGE (MILES)	NUMBER OF SAMPLES COLLECTED	MAXIMUM CONCENTRATION* (E-9 MICROCURIE/CC)	AVERAGE CONCENTRATION* (E-9 MICROCURIE/CC)	PERCENT OF RCG** FOR AVERAGE
0 - 3 (UPWIND)	35	5.48	1.39	0.69
0 - 3 (DOWNWIND)	35	12.19	1.40	0.70
3 - 5 (DOWNWIND)	34	3.99	1.12	0.56
5 - 10 (DOWNWIND)	34	2.39	1.06	0.53
10 - 15 (DOWNWIND)	34	1.51	1.02	0.51
15 - 20 (DOWNWIND)	33	3.58	1.11	0.55

* LOWEST DETECTABLE LIMIT FOR TRITIUM IN AIR IS 1.00 X E-9 MICROCURIE/CC. ALL VALUES WHICH WERE NOT DETECTABLE WERE SET EQUAL TO THIS VALUE WHEN AVERAGE VALUES WERE CALCULATED.

** RCG - RADIOACTIVITY CONCENTRATION GUIDE.

Table 10

SUMMARY OF AIR SAMPLING LOCATIONS
FOR POLONIUM AND PLUTONIUM

North Zone

Sample No.	Location	Range
1a	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
1b	Mound Rd. and Benner Rd. (Miamisburg, Ohio)	0-3 miles upwind
2a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Upper River Rd. and Soldiers Home-Miamisburg Rd.	0-3 miles downwind
2c	One mile north on Upper River Rd. from previous sample	0-3 miles downwind
3a	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
3b	Union Rd. and Farmersville-West Carrollton Rd.	3-5 miles downwind
4a	Dayton Speedway (near intersection of State Route 4 and Liberty Dayton Rd.)	5-10 miles downwind
4b	Union Rd. and Liberty Dayton Rd.	5-10 miles downwind
5a	Siebenthaler Ave. and North Dixie Dr. (Dayton, Ohio)	10-15 miles downwind
5b	Trotwood, Ohio	10-15 miles downwind
6a	North Dixie Dr. and Little York Dr. (Dayton, Ohio)	15-20 miles downwind
6b	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind
6c	State Route 49 at Clayton, Ohio	15-20 miles downwind

Table 10 (continued)

South Zone

Sample No.	Location	Range
1a	West off State Route 725 between river bridge and railroad (Miamisburg, Ohio)	0-3 miles upwind
1b	Municipal Parking Lot on Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
2a	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
2b	Chautauqua, Ohio	0-3 miles downwind
2c	Miami Drive-In Theater on Cincinnati-Dayton Pike	0-3 miles downwind
3a	State Route 73 and Interstate 75	3-5 miles downwind
3b	State Route 123 and Dayton-Oxford Rd.	3-5 miles downwind
4a	Red Lion, Ohio	5-10 miles downwind
4b	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5a	Lebanon, Ohio	10-15 miles downwind
5b	Monroe, Ohio	10-15 miles downwind
6a	Rt. 48 and Mason Rd.	15-20 miles downwind
6b	Bethany Rd. and Mason Montgomery Rd.	15-20 miles downwind
6c	Bethany, Ohio	15-20 miles downwind

East Zone

1a	Riverview Ave. and Lower Miamisburg Rd. (Miamisburg, Ohio)	0-3 miles upwind
1b	State Route 725 and Union Rd.	0-3 miles upwind
2a	Mound Park	0-3 miles downwind
2b	Benner Rd. and Byers Rd.	0-3 miles downwind

Table 10 (continued)

East Zone

Sample No.	Location	Range
2c	State Route 725 and Interstate 75	0-3 miles downwind
3a	Yankee St. and State Route 725	3-5 miles downwind
3b	Waldruhe Park on Springboro Pike	3-5 miles downwind
4a	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
4b	State Route 48 and Social Row Rd.	5-10 miles downwind
5a	Bellbrook, Ohio	10-15 miles downwind
5b	U.S. 42 and Spring Valley-Paintersville Rd.	10-15 miles downwind
6a	Xenia, Ohio	15-20 miles downwind
6b	Spring Valley-Paintersville Rd. and State Route 380	15-20 miles downwind
6c	Mt. Holly, Ohio	15-20 miles downwind

West Zone

1a	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
1b	Maue Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
2a	Miami Drive-In Theater on Cincinnati-Dayton Pike	0-3 miles downwind
2b	Riverview Rd. and Lower Miamisburg Rd.	0-3 miles downwind
2c	Lower Miamisburg Rd. and Jamaica Rd.	0-3 miles downwind
3a	State Route 725 and State Route 4	3-5 miles downwind
3b	Germantown, Ohio	3-5 miles downwind
4a	Manning Rd. and Anthony Rd.	5-10 miles downwind
4b	Oxford Rd. and Browns Run Rd.	5-10 miles downwind

Table 10 (continued)

West Zone

Sample No.	Location	Range
5a	Gratis, Ohio	10-15 miles downwind
5b	Greenbush Rd. and State Route 122	10-15 miles downwind
6a	Eaton, Ohio	15-20 miles downwind
6b	Camden, Ohio	15-20 miles downwind
6c	Somerville, Ohio	15-20 miles downwind

Northeast Zone

1a	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
1b	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles upwind
2a	Harmon Field (Miamisburg, Ohio)	0-3 miles downwind
2b	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
2c	Elm St. and Cincinnati-Dayton Pike (West Carrollton, Ohio)	0-3 miles downwind
3a	Woody's Market on Cincinnati-Dayton Pike (West Carrollton, Ohio)	3-5 miles downwind
3b	Mad River Rd. and Alexandersville-Bellbrook Rd.	3-5 miles downwind
4a	Dorothy Lane and Springboro Pike	5-10 miles downwind
4b	State Route 48 and Stroop Rd.- Town and Country Shopping Center (Kettering Ohio)	5-10 miles downwind
5a	Interstate 75 and Wagner-Ford Rd.	10-15 miles downwind
5b	Belmont Auto Theater, Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind

Table 10 (continued)

Northeast Zone

Sample No.		
6a	State Route 201 and Chambersburg Rd.	15-20 miles downwind
6b	State Route 235 (Fairborn, Ohio)	15-20 miles downwind
6c	New Germany-Trebein Rd. and Fairground Rd.- approximately 3 miles south of previous sample	15-20 miles downwind

Northwest Zone

1a	Mound Ave. and Benner Rd.	0-3 miles upwind
1b	Medlar Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
2a	Cincinnati-Dayton Pike and Mound Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Union Rd. and State Route 725	0-3 miles downwind
2c	State Route 725 and Jamaica Rd.	0-3 miles downwind
3a	Jamaica Rd. and State Route 4	3-5 miles downwind
3b	State Route 4 and Farmersville-West Carrollton Pike	3-5 miles downwind
4a	Diamond Mill Rd. and Mile Rd.	5-10 miles downwind
4b	Farmersville, Ohio	5-10 miles downwind
5a	Clayton Rd. and Providence Rd.	10-15 miles downwind
5b	Farmersville-West Alexandria Pike and DeChant Rd.	10-15 miles downwind
6a	Brookville, Ohio	15-20 miles downwind
6b	Lexington Salem Rd. and Preble County Line Rd.	15-20 miles downwind
6c	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind

Table 10 (continued)

Southeast Zone

Sample No.		
1a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
1b	Union Rd. and State Route 725	0-3 miles upwind
2a	Mound Ave. and Benner Rd.	0-3 miles downwind
2b	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
2c	Mound Park	0-3 miles downwind
3a	Wood Rd. and Pennyroyal Rd.	3-5 miles downwind
3b	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4a	Springboro, Ohio	5-10 miles downwind
4b	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5a	State Route 48 and State Route 73	10-15 miles downwind
5b	Waynesville, Ohio	10-15 miles downwind
6a	State Route 73, 1 mile east of State Route 42	15-20 miles downwind
6b	3 miles east of Harveysburg on State Route 73	15-20 miles downwind
6c	3 miles east of Harveysburg on State Route 73	15-20 miles downwind

Southwest Zone

1a	State Route 725 and Alexandersville Rd.	0-3 miles upwind
1b	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
2a	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles downwind

Table 10 (continued)

Southwest Zone

Sample No.	Location	Range
2b	Farmington Rd. and Chautauqua Rd.	0-3 miles downwind
2c	Farmington Rd. and Union Rd.	0-3 miles downwind
3a	Farmington Rd. and Butter St.	3-5 miles downwind
3b	Carlisle, Ohio	3-5 miles downwind
4a	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
4b	Post Town, Ohio	5-10 miles downwind
5a	State Route 4 and State Route 73	10-15 miles downwind
5b	Jacksonburg, Ohio	10-15 miles downwind
6a	State Route 4 and State Route 747	15-20 miles downwind
6b	New Miami, Ohio	15-20 miles downwind
6c	West Elkton Rd. and Tolbert Rd.	15-20 miles downwind

Table 11

SUMMARY OF AIR SAMPLING LOCATIONS FOR TRITIUM

North Zone

Sample No.	Location	Range
1	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
3	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
4	Dayton Speedway (near intersection of State Route 4 and Liberty-Dayton Rd.)	5-10 miles downwind
5	Trotwood, Ohio	10-15 miles downwind
6	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind

Northeast Zone

1	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
2	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
3	Mad River Rd. and Alexandersville-Bellbrook Rd.)	3-5 miles downwind
4	State Route 48 and Stroop Rd. - Town and Country Shopping Center (Kettering, Ohio)	5-10 miles downwind
5	Belmont Auto Theater - Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind
6	State Route 235 (Fairborn, Ohio)	15-20 miles downwind

East Zone

1	State Route 725 and Union Rd.	0-3 miles upwind
2	Mound Park	0-3 miles downwind

Table 11 (continued)

East Zone

Sample No.	Location	Range
3	Yankee St. and State Route 725	3-5 miles downwind
4	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
5	U. S. 42 and Spring Valley-Paintersville Rd.	10-15 miles downwind
6	Xenia, Ohio	15-20 miles downwind

Southeast Zone

1	Union Rd. and State Route 725	0-3 miles upwind
2	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
3	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5	State Route 48 and State Route 73	10-15 miles downwind
6	Harveysburg, Ohio	15-20 miles downwind

South Zone

1	Municipal Parking Lot on Central Ave.	0-3 miles upwind
2	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
3	State Route 73 and Interstate 75	3-5 miles downwind
4	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5	Monroe, Ohio	10-15 miles downwind
6	Bethany Rd. and Mason-Montgomery Rd.	15-20 miles downwind

Table 11 (continued)

Southwest Zone

Sample No.	Location	Range
1	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Farmington Rd. and Union Rd.	0-3 miles downwind
3	Farmington Rd. and Butter St.	3-5 miles downwind
4	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
5	Jacksonburg, Ohio	10-15 miles downwind
6	New Miami, Ohio	15-20 miles downwind

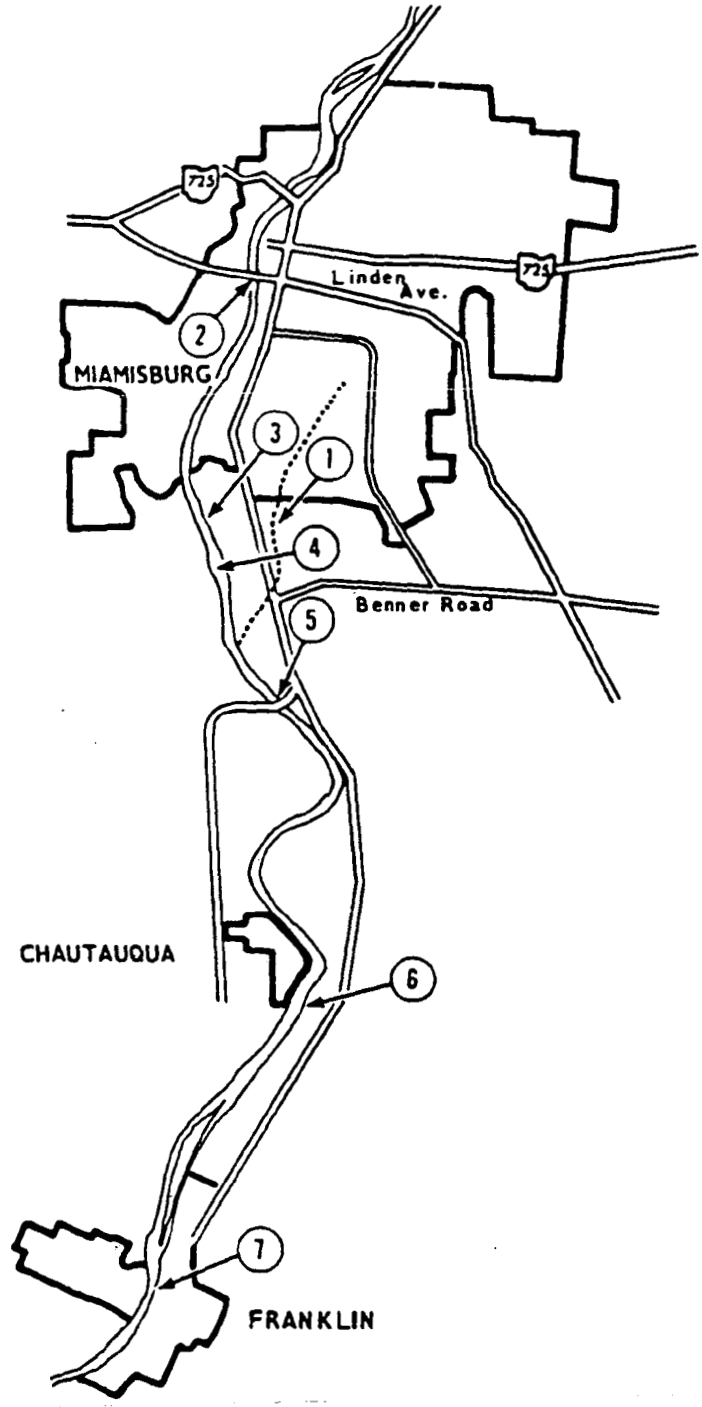
West Zone

1	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
2	Riverview Rd. and Lower Miamisburg Rd.	0-3 miles downwind
3	Germantown, Ohio	3-5 miles downwind
4	Oxford Rd. and Browns Run Rd.	5-10 miles downwind
5	Gratis, Ohio	10-15 miles downwind
6	Camden, Ohio	15-20 miles downwind

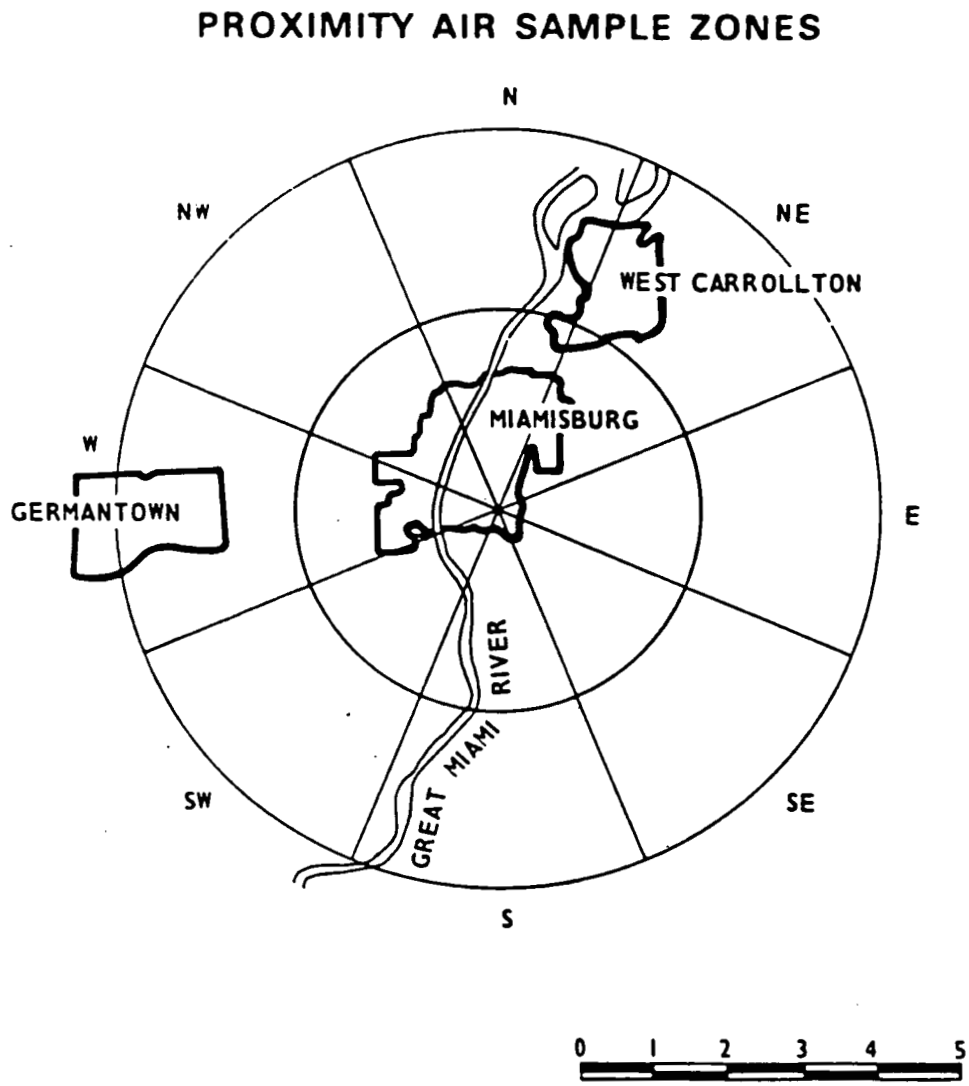
Northwest Zone

1	Mound Ave. and Benner Rd.	0-3 miles upwind
2	State Route 725 and Jamaica Rd.	0-3 miles downwind
3	Jamaica Rd. and State Route 4	3-5 miles downwind
4	Farmersville, Ohio	5-10 miles downwind
5	Clayton Rd. and Providence Rd.	10-15 miles downwind
6	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind

GREAT MIAMI RIVER SAMPLE LOCATIONS

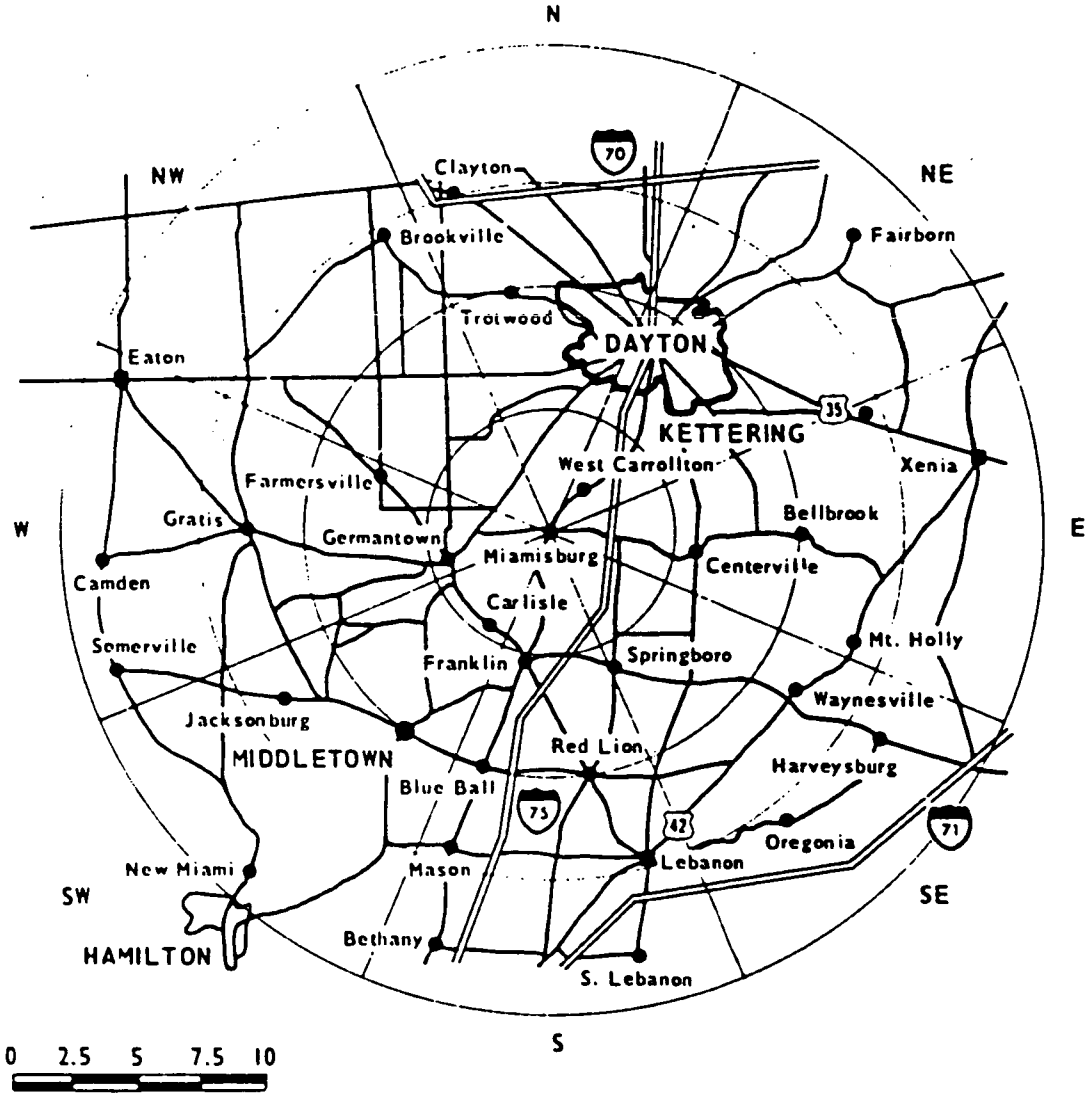


MAP 1 - Great Miami River sample locations.



MAP 2 - Proximity air sample zones.

DISTANT AIR SAMPLE ZONES



MAP 3 - Distant air sample zones.

ENVIRONMENTAL MONITORING REPORT

1968

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

1968

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H. F. Anderson and W. E. Sheehan

AEC Research and Development REPORT

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MONSANTO RESEARCH CORPORATION
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ABSTRACT

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, is presented for the first half of 1968. The average concentration of radionuclides from Mound Laboratory in the Great Miami River and in the environmental air was within the stringent standards of safety specified by the Atomic Energy Commission.

INTRODUCTION

This report is a summary of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program considers all of the projects at Mound Laboratory and all of the radioisotopes which could be released into the environment. The monitoring procedures and counting techniques are those best suited for the detection and measurement of these radioactive materials.

The Radioactivity Concentration Guide (RCG) values in air and in water for the radionuclides in use at Mound Laboratory are taken from the USAEC Manual, Chapter 0524. The Radioactivity Concentration Guides for environmental air and water for the materials used at Mound Laboratory are:

Polonium-210

Air: 2×10^{-11} microcuries per cubic centimeter (uCi/cc)
Water: 7×10^{-7} microcuries per cubic centimeter (uCi/cc)

Plutonium-238

Air: 7×10^{-14} microcuries per cubic centimeter (uCi/cc)
Water: 5×10^{-6} microcuries per cubic centimeter (uCi/cc)

Hydrogen-3 (Tritium)

Air: 2×10^{-7} microcuries per cubic centimeter (uCi/cc)
Water: 3×10^{-3} microcuries per cubic centimeter (uCi/cc)

LIQUID CONTAMINATION

Polonium-Plutonium Liquid radioactive wastes from polonium and plutonium work at the Laboratory are processed separately to reduce the concentration of these radionuclides to a level at which they may be discharged to the environment. Treated polonium liquid waste is discharged to the Great Miami River via a closed sewer line which also carries the treated plant sewage. The treated plutonium waste is discharged to a drainage ditch which runs through the plant site and eventually reaches the river.

Tritium Helium-3 being purified at Mound Laboratory contains small quantities of tritium. In addition, tritium is being recovered from various AEC tritium-contaminated wastes. Liquid waste generated by these operations is treated (diluted with water when necessary) and is discharged to the same closed sewer line described above. Some tritium-contaminated liquid wastes are discharged to the drainage ditch which runs through the site and eventually reaches the river.

Water Sampling Water samples are collected weekly from the Great Miami River, the drainage ditch and two ponds NE of Mound Laboratory. All samples are analyzed for polonium, plutonium and tritium.

Map 1 shows the location of weekly water sampling points on the Great Miami River.

The results of the water sampling program are presented in Table 1, Table 2, and Table 3. The data presented in these tables indicate that the average concentrations of polonium, plutonium and tritium in water discharged to the environment were well below the Radioactivity Concentration Guides.

AIRBORNE CONTAMINATION

Polonium-Plutonium Air which is contaminated with polonium and plutonium particulates is treated by passing it through absolute filters before it is discharged to the environment via several building stacks.

Tritium Air which might be contaminated with gaseous tritium is discharged to the environment via stacks.

Off-Site Air Sampling All environmental air samples are collected weekly to a distance of 20 miles with sampling equipment mounted in a one-ton panel truck. Samples are collected upwind and downwind from the plant according to routes drawn for the different wind directions. The selection of the air sampling zone depends on the wind direction on the days that samples are collected. Since the sampling zone is dependent on the wind direction it is possible that air samples from all zones will not be collected during the reporting period. Maps 2 and 3 show the zones routinely sampled. Results of the air sampling program are presented in Tables 4 to 9. Table 10 lists the specific location of sampling sites by zone for the polonium and plutonium monitoring program. Table 11 lists the specific location of sampling sites by zone for the tritium monitoring program.

Airborne polonium and plutonium particulates are collected with a high volume air sampler. One-fourth of each filter paper is processed by spontaneous deposition to isolate polonium. The remaining three-fourths of each filter paper is processed chemically to remove polonium. The remaining alpha activity is interpreted as plutonium; however, some of this alpha activity is probably due to naturally occurring alpha emitters.

Airborne tritium is monitored by bubbling air through a liquid scintilla-counting solution with p-dioxane as the organic solvent. The counting solution is counted directly in a liquid spectrometer.

Table 1

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

January-June 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-9} µCi/cc)	Average Concentration[a] (10^{-9} µCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	24	21.62	4.01	0.57
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	24	1.80	1.80	0.26
Mound Lab Effluent (location No. 3 on map)	24	1267.57	118.20	16.88
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	24	19.82	3.34	0.47
Chautauqua Road Bridge (location No. 5 on map)	24	5.40	2.02	0.29
Chautauqua Dam (location No. 6 on map)	24	1.80	1.80	0.26
Franklin, Ohio (location No. 7 on map)	24	1.80	1.80	0.26
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	20	1.80	1.80	0.26
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	18	1.80	1.80	0.26

[a] Lowest detectable limit for polonium in water is 1.80×10^{-9} µCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.
[b] RCG - Radioactivity Concentration Guide.

Table 2

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

January-June 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	24	2454.16	481.14	9.62
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	24	15.42	5.95	0.12
Mound Lab Effluent (location No. 3 on map)	23	79.27	18.36	0.37
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	24	36.31	7.72	0.15
Chautauqua Road Bridge (location No. 5 on map)	24	10.84	5.75	0.12
Chautauqua Dam (location No. 6 on map)	24	8.48	5.10	0.12
Franklin, Ohio (location No. 7 on map)	24	28.10	6.29	0.12
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	20	36.37	6.69	0.13
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	17	110.81	12.60	0.25

[a] Lowest detectable limit for plutonium in water is 4.50×10^{-9} μCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 3

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

January-June 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-3} μCi/cc)	Average Concentration[a] (10^{-3} μCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	23	2.79	0.52	17.33
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	0.16	0.06	2.00
Mound Lab Effluent (location No. 3 on map)	23	1.13	0.27	9.00
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	23	0.19	0.06	2.00
Chautauqua Road Bridge (location No. 5 on map)	23	0.28	0.07	2.33
Chautauqua Dam (location No. 6 on map)	23	0.23	0.06	2.00
Franklin, Ohio (location No. 7 on map)	23	0.20	0.07	2.33
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	20	0.21	0.06	2.00
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	18	0.21	0.07	2.33

[a] Lowest detectable limit for tritium in water is 0.05×10^{-3} μCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 4

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} uCi/cc)	Percent of RCC[b] for Average
		North Zone		
0 - 3 (upwind)	3	3.53	2.16	0.11
0 - 3 (downwind)	3	40.42	15.96	0.75
3 - 5 (downwind)	3	3.07	2.09	0.10
5 - 10 (downwind)	3	4.04	2.31	0.12
10 - 15 (downwind)	3	2.26	1.79	0.09
15 - 20 (downwind)	3	1.47	0.84	0.04
		Northeast Zone		
0 - 3 (upwind)	5	2.10	1.41	0.07
0 - 3 (downwind)	5	2.25	1.51	0.07
3 - 5 (downwind)	5	4.21	2.70	0.14
5 - 10 (downwind)	5	3.33	1.84	0.09
10 - 15 (downwind)	5	2.53	1.35	0.07
15 - 20 (downwind)	5	2.39	1.56	0.07

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} µCi/cc)	Average Concentration[a] (10^{-14} µCi/cc)	Percent of RCG[b] for Average
		East Zone		
0 - 3 (upwind)	2	3.60	2.76	0.14
0 - 3 (downwind)	2	2.71	1.92	0.10
3 - 5 (downwind)	2	4.26	3.02	0.15
5 - 10 (downwind)	2	3.22	2.87	0.14
10 - 15 (downwind)	2	3.51	3.39	0.17
15 - 20 (downwind)	2	2.55	2.28	0.11
		Southeast Zone		
0 - 3 (upwind)	2	3.36	3.28	0.16
0 - 3 (downwind)	2	1.94	1.90	0.10
3 - 5 (downwind)	2	4.55	3.64	0.18
5 - 10 (downwind)	2	1.04	0.93	0.05
10 - 15 (downwind)	2	3.95	3.66	0.18
15 - 20 (downwind)	2	2.72	2.15	0.11

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} µCi/cc)	Average Concentration[a] (10^{-14} µCi/cc)	Percent of RCG[b] for Average
		South Zone		
0 - 3 (upwind)	4	44.02	12.32	0.64
0 - 3 (downwind)	4	24.98	7.30	0.36
3 - 5 (downwind)	4	39.66	11.64	0.58
5 - 10 (downwind)	4	33.15	10.80	0.54
10 - 15 (downwind)	4	31.27	9.80	0.49
15 - 20 (downwind)	4	23.68	8.08	0.40
		Southwest Zone		
0 - 3 (upwind)	2	4.90	3.68	0.18
0 - 3 (downwind)	2	3.06	2.24	0.11
3 - 5 (downwind)	2	4.81	4.08	0.20
5 - 10 (downwind)	2	6.12	4.77	0.24
10 - 15 (downwind)	2	3.93	3.46	0.17
15 - 20 (downwind)	2	2.90	2.11	0.10

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} µCi/cc)	Average Concentration[a] (10^{-14} µCi/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	1	1.50	1.50	0.08
0 - 3 (downwind)	1	1.72	1.72	0.09
3 - 5 (downwind)	1	2.30	2.30	0.12
5 - 10 (downwind)	1	1.55	1.55	0.08
10 - 15 (downwind)	1	0.80	0.80	0.04
15 - 20 (downwind)	1	1.81	1.81	0.09
		Northwest Zone		
0 - 3 (upwind)	5	5.45	3.47	0.17
0 - 3 (downwind)	5	2.59	2.08	0.10
3 - 5 (downwind)	5	5.01	3.16	0.16
5 - 10 (downwind)	5	3.34	2.60	0.13
10 - 15 (downwind)	5	4.25	3.35	0.17

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} µCi/cc)	Average Concentration[a] (10^{-14} µCi/cc)	Percent of RCC[b] for Average
		Northwest Zone		
15 - 20 (downwind)	5	3.36	2.10	0.10

[a]Lowest detectable limit for polonium in air is 0.80×10^{-14} µCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.53×10^{-14} µCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b]RCG - Radioactivity Concentration Guide.

Table 5

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January-June 1968, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-14} µCi/cc)	Average Concentration[a] (10^{-14} µCi/cc)	Percent of Polonium RCG[b] for Average
0 - 3 (upwind)	24	44.02	4.30	0.21
0 - 3 (downwind)	24	40.42	4.54	0.23
3 - 5 (downwind)	24	39.66	4.41	0.22
5 - 10 (downwind)	24	33.15	3.79	0.19
10 - 15 (downwind)	24	31.27	3.75	0.19
15 - 20 (downwind)	24	23.68	2.83	0.14

[a] Lowest detectable limit for polonium in air is 0.80 x 10^{-14} µCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind, and 10-15 miles downwind. The LDL is 0.53 x 10^{-14} µCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 6

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		North Zone		
0 - 3 (upwind)	3	3.79	1.45	20.71
0 - 3 (downwind)	3	3.65	1.48	21.14
3 - 5 (downwind)	3	3.35	1.46	20.86
5 - 10 (downwind)	3	3.44	1.37	19.57
10 - 15 (downwind)	3	3.30	1.42	20.28
15 - 20 (downwind)	3	1.61	0.79	11.28
		Northeast Zone		
0 - 3 (upwind)	5	2.58	1.41	20.14
0 - 3 (downwind)	5	1.78	0.93	13.28
3 - 5 (downwind)	5	2.68	1.33	19.00
5 - 10 (downwind)	5	2.87	1.27	18.14
10 - 15 (downwind)	5	2.20	1.31	18.71
15 - 20 (downwind)	5	1.67	0.85	12.14

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} uCi/cc)	Percent of RCG[b] for Average
		East Zone		
0 - 3 (upwind)	2	2.30	2.16	30.86
0 - 3 (downwind)	2	1.54	1.40	20.00
3 - 5 (downwind)	2	2.20	2.10	30.00
5 - 10 (downwind)	2	5.31	4.02	57.43
10 - 15 (downwind)	2	2.28	2.06	29.43
15 - 20 (downwind)	2	2.02	1.74	24.86
		Southeast Zone		
0 - 3 (upwind)	2	3.48	2.13	30.43
0 - 3 (downwind)	2	1.80	1.06	15.14
3 - 5 (downwind)	2	2.15	1.18	16.86
5 - 10 (downwind)	2	1.70	1.22	17.43
10 - 15 (downwind)	2	3.31	1.94	27.71
15 - 20 (downwind)	1	1.21	1.21	17.28

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration* (10^{-14} μCi/cc)	Average Concentration* (10^{-14} μCi/cc)	Percent of RCC for Average
		South Zone		
0 - 3 (upwind)	4	2.92	1.68	24.00
0 - 3 (downwind)	4	2.19	1.31	18.71
3 - 5 (downwind)	4	8.11	2.75	39.28
5 - 10 (downwind)	4	2.63	1.14	16.28
10 - 15 (downwind)	4	3.35	1.36	19.43
15 - 20 (downwind)	4	2.11	1.18	16.86
		Southwest Zone		
0 - 3 (upwind)	2	0.55	0.46	6.57
0 - 3 (downwind)	2	0.40	0.35	5.00
3 - 5 (downwind)	2	0.52	0.50	7.14
5 - 10 (downwind)	2	0.79	0.57	8.14
10 - 15 (downwind)	2	0.40	0.32	4.57
15 - 20 (downwind)	2	0.29	0.19	2.71

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} uCi/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	1	0.67	0.67	9.57
0 - 3 (downwind)	1	0.27	0.27	3.86
3 - 5 (downwind)	1	0.13	0.13	1.86
5 - 10 (downwind)	0	--	--	--
10 - 15 (downwind)	0	--	--	--
15 - 20 (downwind)	0	--	--	--
		Northwest Zone		
0 - 3 (upwind)	5	2.33	1.33	19.00
0 - 3 (downwind)	5	3.59	1.20	17.14
3 - 5 (downwind)	5	5.41	1.97	28.14
5 - 10 (downwind)	5	5.50	2.08	29.71
10 - 15 (downwind)	5	3.65	1.84	26.28

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		Northwest Zone		
15 - 20 (downwind)	5	5.44	1.71	24.43

[a] Lowest detectable limit for plutonium in air is 0.13×10^{-14} μCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.09×10^{-14} μCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 7

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

January-June 1968, All Zones

Range (miles)	Number of Samples	Maximum Concentration* (10^{-14} μCi/cc)	Average Concentration* (10^{-14} μCi/cc)	Percent of Plutonium RCG† for Average
0 - 3 (upwind)	24	3.79	1.46	20.86
0 - 3 (downwind)	24	3.65	1.09	15.57
3 - 5 (downwind)	24	8.11	1.65	23.57
5 - 10 (downwind)	23	5.50	1.61	23.00
10 - 15 (downwind)	23	3.65	1.48	21.14
15 - 20 (downwind)	22	5.44	1.13	16.14

*Lowest detectable limit for plutonium in air is 0.13 x 10^{-14} μCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.09 x 10^{-14} μCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

†RCG - Radioactivity Concentration Guide.

Table 8

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration* (10^{-9} µCi/cc)	Average Concentration* (10^{-9} µCi/cc)	Percent of RCG[illegible] for Average
		North Zone		
0 - 3 (upwind)	3	15.60	9.80	4.90
0 - 3 (downwind)	3	12.95	5.65	2.82
3 - 5 (downwind)	3	3.47	2.69	1.35
5 - 10 (downwind)	3	12.75	5.58	2.79
10 - 15 (downwind)	3	9.30	4.43	2.22
15 - 20 (downwind)	3	16.90	6.97	3.48
		Northeast Zone		
0 - 3 (upwind)	5	10.70	4.73	2.36
0 - 3 (downwind)	5	8.25	3.54	1.77
3 - 5 (downwind)	5	6.00	2.96	1.48
5 - 10 (downwind)	5	8.65	3.65	1.82
10 - 15 (downwind)	5	6.00	3.24	1.62
15 - 20 (downwind)	5	7.50	3.27	1.64

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} µCi/cc)	Average Concentration[a] (10^{-9} µCi/cc)	Percent of RCG[b] for Average
		East Zone		
0 - 3 (upwind)	2	2.00	2.00	1.00
0 - 3 (downwind)	2	2.00	2.00	1.00
3 - 5 (downwind)	2	2.00	2.00	1.00
5 - 10 (downwind)	2	2.00	2.00	1.00
10 - 15 (downwind)	2	2.00	2.00	1.00
15 - 20 (downwind)	2	2.00	2.00	1.00
		Southeast Zone		
0 - 3 (upwind)	2	2.00	2.00	1.00
0 - 3 (downwind)	2	2.00	2.00	1.00
3 - 5 (downwind)	2	2.00	2.00	1.00
5 - 10 (downwind)	2	3.65	2.82	1.41
10 - 15 (downwind)	2	2.00	2.00	1.00
15 - 20 (downwind)	2	2.00	2.00	1.00

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration* (10^{-9} µCi/cc)	Average Concentration* (10^{-9} µCi/cc)	Percent of RCG' for Average
		South Zone		
0 - 3 (upwind)	4	16.55	6.95	3.48
0 - 3 (downwind)	4	11.70	5.99	3.00
3 - 5 (downwind)	4	10.95	5.70	2.85
5 - 10 (downwind)	4	12.85	6.18	3.09
10 - 15 (downwind)	4	10.15	5.95	2.98
15 - 20 (downwind)	4	12.60	6.02	3.01
		Southwest Zone		
0 - 3 (upwind)	2	6.05	4.02	2.01
0 - 3 (downwind)	2	2.00	2.00	1.00
3 - 5 (downwind)	2	2.00	2.00	1.00
5 - 10 (downwind)	2	2.00	2.00	1.00
10 - 15 (downwind)	2	2.00	2.00	1.00
15 - 20 (downwind)	2	2.00	2.00	1.00

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} uCi/cc)	Average Concentration[a] (10^{-9} uCi/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	1	2.30	2.30	1.15
0 - 3 (downwind)	1	2.30	2.30	1.15
3 - 5 (downwind)	1	3.05	3.05	1.52
5 - 10 (downwind)	1	2.55	2.55	1.28
10 - 15 (downwind)	1	3.50	3.50	1.75
15 - 20 (downwind)	1	6.55	6.55	3.28
		Northwest Zone		
0 - 3 (upwind)	4	4.75	3.08	1.54
0 - 3 (downwind)	4	5.95	3.68	1.84
3 - 5 (downwind)	4	5.60	2.90	1.45
5 - 10 (downwind)	4	4.10	2.52	1.26
10 - 15 (downwind)	4	5.45	2.86	1.43

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January-June 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} µCi/cc)	Average Concentration[a] (10^{-9} µCi/cc)	Percent of RCG[b] for Average
15 - 20 (downwind)	4	7.75	3.44	1.72

[a]Lowest detectable limit for tritium in air is 2.00 x 10^{-9} µCi/cc. All values which were not detectable were set equal to this value when average values were calculated.
[b]RCG - Radioactivity Concentration Guide.

Table 9

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January-June 1968, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
0 - 3 (upwind)	23	16.55	4.85	2.42
0 - 3 (downwind)	23	12.95	3.81	1.90
3 - 5 (downwind)	23	10.95	3.14	1.57
5 - 10 (downwind)	23	12.85	3.74	1.87
10 - 15 (downwind)	23	10.15	3.49	1.74
15 - 20 (downwind)	23	16.90	4.07	2.03

[a] Lowest detectable limit for tritium in air is 2.00 x 10^{-9} μCi/cc. All values which were not detectable were set equal to this value when average values were calculated.
[b] RCG - Radioactivity Concentration Guide.

Table 10

SUMMARY OF AIR SAMPLING LOCATIONS
FOR POLONIUM AND PLUTONIUM

North Zone

Sample No.	Location	Range
1a	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
1b	Mound Rd. and Benner Rd. (Miamisburg, Ohio)	0-3 miles upwind
2a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Upper River Rd. and Soldiers Home-Miamisburg Rd.	0-3 miles downwind
2c	One mile north on Upper River Rd. from previous sample	0-3 miles downwind
3a	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
3b	Union Rd. and Farmersville-West Carrollton Rd.	3-5 miles downwind
4a	Dayton Speedway (near intersection of State Route 4 and Liberty Dayton Rd.)	5-10 miles downwind
4b	Union Rd. and Liberty Dayton Rd.	5-10 miles downwind
5a	Siebenthaler Ave. and North Dixie Dr. (Dayton, Ohio)	10-15 miles downwind
5b	Trotwood, Ohio	10-15 miles downwind
6a	North Dixie Dr. and Little York Dr. (Dayton, Ohio)	15-20 miles downwind
6b	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind
6c	State Route 49 at Clayton, Ohio	15-20 miles downwind

Table 10 (continued)

South Zone

Sample No.	Location	Range
1a	West off State Route 725 between river bridge and railroad (Miamisburg, Ohio)	0-3 miles upwind
1b	Municipal Parking Lot on Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
2a	Crains Run Rd. and Medlar Rd.	0-3 miles upwind
2b	Chautauqua, Ohio	0-3 miles downwind
2c	Miami Drive-In Theater on Cincinnati-Dayton Pike	0-3 miles downwind
3a	State Route 73 and Interstate 75	3-5 miles downwind
3b	State Route 123 and Dayton-Oxford Rd.	3-5 miles downwind
4a	Red Lion, Ohio	5-10 miles downwind
4b	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5a	Lebanon, Ohio	10-15 miles downwind
5b	Monroe, Ohio	10-15 miles downwind
6a	Rt. 48 and Mason Rd.	15-20 miles downwind
6b	Bethany Rd. and Mason Montgomery Rd.	15-20 miles downwind
6c	Bethany, Ohio	15-20 miles downwind

East Zone

1a	Riverview Ave. and Lower Miamisburg Rd. (Miamisburg, Ohio)	0-3 miles upwind
~~1b~~	~~State Route 725 and Union Rd.~~	~~0-3 miles upwind~~
2a	Mound Park	0-3 miles downwind
2b	Benner Rd. and Byers Rd.	0-3 miles downwind

Table 10 (continued)

East Zone

Sample No.	Location	Range
2c	State Route 725 and Interstate 75	0-3 miles downwind
3a	Yankee St. and State Route 725	3-5 miles downwind
3b	Waldruhe Park on Springboro Pike	3-5 miles downwind
4a	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
4b	State Route 48 and Social Row Rd.	5-10 miles downwind
5a	Bellbrook, Ohio	10-15 miles downwind
5b	U.S. 42 and Spring Valley-Paintersville Rd.	10-15 miles downwind
6a	Xenia, Ohio	15-20 miles downwind
6b	Spring Valley-Paintersville Rd. and State Route 380	15-20 miles downwind
6c	Mt. Holly, Ohio	15-20 miles downwind

West Zone

1a	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
1b	Maue Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
2a	Miami Drive-In Theater on Cincinnati-Dayton Pike	0-3 miles downwind
2b	Riverview Rd. and Lower Miamisburg Rd.	0-3 miles downwind
2c	Lower Miamisburg Rd. and Jamaica Rd.	0-3 miles downwind
3a	State Route 725 and State Route 4	3-5 miles downwind
3b	Germantown, Ohio	3-5 miles downwind
4a	Manning Rd. and Anthony Rd.	5-10 miles downwind
4b	Oxford Rd. and Browns Run Rd.	5-10 miles downwind

Table 10 (continued)

West Zone

Sample No.	Location	Range
5a	Gratis, Ohio	10-15 miles downwind
5b	Greenbush Rd. and State Route 122	10-15 miles downwind
6a	Eaton, Ohio	15-20 miles downwind
6b	Camden, Ohio	15-20 miles downwind
6c	Somerville, Ohio	15-20 miles downwind

Northeast Zone

1a	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
1b	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles upwind
2a	Harmon Field (Miamisburg, Ohio)	0-3 miles downwind
2b	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
2c	Elm St. and Cincinnati-Dayton Pike (West Carrollton, Ohio)	0-3 miles downwind
3a	Woody's Market on Cincinnati-Dayton Pike (West Carrollton, Ohio)	3-5 miles downwind
3b	Mad River Rd. and Alexandersville-Bellbrook Rd.	3-5 miles downwind
4a	Dorothy Lane and Springboro Pike	5-10 miles downwind
4b	State Route 48 and Stroop Rd.- Town and Country Shopping Center (Kettering Ohio)	5-10 miles downwind
5a	Interstate 75 and Wagner-Ford Rd.	10-15 miles downwind
5b	Belmont Auto Theater, Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind

Table 10 (continued)

Northeast Zone

Sample No.		
6a	State Route 201 and Chambersburg Rd.	15-20 miles downwind
6b	State Route 235 (Fairborn, Ohio)	15-20 miles downwind
6c	New Germany-Trebein Rd. and Fairground Rd.- approximately 3 miles south of previous sample	15-20 miles downwind

Northwest Zone

1a	Mound Ave. and Benner Rd.	0-3 miles upwind
1b	Medlar Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
2a	Cincinnati-Dayton Pike and Mound Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Union Rd. and State Route 725	0-3 miles downwind
2c	State Route 725 and Jamaica Rd.	0-3 miles downwind
3a	Jamaica Rd. and State Route 4	3-5 miles downwind
3b	State Route 4 and Farmersville-West Carrollton Pike	3-5 miles downwind
4a	Diamond Mill Rd. and Mile Rd.	5-10 miles downwind
4b	Farmersville, Ohio	5-10 miles downwind
5a	Clayton Rd. and Providence Rd.	10-15 miles downwind
5b	Farmersville-West Alexandria Pike and DeChant Rd.	10-15 miles downwind
6a	Brookville, Ohio	15-20 miles downwind
6b	Lexington Salem Rd. and Preble County Line Rd.	15-20 miles downwind
6c	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind

Table 10 (continued)

Southeast Zone

Sample No.		
1a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
1b	Union Rd. and State Route 725	0-3 miles upwind
2a	Mound Ave. and Benner Rd.	0-3 miles downwind
2b	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
2c	Mound Park	0-3 miles downwind
3a	Wood Rd. and Pennyroyal Rd.	3-5 miles downwind
3b	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4a	Springboro, Ohio	5-10 miles downwind
4b	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5a	State Route 48 and State Route 73	10-15 miles downwind
5b	Waynesville, Ohio	10-15 miles downwind
6a	State Route 73, 1 mile east of State Route 42	15-20 miles downwind
6b	3 miles east of Harveysburg on State Route 73	15-20 miles downwind
6c	3 miles east of Harveysburg on State Route 73	15-20 miles downwind

Southwest Zone

1a	State Route 725 and Alexandersville Rd.	0-3 miles upwind
1b	State Route 725 and Heincke Rd. (Miamisburg, Ohio	0-3 miles upwind
2a	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles downwind

Table 10 (continued)

Southwest Zone

Sample No.	Location	Range
2b	Farmington Rd. and Chautauqua Rd.	0-3 miles downwind
2c	Farmington Rd. and Union Rd.	0-3 miles downwind
3a	Farmington Rd. and Butter St.	3-5 miles downwind
3b	Carlisle, Ohio	3-5 miles downwind
4a	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
4b	Post Town, Ohio	5-10 miles downwind
5a	State Route 4 and State Route 73	10-15 miles downwind
5b	Jacksonburg, Ohio	10-15 miles downwind
6a	State Route 4 and State Route 747	15-20 miles downwind
6b	New Miami, Ohio	15-20 miles downwind
6c	West Elkton Rd. and Tolbert Rd.	15-20 miles downwind

Table 11

SUMMARY OF AIR SAMPLING LOCATIONS FOR TRITIUM

North Zone

Sample No.	Location	Range
1	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
3	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
4	Dayton Speedway (near intersection of State Route 4 and Liberty-Dayton Rd.)	5-10 miles downwind
5	Trotwood, Ohio	10-15 miles downwind
6	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind

Northeast Zone

1	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
2	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
3	Mad River Rd. and Alexandersville-Bellbrook Rd.)	3-5 miles downwind
4	State Route 48 and Stroop Rd. - Town and Country Shopping Center (Kettering, Ohio)	5-10 miles downwind
5	Belmont Auto Theater - Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind
6	State Route 235 (Fairborn, Ohio)	15-20 miles downwind

East Zone

1	State Route 725 and Union Rd.	0-3 miles upwind
2	Mound Park	0-3 miles downwind

Table 11 (continued)

East Zone

Sample No.	Location	Range
3	Yankee St. and State Route 725	3-5 miles downwind
4	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
5	U. S. 42 and Spring Valley-Paintersville Rd.	10-15 miles downwind
6	Xenia, Ohio	15-20 miles downwind

Southeast Zone

1	Union Rd. and State Route 725	0-3 miles upwind
2	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
3	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5	State Route 48 and State Route 73	10-15 miles downwind
6	Harveysburg, Ohio	15-20 miles downwind

South Zone

1	Municipal Parking Lot on Central Ave.	0-3 miles upwind
2	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
3	State Route 73 and Interstate 75	3-5 miles downwind
4	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5	Monroe, Ohio	10-15 miles downwind
6	Bethany Rd. and Mason-Montgomery Rd.	15-20 miles downwind

Table 11 (continued)

Southwest Zone

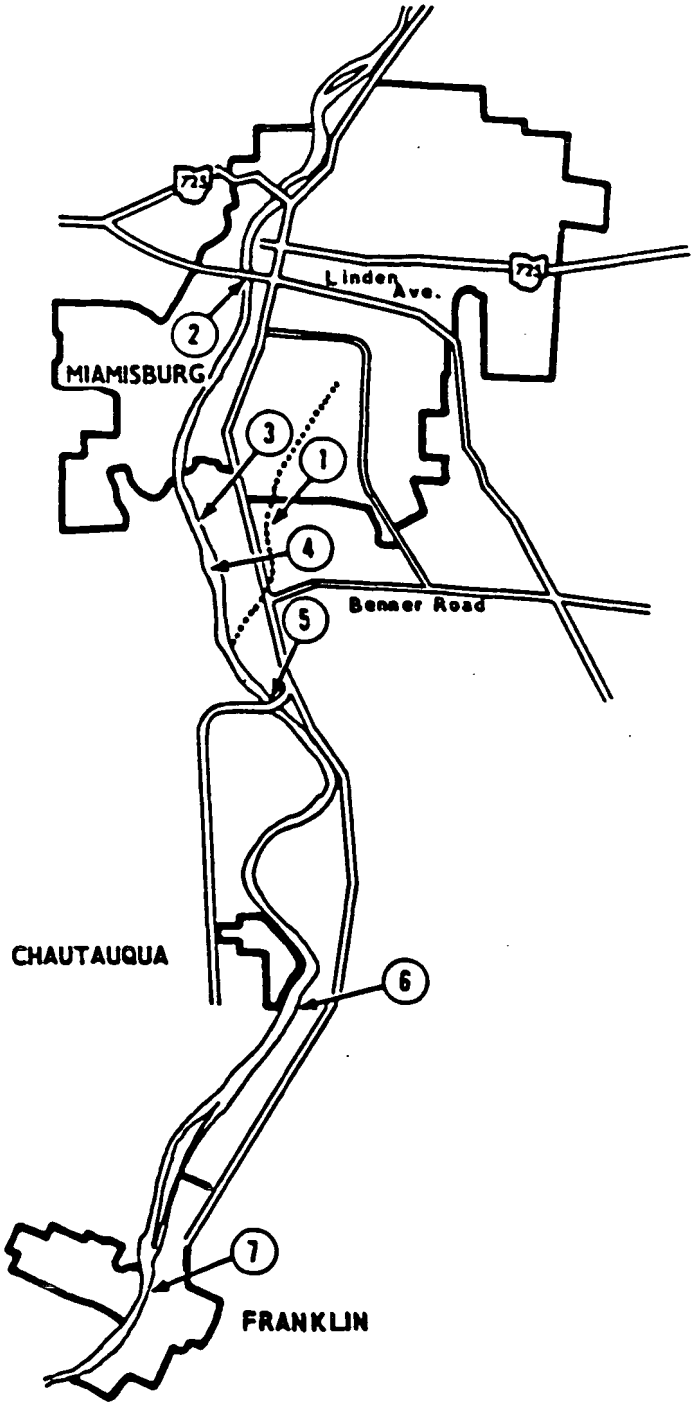
Sample No.	Location	Range
1	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Farmington Rd. and Union Rd.	0-3 miles downwind
3	Farmington Rd. and Butter St.	3-5 miles downwind
4	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
5	Jacksonburg, Ohio	10-15 miles downwind
6	New Miami, Ohio	15-20 miles downwind

West Zone

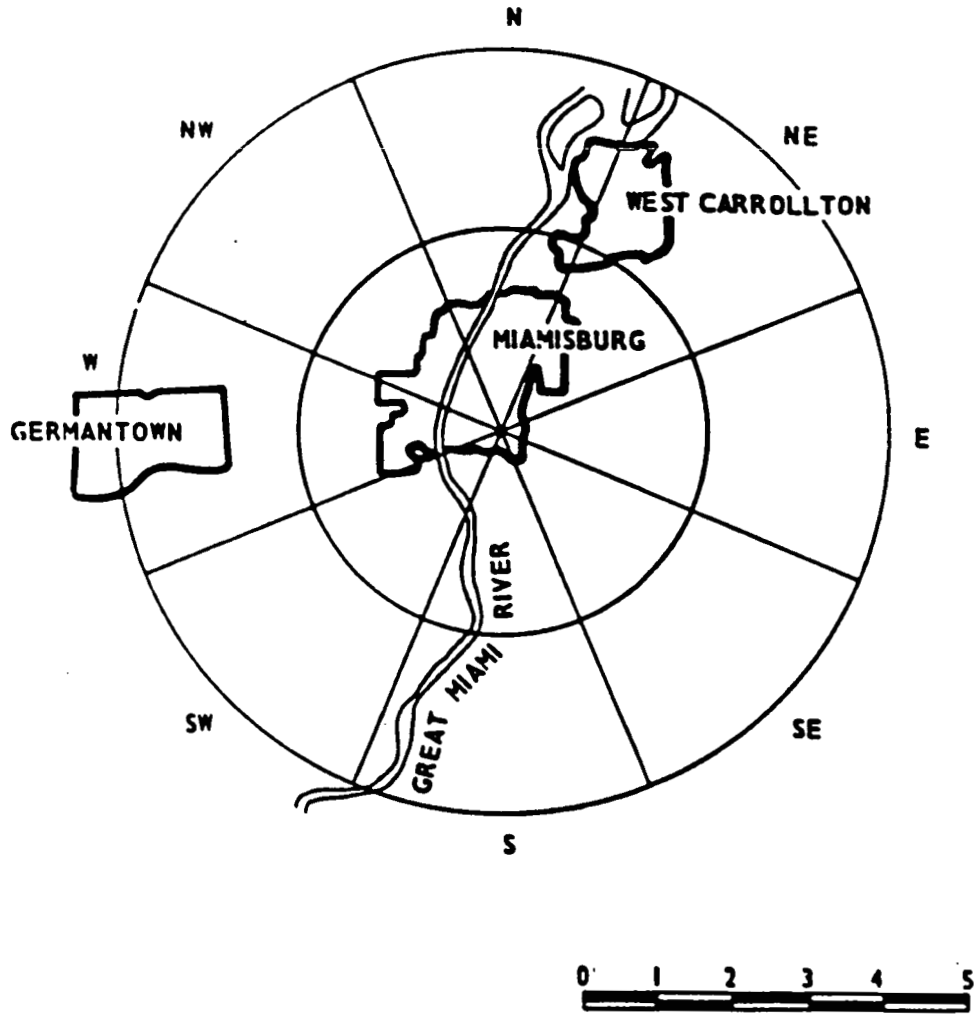
1	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
2	Riverview Rd. and Lower Miamisburg Rd.	0-3 miles downwind
3	Germantown, Ohio	3-5 miles downwind
4	Oxford Rd. and Browns Run Rd.	5-10 miles downwind
5	Gratis, Ohio	10-15 miles downwind
6	Camden, Ohio	15-20 miles downwind

Northwest Zone

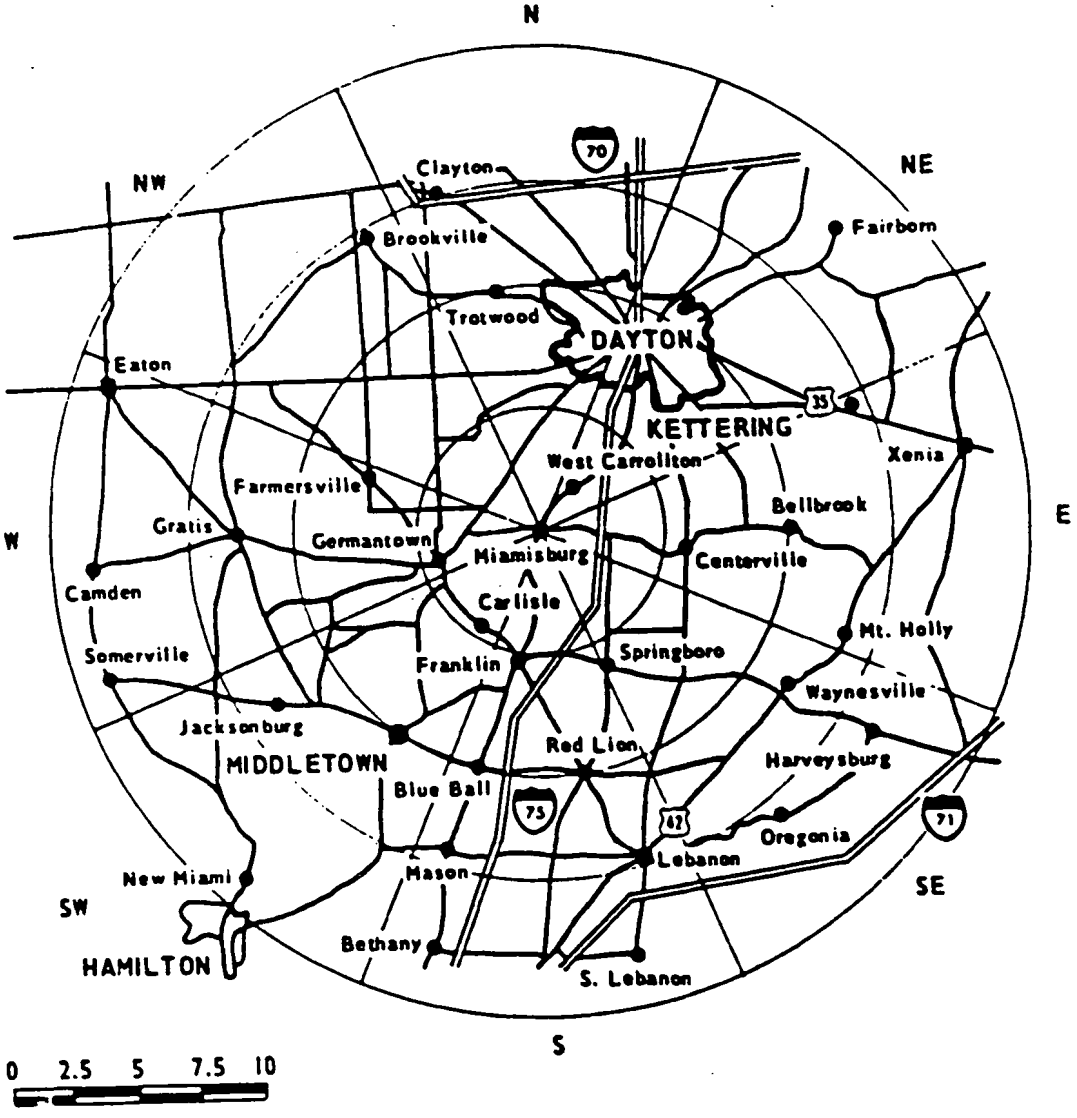
1	Mound Ave. and Benner Rd.	0-3 miles upwind
2	State Route 725 and Jamaica Rd.	0-3 miles downwind
3	Jamaica Rd. and State Route 4	3-5 miles downwind
4	Farmersville, Ohio	5-10 miles downwind
5	Clayton Rd. and Providence Rd.	10-15 miles downwind
6	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind



MAP 1 - Great Miami River sample locations.



MAP 2 - Proximity air sample zones.



MAP 3 - Distant air sample zones.

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ENVIRONMENTAL MONITORING REPORT: JULY–DECEMBER 1968 AND 1968 SUMMARY

H. F. Anderson and W. E. Sheehan

AEC Research and Development REPORT

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

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Prepared by: H. F. Anderson
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ABSTRACT

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, is presented for the second half of 1968, and a summary is presented for the entire year. The average concentration of radionuclides from Mound Laboratory in the Great Miami River (averaged over one year) and in the environmental air was within the stringent standards of safety specified by the Atomic Energy Commission.

INTRODUCTION

This report is a summary of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program considers all of the projects at Mound Laboratory and all of the radioisotopes which could be released into the environment. The monitoring procedures and counting techniques are those best suited for the detection and measurement of these radioactive materials.

The Radioactivity Concentration Guide (RCG) values in air and in water for the radionuclides in use at Mound Laboratory are taken from the USAEC Manual, Chapter 0524. The Radioactivity Concentration Guides for environmental air and water for the materials used at Mound Laboratory are:

Polonium-210

Air: 2×10^{-11} microcuries per cubic centimeter (uCi/cc)
Water: 7×10^{-7} microcuries per cubic centimeter (uCi/cc)

Plutonium-238

Air: 7×10^{-14} microcuries per cubic centimeter (uCi/cc)
Water: 5×10^{-6} microcuries per cubic centimeter (uCi/cc)

Hydrogen-3 (Tritium)

Air: 2×10^{-7} microcuries per cubic centimeter (uCi/cc)
Water: 3×10^{-3} microcuries per cubic centimeter (uCi/cc)

LIQUID CONTAMINATION

Polonium-Plutonium Liquid radioactive wastes from polonium and plutonium work at the Laboratory are processed separately to reduce the concentration of these radionuclides to a level at which they may be discharged to the environment. Treated polonium liquid waste is discharged to the Great Miami River via a closed sewer line which also carries the treated plant sewage. The treated plutonium waste is discharged to a drainage ditch which runs through the plant site and eventually reaches the river.

Tritium Helium-3 being purified at Mound Laboratory contains small quantities of tritium. In addition, tritium is being recovered from various AEC tritium-contaminated wastes. Liquid waste generated by these operations is treated (diluted with water when necessary) and is discharged to the same closed sewer line described above. Some tritium-contaminated liquid wastes are discharged to the drainage ditch which runs through the site and eventually reaches the river.

Water Sampling Water samples are collected weekly from the Great Miami River, the drainage ditch and two ponds NE of Mound Laboratory. All samples are analyzed for polonium, plutonium and tritium.

Map 1 shows the location of weekly water sampling points on the Great Miami River.

The results of the water sampling program are presented in Tables 1, 2 and 3. The data listed in these tables indicate that the average concentrations of plutonium and tritium in water discharged to the environment were well below the Radioactivity Concentration Guides. The data in Table 1 indicate that the average concentration of polonium in the plant effluent water for the six-month period, July-December, was 1.7 times the RCG. However, the average concentration of polonium in the effluent water for the twelve-month period was 0.87 times the RCG (see Table 1) which meets the stringent water pollution standards of the Atomic Energy Commission. The average concentration obtained during the six-month period July-December resulted from a break in buried waste lines which allowed polonium contaminated liquid waste to enter an adjacent sanitary line, thus by-passing the radioactive waste disposal facility. The lines were repaired, and the concentration of polonium in the effluent returned to normal.

AIRBORNE CONTAMINATION

Polonium-Plutonium Air which is contaminated with polonium and plutonium particulates is treated by passing it through absolute filters before it is discharged to the environment via several building stacks.

Tritium Air which might be contaminated with gaseous tritium is discharged to the environment via stacks.

Off-Site Air Sampling All environmental air samples are collected weekly to a distance of 20 miles with sampling equipment mounted in a one-ton panel truck. Samples are collected upwind and downwind from the plant according to routes drawn for the different wind directions. The selection of the air sampling zone depends on the wind direction on the days that samples are collected. Since the sampling zone is dependent on the wind direction it is possible that air samples from all zones will not be collected during the reporting period. Maps 2 and 3 show the zones routinely sampled. Results of the air sampling program are presented in Tables 4 to 9. Table 10 lists the specific location

of sampling sites by zone for the polonium and plutonium monitoring program. Table 11 lists the specific location of sampling sites by zone for the tritium monitoring program.

Airborne polonium and plutonium particulates are collected with a high volume air sampler. One-fourth of each filter paper is processed by spontaneous deposition to isolate polonium. The remaining three-fourths of each filter paper is processed chemically to remove polonium. The remaining alpha activity is interpreted as plutonium; however, some of this alpha activity is probably due to naturally occurring alpha emitters.

Airborne tritium is monitored by bubbling air through a liquid scintillation counting solution with p-dioxane as the organic solvent. The counting solution is counted directly in a liquid spectrometer.

Table 1

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

January-June 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	24	21.62	4.01	0.57
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	24	1.80	1.80	0.26
Mound Lab Effluent (location No. 3 on map)	24	1267.57	118.20	16.88
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	24	19.82	3.34	0.47
Chautauqua Road Bridge (location No. 5 on map)	24	5.40	2.02	0.29
Chautauqua Dam (location No. 6 on map)	24	1.80	1.80	0.26
Franklin, Ohio (location No. 7 on map)	24	1.80	1.80	0.26
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	20	1.80	1.80	0.26
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	18	1.80	1.80	0.26

[a] Lowest detectable limit for polonium in water is 1.80×10^{-9} μCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 1 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

July-December 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-9} uCi/cc)	Average Concentration[a] (10^{-9} uCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	20	47.70	5.54	0.79
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	20	3.60	1.94	0.28
Mound Lab Effluent (location No. 3 on map)	20	8016.20	1202.48	171.78
250 yr Downstream from Mound Lab Effluent (location No. 4 on map)	20	50.40	8.96	1.28
Chautauqua Road Bridge (location No. 5 on map)	20	49.50	7.65	1.09
Chautauqua Dam (location No. 6 on map)	20	298.20	16.41	2.34
Franklin, Ohio (location No. 7 on map)	20	63.10	7.70	1.10
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	20	1.80	1.80	0.26
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	20	3.60	1.94	0.28

[a]Lowest detectable limit for polonium in water is 1.80×10^{-9} uCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.
[b]RCG - Radioactivity Concentration Guide.

Table 1 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

January-December 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-9} µCi/cc)	Average Concentration[a] (10^{-9} µCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	44	47.70	4.71	0.67
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	44	3.60	1.86	0.27
Mound Lab Effluent (location No. 3 on map)	44	8016.20	611.05	87.29
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	44	50.40	5.89	0.84
Chautauqua Road Bridge (location No. 5 on map)	44	49.50	4.58	0.65
Chautauqua Dam (location No. 6 on map)	44	298.20	8.44	1.21
Franklin, Ohio (location No. 7 on map)	44	63.10	4.48	0.64
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	40	1.80	1.80	0.26
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	38	3.60	1.87	0.27

[a]Lowest detectable limit for polonium in water is 1.80×10^{-9} µCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.
[b]RCG - Radioactivity Concentration Guide.

Table 2

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

January-June 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	24	2454.16	481.14	9.62
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	24	15.42	5.95	0.12
Mound Lab Effluent (location No. 3 on map)	23	79.27	18.36	0.37
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	24	36.31	7.72	0.15
Chautauqua Road Bridge (location No. 5 on map)	24	10.84	5.75	0.12
Chautauqua Dam (location No. 6 on map)	24	8.48	5.10	0.12
Franklin, Ohio (location No. 7 on map)	24	28.10	6.29	0.12
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	20	36.37	6.69	0.13
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	17	110.81	12.60	0.25

[a] Lowest detectable limit for plutonium in water is 4.50 x 10^{-9} μCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 2 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

July-December 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-9} uCi/cc)	Average Concentration[a] (10^{-9} µCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	18	253.60	60.36	1.21
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	18	8.11	5.41	0.11
Mound Lab Effluent (location No. 3 on map)	18	157.21	25.22	0.50
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	18	66.67	8.56	0.17
Chautauqua Road Bridge (location No. 5 on map)	18	27.93	6.31	0.13
Chautauqua Dam (location No. 6 on map)	18	14.86	6.31	0.13
Franklin, Ohio (location No. 7 on map)	18	10.81	5.86	0.12
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	18	25.23	5.86	0.12
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	18	9.46	4.95	0.10

[a]Lowest detectable limit for plutonium in water is 4.50 x 10^{-9} uCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide.

Table 2 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

January-December 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	42	2454.16	300.81	6.02
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	42	15.42	5.72	0.11
Mound Lab Effluent (location No. 3 on map)	41	157.21	21.37	0.43
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	42	66.67	8.08	0.16
Chautauqua Road Bridge (location No. 5 on map)	42	27.93	5.99	0.12
Chautauqua Dam (location No. 6 on map)	42	14.86	5.62	0.11
Franklin, Ohio (location No. 7 on map)	42	28.10	6.11	0.12
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	38	36.37	6.30	0.13
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	35	110.81	8.67	0.17

[a] Lowest detectable limit for plutonium in water is 4.50 x 10^{-9} μCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.
[b] RCG - Radioactivity Concentration Guide.

Table 3

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

January-June 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-3} μCi/cc)	Average Concentration[a] (10^{-3} μCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	23	2.79	0.52	17.33
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	0.16	0.06	2.00
Mound Lab Effluent (location No. 3 on map)	23	1.13	0.27	9.00
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	23	0.19	0.06	2.00
Chautauqua Road Bridge (location No. 5 on map)	23	0.28	0.07	2.33
Chautauqua Dam (location No. 6 on map)	23	0.23	0.06	2.00
Franklin, Ohio (location No. 7 on map)	23	0.20	0.07	2.33
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	20	0.21	0.06	2.00
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	18	0.21	0.07	2.33

[a] Lowest detectable limit for tritium in water is 0.05 x 10^{-3} μCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 3 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

July-December 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-3} uCi/cc)	Average Concentration[a] (10^{-3} uCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	20	7.76	1.10	36.67
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	20	1.04	0.10	3.33
Mound Lab Effluent (location No. 3 on map)	20	2.74	0.25	8.33
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	20	0.05	0.05	1.67
Chautauqua Road Bridge (location No. 5 on map)	20	0.05	0.05	1.67
Chautauqua Dam (location No. 6 on map)	20	0.05	0.05	1.67
Franklin, Ohio (location No. 7 on map)	20	0.05	0.05	1.67
Pond - Opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	20	0.36	0.07	2.33
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	20	0.05	0.05	1.67

[a]Lowest detectable limit for tritium in water is 0.05×10^{-3} uCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide.

Table 3 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

January-December 1968

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-3} uCi/cc)	Average Concentration[a] (10^{-3} uCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	43	7.76	0.79	26.33
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	43	1.04	0.08	2.67
Mound Lab Effluent (location No. 3 on map)	43	2.74	0.26	8.67
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	43	0.19	0.06	2.00
Chautauqua Road Bridge (location No. 5 on map)	43	0.28	0.06	2.00
Chautauqua Dam (location No. 6 on map)	43	0.23	0.06	2.00
Franklin, Ohio (location No. 7 on map)	43	0.20	0.06	2.00
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab)	40	0.36	0.06	2.00
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab)	36	0.21	0.06	2.00

[a]Lowest detectable limit for tritium in water is 0.05×10^{-3} uCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide.

Table 4

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} uCi/cc)	Percent of RCG[b] for Average
		North Zone		
0 - 3 (upwind)	5	4.12	2.57	0.13
0 - 3 (downwind)	5	5.10	2.36	0.12
3 - 5 (downwind)	5	3.67	2.63	0.13
5 - 10 (downwind)	5	11.46	3.73	0.19
10 - 15 (downwind)	5	4.64	2.67	0.13
15 - 20 (downwind)	5	5.15	2.06	0.10
		Northeast Zone		
0 - 3 (upwind)	3	3.67	1.86	0.09
0 - 3 (downwind)	3	5.70	3.11	0.16
3 - 5 (downwind)	3	2.19	1.97	0.10
5 - 10 (downwind)	3	2.96	1.89	0.09
10 - 15 (downwind)	3	4.24	3.08	0.15
15 - 20 (downwind)	3	2.37	2.00	0.10

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		East Zone		
0 - 3 (upwind)	0			
0 - 3 (downwind)	0			
3 - 5 (downwind)	0	No samples were obtained in this zone because the prevailing winds were not out of the west on days samples were collected.		
5 - 10 (downwind)	0			
10 - 15 (downwind)	0			
15 - 20 (downwind)	0			
		Southeast Zone		
0 - 3 (upwind)	1	2.87	2.87	0.14
0 - 3 (downwind)	1	2.95	2.95	0.15
3 - 5 (downwind)	1	2.07	2.07	0.10
5 - 10 (downwind)	1	0.87	0.87	0.04
10 - 15 (downwind)	1	0.80	0.80	0.04
15 - 20 (downwind)	1	1.57	1.57	0.08

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration* (10^{-14} uCi/cc)	Average Concentration* (10^{-14} uCi/cc)	Percent of RCG[b] for Average
		South Zone		
0 - 3 (upwind)	0			
0 - 3 (downwind)	0			
3 - 5 (downwind)	0	No samples were obtained in this zone because the prevailing winds were not out of the north on days samples were collected.		
5 - 10 (downwind)	0			
10 - 15 (downwind)	0			
15 - 20 (downwind)	0			
		Southwest Zone		
0 - 3 (upwind)	2	1.34	1.14	0.06
0 - 3 (downwind)	2	1.32	1.18	0.06
3 - 5 (downwind)	2	2.58	2.20	0.11
5 - 10 (downwind)	2	1.75	1.28	0.06
10 - 15 (downwind)	2	2.78	2.40	0.12
15 - 20 (downwind)	2	1.23	0.88	0.04

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} µCi/cc)	Average Concentration[a] (10^{-14} µCi/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	1	0.84	0.84	0.04
0 - 3 (downwind)	1	0.53	0.53	0.03
3 - 5 (downwind)	1	0.80	0.80	0.04
5 - 10 (downwind)	1	0.80	0.80	0.04
10 - 15 (downwind)	1	10.02	10.02	0.50
15 - 20 (downwind)	1	1.33	1.33	0.07
		Northwest Zone		
0 - 3 (upwind)	4	1.46	1.03	0.05
0 - 3 (downwind)	4	1.90	1.12	0.06
3 - 5 (downwind)	4	2.61	1.82	0.09
5 - 10 (downwind)	4	1.95	1.37	0.07
10 - 15 (downwind)	4	2.75	1.66	0.08

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		Northwest Zone		
15 - 20 (downwind)	4	1.38	0.86	0.04

[a] Lowest detectable limit for polonium in air is 0.80×10^{-14} uCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.53×10^{-14} uCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.
[b] RCG - Radioactivity Concentration Guide.

Table 5

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January-June 1968, All Zones

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} µCi/cc)	Average Concentration[a] (10^{-14} µCi/cc)	Percent of Polonium RCG[b] for Average
0 - 3 (upwind)	24	44.02	4.30	0.21
0 - 3 (downwind)	24	40.42	4.54	0.23
3 - 5 (downwind)	24	39.66	4.41	0.22
5 - 10 (downwind)	24	33.15	3.79	0.19
10 - 15 (downwind)	24	31.27	3.75	0.19
15 - 20 (downwind)	24	23.68	2.83	0.14

July-December 1968, All Zones

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} uCi/cc)	Percent of Polonium RCG[b] for Average
0 - 3 (upwind)	16	4.12	1.78	0.09
0 - 3 (downwind)	16	5.70	1.97	0.10
3 - 5 (downwind)	16	3.67	2.10	0.10
5 - 10 (downwind)	16	11.46	2.13	0.11
10 - 15 (downwind)	16	10.02	2.80	0.14
15 - 20 (downwind)	16	5.15	1.52	0.08

Table 5 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January-December 1968, All Zones

Range (miles)	Number of Samples Collected	Maximum Concentration* (10^{-14} uCi/cc)	Average Concentration* (10^{-14} uCi/cc)	Percent of Polonium RCG[b] for Average
0 - 3 (upwind)	40	44.02	3.29	0.16
0 - 3 (downwind)	40	40.42	3.51	0.18
3 - 5 (downwind)	40	39.66	3.49	0.17
5 - 10 (downwind)	40	33.15	3.13	0.16
10 - 15 (downwind)	40	31.27	3.37	0.17
15 - 20 (downwind)	40	23.68	2.31	0.12

*Lowest detectable limit for polonium in air is 0.80×10^{-14} uCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind, and 10-15 miles downwind. The LDL is 0.53×10^{-14} uCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 6

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} µCi/cc)	Percent of RCG[b] for Average
		North Zone		
0 - 3 (upwind)	5	1.18	0.74	10.57
0 - 3 (downwind)	5	0.75	0.47	6.71
3 - 5 (downwind)	5	0.81	0.57	8.14
5 - 10 (downwind)	5	2.30	0.77	11.00
10 - 15 (downwind)	5	1.37	0.97	13.90
15 - 20 (downwind)	5	0.62	0.50	7.14
		Northeast Zone		
0 - 3 (upwind)	2	0.89	0.56	8.00
0 - 3 (downwind)	2	0.65	0.52	7.42
3 - 5 (downwind)	2	4.18	2.35	33.57
5 - 10 (downwind)	2	1.02	0.70	10.00
10 - 15 (downwind)	2	0.61	0.37	5.28
15 - 20 (downwind)	2	0.26	0.17	2.43

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration* (10^{-14} uCi/cc)	Average Concentration* (10^{-14} uCi/cc)	Percent of RCG for Average
		East Zone		
0 - 3 (upwind)	0			
0 - 3 (downwind)	0			
3 - 5 (downwind)	0	No samples were obtained in this zone because the prevailing winds were not out of the west on days samples were collected.		
5 - 10 (downwind)	0			
10 - 15 (downwind)	0			
15 - 20 (downwind)	0			
		Southeast Zone		
0 - 3 (upwind)	1	1.41	1.41	20.14
0 - 3 (downwind)	1	0.77	0.77	11.00
3 - 5 (downwind)	1	4.35	4.35	62.14
5 - 10 (downwind)	1	0.75	0.75	10.71
10 - 15 (downwind)	1	2.54	2.54	36.28
15 - 20 (downwind)	1	0.49	0.49	7.00

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration* (10^{-14} uCi/cc)	Average Concentration* (10^{-14} uCi/cc)	Percent of RCG† for Average
		South Zone		
0 - 3 (upwind)	0			
0 - 3 (downwind)	0			
3 - 5 (downwind)	0	No samples were obtained in this zone because the prevailing winds were not out of the north on days samples were collected.		
5 - 10 (downwind)	0			
10 - 15 (downwind)	0			
15 - 20 (downwind)	0			
		Southwest Zone		
0 - 3 (upwind)	2	0.59	0.36	5.14
0 - 3 (downwind)	2	0.58	0.49	7.00
3 - 5 (downwind)	2	0.50	0.35	5.00
5 - 10 (downwind)	2	1.36	1.19	17.00
10 - 15 (downwind)	2	1.17	0.92	13.14
15 - 20 (downwind)	2	1.85	1.08	15.43

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} uCi/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	1	0.13	0.13	1.86
0 - 3 (downwind)	1	0.09	0.09	1.28
3 - 5 (downwind)	1	0.24	0.24	3.43
5 - 10 (downwind)	1	0.13	0.13	1.86
10 - 15 (downwind)	1	0.28	0.28	4.00
15 - 20 (downwind)	1	0.09	0.09	1.28
		Northwest Zone		
0 - 3 (upwind)	3	2.42	1.03	14.71
0 - 3 (downwind)	3	2.76	1.18	16.86
3 - 5 (downwind)	3	1.56	1.11	15.86
5 - 10 (downwind)	3	2.23	0.98	14.00
10 - 15 (downwind)	3	2.96	1.22	17.43

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		Northwest Zone		
15 - 20 (downwind)	3	1.85	0.79	11.28

[a] Lowest detectable limit for plutonium in air is 0.13 x 10^{-14} μCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.09 x 10^{-14} μCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 7

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

January-June 1968, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} uCi/cc)	Percent of Plutonium RCG[b] for Average
0 - 3 (upwind)	24	3.79	1.46	20.86
0 - 3 (downwind)	24	3.65	1.09	15.57
3 - 5 (downwind)	24	8.11	1.65	23.57
5 - 10 (downwind)	23	5.50	1.61	23.00
10 - 15 (downwind)	23	3.65	1.48	21.14
15 - 20 (downwind)	22	5.44	1.13	16.14

July-December 1968, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} uCi/cc)	Percent of Plutonium RCG[b] for Average
0 - 3 (upwind)	14	2.42	0.73	10.43
0 - 3 (downwind)	14	2.76	0.63	9.00
3 - 5 (downwind)	14	4.35	1.15	16.43
5 - 10 (downwind)	14	2.30	0.82	11.71
10 - 15 (downwind)	14	2.96	0.99	14.14
15 - 20 (downwind)	14	1.85	0.57	8.14

Table 7 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

January-December 1968, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-14} µCi/cc)	Average Concentration[a] (10^{-14} µCi/cc)	Percent of Plutonium RCG[b] for Average
0 - 3 (upwind)	38	3.79	1.19	17.00
0 - 3 (downwind)	38	3.65	0.92	13.14
3 - 5 (downwind)	24	8.11	1.47	21.00
5 - 10 (downwind)	23	5.50	1.31	18.71
10 - 15 (downwind)	23	3.65	1.29	18.43
15 - 20 (downwind)	22	5.44	0.91	13.00

[a] Lowest detectable limit for plutonium in air is 0.13 x 10^{-14} µCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.09 x 10^{-14} µCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 8

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} µCi/cc)	Average Concentration[a] (10^{-9} µCi/cc)	Percent of RCG[b] for Average
		North Zone		
0 - 3 (upwind)	5	2.23	2.07	1.03
0 - 3 (downwind)	5	2.01	2.00	1.00
3 - 5 (downwind)	5	2.35	2.07	1.03
5 - 10 (downwind)	5	2.00	2.00	1.00
10 - 15 (downwind)	5	2.00	2.00	1.00
15 - 20 (downwind)	5	2.00	2.00	1.00
		Northeast Zone		
0 - 3 (upwind)	3	2.63	2.21	1.10
0 - 3 (downwind)	3	2.00	2.00	1.00
3 - 5 (downwind)	3	2.03	2.01	1.00
5 - 10 (downwind)	3	2.00	2.00	1.00
10 - 15 (downwind)	3	2.00	2.00	1.00
15 - 20 (downwind)	3	2.53	2.18	1.09

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} µCi/cc)	Average Concentration[a] (10^{-9} µCi/cc)	Percent of RCG[b] for Average
		East Zone		
0 - 3 (upwind)	0			
0 - 3 (downwind)	0			
3 - 5 (downwind)	0	No samples were obtained in this zone because the prevailing winds were not out of the west on days samples were collected.		
5 - 10 (downwind)	0			
10 - 15 (downwind)	0			
15 - 20 (downwind)	0			
		Southeast Zone		
0 - 3 (upwind)	2	2.30	2.15	1.07
0 - 3 (downwind)	2	2.66	2.33	1.16
3 - 5 (downwind)	2	3.10	2.55	1.27
5 - 10 (downwind)	2	2.00	2.00	1.00
10 - 15 (downwind)	2	3.10	2.55	1.27
15 - 20 (downwind)	2	2.00	2.00	1.00

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration* (10^{-9} µCi/cc)	Average Concentration* (10^{-9} µCi/cc)	Percent of RCG† for Average
		South Zone		
0 - 3 (upwind)	0			
0 - 3 (downwind)	0			
3 - 5 (downwind)	0	No samples were obtained in this zone because the prevailing winds were not out of the north on days samples were collected.		
5 - 10 (downwind)	0			
10 - 15 (downwind)	0			
15 - 20 (downwind)	0			
		Southwest Zone		
0 - 3 (upwind)	2	2.01	2.00	1.00
0 - 3 (downwind)	2	2.00	2.00	1.00
3 - 5 (downwind)	2	2.00	2.00	1.00
5 - 10 (downwind)	2	2.00	2.00	1.00
10 - 15 (downwind)	2	2.00	2.00	1.00
15 - 20 (downwind)	2	2.00	2.00	1.00

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} uCi/cc)	Average Concentration[a] (10^{-9} uCi/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	1	2.00	2.00	1.00
0 - 3 (downwind)	1	2.00	2.00	1.00
3 - 5 (downwind)	1	2.00	2.00	1.00
5 - 10 (downwind)	1	2.00	2.00	1.00
10 - 15 (downwind)	1	2.00	2.00	1.00
15 - 20 (downwind)	1	2.00	2.00	1.00
		Northwest Zone		
0 - 3 (upwind)	4	2.51	2.13	1.06
0 - 3 (downwind)	4	41.74	11.94	5.97
3 - 5 (downwind)	4	3.34	2.34	1.17
5 - 10 (downwind)	4	2.33	2.08	1.04
10 - 15 (downwind)	4	2.06	2.01	1.00

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

July-December 1968

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-8} uCi/cc)	Average Concentration[a] (10^{-9} uCi/cc)	Percent of RCG[b] for Average
15 - 20 (downwind)	4	2.22	2.05	1.02

[a]Lowest detectable limit for tritium in air is 2.00 x 10^{-} uCi/cc. All values which were not detectable were set equal to this value when average values were calculated.
[b]RCG - Radioactivity Concentration Guide.

Table 9

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January-June 1968, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-9} uCi/cc)	Average Concentration[a] (10^{-9} uCi/cc)	Percent of RCG[b] for Average
0 - 3 (upwind)	23	16.55	4.85	2.42
0 - 3 (downwind)	23	12.95	3.81	1.90
3 - 5 (downwind)	23	10.95	3.14	1.57
5 - 10 (downwind)	23	12.85	3.74	1.87
10 - 15 (downwind)	23	10.15	3.49	1.74
15 - 20 (downwind)	23	16.90	4.07	2.03

July-December 1968, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-9} uCi/cc)	Average Concentration[a] (10^{-9} uCi/cc)	Percent of RCG[b] for Average
0 - 3 (upwind)	17	2.63	2.11	1.05
0 - 3 (downwind)	17	41.74	4.38	2.19
3 - 5 (downwind)	17	3.34	2.17	1.08
5 - 10 (downwind)	17	2.33	2.02	1.01
10 - 15 (downwind)	17	3.10	2.07	1.03
15 - 20 (downwind)	17	2.53	2.04	1.02

Table 9 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January-December 1968, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-9} uCi/cc)	Average Concentration[a] (10^{-9} uCi/cc)	Percent of RCG[b] for Average
0 - 3 (upwind)	40	16.55	3.69	1.84
0 - 3 (downwind)	40	41.74	4.05	2.02
3 - 5 (downwind)	40	10.95	2.73	1.36
5 - 10 (downwind)	40	12.85	3.01	1.50
10 - 15 (downwind)	40	10.15	2.89	1.44
15 - 20 (downwind)	40	16.90	3.21	1.60

[a] Lowest detectable limit for tritium in air is 2.00×10^{-3} uCi/cc. All values which were not detectable were set equal to this value when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 10

SUMMARY OF AIR SAMPLING LOCATIONS
FOR POLONIUM AND PLUTONIUM

North Zone

Sample No.	Location	Range
1a	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
1b	Mound Rd. and Benner Rd. (Miamisburg, Ohio)	0-3 miles upwind
2a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Upper River Rd. and Soldiers Home-Miamisburg Rd.	0-3 miles downwind
2c	One mile north on Upper River Rd. from previous sample	0-3 miles downwind
3a	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
3b	Union Rd. and Farmersville-West Carrollton Rd.	3-5 miles downwind
4a	Dayton Speedway (near intersection of State Route 4 and Liberty Dayton Rd.)	5-10 miles downwind
4b	Union Rd. and Liberty Dayton Rd.	5-10 miles downwind
5a	Siebenthaler Ave. and North Dixie Dr. (Dayton, Ohio)	10-15 miles downwind
5b	Trotwood, Ohio	10-15 miles downwind
6a	North Dixie Dr. and Little York Dr. (Dayton, Ohio)	15-20 miles downwind
6b	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind
6c	State Route 49 at Clayton, Ohio	15-20 miles downwind

Table 10 (continued)

South Zone

Sample No.	Location	Range
1a	West off State Route 725 between river bridge and railroad (Miamisburg, Ohio)	0-3 miles upwind
1b	Municipal Parking Lot on Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
2a	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
2b	Chautauqua, Ohio	0-3 miles downwind
2c	Miami Drive-In Theater on Cincinnati-Dayton Pike	0-3 miles downwind
3a	State Route 73 and Interstate 75	3-5 miles downwind
3b	State Route 123 and Dayton-Oxford Rd.	3-5 miles downwind
4a	Red Lion, Ohio	5-10 miles downwind
4b	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5a	Lebanon, Ohio	10-15 miles downwind
5b	Monroe, Ohio	10-15 miles downwind
6a	Rt. 48 and Mason Rd.	15-20 miles downwind
6b	Bethany Rd. and Mason Montgomery Rd.	15-20 miles downwind
6c	Bethany, Ohio	15-20 miles downwind

East Zone

1a	Riverview Ave. and Lower Miamisburg Rd. (Miamisburg, Ohio)	0-3 miles upwind
1b	State Route 725 and Union Rd.	0-3 miles upwind
2a	Mound Park	0-3 miles downwind
2b	Benner Rd. and Byers Rd.	0-3 miles downwind

Table 10 (continued)

East Zone

Sample No.	Location	Range
2c	State Route 725 and Interstate 75	0-3 miles downwind
3a	Yankee St. and State Route 725	3-5 miles downwind
3b	Waldruhe Park on Springboro Pike	3-5 miles downwind
4a	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
4b	State Route 48 and Social Row Rd.	5-10 miles downwind
5a	Bellbrook, Ohio	10-15 miles downwind
5b	U.S. 42 and Spring Valley-Paintersville Rd.	10-15 miles downwind
6a	Xenia, Ohio	15-20 miles downwind
6b	Spring Valley-Paintersville Rd. and State Route 380	15-20 miles downwind
6c	Mt. Holly, Ohio	15-20 miles downwind

West Zone

1a	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
1b	Maue Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
2a	Miami Drive-In Theater on Cincinnati-Dayton Pike	0-3 miles downwind
2b	Riverview Rd. and Lower Miamisburg Rd.	0-3 miles downwind
2c	Lower Miamisburg Rd. and Jamaica Rd.	0-3 miles downwind
3a	State Route 725 and State Route 4	3-5 miles downwind
3b	Germantown, Ohio	3-5 miles downwind
4a	Manning Rd. and Anthony Rd.	5-10 miles downwind
4b	Oxford Rd. and Browns Run Rd.	5-10 miles downwind

Table 10 (continued)

West Zone

Sample No.	Location	Range
5a	Gratis, Ohio	10-15 miles downwind
5b	Greenbush Rd. and State Route 122	10-15 miles downwind
6a	Eaton, Ohio	15-20 miles downwind
6b	Camden, Ohio	15-20 miles downwind
6c	Somerville, Ohio	15-20 miles downwind

Northeast Zone

1a	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
1b	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles upwind
2a	Harmon Field (Miamisburg, Ohio)	0-3 miles downwind
2b	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
2c	Elm St. and Cincinnati-Dayton Pike (West Carrollton, Ohio)	0-3 miles downwind
3a	Woody's Market on Cincinnati-Dayton Pike (West Carrollton, Ohio)	3-5 miles downwind
3b	Mad River Rd. and Alexandersville-Bellbrook Rd.	3-5 miles downwind
4a	Dorothy Lane and Springboro Pike	5-10 miles downwind
4b	State Route 48 and Stroop Rd.- Town and Country Shopping Center (Kettering Ohio)	5-10 miles downwind
5a	Interstate 75 and Wagner-Ford Rd.	10-15 miles downwind
5b	Belmont Auto Theater, Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind

Table 10 (continued)

Northeast Zone

Sample No.		
6a	State Route 201 and Chambersburg Rd.	15-20 miles downwind
6b	State Route 235 (Fairborn, Ohio)	15-20 miles downwind
6c	New Germany-Trebein Rd. and Fairground Rd.- approximately 3 miles south of previous sample	15-20 miles downwind

Northwest Zone

1a	Mound Ave. and Benner Rd.	0-3 miles upwind
1b	Medlar Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
2a	Cincinnati-Dayton Pike and Mound Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Union Rd. and State Route 725	0-3 miles downwind
2c	State Route 725 and Jamaica Rd.	0-3 miles downwind
3a	Jamaica Rd. and State Route 4	3-5 miles downwind
3b	State Route 4 and Farmersville-West Carrollton Pike	3-5 miles downwind
4a	Diamond Mill Rd. and Mile Rd.	5-10 miles downwind
4b	Farmersville, Ohio	5-10 miles downwind
5a	Clayton Rd. and Providence Rd.	10-15 miles downwind
5b	Farmersville-West Alexandria Pike and DeChant Rd.	10-15 miles downwind
6a	Brookville, Ohio	15-20 miles downwind
6b	Lexington Salem Rd. and Preble County Line Rd.	15-20 miles downwind
6c	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind

Table 10 (continued)

Southeast Zone

Sample No.		
1a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
1b	Union Rd. and State Route 725	0-3 miles upwind
2a	Mound Ave. and Benner Rd.	0-3 miles downwind
2b	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
2c	Mound Park	0-3 miles downwind
3a	Wood Rd. and Pennyroyal Rd.	3-5 miles downwind
3b	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4a	Springboro, Ohio	5-10 miles downwind
4b	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5a	State Route 48 and State Route 73	10-15 miles downwind
5b	Waynesville, Ohio	10-15 miles downwind
6a	State Route 73, 1 mile east of State Route 42	15-20 miles downwind
6b	3 miles east of Harveysburg on State Route 73	15-20 miles downwind
6c	3 miles east of Harveysburg on State Route 73	15-20 miles downwind

Southwest Zone

1a	State Route 725 and Alexandersville Rd.	0-3 miles upwind
1b	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
2a	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles downwind

Table 10 (continued)

Southwest Zone

Sample No.	Location	Range
2b	Farmington Rd. and Chautauqua Rd.	0-3 miles downwind
2c	Farmington Rd. and Union Rd.	0-3 miles downwind
3a	Farmington Rd. and Butter St.	3-5 miles downwind
3b	Carlisle, Ohio	3-5 miles downwind
4a	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
4b	Post Town, Ohio	5-10 miles downwind
5a	State Route 4 and State Route 73	10-15 miles downwind
5b	Jacksonburg, Ohio	10-15 miles downwind
6a	State Route 4 and State Route 747	15-20 miles downwind
6b	New Miami, Ohio	15-20 miles downwind
6c	West Elkton Rd. and Tolbert Rd.	15-20 miles downwind

Table 11

SUMMARY OF AIR SAMPLING LOCATIONS FOR TRITIUM

North Zone

Sample No.	Location	Range
1	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
3	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
4	Dayton Speedway (near intersection of State Route 4 and Liberty-Dayton Rd.)	5-10 miles downwind
5	Trotwood, Ohio	10-15 miles downwind
6	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind

Northeast Zone

1	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
2	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
3	Mad River Rd. and Alexandersville-Bellbrook Rd.)	3-5 miles downwind
4	State Route 48 and Stroop Rd. - Town and Country Shopping Center (Kettering, Ohio)	5-10 miles downwind
5	Belmont Auto Theater - Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind
6	State Route 235 (Fairborn, Ohio)	15-20 miles downwind

East Zone

1	State Route 725 and Union Rd.	0-3 miles upwind
2	Mound Park	0-3 miles downwind

Table 11 (continued)

East Zone

Sample No.	Location	Range
3	Yankee St. and State Route 725	3-5 miles downwind
4	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
5	U. S. 42 and Spring Valley-Paintersville Rd.	10-15 miles downwind
6	Xenia, Ohio	15-20 miles downwind

Southeast Zone

1	Union Rd. and State Route 725	0-3 miles upwind
2	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
3	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5	State Route 48 and State Route 73	10-15 miles downwind
6	Harveysburg, Ohio	15-20 miles downwind

South Zone

1	Municipal Parking Lot on Central Ave.	0-3 miles upwind
2	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
3	State Route 73 and Interstate 75	3-5 miles downwind
4	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5	Monroe, Ohio	10-15 miles downwind
6	Bethany Rd. and Mason-Montgomery Rd.	15-20 miles downwind

Table 11 (continued)

Southwest Zone

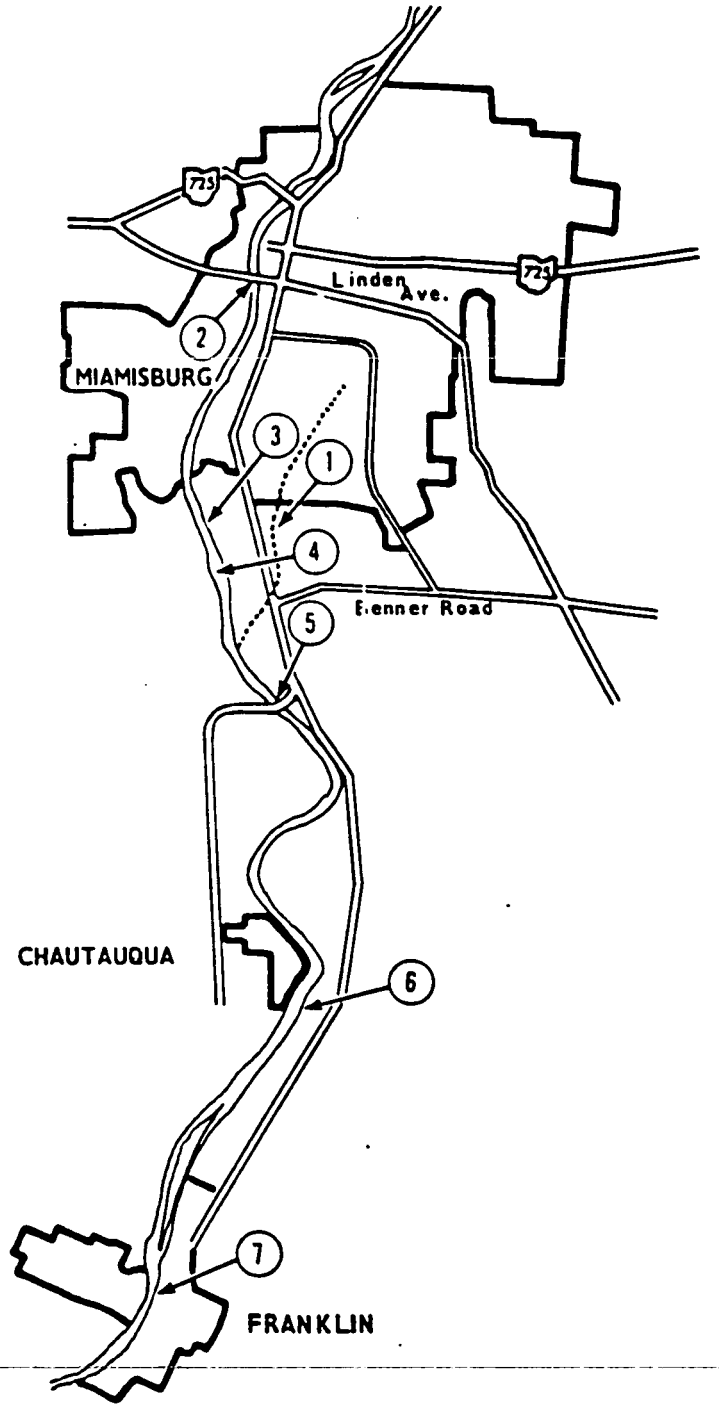
Sample No.	Location	Range
1	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Farmington Rd. and Union Rd.	0-3 miles downwind
3	Farmington Rd. and Butter St.	3-5 miles downwind
4	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
5	Jacksonburg, Ohio	10-15 miles downwind
6	New Miami, Ohio	15-20 miles downwind

West Zone

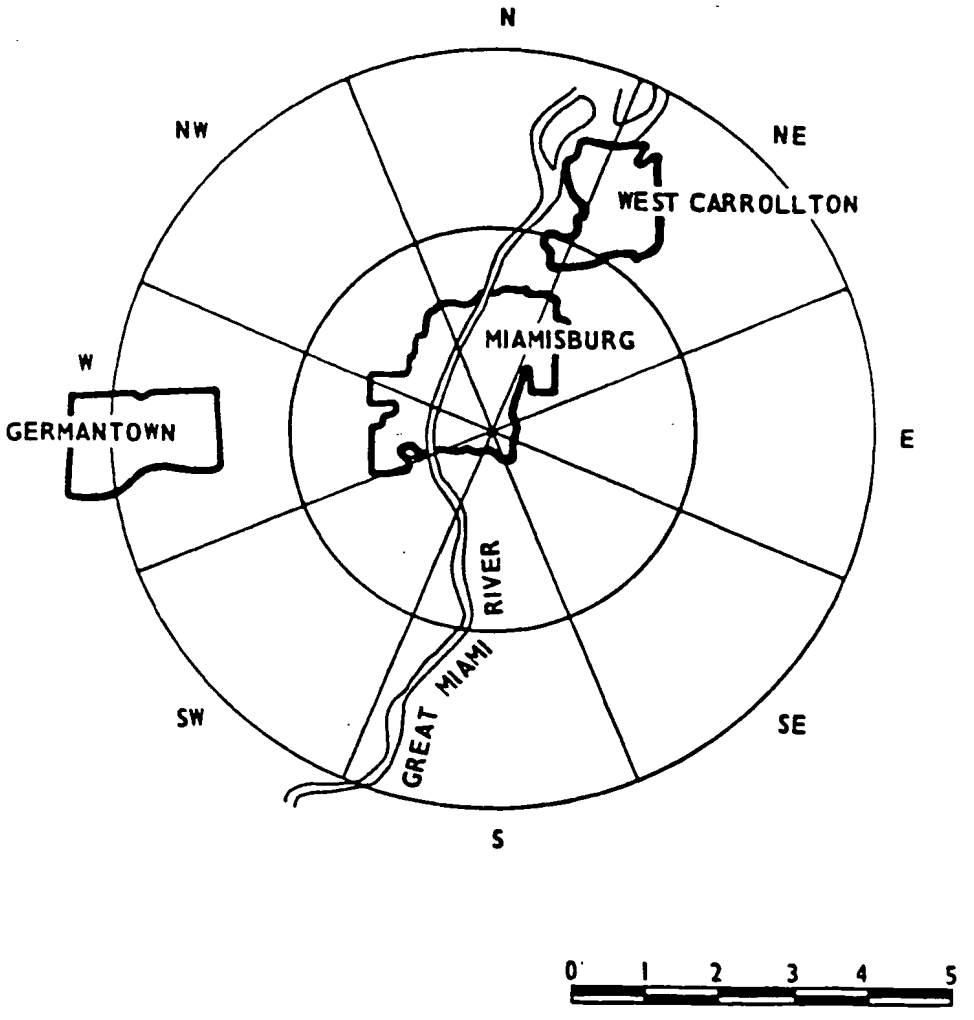
1	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
2	Riverview Rd. and Lower Miamisburg Rd.	0-3 miles downwind
3	Germantown, Ohio	3-5 miles downwind
4	Oxford Rd. and Browns Run Rd.	5-10 miles downwind
5	Gratis, Ohio	10-15 miles downwind
6	Camden, Ohio	15-20 miles downwind

Northwest Zone

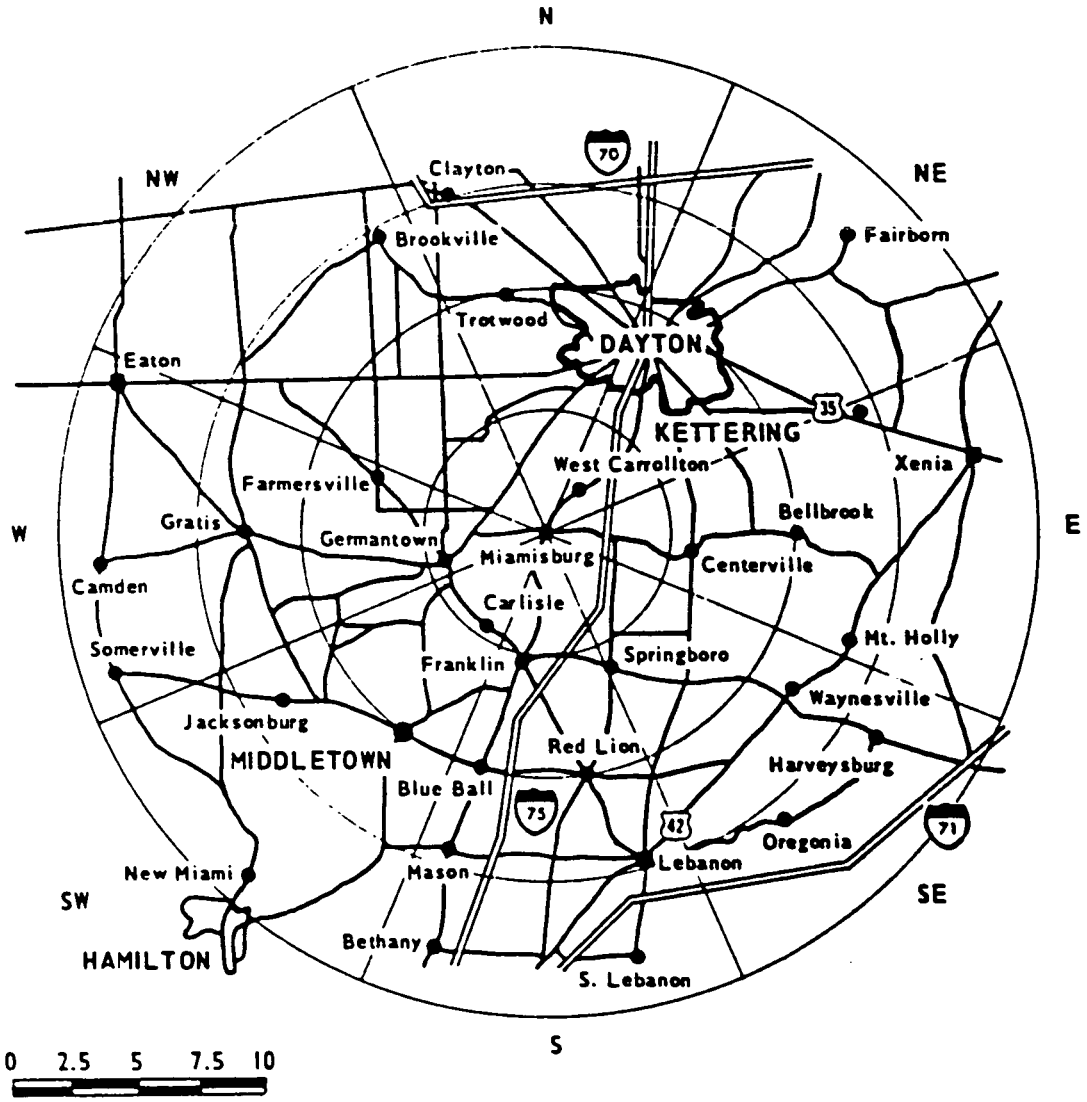
1	Mound Ave. and Benner Rd.	0-3 miles upwind
2	State Route 725 and Jamaica Rd.	0-3 miles downwind
3	Jamaica Rd. and State Route 4	3-5 miles downwind
4	Farmersville, Ohio	5-10 miles downwind
5	Clayton Rd. and Providence Rd.	10-15 miles downwind
6	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind



MAP 1 - Great Miami River sample locations.



MAP 2 - Proximity air sample zones.



MAP 3 - Distant air sample zones.

ENVIRONMENTAL MONITORING REPORT

1967

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

1967

MLM-1425

ENVIRONMENTAL MONITORING REPORT: JANUARY - JUNE, 1967

H. F. Anderson and W. E. Sheehan

AEC Research and Development REPORT

MONSANTO RESEARCH CORPORATION

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MLM-1425
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UC-41 Health and Safety

ENVIRONMENTAL MONITORING REPORT: JANUARY-JUNE, 1967

Prepared by: H. F. Anderson
W. E. Sheehan
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Date: July 17, 1967
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MONSANTO RESEARCH CORPORATION
A Subsidiary of Monsanto Company

MOUND LABORATORY
Miamisburg, Ohio operated for

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio is presented for the first half of 1967. The average concentration of radionuclides from Mound Laboratory in the Great Miami River and in the environmental air (average of all zones) was within the standards specified by the Atomic Energy Commission.

INTRODUCTION

This report is a summary of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program considers all of the projects at Mound Laboratory, and all of the radioisotopes which could be released in the environment. The monitoring procedures and counting techniques are those best suited for the detection and measurement of these radioactive materials.

The Radioactivity Concentration Guide (RCG) values in air and in water for the radionuclides in use at Mound Laboratory are taken from the USAEC Manual, Chapter 0524. The Radioactivity Concentration Guides for environmental air and water for the materials used at Mound Laboratory are:

Polonium-210

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium-238

Air - 7×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Hydrogen-3 (Tritium)

Air - 2×10^{-7} microcuries per cubic centimeter

Water - 3×10^{-3} microcuries per cubic centimeter

LIQUID CONTAMINATION

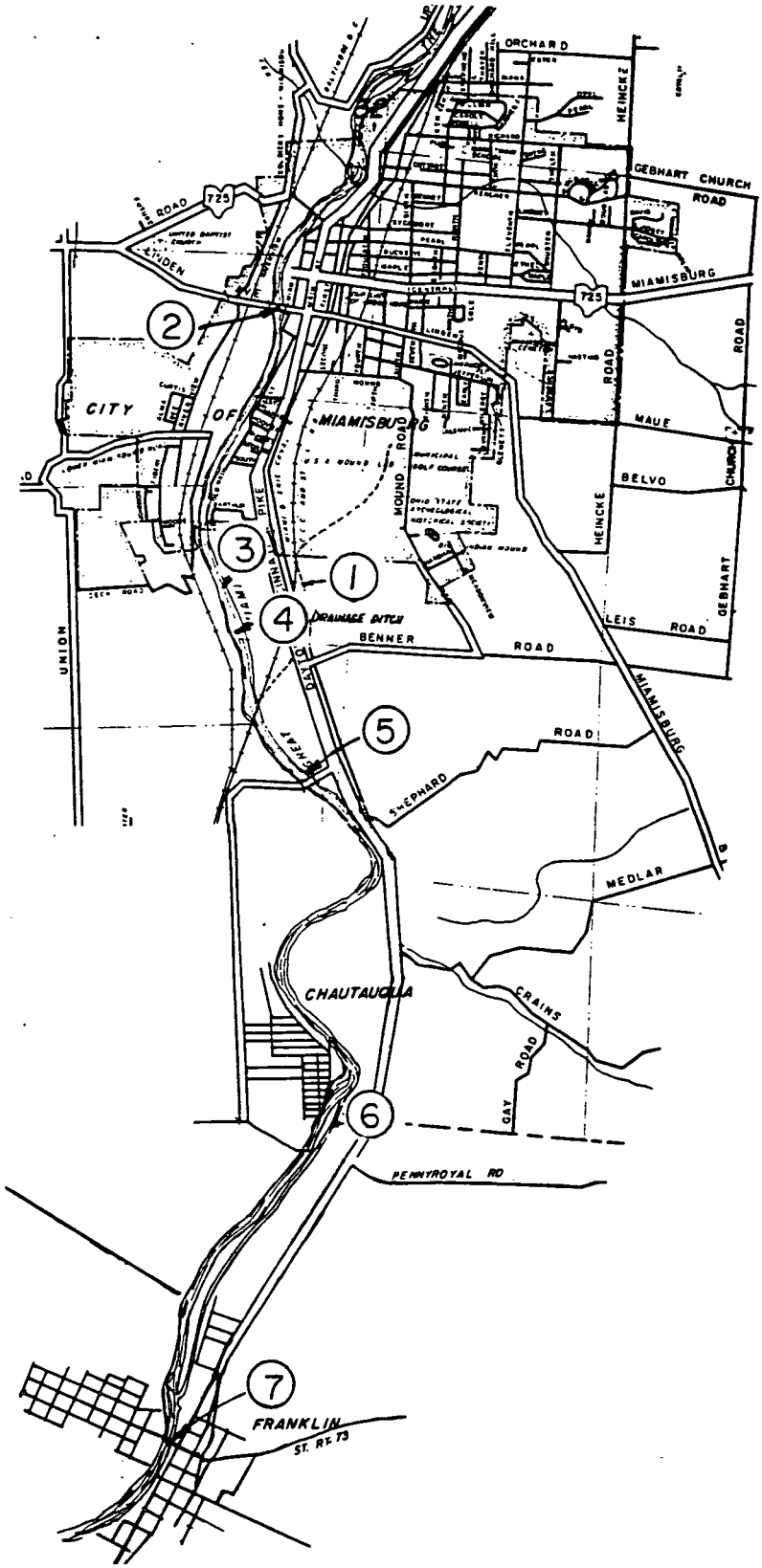
Polonium-Plutonium Liquid radioactive wastes from polonium and plutonium work at the Laboratory are processed separately to reduce the concentration of the radionuclides to a level at which they may be discharged to the environment. Treated polonium liquid waste is discharged directly to the Great Miami River via a closed sewer line which also carries the treated plant sewage. Treated plutonium liquid waste is discharged to a drainage ditch which runs through the plant site and eventually reaches the river.

Tritium Helium-3 being purified at Mound Laboratory contains small quantities of tritium. Liquid waste from this work is treated (diluted with water when necessary) before it is discharged to the drainage ditch. Tritium is being recovered from various AEC tritium-contaminated wastes.

Water Sampling Water samples are collected weekly from the Great Miami River and from the drainage ditch. Samples collected from the river are analyzed for polonium, plutonium and tritium. Samples collected from the drainage ditch are analyzed for plutonium and tritium.

Map 1 shows the location of weekly water sampling points.

The results of the water sampling program are presented in Table 1, Table 2, Table 3, and Table 4. The data presented in these tables indicate that the average concentration of polonium, plutonium, and tritium in environmental water was well below the Radioactivity Concentration Guides for the first half of 1967.



MAP I
GREAT MIAMI RIVER SAMPLE LOCATIONS

Table I

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

January Through June, 1967

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μc/cc)	Average Concentration[a] (10^{-9} μc/cc)	Percent of RCG[b] for Average
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	26	4.50	1.97	0.28
Mound Lab Effluent (location No. 3 on map)	26	900.90	71.20	10.17
250 yards Downstream from Mound Lab Effluent (location No. 4 on map)	26	234.23	13.20	1.89
Chautauqua Road Bridge (location No. 5 on map)	26	3.60	1.87	0.27
Chautauqua Dam (location No. 6 on map)	26	3.60	1.91	0.27
Franklin, Ohio (location No. 7 on map)	25	1.80	1.80	0.26

[a]Lowest detectable limit for polonium in water is 1.80×10^{-9} μc/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide

Table 2

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

January Through June, 1967

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μc/cc)	Average Concentration[a] (10^{-9} μc/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	26	945.94	73.87	1.48
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	16	22.50	6.30	0.13
Mound Lab Effluent (location No. 3 on map)	14	27.00	8.10	0.16
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	17	9.00	4.95	0.10
Chautauqua Road Bridge (location No. 5 on map)	17	22.50	6.75	0.14
Chautauqua Dam (location No. 6 on map)	17	9.00	4.95	0.10
Franklin, Ohio (location No. 7 on map)	17	54.05	7.65	0.15

[a]Lowest detectable limit for plutonium in water is 4.50×10^{-9} μc/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide

Table 3

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

January Through June, 1967

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-3} μc/cc)	Average Concentration[a] (10^{-3} μc/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	26	0.55	0.09	3.00
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	26	0.10	0.05	1.67
Mound Lab Effluent (location No. 3 on map)	26	0.21	0.11	3.67
Chautauqua Road Bridge (location No. 5 on map)	26	0.07	0.05	1.67

[a]Lowest detectable limit for tritium in water is 0.05×10^{-3} μc/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide.

Table 4

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

January Through June, 1967

I. Polonium-210

Number of Samples Collected	Maximum Concentration[a] (10^{-9} μc/cc)	Average Concentration[a] (10^{-9} μc/cc)	Percent of RCG[d] for Average
155	900.90	15.41	2.20

II. Plutonium-238

Number of Samples Collected	Maximum Concentration[b] (10^{-9} μc/cc)	Average Concentration[b] (10^{-9} μc/cc)	Percent of RCG[d] for Average
124	945.94	20.55	0.41

III. Tritium

Number of Samples Collected	Maximum Concentration[c] (10^{-3} μc/cc)	Average Concentration[c] (10^{-3} μc/cc)	Percent of RCG[d] for Average
104	0.55	0.07	2.50

[a] Lowest detectable limit for polonium in water is 1.80×10^{-9} μc/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b] Lowest detectable limit for plutonium in water is 4.50×10^{-9} μc/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[c] Lowest detectable limit for tritium in water is 0.05×10^{-3} μc/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[d] RCG - Radioactivity Concentration Guide.

AIRBORNE CONTAMINATION

Polonium-Plutonium Air which is contaminated with polonium and plutonium particulates is treated by passing it through absolute filters before it is discharged to the environment via several building stacks.

Tritium Air which might be contaminated with gaseous tritium is discharged to the environment via stacks.

Off-Site Air Sampling All environmental air samples are collected weekly to a distance of 20 miles with sampling equipment mounted in a one-ton panel truck. Samples are collected upwind and downwind from the plant according to routes drawn for the different wind directions. The selection of the air sampling zone depends on the wind direction on the days that samples are collected. Since the sampling zone is dependent on the wind direction it is possible that air samples from all zones will not be collected during the reporting period. Maps 2 and 3 show the zones routinely sampled. Table 11 lists the specific location of sampling sites by zone for the polonium and plutonium monitoring program. Table 12 lists the specific location of sampling sites by zone for the tritium monitoring program.

Airborne polonium and plutonium particulates are collected with a high volume air sampler. The filter papers are then processed such that counting results are specific for polonium and plutonium. One fourth of each filter paper is processed by spontaneous deposition to isolate polonium. Plutonium is isolated by processing the remaining three fourths of each filter paper through a resin column.

Airborne tritium is monitored by drawing air through a calcium chloride drying tube. The water collected in the sample tube is distilled and analyzed for tritium content.

Beginning January 1, 1967, all particulate air samples collected in the same zone, in the same range, and on the same day are combined before processing and are considered as one sample. This is done to improve the lower detectable limit for plutonium. The use of the word "sample" in Tables 5, 6, 7, and 8 refers to this composite sample made up of the individual filter papers.

The results of the airborne monitoring program are presented in Tables 5, 6, 7, 8, 9, and 10. Tables 6, 8, and 10, show that the average concentration (all zones combined) of plutonium, polonium, and tritium in the environment are below their respective Radioactivity Concentration Guides.

Table 5

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μc/cc)	Average Concentration[a] (10^{-14} μc/cc)	Percent of RCG[b] for Average
		North Zone		
0 - 3 (upwind)	2	3.37	3.26	0.16
0 - 3 (downwind)	1	1.75	1.75	0.09
3 - 5 (downwind)	2	2.45	2.30	0.12
5 - 10 (downwind)	2	4.22	2.51	0.13
10 - 15 (downwind)	2	2.80	2.20	0.11
15 - 20 (downwind)	2	1.87	1.82	0.09
		Northeast Zone		
0 - 3 (upwind)	4	1.74	1.21	0.06
0 - 3 (downwind)	4	1.70	0.90	0.05
3 - 5 (downwind)	4	1.86	1.51	0.08
5 - 10 (downwind)	4	1.97	1.46	0.07
10 - 15 (downwind)	4	2.10	1.49	0.07
15 - 20 (downwind)	4	1.24	0.88	0.04

Table 5 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μc/cc)	Average Concentration[a] (10^{-14} μc/cc)	Percent of RCG[b] for Average
		East Zone		
0 - 3 (upwind)	2	4.66	2.73	0.14
0 - 3 (downwind)	2	0.93	0.73	0.04
3 - 5 (downwind)	2	0.80	0.80	0.04
5 - 10 (downwind)	2	3.39	2.10	0.11
10 - 15 (downwind)	2	1.06	0.93	0.05
15 - 20 (downwind)	2	1.89	1.21	0.06
		Southeast Zone		
0 - 3 (upwind)	5	2.47	1.50	0.08
0 - 3 (downwind)	5	10.47	2.69	0.13
3 - 5 (downwind)	5	1.56	1.16	0.06
5 - 10 (downwind)	5	1.48	1.01	0.05
10 - 15 (downwind)	5	1.73	1.10	0.06
15 - 20 (downwind)	4	0.91	0.72	0.04

Table 5 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μc/cc)	Average Concentration[a] (10^{-14} μc/cc)	Percent of RCG[b] for Average
		South Zone		
0 - 3 (upwind)	1	0.80	0.80	0.04
0 - 3 (downwind)	1	0.53	0.53	0.03
3 - 5 (downwind)	1	0.80	0.80	0.04
5 - 10 (downwind)	1	0.80	0.80	0.04
10 - 15 (downwind)	1	0.80	0.80	0.04
15 - 20 (downwind)	1	0.53	0.53	0.03
		Southwest Zone		
0 - 3 (upwind)	6	2.65	1.37	0.07
0 - 3 (downwind)	6	1.79	0.90	0.05
3 - 5 (downwind)	6	3.81	1.60	0.08
5 - 10 (downwind)	6	2.04	1.46	0.07
10 - 15 (downwind)	6	2.57	1.44	0.07
15 - 20 (downwind)	6	2.65	1.08	0.05

Table 5 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μc/cc)	Average Concentration[a] (10^{-14} μc/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	3	2.85	2.23	0.11
0 - 3 (downwind)	3	2.43	1.35	0.07
3 - 5 (downwind)	3	3.80	2.24	0.11
5 - 10 (downwind)	3	2.74	1.63	0.08
10 - 15 (downwind)	3	3.23	1.96	0.10
15 - 20 (downwind)	3	2.15	1.50	0.08
		Northwest Zone		
0 - 3 (upwind)	1	0.80	0.80	0.04
0 - 3 (downwind)	1	0.53	0.53	0.03
3 - 5 (downwind)	1	5.33	5.33	0.27
5 - 10 (downwind)	1	0.80	0.80	0.04
10 - 15 (downwind)	1	1.06	1.06	0.05
15 - 20 (downwind)	1	0.53	0.53	0.03

[a] Lowest detectable limit for polonium in air is 0.80 x 10^{-14} μc/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.53 x 10^{-14} μc/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 6

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January Through June, 1967

All Zones

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μc/cc)	Average Concentration[a] (10^{-14} μc/cc)	Percent of RCG[b] for Average
0 - 3 (upwind)	24	4.66	1.70	0.09
0 - 3 (downwind)	23	10.47	1.34	0.07
3 - 5 (downwind)	24	5.33	1.69	0.08
5 - 10 (downwind)	24	4.22	1.47	0.07
10 - 15 (downwind)	24	3.23	1.42	0.07
15 - 20 (downwind)	23	2.65	1.07	0.05

[a]Lowest detectable limit for polonium in air is 0.80 x 10^{-14} μc/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind, and 10-15 miles downwind. The LDL is 0.53 x 10^{-14} μc/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b]RCG - Radioactivity Concentration Guide.

Table 7

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μc/cc)	Average Concentration[a] (10^{-14} μc/cc)	Percent of RCG[b] for Average
		North Zone		
0 - 3 (upwind)	2	1.40	1.24	17.71
0 - 3 (downwind)	2	2.40	1.73	24.71
3 - 5 (downwind)	2	5.79	3.06	43.71
5 - 10 (downwind)	2	0.53	0.41	5.86
10 - 15 (downwind)	2	5.62	3.17	45.28
15 - 20 (downwind)	2	0.28	0.25	3.57
		Northeast Zone		
0 - 3 (upwind)	4	0.38	0.28	4.00
0 - 3 (downwind)	4	0.14	0.10	1.43
3 - 5 (downwind)	4	0.27	0.20	2.86
5 - 10 (downwind)	4	0.40	0.20	2.86
10 - 15 (downwind)	4	0.17	0.15	2.14
15 - 20 (downwind)	4	0.32	0.22	3.14

Table 7 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μc/cc)	Average Concentration[a] (10^{-14} μc/cc)	Percent of RCG[b] for Average
		East Zone		
0 - 3 (upwind)	2	0.28	0.24	3.43
0 - 3 (downwind)	2	0.36	0.24	3.43
3 - 5 (downwind)	2	0.83	0.48	6.86
5 - 10 (downwind)	2	0.22	0.21	3.00
10 - 15 (downwind)	2	0.32	0.29	4.14
15 - 20 (downwind)	2	0.11	0.11	1.57
		Southeast Zone		
0 - 3 (upwind)	5	0.86	0.42	6.00
0 - 3 (downwind)	5	12.17	2.83	40.43
3 - 5 (downwind)	5	0.81	0.31	4.43
5 - 10 (downwind)	5	0.55	0.25	3.57
10 - 15 (downwind)	5	0.98	0.39	5.57
15 - 20 (downwind)	5	2.38	0.80	11.43

Table 7 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μc/cc)	Average Concentration[a] (10^{-14} μc/cc)	Percent of RCG[b] for Average
		South Zone		
0 - 3 (upwind)	1	0.16	0.16	2.28
0 - 3 (downwind)	1	0.15	0.15	2.14
3 - 5 (downwind)	1	0.13	0.13	1.86
5 - 10 (downwind)	--	--	--	--
10 - 15 (downwind)	1	0.33	0.33	4.71
15 - 20 (downwind)	1	0.10	0.10	1.43
		Southwest Zone		
0 - 3 (upwind)	7	2.84	0.79	11.28
0 - 3 (downwind)	7	1.03	0.39	5.57
3 - 5 (downwind)	7	4.51	1.01	14.43
5 - 10 (downwind)	7	1.11	0.59	8.43
10 - 15 (downwind)	7	0.53	0.25	3.57
15 - 20 (downwind)	7	0.60	0.30	4.28

Table 7 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μc/cc)	Average Concentration[a] (10^{-14} μc/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	3	28.22	9.49	135.57
0 - 3 (downwind)	3	4.98	1.99	28.43
3 - 5 (downwind)	3	2.33	0.96	13.71
5 - 10 (downwind)	3	0.24	0.19	2.71
10 - 15 (downwind)	3	0.21	0.17	2.43
15 - 20 (downwind)	3	0.49	0.22	3.14
		Northwest Zone		
0 - 3 (upwind)	1	0.32	0.32	4.57
0 - 3 (downwind)	1	1.04	1.04	14.86
3 - 5 (downwind)	1	0.47	0.47	6.71
5 - 10 (downwind)	1	0.17	0.17	2.43
10 - 15 (downwind)	1	0.63	0.63	9.00
15 - 20 (downwind)	1	0.11	0.11	1.57

[a]Lowest detectable limit for plutonium in air is 0.13×10^{-14} μc/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.09×10^{-14} μc/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b]RCG - Radioactivity Concentration Guide.

Table 8

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

January Through June, 1967

All Zones

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μc/cc)	Average Concentration[a] (10^{-14} μc/cc)	Percent of RCG[b] for Average
0 - 3 (upwind)	25	28.22	1.62	23.14
0 - 3 (downwind)	25	12.17	1.14	16.28
3 - 5 (downwind)	25	5.79	0.80	11.43
5 - 10 (downwind)	24	1.11	0.34	4.86
10 - 15 (downwind)	25	5.62	0.51	7.28
15 - 20 (downwind)	25	2.38	0.34	4.86

[a] Lowest detectable limit for plutonium in air is 0.13×10^{-14} μc/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.09×10^{-14} μc/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 9

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μc/cc)	Average Concentration[a] (10^{-9} μc/cc)	Percent of RCG[b] for Average
		North Zone		
0 - 3 (upwind)	3	8.00	8.00	4.00
0 - 3 (downwind)	3	11.06	9.02	4.51
3 - 5 (downwind)	3	8.00	8.00	4.00
5 - 10 (downwind)	3	8.00	8.00	4.00
10 - 15 (downwind)	3	8.00	8.00	4.00
15 - 20 (downwind)	2	8.00	8.00	4.00
		Northeast Zone		
0 - 3 (upwind)	2	8.00	8.00	4.00
0 - 3 (downwind)	2	12.79	10.40	5.20
3 - 5 (downwind)	2	8.00	8.00	4.00
5 - 10 (downwind)	2	8.00	8.00	4.00
10 - 15 (downwind)	2	8.00	8.00	4.00
15 - 20 (downwind)	2	8.57	8.29	4.14

Table 9 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μc/cc)	Average Concentration[a] (10^{-9} μc/cc)	Percent of RCG[b] for Average
		South Zone		
0 - 3 (upwind)	3	8.00	8.00	4.00
0 - 3 (downwind)	3	8.00	8.00	4.00
3 - 5 (downwind)	3	8.00	8.00	4.00
5 - 10 (downwind)	3	8.00	8.00	4.00
10 - 15 (downwind)	3	8.00	8.00	4.00
15 - 20 (downwind)	0	- -	- -	- -
		Southwest Zone		
0 - 3 (upwind)	1	8.00	8.00	4.00
0 - 3 (downwind)	1	8.00	8.00	4.00
3 - 5 (downwind)	1	8.00	8.00	4.00
5 - 10 (downwind)	1	8.00	8.00	4.00
10 - 15 (downwind)	1	8.00	8.00	4.00
15 - 20 (downwind)	0	- -	- -	- -

Table 9 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μc/cc)	Average Concentration[a] (10^{-9} μc/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	2	8.00	8.00	4.00
0 - 3 (downwind)	2	8.00	8.00	4.00
3 - 5 (downwind)	2	8.00	8.00	4.00
5 - 10 (downwind)	2	8.00	8.00	4.00
10 - 15 (downwind)	2	8.00	8.00	4.00
15 - 20 (downwind)	0	- -	- -	- -
		Northwest Zone		
0 - 3 (upwind)	1	8.00	8.00	4.00
0 - 3 (downwind)	1	8.00	8.00	4.00
3 - 5 (downwind)	0	- -	- -	- -
5 - 10 (downwind)	1	8.00	8.00	4.00
10 - 15 (downwind)	1	8.00	8.00	4.00
15 - 20 (downwind)	1	8.00	8.00	4.00

Table 9 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January Through June, 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μc/cc)	Average Concentration[a] (10^{-9} μc/cc)	Percent of RCG[b] for Average
		East Zone		
0 - 3 (upwind)	1	8.00	8.00	4.00
0 - 3 (downwind)	1	8.00	8.00	4.00
3 - 5 (downwind)	1	8.00	8.00	4.00
5 - 10 (downwind)	1	8.00	8.00	4.00
10 - 15 (downwind)	0	- -	- -	- -
15 - 20 (downwind)	1	8.00	8.00	4.00

[a] Lowest detectable limit for tritium in air is 8.00×10^{-9} μc/cc. All values which were not detectable were set equal to this value when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 10

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January Through June, 1967

All Zones

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μc/cc)	Average Concentration[a] (10^{-9} μc/cc)	Percent of RCG[b] for Average
0 - 3 (upwind)	13	8.00	8.00	4.00
0 - 3 (downwind)	13	12.79	8.60	4.30
3 - 5 (downwind)	12	8.00	8.00	4.00
5 - 10 (downwind)	13	8.00	8.00	4.00
10 - 15 (downwind)	12	8.00	8.00	4.00
15 - 20 (downwind)	6	8.57	8.10	4.05

[a]Lowest detectable limit for tritium in air is 8.00×10^{-9} μc/cc. All values which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide.

Table 11

SUMMARY OF AIR SAMPLING LOCATIONS FOR POLONIUM AND PLUTONIUM

North Zone

Sample No.	Location	Range
1a	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
1b	Mound Rd. and Benner Rd. (Miamisburg, Ohio)	0-3 miles upwind
2a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Upper River Rd. and Soldiers Home-Miamisburg Rd.	0-3 miles downwind
2c	One mile north on Upper River Rd. from previous sample	0-3 miles downwind
3a	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
3b	Union Rd. and Bear Creek Rd. (after 6/1/67, Union Rd. and Farmersville-West Carrollton Rd.)	3-5 miles downwind
4a	Dayton Speedway (near intersection of State Route 4 and Liberty Dayton Rd.)	5-10 miles downwind
4b	Union Rd. and Liberty Dayton Rd.	5-10 miles downwind
5a	Siebenthaler Ave. and North Dixie Dr. (Dayton, Ohio)	10-15 miles downwind
5b	Trotwood, Ohio	10-15 miles downwind
6a	Murlin Heights on North Dixie Dr. (Dayton, Ohio) (after 6/1/67, North Dixie Dr. and Little York Dr.)	15-20 miles downwind
6b	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind
6c	State Route 49 at Clayton, Ohio	15-20 miles downwind

South Zone

1a	West off State Route 725 between river bridge and railroad (Miamisburg, Ohio)	0-3 miles upwind
1b	First St. and Central Ave. (Miamisburg, Ohio) (after 6/1/67, Municipal Parking Lot on Central Ave.)	0-3 miles upwind
2a	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
2b	Chautauqua, Ohio	0-3 miles downwind
2c	Cincinnati-Dayton Pike at south city limits of Miamisburg, Ohio (after 6/1/67, Miami Drive-In Theater on Cincinnati-Dayton Pike)	0-3 miles downwind
3a	State Route 73 and Interstate 75	3-5 miles downwind
~~3b~~	~~State Route 123 and Dayton-Oxford Rd.~~	3-5 miles downwind
4a	Red Lion, Ohio	5-10 miles downwind
4b	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5a	Lebanon, Ohio	10-15 miles downwind

Table 11 (continued)

Sample No.	Location	Range
	South Zone	
5b	Monroe, Ohio	10-15 miles downwind
6a	South Lebanon, Ohio (after 6/1/67, Rt. 48 and Mason Rd.)	15-20 miles downwind
6b	Bethany Rd. and Mason Montgomery Rd.	15-20 miles downwind
6c	Bethany, Ohio	15-20 miles downwind
	East Zone	
1a	Riverview Ave. and Lower Miamisburg Rd. (Miamisburg, Ohio)	0-3 miles upwind
1b	Lower Miamisburg Rd. and Union Rd. (after 6/1/67, State Route 725 and Union Rd.)	0-3 miles upwind
2a	Maue Rd. and Linden Ave. (Miamisburg, Ohio) (after 6/1/67, Mound Park)	0-3 miles downwind
2b	Byers Rd. and Belvo Rd. (after 6/1/67, Benner Rd. and Byers Rd.)	0-3 miles downwind
2c	State Route 725 and Interstate 75	0-3 miles downwind
3a	Yankee St. and State Route 725	3-5 miles downwind
3b	Waldruhe Park on Springboro Pike	3-5 miles downwind
4a	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
4b	State Route 48 and Social Row Rd.	5-10 miles downwind
5a	Bellbrook, Ohio	10-15 miles downwind
5b	State Route 725 and U.S. 42 (after 6/1/67, U.S. 42 and Spring Valley-Paintersville Rd.)	10-15 miles downwind
6a	Xenia, Ohio	15-20 miles downwind
6b	Spring Valley-Paintersville Rd. and State Route 380	15-20 miles downwind
6c	Mt. Holly, Ohio	15-20 miles downwind
	West Zone	
1a	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
1b	Maue Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
2a	Cincinnati-Dayton Pike at south city limits of Miamisburg (after 6/1/67, Miami Drive-In Theater on Cincinnati-Dayton Pike)	0-3 miles downwind
2b	Lower Miamisburg Rd. and Union Rd. (after 6/1/67, Riverview Rd. and Lower Miamisburg Rd.)	0-3 miles downwind
2c	Lower Miamisburg Rd. and Jamaica Rd.	0-3 miles downwind
3a	State Route 725 and State Route 4	3-5 miles downwind

Table 11 (continued)

West Zone

Sample No.	Location	Range
3b	Germantown, Ohio	3-5 miles downwind
4a	Manning Rd. and Farmersville-Johnsville Rd. (after 6/1/67, Manning Rd. and Anthony Rd.)	5-10 miles downwind
4b	Oxford Rd. and Browns Run Rd.	5-10 miles downwind
5a	Gratis, Ohio	10-15 miles downwind
5b	Greenbush Rd. and State Route 122	10-15 miles downwind
6a	Eaton, Ohio	15-20 miles downwind
6b	Camden, Ohio	15-20 miles downwind
6c	Somerville, Ohio	15-20 miles downwind

Northeast Zone

1a	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
1b	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles upwind
2a	Harmon Field (Miamisburg, Ohio)	0-3 miles downwind
2b	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
2c	Elm St. and Cincinnati-Dayton Pike (West Carrollton, Ohio)	0-3 miles downwind
3a	Woody's Market on Cincinnati-Dayton Pike (West Carrollton, Ohio)	3-5 miles downwind
3b	Yankee St. and Mad River Rd. (after 6/1/67, Mad River Rd. and Alexandersville-Bellbrook Rd.	3-5 miles downwind
4a	Springboro Pike and Dryden Rd. (Village of Moraine, Ohio) (after 6/1/67, Dorothy Lane and Springboro Pike)	5-10 miles downwind
4b	State Route 48 and Stroop Rd. - Town and Country Shopping Center - (Kettering, Ohio)	5-10 miles downwind
5a	Interstate 75 and Wagner-Ford Rd.	10-15 miles downwind
5b	Belmont Auto Theater, Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind
6a	State Route 201 and Chambersburg Rd.	15-20 miles downwind
6b	State Route 235 (Fairborn, Ohio)	15-20 miles downwind
6c	New Germany-Trebein Rd. and Fairground Rd. - approximately 3 miles south of previous sample	15-20 miles downwind

Northwest Zone

1a	Mound Ave. and Benner Rd.	0-3 miles upwind
1b	Medlar Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind

Table 11 (continued)

Northwest Zone

Sample No.	Location	Range
2a	Cincinnati-Dayton Pike and Mound Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Union Rd. and State Route 725	0-3 miles downwind
2c	Union Rd. and Manning Rd. (after 6/1/67, State Route 725 and Jamaica Rd.)	0-3 miles downwind
3a	State Route 4 and Manning Rd. (after 6/1/67, Jamaica Rd. and State Route 4)	3-5 miles downwind
3b	State Route 4 and Farmersville-West Carrollton Pike	3-5 miles downwind
4a	Diamond Mill Rd. and Mile Rd.	5-10 miles downwind
4b	Farmersville, Ohio	5-10 miles downwind
5a	Clayton Rd. and Amity Rd. (after 6/1/67, Clayton Rd. and Providence Rd.)	10-15 miles downwind
5b	Farmersville-West Alexandria Pike and DeChant Rd.	10-15 miles downwind
6a	Brookville, Ohio	15-20 miles downwind
6b	Lexington Salem Rd. and Preble County Line Rd.	15-20 miles downwind
6c	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind

Southeast Zone

1a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
1b	Union Rd. and State Route 725	0-3 miles upwind
2a	Mound Ave. and Benner Rd.	0-3 miles downwind
2b	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
2c	Medlar Rd. and Miamisburg-Springboro Pike (after 6/1/67, Mound Park)	0-3 miles downwind
3a	Wood Rd. and Pennyroyal Rd.	3-5 miles downwind
3b	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4a	Springboro, Ohio	5-10 miles downwind
4b	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5a	State Route 122 and Utica Rd. (after 6/1/67, State Route 48 and State Route 73)	10-15 miles downwind
5b	Waynesville, Ohio	10-15 miles downwind
6a	Oregonia, Ohio (after 6/1/67, State Route 73, 1 mile east of State Route 42)	15-20 miles downwind
6b	Harveysburg, Ohio (after 6/1/67, 3 miles east of Harveysburg on State Route 73)	15-20 miles downwind
6c	After 6/1/67, 3 miles east of Harveysburg on State Route 73	15-20 miles downwind

Table 11 (continued)

Southwest Zone

Sample No.	Location	Range
1a	State Route 725 and Alexandersville Rd.	0-3 miles upwind
1b	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
2a	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles downwind
2b	Farmington Rd. and Chautauqua Rd.	0-3 miles downwind
2c	Farmington Rd. and Union Rd.	0-3 miles downwind
3a	Farmington Rd. and Butter St.	3-5 miles downwind
3b	Carlisle, Ohio	3-5 miles downwind
4a	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
4b	Hetzler Rd. and Hinkle Rd. (after 6/1/67, Post Town, Ohio)	5-10 miles downwind
5a	State Route 4 and State Route 73	10-15 miles downwind
5b	Jacksonburg, Ohio	10-15 miles downwind
6a	State Route 4 and State Route 747	15-20 miles downwind
6b	New Miami, Ohio	15-20 miles downwind
6c	West Elkton Rd. and Tolbert Rd.	15-20 miles downwind

Table 12

SUMMARY OF AIR SAMPLING LOCATION FOR TRITIUM

North Zone

Sample No.	Location	Range
1	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
3	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
4	Dayton Speedway (near intersection of State Route 4 and Liberty-Dayton Rd.)	5-10 miles downwind
5	Trotwood, Ohio	10-15 miles downwind
6	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind

Northeast Zone

1	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
2	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
3	Yankee St. and Mad River Rd. (after 6/1/67, Mad River Rd. and Alexandersville-Bellbrook Rd.)	3-5 miles downwind
4	State Route 48 and Stroop Rd. - Town and Country Shopping Center (Kettering, Ohio)	5-10 miles downwind
5	Belmont Auto Theater - Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind
6	State Route 235 (Fairborn, Ohio)	15-20 miles downwind

East Zone

1	Lower Miamisburg Rd. and Union Rd. (after 6/1/67, State Route 725 and Union Rd.)	0-3 miles upwind
2	Maue Rd. and Linden Ave. (Miamisburg, Ohio) (after 6/1/67, Mound Park)	0-3 miles downwind
3	Yankee St. and State Route 725	3-5 miles downwind
4	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
5	State Route 725 and U.S. 42 (after 6/1/67, U.S. 42 and Spring Valley-Paintersville Rd.	10-15 miles downwind
6	Xenia, Ohio	15-20 miles downwind

Southeast Zone

1	Union Rd. and State Route 725	0-3 miles upwind
2	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind

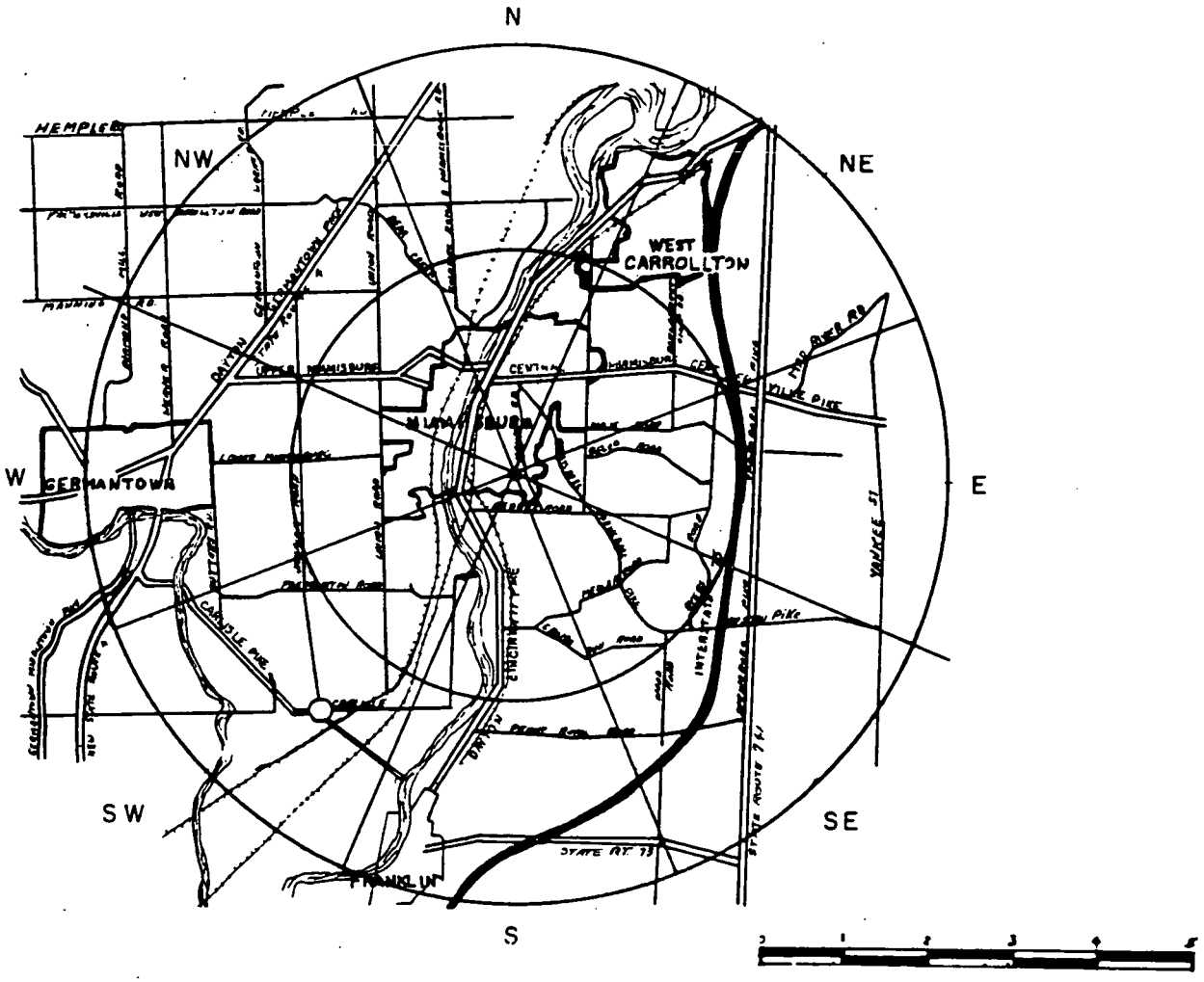
Table 12 (continued)

Sample No.	Location	Range
	Southeast Zone	
3	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5	State Route 122 and Utica Rd. (after 6/1/67, State Route 48 and State Route 73)	10-15 miles downwind
6	Harveysburg, Ohio	15-20 miles downwind
	South Zone	
1	Fifth St. and Central Ave. (Miamisburg, Ohio) (after 6/1/67, Municipal Parking Lot on Central Ave.)	0-3 miles upwind
2	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
3	State Route 73 and Interstate 75	3-5 miles downwind
4	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5	Monroe, Ohio	10-15 miles downwind
6	Bethany Rd. and Mason-Montgomery Rd.	15-20 miles downwind
	Southwest Zone	
1	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Farmington Rd. and Union Rd.	0-3 miles downwind
3	Farmington Rd. and Butter St.	3-5 miles downwind
4	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
5	Jacksonburg, Ohio	10-15 miles downwind
6	New Miami, Ohio	15-20 miles downwind
	West Zone	
1	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
2	Lower Miamisburg Rd. and Union Rd. (after 6/1/67, Riverview Rd. and Lower Miamisburg Rd.)	0-3 miles downwind
3	Germantown, Ohio	3-5 miles downwind
4	Oxford Rd. and Browns Run Rd.	5-10 miles downwind
5	Gratis, Ohio	10-15 miles downwind
6	Camden, Ohio	15-20 miles downwind

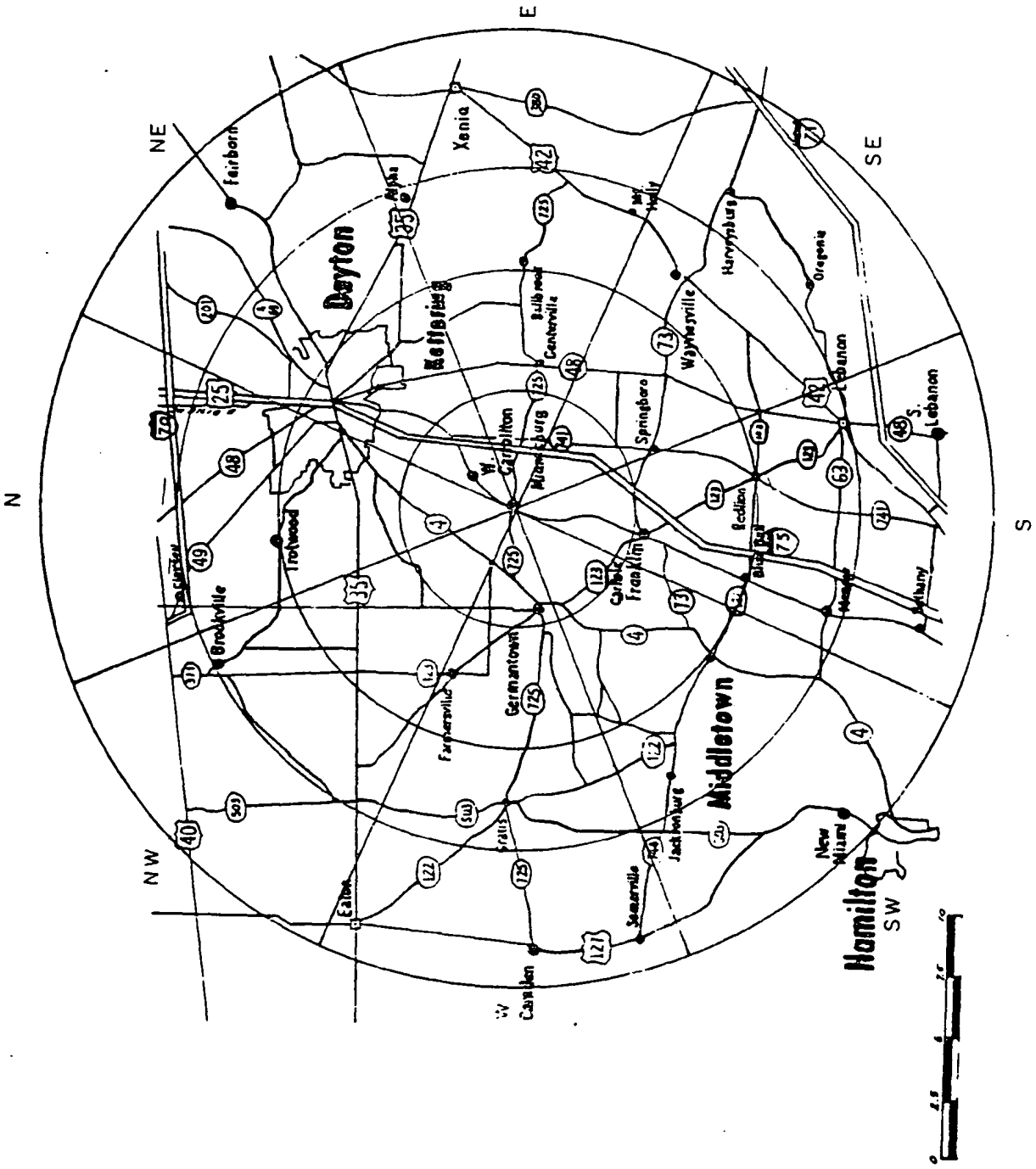
Table 12 (continued)

Northwest Zone

Sample No.	Location	Range
1	Mound Ave. and Benner Rd.	0-3 miles upwind
2	Union Rd. and Manning Rd. (after 6/1/67, State Route 725 and Jamaica Rd.)	0-3 miles downwind
3	State Route 4 and Manning Rd. (after 6/1/67, Jamaica Rd. and State Route 4)	3-5 miles downwind
4	Farmersville, Ohio	5-10 miles downwind
5	Clayton Rd. and Amity Rd. (after 6/1/67, Clayton Rd. and Providence Rd.)	10-15 miles downwind
6	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind



MAP 2
PROXIMITY AIR SAMPLE ZONES



MAP 3
DISTANT AIR SAMPLE ZONES

MLM-1464

ENVIRONMENTAL MONITORING REPORT: JULY–DECEMBER 1967 AND 1967 SUMMARY

H. F. Anderson and W. E. Sheehan

AEC Research and Development REPORT

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

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MLM-1464
TID-4500
UC-41 Health and Safety

ENVIRONMENTAL MONITORING REPORT: JULY–DECEMBER 1967 AND 1967 SUMMARY

Prepared by: H. F. Anderson
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Date: January 15, 1968

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A Subsidiary of Monsanto Company

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ABSTRACT

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, is presented for the second half of 1967, and a summary is presented for the entire year. The average concentration of radionuclides from Mound Laboratory in the Great Miami River and in the environmental air (average of all zones) was within the standards specified by the Atomic Energy Commission.

INTRODUCTION

This report is a summary of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program considers all of the projects at Mound Laboratory and all of the radioisotopes which could be released into the environment. The monitoring procedures and counting techniques are those best suited for the detection and measurement of these radioactive materials.

The Radioactivity Concentration Guide (RCG) values in air and in water for the radionuclides in use at Mound Laboratory are taken from the USAEC Manual, Chapter 0524. The Radioactivity Concentration Guides for environmental air and water for the materials used at Mound Laboratory are:

Polonium-210

Air: 2×10^{-11} microcuries per cubic centimeter (μCi/cc)
Water: 7×10^{-7} microcuries per cubic centimeter (μCi/cc)

Plutonium-238

Air: 7×10^{-14} microcuries per cubic centimeter (μCi/cc)
Water: 5×10^{-6} microcuries per cubic centimeter (μCi/cc)

Hydrogen-3 (Tritium)

Air: 2×10^{-7} microcuries per cubic centimeter (μCi/cc)
Water: 3×10^{-3} microcuries per cubic centimeter (μCi/cc)

LIQUID CONTAMINATION

Polonium-Plutonium Liquid radioactive wastes from polonium and plutonium work at the Laboratory are processed separately to reduce the concentration of these radionuclides to a level at which they may be discharged to the environment. Treated polonium liquid waste is discharged to the Great Miami River via a closed sewer line which also carries the treated plant sewage. The treated plutonium waste is discharged to a drainage ditch which runs through the plant site and eventually reaches the river.

Tritium Helium-3 being purified at Mound Laboratory contains small quantities of tritium. In addition, tritium is being recovered from various AEC tritium-contaminated wastes. Liquid waste generated by these operations is treated (diluted with water when necessary) and is discharged to the same closed sewer line described above. Some tritium-contaminated liquid wastes are discharged to the drainage ditch which runs through the site and eventually reaches the river.

Water Sampling Water samples are collected weekly from the Great Miami River and from the drainage ditch. Samples collected from the river are analyzed for polonium, plutonium and tritium. Samples collected from the drainage ditch are analyzed for plutonium and tritium.

Map 1 shows the location of weekly water sampling points.

The results of the water sampling program are presented in Table 1, Table 2, and Table 3. The data presented in these tables indicate that the average concentrations of polonium, plutonium and tritium in water discharged to the environment were well below the Radioactivity Concentration Guides.

AIRBORNE CONTAMINATION

Polonium-Plutonium Air which is contaminated with polonium and plutonium particulates is treated by passing it through absolute filters before it is discharged to the environment via several building stacks.

Tritium Air which might be contaminated with gaseous tritium is discharged to the environment via stacks.

Off-Site Air Sampling All environmental air samples are collected weekly to a distance of 20 miles with sampling equipment mounted in a one-ton panel truck. Samples are collected upwind and downwind from the plant according to routes drawn for the different wind directions. The selection of the air sampling zone depends on the wind direction on the days that samples are collected. Since the sampling zone is dependent on the wind direction it is possible that air samples from all zones will not be collected during the reporting period. Maps 2 and 3 show the zones routinely sampled. Results of the air sampling program are presented in Tables 4 to 9. Table 10 lists the specific location of sampling sites by zone for the polonium and plutonium monitoring program. Table 11 lists the specific location of sampling sites by zone for the tritium monitoring program.

Airborne polonium and plutonium particulates are collected with a high volume air sampler. The filter papers are then processed such that counting results are specific for polonium and plutonium. One fourth of each filter paper is processed by spontaneous deposition to isolate polonium. Plutonium is isolated by processing the remaining three fourths of each filter paper through a resin column.

Prior to August 22, 1967, airborne tritium was monitored by drawing air through a calcium chloride drying tube then analyzing the collected moisture for tritium. Beginning August 22, 1967, the procedure was changed to bubbling an air sample through a liquid scintillation counting solution with p-dioxane as the organic solvent. The counting solution is then counted directly in a liquid spectrometer.

Table 1

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

January-June 1967

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} uCi/cc)	Average Concentration[a] (10^{-9} uCi/cc)	Percent of RCG[b] for Average
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	26	4.50	1.97	0.28
Mound Lab Effluent (location No. 3 on map)	26	900.90	71.20	10.17
250 yards Downstream from Mound Lab Effluent (location No. 4 on map)	26	234.23	13.20	1.89
Chautauqua Road Bridge (location No. 5 on map)	26	3.60	1.87	0.27
Chautauqua Dam (location No. 6 on map)	26	3.60	1.91	0.27
Franklin, Ohio (location No. 7 on map)	25	1.80	1.80	0.26
		July-December 1967		
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	1.80	1.80	0.26
Mound Lab Effluent (location No. 3 on map)	23	1180.18	86.89	12.41
250 yards Downstream from Mound Lab Effluent (location No. 4 on map)	23	1.80	1.80	0.26

Table 1 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

July-December 1967

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} µCi/cc)	Average Concentration[a] (10^{-9} µCi/cc)	Percent of RCG[b] for Average
Chautauqua Road Bridge (location No. 5 on map)	23	7.21	2.03	0.29
Chautauqua Dam (location No. 6 on map)	23	4.50	1.94	0.28
Franklin, Ohio (location No. 7 on map)	23	1.80	1.80	0.26
	January-December 1967			
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	49	4.50	1.89	0.27
Mound Lab Effluent (location No. 3 on map)	49	1180.18	78.56	11.22
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	49	234.23	7.85	1.12
Chautauqua Road Bridge (location No. 5 on map)	49	7.21	1.95	0.28
Chautauqua Dam (location No. 6 on map)	49	4.50	1.92	0.27
Franklin, Ohio (location No. 7 on map)	48	1.80	1.80	0.26

[a] Lowest detectable limit for polonium in water is 1.80×10^{-9} µCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.
[b] RCG - Radioactivity Concentration Guide.

Table 2

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

January-June 1967

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	26	945.94	73.87	1.48
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	16	22.50	6.30	0.13
Mound Lab Effluent (location No. 3 on map)	14	27.00	8.10	0.16
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	17	9.00	4.95	0.10
Chautauqua Road Bridge (location No. 5 on map)	17	22.50	6.75	0.14
Chautauqua Dam (location No. 6 on map)	17	9.00	4.95	0.10
Franklin, Ohio (location No. 7 on map)	17	54.05	7.65	0.15
July-December 1967				
Mound Lab Drainage Ditch (location No. 1 on map)	23	23,423.42	1,365.32	27.31
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	324.32	18.47	0.37
Mound Lab Effluent (location No. 3 on map)	23	1,279.28	101.35	2.03

Table 2 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
July-December 1967				
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	23	18.02	5.41	0.11
Chautauqua Road Bridge (location No. 5 on map)	23	207.21	13.51	0.27
Chautauqua Dam (location No. 6 on map)	23	4.50	4.50	0.09
Franklin, Ohio (location No. 7 on map)	23	9.01	4.95	0.10
January-December 1967				
Mound Lab Drainage Ditch (location No. 1 on map)	49	23,423.42	680.06	13.60
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	39	324.32	13.48	0.27
Mound Lab Effluent (location No. 3 on map)	37	1,279.28	66.07	1.32
250 yd Downstream from Mound Lab Effluent (location No. 4 on map)	40	18.02	5.21	0.10
Chautauqua Road Bridge (location No. 5 on map)	40	207.21	10.64	0.21

Table 2 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

January-December 1967

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
Chautauqua Dam (location No. 6 on map)	40	9.00	4.69	0.09
Franklin, Ohio (location No. 7 on map)	40	54.05	6.10	0.12

[a] Lowest detectable limit for plutonium in water is 4.50×10^{-9} μCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.
[b] RCG - Radioactivity Concentration Guide.

Table 3

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-3} μCi/cc)	Average Concentration[a] (10^{-3} μCi/cc)	Percent of RCG[b] for Average
January-June 1967				
Mound Lab Drainage Ditch (location No. 1 on map)	26	0.55	0.09	3.00
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	26	0.10	0.05	1.67
Mound Lab Effluent (location No. 3 on map)	26	0.21	0.11	3.67
Chautauqua Road Bridge (location No. 5 on map)	26	0.07	0.05	1.67
July-December 1967				
Mound Lab Drainage Ditch (location No. 1 on map)	23	1.80	0.22	7.33
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	0.63	0.08	2.67
Mound Lab Effluent (location No. 3 on map)	23	16.00	0.97	32.33
Chautauqua Road Bridge (location No. 5 on map)	23	0.08	0.05	1.67
January-December 1967				
Mound Lab Drainage Ditch (location No. 1 on map)	49	1.80	0.15	5.00

Table 3 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

January-December 1967

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-3} μCi/cc)	Average Concentration[a] (10^{-3} μCi/cc)	Percent of RCG[b] for Average
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	49	0.63	0.06	2.00
Mound Lab Effluent (location No. 3 on map)	49	16.00	0.51	17.00
Chautauqua Road Bridge (location No. 5 on map)	49	0.08	0.05	1.67

[a] Lowest detectable limit for tritium in water is 0.05×10^{-3} μCi/cc. All samples which were not detectable were set equal to this value when average values were calculated.
[b] RCG-Radioactivity Concentration Guide.

Table 4

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} uCi/cc)	Percent of RCG[b] for Average
		North Zone		
0 - 3 (upwind)	3	3.86	2.97	0.15
0 - 3 (downwind)	3	2.25	1.69	0.08
3 - 5 (downwind)	3	4.00	3.19	0.16
5 - 10 (downwind)	3	4.14	3.72	0.19
10 - 15 (downwind)	3	4.59	4.09	0.20
15 - 20 (downwind)	3	3.66	2.29	0.11
		Northeast Zone		
0 - 3 (upwind)	5	3.58	2.87	0.14
0 - 3 (downwind)	5	3.20	2.54	0.13
3 - 5 (downwind)	5	4.09	2.93	0.15
5 - 10 (downwind)	5	4.19	3.15	0.16
10 - 15 (downwind)	5	3.36	2.88	0.14
15 - 20 (downwind)	5	2.26	1.93	0.10

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} uCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		East Zone		
0 - 3 (upwind)	5	1.95	1.07	0.05
0 - 3 (downwind)	5	1.26	1.12	0.06
3 - 5 (downwind)	5	3.48	1.99	0.10
5 - 10 (downwind)	5	3.29	1.69	0.08
10 - 15 (downwind)	5	2.82	1.42	0.07
15 - 20 (downwind)	5	2.24	1.02	0.05
		Southeast Zone		
0 - 3 (upwind)	0			
0 - 3 (downwind)	0			
3 - 5 (downwind)	0	No samples were collected in this zone during the second half of 1967 because the prevailing winds were not out of the northwest on the days air samples were collected.		
5 - 10 (downwind)	0			
15 - 20 (downwind)	0			

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		South Zone		
0 - 3 (upwind)	1	3.62	3.62	0.18
0 - 3 (downwind)	1	1.90	1.90	0.10
3 - 5 (downwind)	1	0.80	0.80	0.04
5 - 10 (downwind)	1	2.24	2.24	0.11
10 - 15 (downwind)	1	2.28	2.28	0.11
15 - 20 (downwind)	1	1.08	1.08	0.05
		Southwest Zone		
0 - 3 (upwind)	3	2.26	1.60	0.08
0 - 3 (downwind)	3	1.99	1.72	0.09
3 - 5 (downwind)	3	2.64	2.21	0.11
5 - 10 (downwind)	3	3.84	3.31	0.17
10 - 15 (downwind)	3	2.61	2.03	0.10
15 - 20 (downwind)	3	2.89	1.92	0.10

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	2	66.90	34.25	1.71
0 - 3 (downwind)	2	2.37	1.80	0.09
3 - 5 (downwind)	2	68.92	35.73	1.79
5 - 10 (downwind)	2	9.91	6.62	0.33
10 - 15 (downwind)	2	8.00	4.80	0.24
15 - 20 (downwind)	2	2.94	2.22	0.11
		Northwest Zone		
0 - 3 (upwind)	2	2.54	1.75	0.09
0 - 3 (downwind)	2	1.88	1.20	0.06
3 - 5 (downwind)	2	4.02	2.41	0.12
5 - 10 (downwind)	2	3.46	2.73	0.14
10 - 15 (downwind)	2	1.51	1.33	0.07

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		Northwest Zone		
15 - 20 (downwind)	2	3.03	2.36	0.12

[a] Lowest detectable limit for polonium in air is 0.80×10^{-14} μCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.53×10^{-14} μCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 5

1967 YEARLY SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January-June 1967, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-14} µCi/cc)	Average Concentration[a] (10^{-14} µCi/cc)	Percent of Polonium RCG[b] for Average
0 - 3 (upwind)	24	4.66	1.70	0.09
0 - 3 (downwind)	23	10.47	1.34	0.07
3 - 5 (downwind)	24	5.33	1.69	0.08
5 - 10 (downwind)	24	4.22	1.47	0.07
10 - 15 (downwind)	24	3.23	1.42	0.07
15 - 20 (downwind)	23	2.65	1.07	0.05

July-December 1967, All Zones

0 - 3 (upwind)	21	66.90	5.19	0.26
0 - 3 (downwind)	21	3.20	1.73	0.09
3 - 5 (downwind)	21	68.92	5.61	0.28
5 - 10 (downwind)	21	9.91	3.15	0.16
10 - 15 (downwind)	21	8.00	2.59	0.13
15 - 20 (downwind)	21	3.66	1.79	0.09

Table 5 (continued)

1967 YEARLY SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM

January-December 1967, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of Polonium RCG[b] for Average
0 - 3 (upwind)	45	66.90	3.33	0.17
0 - 3 (downwind)	44	10.47	1.53	0.08
3 - 5 (downwind)	45	68.92	3.52	0.18
5 - 10 (downwind)	45	9.91	2.25	0.11
10 - 15 (downwind)	45	8.00	1.97	0.10
15 - 20 (downwind)	44	3.66	1.41	0.07

[a] Lowest detectable limit for polonium in air is 0.80×10^{-14} μCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind, and 10-15 miles downwind. The LDL is 0.53×10^{-14} μCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 6

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		North Zone		
0 - 3 (upwind)	3	0.89	0.71	10.14
0 - 3 (downwind)	3	0.61	0.46	6.58
3 - 5 (downwind)	3	1.20	0.67	9.57
5 - 10 (downwind)	3	1.15	0.71	10.14
10 - 15 (downwind)	3	0.79	0.61	8.71
15 - 20 (downwind)	3	0.74	0.54	7.71
		Northeast Zone		
0 - 3 (upwind)	5	2.64	1.02	14.57
0 - 3 (downwind)	5	6.05	1.70	24.29
3 - 5 (downwind)	5	7.24	2.11	30.14
5 - 10 (downwind)	5	0.92	0.54	7.71
10 - 15 (downwind)	5	1.02	0.51	7.29
15 - 20 (downwind)	5	2.73	0.82	11.71

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} µCi/cc)	Average Concentration[a] (10^{-14} uCi/cc)	Percent of RCG[b] for Average
		East Zone		
0 - 3 (upwind)	5	0.91	0.53	7.57
0 - 3 (downwind)	5	0.55	0.36	5.14
3 - 5 (downwind)	5	1.01	0.60	8.57
5 - 10 (downwind)	5	1.16	0.54	7.71
10 - 15 (downwind)	5	4.18	1.48	21.14
15 - 20 (downwind)	5	0.84	0.60	8.57
		Southeast Zone		
0 - 3 (upwind)	0			
0 - 3 (downwind)	0			
3 - 5 (downwind)	0	No samples were collected in this zone the second half of 1967 because the prevailing winds were not out of the northwest on the days air samples were collected.		
5 - 10 (downwind)	0			
10 - 15 (downwind)	0			
15 - 20 (downwind)	0			

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		South Zone		
0 - 3 (upwind)	1	0.37	0.37	5.29
0 - 3 (downwind)	1	0.70	0.70	10.00
3 - 5 (downwind)	1	0.31	0.31	4.43
5 - 10 (downwind)	1	0.31	0.31	4.43
10 - 15 (downwind)	1	0.56	0.56	8.00
15 - 20 (downwind)	1	0.24	0.24	3.43
		Southwest Zone		
0 - 3 (upwind)	3	0.66	0.36	5.14
0 - 3 (downwind)	3	2.29	0.96	13.71
3 - 5 (downwind)	3	11.14	3.87	55.29
5 - 10 (downwind)	3	1.42	0.68	9.71
10 - 15 (downwind)	3	9.84	3.73	53.29
15 - 20 (downwind)	3	1.49	0.66	9.43

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} µCi/cc)	Average Concentration[a] (10^{-14} µCi/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	2	1.16	1.10	16.71
0 - 3 (downwind)	2	1.06	0.72	10.29
3 - 5 (downwind)	2	1.52	1.26	18.00
5 - 10 (downwind)	2	0.86	0.78	11.14
10 - 15 (downwind)	2	0.57	0.54	7.71
15 - 20 (downwind)	2	0.55	0.43	6.14
		Northwest Zone		
0 - 3 (upwind)	2	0.64	0.53	7.57
0 - 3 (downwind)	2	0.40	0.31	4.43
3 - 5 (downwind)	2	0.76	0.59	8.43
5 - 10 (downwind)	2	0.81	0.73	10.43
10 - 15 (downwind)	2	0.44	0.29	4.14

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING RESULTS FOR PLUTONIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of RCG[b] for Average
		Northwest Zone		
15 - 20 (downwind)	2	0.18	0.16	2.29

[a] Lowest detectable limit for plutonium in air is 0.13 x 10^{-14} μCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.09 x 10^{-14} μCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 7

1967 YEARLY SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

January-June 1967, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of Plutonium RCG[b] for Average
0 - 3 (upwind)	25	28.22	1.62	23.14
0 - 3 (downwind)	25	12.17	1.14	16.28
3 - 5 (downwind)	25	5.79	0.80	11.43
5 - 10 (downwind)	24	1.11	0.34	4.86
10 - 15 (downwind)	25	5.62	0.51	7.28
15 - 20 (downwind)	25	2.38	0.34	4.86

July-December 1967, All Zones

0 - 3 (upwind)	21	2.64	0.69	9.86
0 - 3 (downwind)	21	6.05	0.82	11.71
3 - 5 (downwind)	21	11.14	1.48	21.14
5 - 10 (downwind)	21	1.42	0.61	8.71
10 - 15 (downwind)	21	9.84	1.20	17.14
15 - 20 (downwind)	21	2.73	0.58	8.29

Table 7 (continued)

1967 YEARLY SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM

January-December 1967, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-14} μCi/cc)	Average Concentration[a] (10^{-14} μCi/cc)	Percent of Plutonium RCG[b] for Average
0 - 3 (upwind)	46	28.22	1.20	17.14
0 - 3 (downwind)	46	12.17	0.99	14.14
3 - 5 (downwind)	46	11.14	1.11	15.86
5 - 10 (downwind)	45	1.42	0.47	6.71
10 - 15 (downwind)	46	9.84	0.83	11.86
15 - 20 (downwind)	46	2.73	0.45	6.43

[a] Lowest detectable limit for plutonium in air is 0.13 x 10^{-14} μCi/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.09 x 10^{-14} μCi/cc for samples collected 0-3 miles downwind and 15-20 miles downwind. All values which were not detectable were set equal to these values when average values were calculated.

[b] RCG - Radioactivity Concentration Guide.

Table 8

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
		North Zone		
0 - 3 (upwind)	3	8.00	8.00	4.00
0 - 3 (downwind)	3	8.00	8.00	4.00
3 - 5 (downwind)	3	8.00	8.00	4.00
5 - 10 (downwind)	3	8.00	8.00	4.00
10 - 15 (downwind)	3	8.00	8.00	4.00
15 - 20 (downwind)	3	8.00	8.00	4.00
		Northeast Zone		
0 - 3 (upwind)	5	9.61	8.32	4.16
0 - 3 (downwind)	4	8.00	8.00	4.00
3 - 5 (downwind)	4	8.00	8.00	4.00
5 - 10 (downwind)	4	8.00	8.00	4.00
10 - 15 (downwind)	4	8.00	8.00	4.00
15 - 20 (downwind)	4	8.00	8.00	4.00

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} µCi/cc)	Average Concentration[a] (10^{-9} µCi/cc)	Percent of RCG[b] for Average
		East Zone		
0 - 3 (upwind)	4	8.00	8.00	4.00
0 - 3 (downwind)	4	8.30	8.07	4.04
3 - 5 (downwind)	4	8.00	8.00	4.00
55 - 10 (downwind)	4	8.00	8.00	4.00
10 - 15 (downwind)	4	8.00	8.00	4.00
15 - 20 (downwind)	4	8.00	8.00	4.00
		Southeast Zone		
0 - 3 (upwind)	0			
0 - 3 (downwind)	0			
3 - 5 (downwind)	0	No samples were collected in this zone the second half of 1967 because the prevailing winds were not out of the northwest on the days air samples were collected.		
5 - 10 (downwind)	0			
10 - 15 (downwind)	0			
15 - 20 (downwind)	0			

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
		South Zone		
0 - 3 (upwind)	1	8.00	8.00	4.00
0 - 3 (downwind)	1	8.00	8.00	4.00
3 - 5 (downwind)	1	8.00	8.00	4.00
5 - 10 (downwind)	1	8.00	8.00	4.00
10 - 15 (downwind)	1	8.00	8.00	4.00
15 - 20 (downwind)	1	8.00	8.00	4.00
		Southwest Zone		
0 - 3 (upwind)	3	8.00	8.00	4.00
0 - 3 (downwind)	3	8.00	8.00	4.00
3 - 5 (downwind)	3	8.00	8.00	4.00
5 - 10 (downwind)	3	8.00	8.00	4.00
10 - 15 (downwind)	3	8.00	8.00	4.00
15 - 20 (downwind)	3	8.00	8.00	4.00

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
		West Zone		
0 - 3 (upwind)	3	25.00	14.65	7.33
0 - 3 (downwind)	3	26.90	16.15	8.08
3 - 5 (downwind)	3	10.55	8.85	4.43
5 - 10 (downwind)	2	10.69	9.34	4.67
10 - 15 (downwind)	1	8.00	8.00	4.00
15 - 20 (downwind)	2	9.40	8.70	4.35
		Northwest Zone		
0 - 3 (upwind)	1	8.00	8.00	4.00
0 - 3 (downwind)	1	8.00	8.00	4.00
3 - 5 (downwind)	1	8.00	8.00	4.00
5 - 10 (downwind)	1	8.00	8.00	4.00
10 - 15 (downwind)	1	8.00	8.00	4.00

Table 8 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

July-December 1967

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
15 - 20 (downwind)	1	8.00	8.00	4.00

[a] Lowest detectable limit for tritium in air is 8.00 x 10^{-9} μCi/cc. All values which were not detectable were set equal to this value when average values were calculated.
[b] RCG - Radioactivity Concentration Guide.

Table 9

1967 YEARLY SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January-June 1967, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-9} µCi/cc)	Average Concentration[a] (10^{-9} µCi/cc)	Percent of RCG[b] for Average
0 - 3 (upwind)	13	8.00	8.00	4.00
0 - 3 (downwind)	13	12.79	8.60	4.30
3 - 5 (downwind)	12	8.00	8.00	4.00
5 - 10 (downwind)	13	8.00	8.00	4.00
10 - 15 (downwind)	12	8.00	8.00	4.00
15 - 20 (downwind)	6	8.57	8.10	4.05

July-December 1967, All Zones

0 - 3 (upwind)	20	25.00	9.08	4.54
0 - 3 (downwind)	19	26.90	9.30	4.65
3 - 5 (downwind)	19	10.55	8.13	4.07
5 - 10 (downwind)	18	10.69	8.15	4.08
10 - 15 (downwind)	17	8.00	8.00	4.00
15 - 20 (downwind)	18	9.40	8.08	4.04

Table 9 (continued)

1967 YEARLY SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

January-December 1967, All Zones

Range (miles)	Number of Samples	Maximum Concentration[a] (10^{-9} μCi/cc)	Average Concentration[a] (10^{-9} μCi/cc)	Percent of RCG[b] for Average
0 - 3 (upwind)	33	25.00	8.65	4.33
0 - 3 (downwind)	32	26.90	9.02	4.51
3 - 5 (downwind)	31	12.79	8.08	4.04
5 - 10 (downwind)	31	10.69	8.09	4.05
10 - 15 (downwind)	29	8.00	8.00	4.00
15 - 20 (downwind)	24	9.40	8.09	4.05

[a] Lowest detectable limit for tritium in air is 8.00×10^{-9} μCi/cc. All values which were not detectable were set equal to this value when average values were calculated.
[b] RCG - Radioactivity Concentration Guide.

Table 10

SUMMARY OF AIR SAMPLING LOCATIONS FOR POLONIUM AND PLUTONIUM

North Zone

Sample No.	Location	Range
1a	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
1b	Mound Rd. and Benner Rd. (Miamisburg, Ohio)	0-3 miles upwind
2a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Upper River Rd. and Soldiers Home-Miamisburg Rd.	0-3 miles downwind
2c	One mile north on Upper River Rd. from previous sample	0-3 miles downwind
3a	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
3b	Union Rd. and Bear Creek Rd. (after 6/1/67, Union Rd. and Farmersville-West Carrollton Rd.)	3-5 miles downwind
4a	Dayton Speedway (near intersection of State Route 4 and Liberty Dayton Rd.)	5-10 miles downwind
4b	Union Rd. and Liberty Dayton Rd.	5-10 miles downwind
5a	Siebenthaler Ave. and North Dixie Dr. (Dayton, Ohio)	10-15 miles downwind
5b	Trotwood, Ohio	10-15 miles downwind
6a	Murlin Heights on North Dixie Dr. (Dayton, Ohio) (after 6/1/67, North Dixie Dr. and Little York Dr.)	15-20 miles downwind
6b	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind
6c	State Route 49 at Clayton, Ohio	15-20 miles downwind

South Zone

1a	West off State Route 725 between river bridge and railroad (Miamisburg, Ohio)	0-3 miles upwind
1b	First St. and Central Ave. (Miamisburg, Ohio) (after 6/1/67, Municipal Parking Lot on Central Ave.)	0-3 miles upwind
2a	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
2b	Chautauqua, Ohio	0-3 miles downwind
2c	Cincinnati-Dayton Pike at south city limits of Miamisburg, Ohio (after 6/1/67, Miami Drive-In Theater on Cincinnati-Dayton Pike)	0-3 miles downwind
3a	State Route 73 and Interstate 75	3-5 miles downwind
3b	State Route 123 and Dayton-Oxford Rd.	3-5 miles downwind
4a	Red Lion, Ohio	5-10 miles downwind
4b	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5a	Lebanon, Ohio	10-15 miles downwind

Table 10 (continued)

South Zone

Sample No.	Location	Range
5b	Monroe, Ohio	10-15 miles downwind
6a	South Lebanon, Ohio (after 6/1/67, Rt. 48 and Mason Rd.)	15-20 miles downwind
6b	Bethany Rd. and Mason Montgomery Rd.	15-20 miles downwind
6c	Bethany, Ohio	15-20 miles downwind

East Zone

1a	Riverview Ave. and Lower Miamisburg Rd. (Miamisburg, Ohio)	0-3 miles upwind
1b	Lower Miamisburg Rd. and Union Rd. (after 6/1/67, State Route 725 and Union Rd.)	0-3 miles upwind
2a	Maue Rd. and Linden Ave. (Miamisburg, Ohio) (after 6/1/67, Mound Park)	0-3 miles downwind
2b	Byers Rd. and Belvo Rd. (after 6/1/67, Benner Rd. and Byers Rd.)	0-3 miles downwind
2c	State Route 725 and Interstate 75	0-3 miles downwind
3a	Yankee St. and State Route 725	3-5 miles downwind
3b	Waldruhe Park on Springboro Pike	3-5 miles downwind
4a	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
4b	State Route 48 and Social Row Rd.	5-10 miles downwind
5a	Bellbrook, Ohio	10-15 miles downwind
5b	State Route 725 and U.S. 42 (after 6/1/67, U.S. 42 and Spring Valley-Paintersville Rd.)	10-15 miles downwind
6a	Xenia, Ohio	15-20 miles downwind
6b	Spring Valley-Paintersville Rd. and State Route 380	15-20 miles downwind
6c	Mt. Holly, Ohio	15-20 miles downwind

West Zone

1a	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
1b	Maue Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
2a	Cincinnati-Dayton Pike at south city limits of Miamisburg (after 6/1/67, Miami Drive-In Theater on Cincinnati-Dayton Pike)	0-3 miles downwind
2b	Lower Miamisburg Rd. and Union Rd. (after 6/1/67, Riverview Rd. and Lower Miamisburg Rd.)	0-3 miles downwind
2c	Lower Miamisburg Rd. and Jamaica Rd.	0-3 miles downwind
3a	State Route 725 and State Route 4	3-5 miles downwind

Table 10 (continued)

West Zone

Sample No.	Location	Range
3b	Germantown, Ohio	3-5 miles downwind
4a	Manning Rd. and Farmersville-Johnsville Rd. (after 6/1/67, Manning Rd. and Anthony Rd.)	5-10 miles downwind
4b	Oxford Rd. and Browns Run Rd.	5-10 miles downwind
5a	Gratis, Ohio	10-15 miles downwind
5b	Greenbush Rd. and State Route 122	10-15 miles downwind
6a	Eaton, Ohio	15-20 miles downwind
6b	Camden, Ohio	15-20 miles downwind
6c	Somerville, Ohio	15-20 miles downwind

Northeast Zone

1a	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
1b	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles upwind
2a	Harmon Field (Miamisburg, Ohio)	0-3 miles downwind
2b	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
2c	Elm St. and Cincinnati-Dayton Pike (West Carrollton, Ohio)	0-3 miles downwind
3a	Woody's Market on Cincinnati-Dayton Pike (West Carrollton, Ohio)	3-5 miles downwind
3b	Yankee St. and Mad River Rd. (after 6/1/67, Mad River Rd. and Alexandersville-Bellbrook Rd.	3-5 miles downwind
4a	Springboro Pike and Dryden Rd. (Village of Moraine, Ohio) (after 6/1/67, Dorothy Lane and Springboro Pike)	5-10 miles downwind
4b	State Route 48 and Stroop Rd. - Town and Country Shopping Center - (Kettering, Ohio)	5-10 miles downwind
5a	Interstate 75 and Wagner-Ford Rd.	10-15 miles downwind
5b	Belmont Auto Theater, Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind
6a	State Route 201 and Chambersburg Rd.	15-20 miles downwind
6b	State Route 235 (Fairborn, Ohio)	15-20 miles downwind
6c	New Germany-Trebein Rd. and Fairground Rd. - approximately 3 miles south of previous sample	15-20 miles downwind

Northwest Zone

1a	Mound Ave. and Benner Rd.	0-3 miles upwind
1b	Medlar Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind

Table 10 (continued)

Northwest Zone

Sample No.	Location	Range
2a	Cincinnati-Dayton Pike and Mound Ave. (Miamisburg, Ohio)	0-3 miles downwind
2b	Union Rd. and State Route 725	0-3 miles downwind
2c	Union Rd. and Manning Rd. (after 6/1/67, State Route 725 and Jamaica Rd.)	0-3 miles downwind
3a	State Route 4 and Manning Rd. (after 6/1/67, Jamaica Rd. and State Route 4)	3-5 miles downwind
3b	State Route 4 and Farmersville-West Carrollton Pike	3-5 miles downwind
4a	Diamond Mill Rd. and Mile Rd.	5-10 miles downwind
4b	Farmersville, Ohio	5-10 miles downwind
5a	Clayton Rd. and Amity Rd. (after 6/1/67, Clayton Rd. and Providence Rd.)	10-15 miles downwind
5b	Farmersville-West Alexandria Pike and DeChant Rd.	10-15 miles downwind
6a	Brookville, Ohio	15-20 miles downwind
6b	Lexington Salem Rd. and Preble County Line Rd.	15-20 miles downwind
6c	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind

Southeast Zone

1a	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
1b	Union Rd. and State Route 725	0-3 miles upwind
2a	Mound Ave. and Benner Rd.	0-3 miles downwind
2b	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
2c	Medlar Rd. and Miamisburg-Springboro Pike (after 6/1/67, Mound Park)	0-3 miles downwind
3a	Wood Rd. and Pennyroyal Rd.	3-5 miles downwind
3b	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4a	Springboro, Ohio	5-10 miles downwind
4b	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5a	State Route 122 and Utica Rd. (after 6/1/67, State Route 48 and State Route 73)	10-15 miles downwind
5b	Waynesville, Ohio	10-15 miles downwind
6a	Oregonia, Ohio (after 6/1/67, State Route 73, 1 mile east of State Route 42)	15-20 miles downwind
6b	Harveysburg, Ohio (after 6/1/67, 3 miles east of Harveysburg on State Route 73)	15-20 miles downwind
6c	After 6/1/67, 3 miles east of Harveysburg on State Route 73	15-20 miles downwind

Table 10 *(continued)*

Southwest Zone

Sample No.	Location	Range
1a	State Route 725 and Alexandersville Rd.	0-3 miles upwind
1b	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
2a	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles downwind
2b	Farmington Rd. and Chautauqua Rd.	0-3 miles downwind
2c	Farmington Rd. and Union Rd.	0-3 miles downwind
3a	Farmington Rd. and Butter St.	3-5 miles downwind
3b	Carlisle, Ohio	3-5 miles downwind
4a	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
4b	Hetzler Rd. and Hinkle Rd. (after 6/1/67, Post Town, Ohio)	5-10 miles downwind
5a	State Route 4 and State Route 73	10-15 miles downwind
5b	Jacksonburg, Ohio	10-15 miles downwind
6a	State Route 4 and State Route 747	15-20 miles downwind
6b	New Miami, Ohio	15-20 miles downwind
6c	West Elkton Rd. and Tolbert Rd.	15-20 miles downwind

Table 11

SUMMARY OF AIR SAMPLING LOCATIONS FOR TRITIUM

North Zone

Sample No.	Location	Range
1	Cincinnati-Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
3	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
4	Dayton Speedway (near intersection of State Route 4 and Liberty-Dayton Rd.)	5-10 miles downwind
5	Trotwood, Ohio	10-15 miles downwind
6	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind

Northeast Zone

1	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
2	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
3	Yankee St. and Mad River Rd. (after 6/1/67, Mad River Rd. and Alexandersville-Bellbrook Rd.)	3-5 miles downwind
4	State Route 48 and Stroop Rd. - Town and Country Shopping Center (Kettering, Ohio)	5-10 miles downwind
5	Belmont Auto Theater - Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind
6	State Route 235 (Fairborn, Ohio)	15-20 miles downwind

East Zone

1	Lower Miamisburg Rd. and Union Rd. (after 6/1/67, State Route 725 and Union Rd.)	0-3 miles upwind
2	Maue Rd. and Linden Ave. (Miamisburg, Ohio) (after 6/1/67, Mound Park)	0-3 miles downwind
3	Yankee St. and State Route 725	3-5 miles downwind
4	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
5	State Route 725 and U.S. 42 (after 6/1/67, U.S. 42 and Spring Valley-Paintersville Rd.	10-15 miles downwind
6	Xenia, Ohio	15-20 miles downwind

Southeast Zone

1	Union Rd. and State Route 725	0-3 miles upwind
2	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind

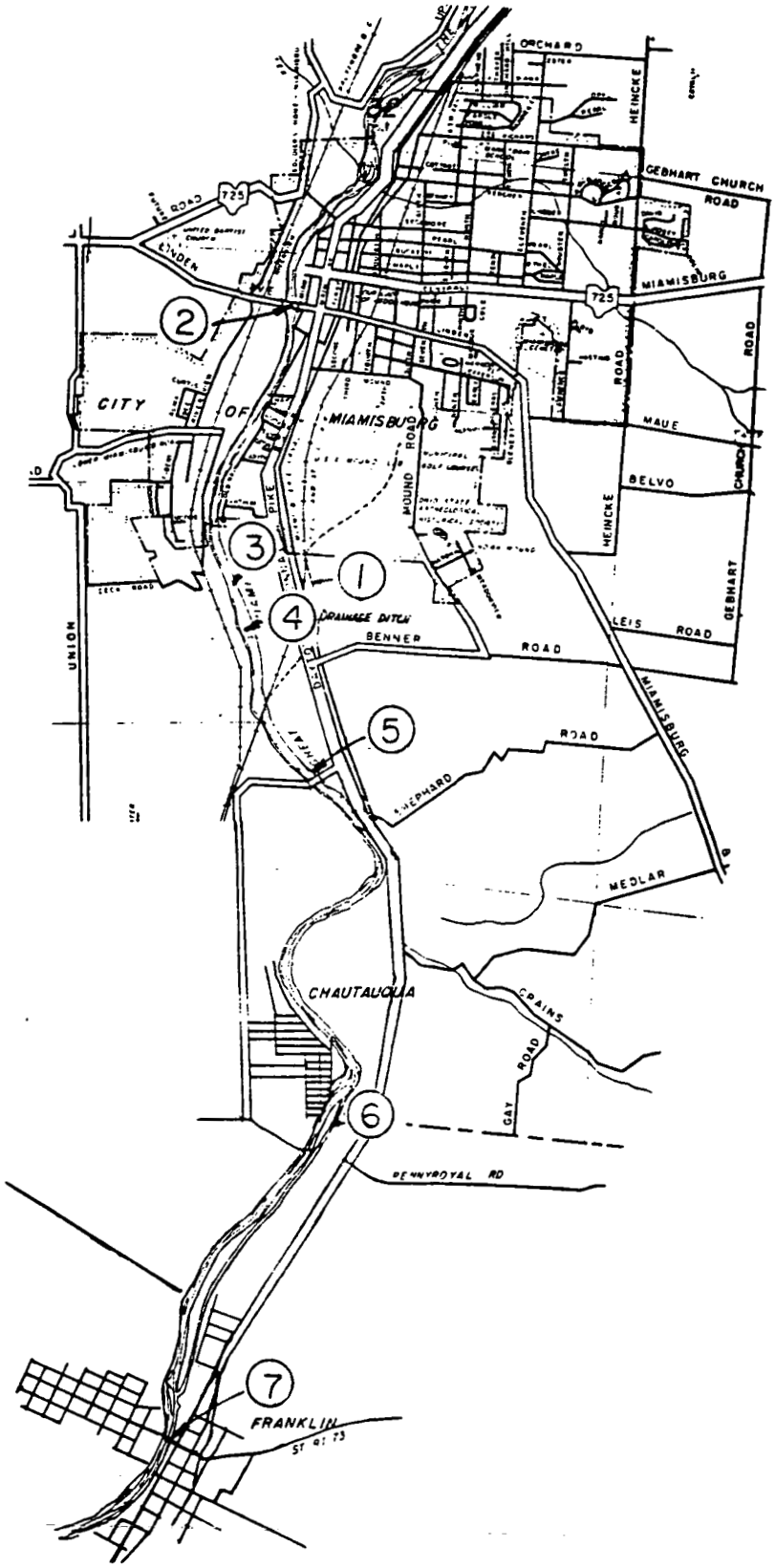
Table 11 (continued)

Sample No.	Location	Range
	Southeast Zone	
3	South Montgomery County Airport on State Route 741 at Austin Rd.	3-5 miles downwind
4	At TV Tower on Lytle-Five Points Rd.	5-10 miles downwind
5	State Route 122 and Utica Rd. (after 6/1/67, State Route 48 and State Route 73)	10-15 miles downwind
6	Harveysburg, Ohio	15-20 miles downwind
	South Zone	
1	Fifth St. and Central Ave. (Miamisburg, Ohio) (after 6/1/67, Municipal Parking Lot on Central Ave.)	0-3 miles upwind
2	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
3	State Route 73 and Interstate 75	3-5 miles downwind
4	Blue Ball, Ohio (east edge of Middletown, Ohio)	5-10 miles downwind
5	Monroe, Ohio	10-15 miles downwind
6	Bethany Rd. and Mason-Montgomery Rd.	15-20 miles downwind
	Southwest Zone	
1	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
2	Farmington Rd. and Union Rd.	0-3 miles downwind
3	Farmington Rd. and Butter St.	3-5 miles downwind
4	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
5	Jacksonburg, Ohio	10-15 miles downwind
6	New Miami, Ohio	15-20 miles downwind
	West Zone	
1	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
2	Lower Miamisburg Rd. and Union Rd. (after 6/1/67, Riverview Rd. and Lower Miamisburg Rd.)	0-3 miles downwind
3	Germantown, Ohio	3-5 miles downwind
4	Oxford Rd. and Browns Run Rd.	5-10 miles downwind
5	Gratis, Ohio	10-15 miles downwind
6	Camden, Ohio	15-20 miles downwind

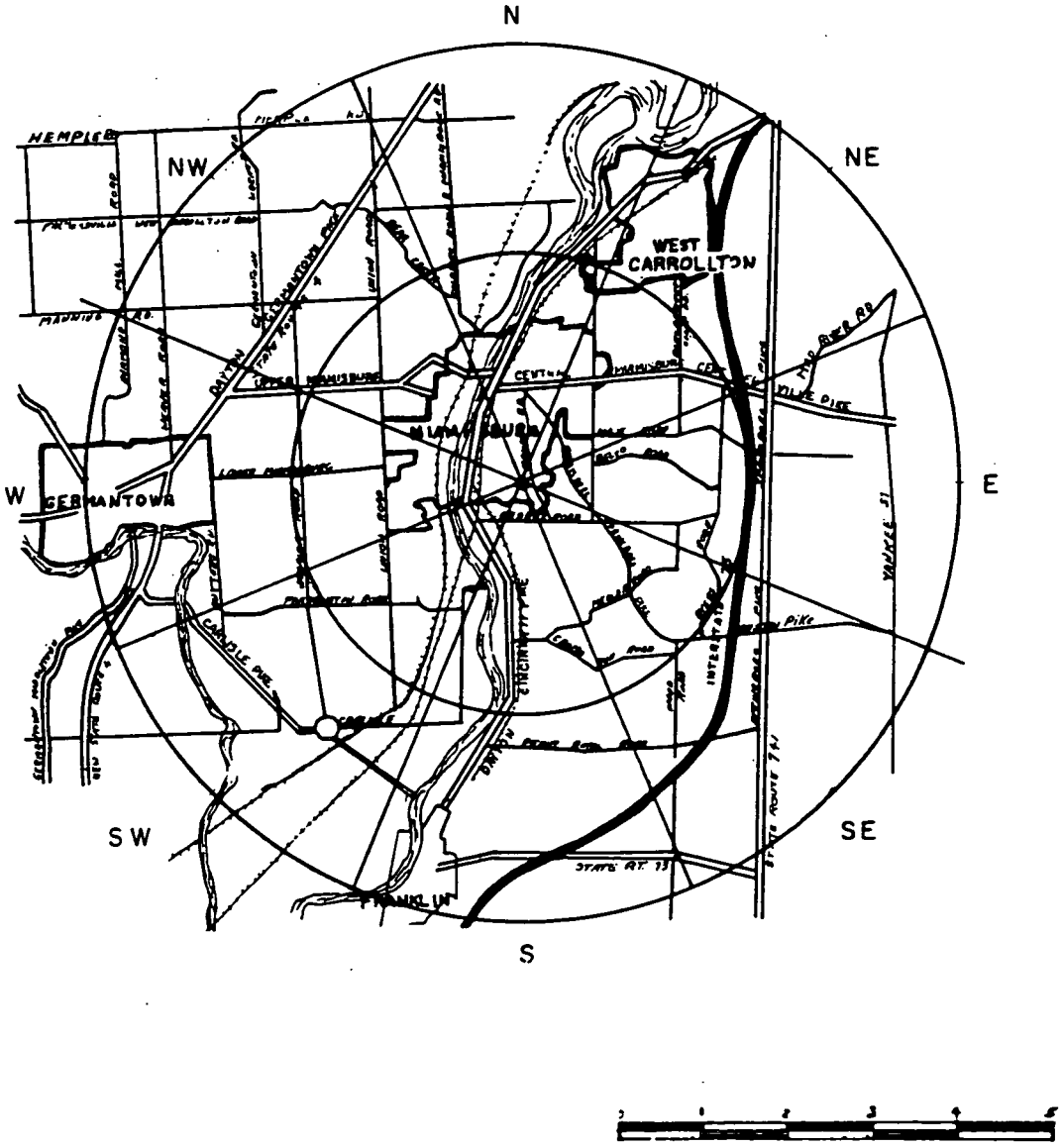
Table 11 (continued)

Northwest Zone

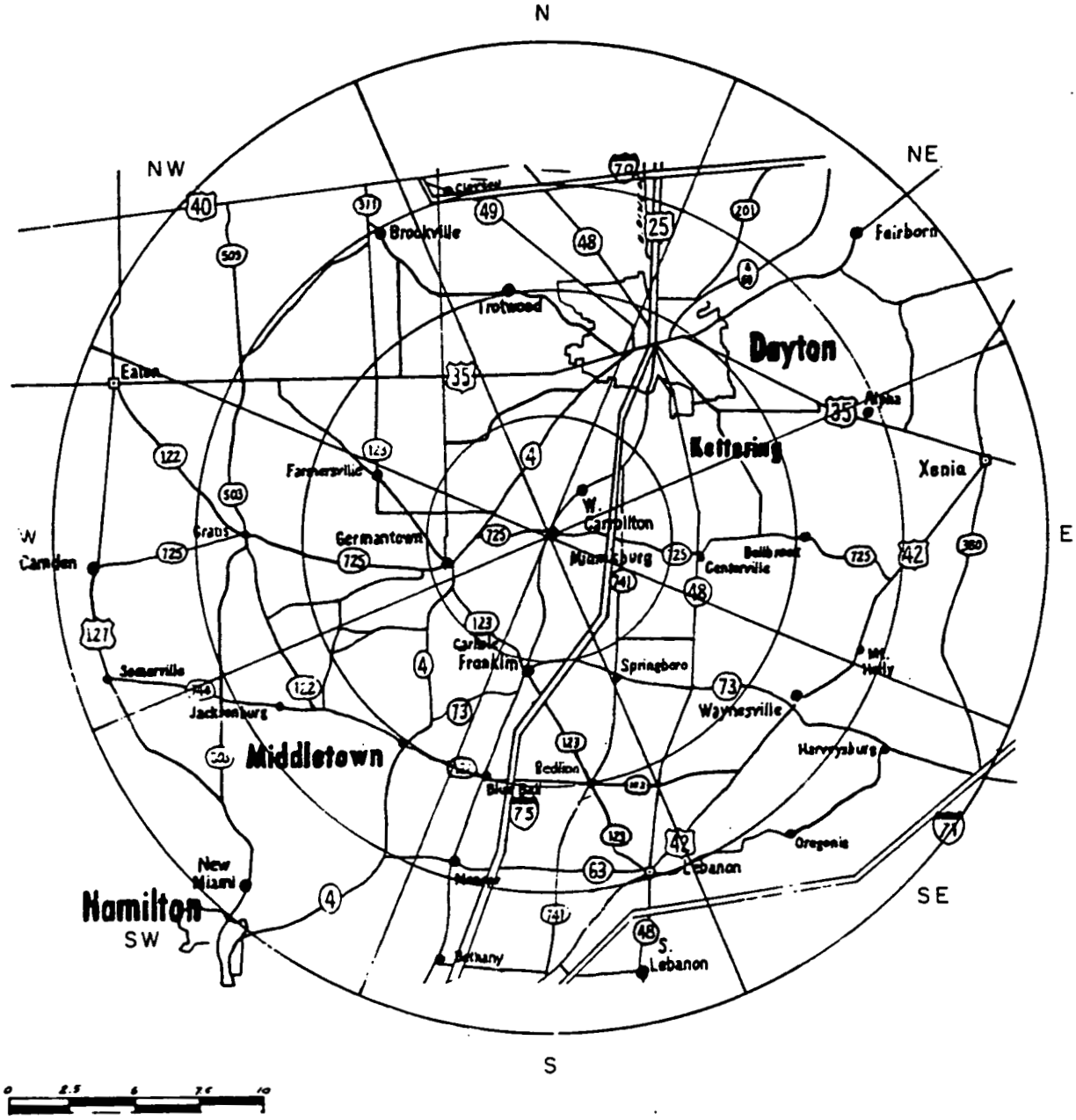
Sample No.	Location	Range
1	Mound Ave. and Benner Rd.	0-3 miles upwind
2	Union Rd. and Manning Rd. (after 6/1/67, State Route 725 and Jamaica Rd.)	0-3 miles downwind
3	State Route 4 and Manning Rd. (after 6/1/67, Jamaica Rd. and State Route 4)	3-5 miles downwind
4	Farmersville, Ohio	5-10 miles downwind
5	Clayton Rd. and Amity Rd. (after 6/1/67, Clayton Rd. and Providence Rd.)	10-15 miles downwind
6	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind



MAP 1 - Great Miami River sample locations.



MAP 2 - Proximity air sample zones.



MAP 3 - Distant air sample zones.

ENVIRONMENTAL MONITORING REPORT

1966

1966

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

MLM-1356

ENVIRONMENTAL MONITORING REPORT: JANUARY - JUNE, 1966

H. F. Anderson and W. E. Sheehan

AEC Research and Development REPORT

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MLM-1356
TID-4500
UC-41 Health and Safety

ENVIRONMENTAL MONITORING REPORT: JANUARY-JUNE, 1966

Prepared by: H. F. Anderson
W. E. Sheehan
Approved by: H. E. Meyer

Date: September 1, 1966
Issued: December 9, 1966

MONSANTO RESEARCH CORPORATION
A Subsidiary of Monsanto Company

MOUND LABORATORY
Miamisburg, Ohio operated for

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio is presented for the first half of 1966. The concentration of radionuclides from Mound Laboratory in the Great Miami River and in the environmental air was within the standards specified by the Atomic Energy Commission.

INTRODUCTION

This report is a summary of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program considers all of the projects at Mound Laboratory, and all of the radioisotopes which could be released in the environment. The monitoring procedures and counting techniques are those best suited for the detection and measurement of these radioactive materials.

The Radioactivity Concentration Guide (RCG) values in air and in water for the radionuclides in use at Mound Laboratory are taken from the USAEC Manual, Chapter 0524. The Radioactivity Concentration Guides for environmental air and water for the materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water- 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water- 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 2×10^{-7} microcuries per cubic centimeter

Water- 3×10^{-3} microcuries per cubic centimeter

LIQUID CONTAMINATION

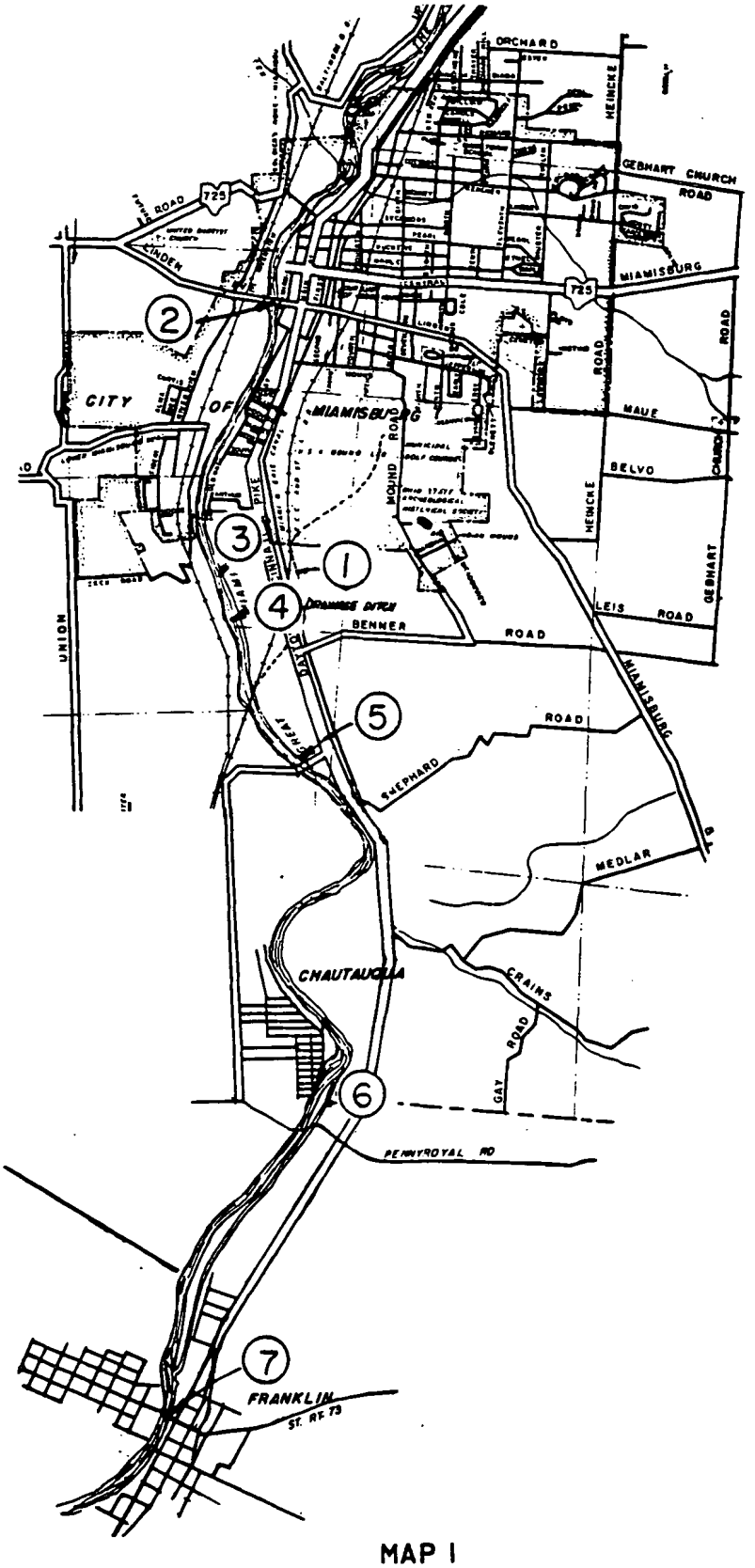
Polonium-Plutonium Liquid radioactive wastes from polonium and plutonium work at the Laboratory are processed separately to reduce the concentration of the radionuclides to a level at which they may be discharged to the environment. Treated polonium liquid waste is discharged directly to the Great Miami River via a closed sewer line which also carries the treated plant sewage. Treated plutonium liquid waste is discharged to a drainage ditch which runs through the plant site and eventually reaches the river.

Tritium Helium - 3 being purified at Mound Laboratory contains small quantities of tritium. Liquid waste from this work is treated (diluted with water when necessary) before it is discharged to the drainage ditch.

Water Sampling Water samples are collected weekly from the Great Miami River and from the drainage ditch. Samples collected from the river are analyzed for polonium and tritium. Samples collected from the drainage ditch are analyzed for plutonium and tritium.

Map 1 shows the location of weekly water sampling points. Not shown on the map is the location of the quarterly water samples which are collected from the Great Miami River every three months at several points downstream to a distance of a little over 40 miles.

The results of the water sampling program are presented in Table 1, Table 2, and Table 3. The data presented in these tables indicate that the average concentration of polonium, plutonium, and tritium in environmental water was well below the Radioactivity Concentration Guides for the first half of 1966.



MAP I
GREAT MIAMI RIVER SAMPLE LOCATIONS

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

January Through June, 1966

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-9} $\mu c/cc$)	Average Concentration[a] (10^{-9} $\mu c/cc$)	Percent of RCG[b] for Average
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	26	1.80	1.80	0.26
Mound Lab Effluent (location No. 3 on map)	26	1680.00	104.00	14.86
250 yards Downstream from Mound Lab Effluent (location No. 4 on map)	26	3.60	1.94	0.28
Chautauqua Road Bridge (location No. 5 on map)	26	1.80	1.80	0.26
Chautauqua Dam (location No. 6 on map)	26	1.80	1.80	0.26
Franklin, Ohio (location No. 7 on map)	26	2.70	1.84	0.26
Trenton, Ohio (approximately 15 miles S.W. of Miamisburg)	2	1.80	1.80	0.26
New Miami, Ohio (approximately 20 miles S. W. of Miamisburg)	2	1.80	1.80	0.26
7 miles North of New Baltimore, Ohio (approximately 26 miles S. W. of Miamisburg)	2	1.80	1.80	0.26
New Baltimore, Ohio (approximately 33 miles S. W. of Miamisburg)	2	1.80	1.80	0.26
Elizabethtown, Ohio (approximately 43 miles S. W. of Miamisburg)	2	1.80	1.80	0.26

[a]Lowest detectable limit for polonium in water is 1.80×10^{-9} $\mu c/cc$. All samples which were not dectectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide

TABLE 2

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

January Through June, 1966

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration[a] (10^{-3} μc/cc)	Average Concentration[a] (10^{-3} μc/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	25	7.10	0.40	13.23
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	25	0.22	0.06	2.00
Mound Lab Effluent (location No. 3 on map)	25	3.50	0.38	12.67
Chautauqua Road Bridge (location No. 5 on map)	24	0.27	0.07	2.33

[a]Lowest detectable limit for tritium in water is 0.05×10^{-3} μc/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide

TABLE 3

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

January Through June, 1966

Sample Location	Number of Samples Collected	Maximum Concentration[a] (10^{-6} μc/cc)	Average Concentration[a] (10^{-6} μc/cc)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	25	0.10	0.03	0.60

[a]Lowest detectable limit for plutonium in water is 0.09×10^{-9} μc/cc. All samples which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide

AIRBORNE CONTAMINATION

Polonium-- Plutonium Air which is contaminated with polonuium and plutonium particulates is treated by passing it through absolute filters before it is discharged to the environment via several building stacks.

Tritium Air which is contaminated with gaseous tritium is discharged to the environment via stacks.

Stack Monitoring The results of routine stack monitoring for polonium, plutonium, and tritium considered with standard meteorological dilution factors indicated that the average concentration of the radionuclides in the environmental air discharged from Mound Laboratory stacks was well below the Radioactivity Concentration Guides.

Off-Site Air Sampling Possible airborne polonium and plutonium in the environment is monitored by particulate air sampling equipment mounted in a one-ton panel truck. Samples are collected weekly to a distance of 20 miles.

The results of the monitoring program for airborne polonium and plutonium are summarized in Table 4. As may be seen from the table, the average concentration of long-lived alpha activity in the environmental air is below the RCG for polonium and plutonium.

Samples are collected upwind and downwind from the plant according to routes drawn for the different wind directions. The selection of the air sampling zone depends on the wind direction on the days that samples are collected. Since the sampling zone is dependent on the wind direction, it is possible that air samples from all zones will not be collected during the reporting period. Maps 2 and 3 show the zones routinely sampled. Table 5 lists the specific location of sampling sites by zone.

Monitoring of the environmental air for tritium, by means of an air monitor mounted in the panel truck mentioned above, was performed weekly to a distance of 20 miles. The locations sampled for tritium are the same ones sampled for polonium and plutonium. To date no tritium has been detected in the environmental air.

TABLE 4

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-PLUTONIUM

January Through June, 1966

Northeast Zone

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} $\mu c/cc$)	Average Concentration[a] (10^{-14} $\mu c/cc$)	Percent of Polonium RCG[b] for Average	Percent of Plutonium RCG[b] for Average
0-3 (upwind)	5	0.35	0.35	0.02	5.85
0-3 (downwind)	11	1.67	0.71	0.04	11.86
3-5 (downwind)	5	0.63	0.41	0.02	6.85
5-10 (downwind)	6	1.34	0.61	0.03	10.19
10-15 (downwind)	7	1.58	0.53	0.03	8.85
15-20 (downwind)	10	2.10	0.54	0.03	9.02

TABLE 4 (continued)

East Zone

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} $\mu c/cc$)	Average Concentration[a] (10^{-14} $\mu c/cc$)	Percent of Polonium RCG[b] for Average	Percent of Plutonium RCG[b] for Average
0-3 (upwind)	3	0.35	0.35	0.02	5.85
0-3 (downwind)	8	2.46	0.70	0.03	11.69
3-5 (downwind)	5	0.98	0.48	0.02	8.02
5-10 (downwind)	5	0.35	0.35	0.02	5.85
10-15 (downwind)	4	2.32	1.29	0.06	21.54
15-20 (downwind)	6	1.03	0.46	0.02	7.68

TABLE 4 (continued)

South Zone

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} $\mu c/cc$)	Average Concentration[a] (10^{-14} $\mu c/cc$)	Percent of Polonium RCG[b] for Average	Percent of Plutonium RCG[b] for Average
0-3 (upwind)	2	0.35	0.35	0.02	5.85
0-3 (downwind)	3	0.35	0.35	0.02	5.85
3-5 (downwind)	2	0.47	0.41	0.02	6.85
5-10 (downwind)	2	0.35	0.35	0.02	5.85
10-15 (downwind)	2	0.42	0.39	0.02	6.51
15-20 (downwind)	3	0.83	0.51	0.03	8.52

TABLE 4 (continued)

Southwest Zone

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} $\mu c/cc$)	Average Concentration[a] (10^{-14} $\mu c/cc$)	Percent of Polonium RCG[b] for Average	Percent of Plutonium RCG[b] for Average
0-3 (upwind)	4	0.35	0.35	0.02	5.85
0-3 (downwind)	11	1.16	0.42	0.02	7.01
3-5 (downwind)	5	1.03	0.49	0.02	8.18
5-10 (downwind)	5	0.35	0.35	0.02	5.85
10-15 (downwind)	8	1.39	0.48	0.02	8.02
15-20 (downwind)	8	11.12	1.72	0.09	28.72

TABLE 4 (continued)

Northwest Zone

Range (miles)	Number of Samples Collected	Maximum Concentration[a] (10^{-14} μc/cc)	Average Concentration[a] (10^{-14} μc/cc)	Percent of Polonium RCG[b] for Average	Percent of Plutonium RCG[b] for Average
0-3 (upwind)	11	0.35	0.35	0.02	5.85
0-3 (downwind)	17	1.43	0.48	0.02	8.02
3-5 (downwind)	12	0.74	0.40	0.02	6.68
5-10 (downwind)	11	0.35	0.35	0.02	5.85
10-15 (downwind)	13	0.69	0.40	0.02	6.68
15-20 (downwind)	18	1.39	0.41	0.02	6.85

[a]Lowest detectable limit for long lived alpha activity in air is 0.35×10^{-14} μc/cc. All values which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide

Note - The North Zone, the Southeast Zone, and the West Zone were not sampled during the first six months of 1966 because the prevailing winds were not in these directions on sample collection dates.

TABLE 5

SUMMARY OF AIR SAMPLING LOCATIONS

North Zone

Location		Range
1.	Cincinnati - Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
2.	Mound Rd. and Benner Rd. (Miamisburg, Ohio)	0-3 miles upwind
3.	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
4.	Upper River Rd. and Soldiers Home-Miamisburg Rd.	0-3 miles downwind
5.	One mile north on Upper River Rd. from previous sample (No. 4)	0-3 miles downwind
6.	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
7.	Union Rd. and Bear Creek Rd.	3-5 miles downwind
8.	Dayton Speedway (near intersection of State Route 4 and Liberty Dayton Rd.)	5-10 miles downwind
9.	Union Rd. and Liberty Dayton Rd.	5-10 miles downwind
10.	Siebenthaler Ave. and North Dixie Dr. (Dayton, Ohio)	10-15 miles downwind
11.	Trotwood, Ohio	10-15 miles downwind
12.	Murlin Heights on North Dixie Dr. (Dayton, Ohio)	15-20 miles downwind
13.	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind
14.	State Route 49 at Clayton, Ohio	15-20 miles downwind

South Zone

1.	West off State Route 725 between river bridge and railroad (Miamisburg, Ohio)	0-3 miles upwind
2.	First St. and Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
3.	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
4.	Chautauqua, Ohio	0-3 miles downwind
5.	Cincinnati-Dayton Pike at south city limits of Miamisburg, Ohio	0-3 miles downwind
6.	State Route 73 and Interstate 75	3-5 miles downwind
7.	State Route 123 and Dayton-Oxford Rd.	3-5 miles downwind
8.	Red Lion, Ohio	5-10 miles downwind
9.	Blue Ball, Ohio	5-10 miles downwind
10.	Lebanon, Ohio	10-15 miles downwind

TABLE 5 (continued)

South Zone

Location		Range
11.	Monroe, Ohio	10-15 miles downwind
12.	South Lebanon, Ohio	15-10 miles downwind
13.	Bethany Rd. and Mason Montgomery Rd.	15-20 miles downwind
14.	Bethany, Ohio	15-20 miles downwind

East Zone

1.	Riverview Ave. and Lower Miamisburg Rd. (Miamisburg, Ohio)	0-3 miles upwind
2.	Lower Miamisburg Rd. and Union Rd.	0-3 miles upwind
3.	Maue Rd. and Linden Ave. (Miamisburg, Ohio)	0-3 miles downwind
4.	Byers Rd. and Belvo Rd.	0-3 miles downwind
5.	State Route 725 and Interstate 75	0-3 miles downwind
6.	Yankee St. and State Route 725	3-5 miles downwind
7.	Waldruhe Park on Springboro Pike	3-5 miles downwind
8.	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
9.	State Route 48 and Social Row Rd.	5-10 miles downwind
10.	Bellbrook, Ohio	10-15 miles downwind
11.	State Route 725 and U.S. 42	10-15 miles downwind
12.	Xenia, Ohio	15-20 miles downwind
13.	Spring Valley Rd. and Paintersville Rd.	15-20 miles downwind
14.	Mt. Holly, Ohio	15-20 miles downwind

West Zone

1.	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
2.	Maue Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
3.	Cincinnati-Dayton Pike at south city limits of Miamisburg	0-3 miles downwind
4.	Lower Miamisburg Rd. and Union Rd.	0-3 miles downwind
5.	Lower Miamisburg Rd. and Jamaica Rd.	0-3 miles downwind
6.	State Route 725 and State Route 4	3-5 miles downwind
7.	Germantown, Ohio	3-5 miles downwind
8.	Manning Rd. and Farmersville-Johnsville Rd.	5-10 miles downwind
9.	Oxford Rd. and Browns Run Rd.	5-10 miles downwind
10.	Gratis, Ohio	10-15 miles downwind

TABLE 5 (*continued*)

West Zone

Location		Range
11.	Greenbush Rd. and State Route 122	10-15 miles downwind
12.	Eaton, Ohio	15-20 miles downwind
13.	Camden, Ohio	15-20 miles downwind
14.	Somerville, Ohio	15-20 miles downwind

Northeast Zone

1.	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
2.	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles upwind
3.	Harmon Field (Miamisburg, Ohio)	0-3 miles downwind
4.	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
5.	Elm St. and Cincinnati-Dayton Pike (West Carrollton, Ohio)	0-3 miles downwind
6.	Woody's Market on Cincinnati-Dayton Pike (West Carrollton, Ohio)	3-5 miles downwind
7.	Yankee St. and Mad River Rd.	3-5 miles downwind
8.	Springboro Pike and Dryden Rd. (Village of Moraine, Ohio)	5-10 miles downwind
9.	State Route 48 and Stroop Rd.- Town and Country Shopping Center- (Kettering, Ohio)	5-10 miles downwind
10.	Interstate 75 and Wagner - Ford Rd.	10-15 miles downwind
11.	Belmont Auto Theater-Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind
12.	State Route 201 and Chambersburg Rd.	15-20 miles downwind
13.	State Route 235 (Fairborn, Ohio)	15-20 miles downwind
14.	Germany Trebein Rd. and Fairground Rd.-approximately 3 miles south of previous sample No. 13	15-20 miles downwind

Northwest Zone

1.	Mound Ave. and Benner Rd.	0-3 miles upwind
2.	Medlar Rd. and Miamisburg-Springboro Pike	0-3 miles upwind
3.	Cincinnati-Dayton Pike and Mound Ave. (Miamisburg, Ohio)	0-3 miles downwind
4.	Union Rd. and State Route 725	0-3 miles downwind
5.	Union Rd. and Manning Rd.	0-3 miles downwind
6.	State Route 4 Manning Rd.	3-5 miles downwind
7.	State Route 4 and Farmersville-West Carrollton Pike	3-5 miles downwind
8.	Diamond Mill Rd. and Mile Rd.	5-10 miles downwind

TABLE 5 (continued)

Northwest Zone

Location		Range
9.	Farmersville, Ohio	5-10 miles downwind
10.	Clayton Rd. and Amity Rd.	10-15 miles downwind
11.	Farmersville-West Alexandria Pike and DeChant Rd.	10-15 miles downwind
12.	Brookville, Ohio	15-20 miles downwind
13.	Lexington Salem Rd. and Preble County Line Rd.	15-20 miles downwind
14.	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind

Southeast Zone

1.	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
2.	Union Rd. and State Route 725	0-3 miles upwind
3.	Mound Ave. and Benner Rd.	0-3 miles downwind
4.	Benner Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
5.	Medlar Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
6.	Wood Rd. and Pennyroyal Rd.	3-5 miles downwind
7.	South Montgomery County Airport on State Route 741 at Austin Pike	3-5 miles downwind
8.	Springboro, Ohio	5-10 miles downwind
9.	At T.V. Tower on Lytle-Five Points Rd.	5-10 miles downwind
10.	State Route 122 and Utica Rd.	10-15 miles downwind
11.	Waynesville, Ohio	10-15 miles downwind
12.	Oregonia, Ohio	15-20 miles downwind
13.	Harveysburg, Ohio	15-20 miles downwind

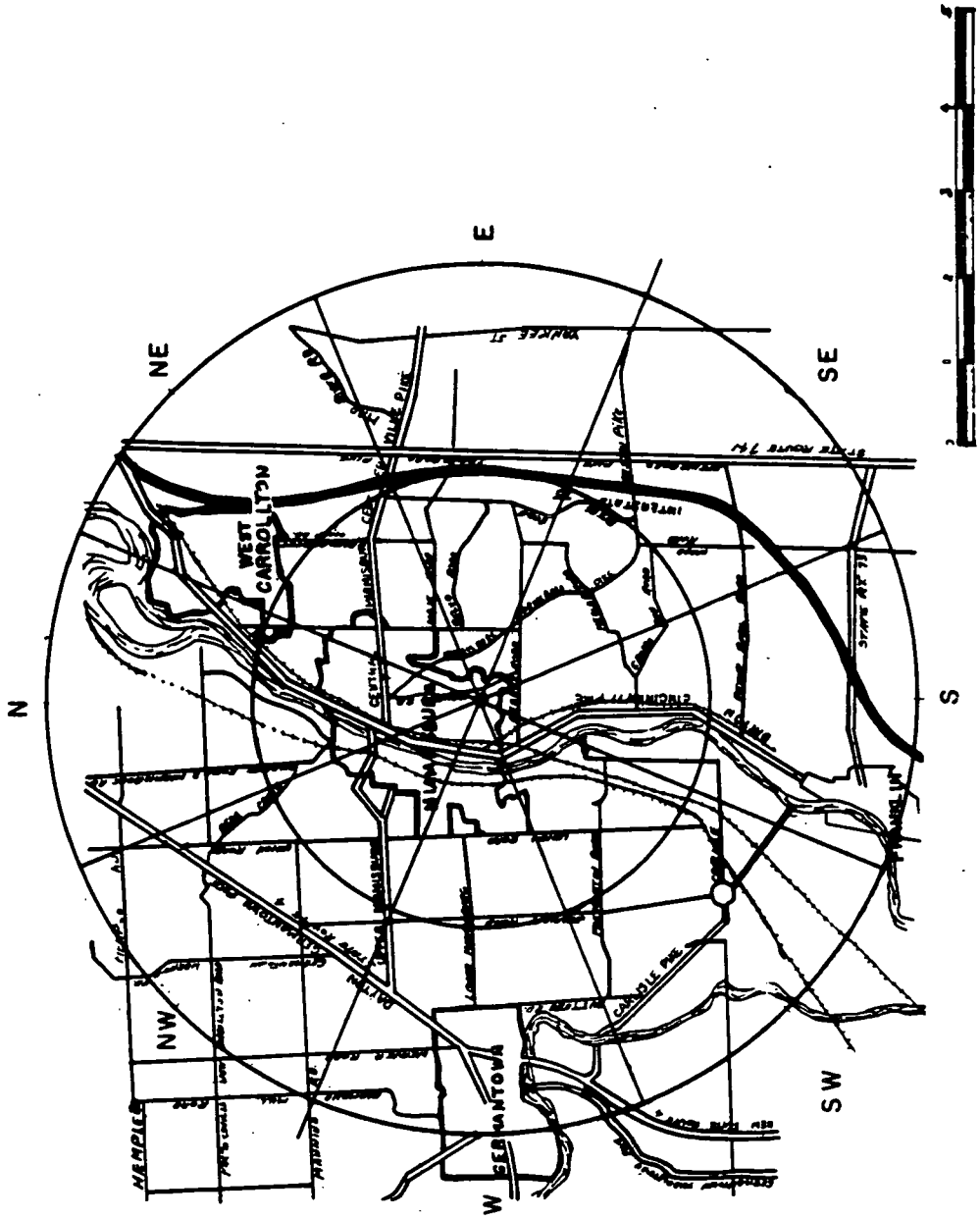
Southwest Zone

1.	State Route 725 and Alexanderville Rd.	0-3 miles upwind
2.	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
3.	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles downwind
4.	Farmington Rd. and Chautauqua Rd.	0-3 miles downwind
5.	Farmington Rd. and Union Rd.	0-3- miles downwind
6.	Farmington Rd. and Butler St.	3-5 miles downwind
7.	Carlisle, Ohio	3-5 miles downwind
8.	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
9.	Hetzler Rd. and Hinkle Rd.	5-10 miles downwind
10.	State Route 4 and State Route 73	10-15 miles downwind

TABLE 5 (continued)

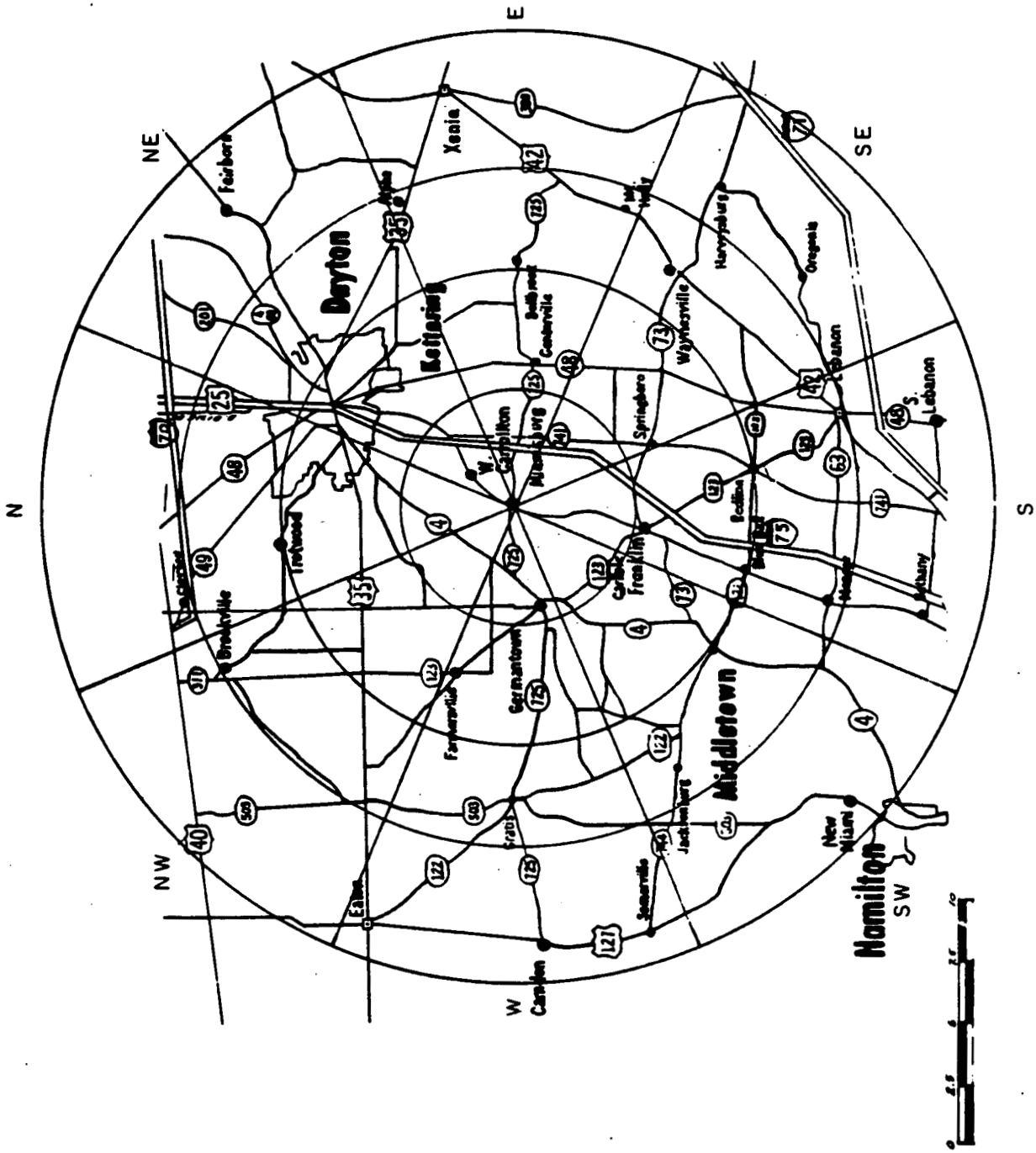
Southwest Zone

Location		Range
11..	Jacksonburg, Ohio	10-15 miles downwind
12.	State Route 4 and State Route 747	15-20 miles downwind
13.	New Maimi, Ohio	15-20 miles downwind
14.	West Elkton Rd. and Tolbert Rd.	15-20 miles downwind



MAP 2

PROXIMITY AIR SAMPLE ZONES



MAP 3

DISTANT AIR SAMPLE ZONES

MLM-1391

ENVIRONMENTAL MONITORING REPORT: JULY-DECEMBER, 1966 AND 1966 SUMMARY

H. F. Anderson and W. E. Sheehan

AEC Research and Development REPORT

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

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MLM-1391
TID-4500
UC-41 Health and Safety

ENVIRONMENTAL MONITORING REPORT: JULY-DECEMBER, 1966 AND 1966 SUMMARY

Prepared by: H. F. Anderson
W. E. Sheehan
Approved by: H. E. Meyer

Date: February 10, 1967
Issued: March 18, 1967

MONSANTO RESEARCH CORPORATION
A Subsidiary of Monsanto Company

MOUND LABORATORY
Miamisburg, Ohio operated for

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio is presented for the second half of 1966 and a summary is presented for the entire year. The concentration of radionuclides from Mound Laboratory in the Great Miami River and in the environmental air was within the standards specified by the Atomic Energy Commission.

INTRODUCTION

This report is a summary of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program considers all of the projects at Mound Laboratory, and all of the radioisotopes which could be released in the environment. The monitoring procedures and counting techniques are those best suited for the detection and measurement of these radioactive materials.

The Radioactivity Concentration Guide (RCG) values in air and in water for the radionuclides in use at Mound Laboratory are taken from the USAEC Manual, Chapter 0524. The Radioactivity Concentration Guides for environmental air and water for the materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water- 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water- 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 2×10^{-7} microcuries per cubic centimeter

Water- 3×10^{-3} microcuries per cubic centimeter

LIQUID CONTAMINATION

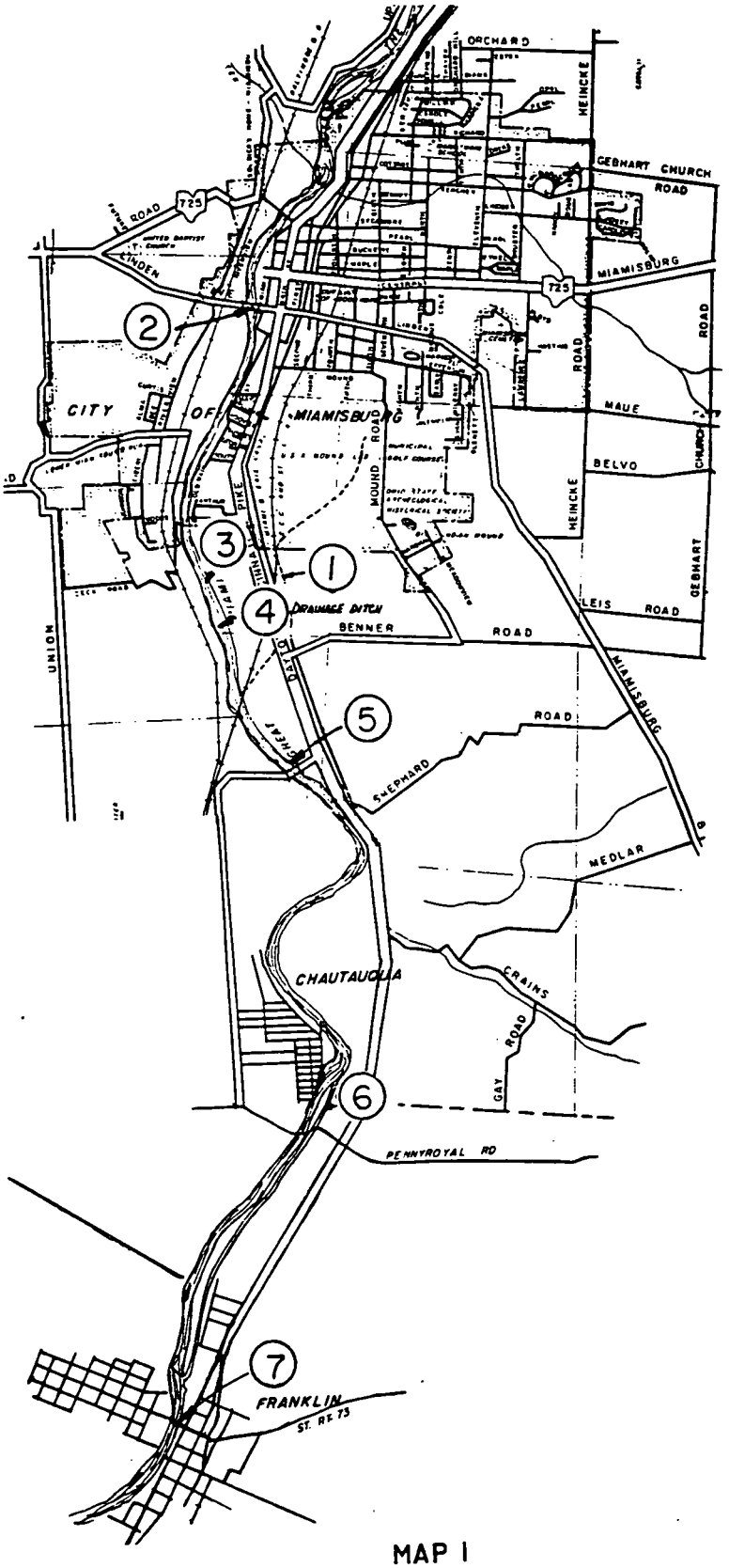
Polonium-Plutonium Liquid contaminated with radioactive material from polonium and plutonium work at the Laboratory are processed separately to reduce the concentration of the radionuclides to a level at which they may be discharged to the environment. The treated polonium liquid effluent is discharged directly to the Great Miami River via a closed sewer line which also carries the treated plant sewage. The treated plutonium liquid effluent is discharged to a drainage ditch which runs through the plant site and eventually reaches the river.

Tritium Helium-3 being purified at Mound Laboratory contains small quantities of tritium. Contaminated liquids from this work are treated (diluted with water when necessary) before discharge to the drainage ditch.

Water Sampling Water samples are collected weekly from the Great Miami River and from the drainage ditch. Samples collected from the river are analyzed for polonium and tritium. Samples collected from the drainage ditch are analyzed for plutonium and tritium.

Map 1 shows the location of weekly water sampling points. Not shown on the map is the location of the quarterly water samples which are collected from the Great Miami River every three months at several points downstream to a distance of a little over 40 miles.

The results of the water sampling program are presented in Table 1, Table 2, Table 3, and Table 4. The data presented in these tables indicate that the average concentration of polonium, plutonium, and tritium in environmental water was well below the Radioactivity Concentration Guides.



MAP I
GREAT MIAMI RIVER SAMPLE LOCATIONS

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM

July Through December, 1966

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration (10^{-9} $\mu c/cc$)	Average Concentration[a] (10^{-9} $\mu c/cc$)	Percent of RCG[b] for Average
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	24	2.70	1.80	0.26
Mound Lab Effluent (location No. 3 on map)	24	1792.80	121.20	17.31
250 yards Downstream from Mound Lab Effluent (location No. 4 on map)	24	3.60	1.89	0.27
Chautauqua Road Bridge (location No. 5 on map)	24	2.70	1.80	0.26
Chautauqua Dam (location No. 6 on map)	23	1.80	1.80	0.26
Franklin, Ohio (location No. 7 on map)	24	3.60	1.89	0.27
Trenton, Ohio (approximately 15 miles S.W. of Miamisburg)	2	1.80	1.80	0.26
New Miami, Ohio (approximately 20 miles S. W. of Miamisburg)	2	1.80	1.80	0.26
7 miles North of New Baltimore, Ohio (approximately 26 miles S. W. of Miamisburg)	2	1.80	1.80	0.26
New Baltimore, Ohio (approximately 33 miles S. W. of Miamisburg)	2	1.80	1.80	0.26
Elizabethtown, Ohio (approximately 43 miles S. W. of Miamisburg)	2	1.80	1.80	0.26

[a]Lowest detectable limit for polonium in water is 1.80×10^{-9} $\mu c/cc$. All samples which were not dectectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide

TABLE 2

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

July Through December, 1966

Sample Location (Great Miami River)	Number of Samples Collected	Maximum Concentration (10^{-3} $\mu c/cc$)	Average Concentration[a] (10^{-3} $\mu c/cc$)	Percent of RCG[b] for Average
Mound Lab Drainage Ditch (location No. 1 on map)	24	0.43	0.10	3.33
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	24	0.11	0.05	1.67
Mound Lab Effluent (location No. 3 on map)	24	0.58	0.14	4.67
Chautauqua Road Bridge (location No. 5 on map)	24	0.14	0.06	2.00

[a]Lowest detectable limit for tritium in water is 0.05×10^{-3} $\mu c/cc$. All samples which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide

TABLE 3

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM

July Through December, 1966

Sample Location	Number of Samples Collected	Maximum Concentration (10^{-6} $\mu c/cc$)	Average Concentration[a] (10^{-6} $\mu c/cc$)	Percent of RCG[b] for Average
Mound Lab Drainage Dtich (location No. 1 on map)	22	1.42	0.11	2.20

[a]Lowest detectable limit for plutonium in water is 0.09×10^{-9} $\mu c/cc$. All samples which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide

TABLE 4

1966 YEARLY SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

I. Polonium (River Samples)

Period	Number of Samples	Maximum Concentration (10^{-7} $\mu c/cc$)	Average Concentration[a] (10^{-7} $\mu c/cc$)	Percent of RCG[d] for Average
Jan.-June	166	16.80	0.18	2.57
July-Dec.	153	17.93	0.21	3.00
Jan.-Dec.	319	17.93	0.19	2.71

II. Tritium (River and Drainage Ditch Samples)

Period	Number of Samples	Maximum Concentration (10^{-3} $\mu c/cc$)	Average Concentration[b] (10^{-3} $\mu c/cc$)	Percent of RCG[d] for Average
Jan.-June	99	7.10	0.23	7.67
July-Dec.	96	0.58	0.09	3.00
Jan.-Dec.	195	7.10	0.16	5.33

III. Plutonium (Drainage Ditch Samples)

Period	Number of Samples	Maximum Concentration (10^{-6} $\mu c/cc$)	Average Concentration[c] (10^{-6} $\mu c/cc$)	Percent of RCG[d] for Average
Jan.-June	25	0.10	0.03	0.60
July-Dec.	22	1.42	0.11	2.20
Jan.-Dec.	47	1.42	0.07	1.35

[a] Lowest detectable limit for polonium in water is 1.80×10^{-9} $\mu c/cc$. All samples which were not detectable were set equal to this value when average values were calculated.

[b] Lowest detectable limit for tritium in water is 0.05×10^{-3} $\mu c/cc$. All samples which were not detectable were set equal to this value when average values were calculated.

[c] Lowest detectable limit for plutonium in water is 0.09×10^{-9} $\mu c/cc$. All samples which were not detectable were set equal to this value when average values were calculated.

[d] RCG - Radioactivity Concentration Guide

AIRBORNE CONTAMINATION

Polonium - Plutonium Air which is contaminated with polonuium and plutonium particulates is treated by passing it through absolute filters before it is discharged to the environment via several building stacks.

Tritium Air which is contaminated with gaseous tritium is discharged to the environment via stacks.

Stack Monitoring The results of routine stack monitoring for polonium, plutonium, and tritium considered with standard meteorological dilution factors indicated that the average concentration of the radionuclides in the environmental air discharged from Mound Laboratory stacks was well below the Radioactivity Concentration Guides.

Off-Site Air Sampling Possible airborne polonium and plutonium in the environment is monitored by particulate air sampling equipment mounted in a one-ton panel truck. Samples are collected weekly to a distance of 20 miles.

The results of the monitoring program for airborne polonium and plutonium are summarized in Tables 5 and 6. As may be seen from the tables, the average concentration of long-lived alpha activity in the environmental air is below the RCG for polonium and plutonium.

Samples are collected upwind and downwind from the plant according to routes drawn for the different wind directions. The selection of the air sampling zone depends on the wind direction on the days that samples are collected. Since the sampling zone is dependent on the wind direction, it is possible that air samples from all zones will not be collected during the reporting period. Maps 2 and 3 show the zones routinely sampled. Table 7 lists the specific location of sampling sites by zone.

Monitoring of the environmental air for tritium, by means of an air monitor mounted in the panel truck mentioned above, was performed weekly to a distance of 20 miles. The locations sampled for tritium are the same ones sampled for polonium and plutonium. To date no tritium has been detected in the environmental air.

TABLE 5

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-PLUTONIUM

July Through December, 1966

Range (miles)	Number of Samples Collected	Maximum Concentration (10^{-14} $\mu c/cc$)	Average Concentration[a] (10^{-14} $\mu c/cc$)	Percent of Polonium RCG[b] for Average	Percent of Plutonium RCG[b] for Average
North Zone					
0-3 (upwind)	10	0.35	0.35	0.02	5.85
0-3 (downwind)	15	0.89	0.47	0.02	7.85
3-5 (downwind)	10	0.64	0.38	0.02	6.35
5-10 (downwind)	10	0.35	0.35	0.02	5.85
10-15 (downwind)	10	1.41	0.48	0.02	8.02
15-20 (downwind)	15	1.00	0.41	0.02	6.85
Northeast Zone					
0-3 (upwind)	18	1.68	0.42	0.02	7.01
0-3 (downwind)	27	1.86	0.55	0.03	9.19
3-5 (downwind)	18	1.32	0.46	0.02	7.68
5-10 (downwind)	18	0.73	0.46	0.02	7.68
10-15 (downwind)	18	2.21	0.40	0.02	6.68
15-20 (downwind)	27	1.09	0.49	0.02	8.18
East Zone					
0-3 (upwind)	4	0.35	0.35	0.02	5.85
0-3 (downwind)	6	0.35	0.35	0.02	5.85
3-5 (downwind)	4	0.71	0.44	0.02	7.35
5-10 (downwind)	4	0.35	0.35	0.02	5.85
10-15 (downwind)	4	1.13	0.54	0.03	9.02
15-20 (downwind)	6	0.67	0.45	0.02	7.52

TABLE 5 (Continued)

Range (miles)	Number of Samples Collected	Maximum Concentration (10^{-14} $\mu c/cc$)	Average Concentration[a] (10^{-14} $\mu c/cc$)	Percent of Polonium RCG[b] for Average	Percent of Plutonium RCG[b] for Average
Southeast Zone					
0-3 (upwind)	6	0.35	0.35	0.02	5.85
0-3 (downwind)	8	53.42	10.26	0.51	171.34
3-5 (downwind)	7	0.35	0.35	0.02	5.85
5-10 (downwind)	7	5.46	1.23	0.06	20.54
10-15 (downwind)	7	1.40	0.62	0.03	10.35
15-20 (downwind)	9	2.75	0.66	0.03	11.02
South Zone					
0-3 (upwind)	2	0.35	0.35	0.02	5.85
0-3 (downwind)	3	0.43	0.38	0.02	6.35
3-5 (downwind)	2	0.35	0.35	0.02	5.85
5-10 (downwind)	2	0.67	0.51	0.03	8.52
10-15 (downwind)	2	0.35	0.35	0.02	5.85
15-20 (downwind)	3	0.35	0.35	0.02	5.85
Southwest Zone					
0-3 (upwind)	4	0.86	0.48	0.02	8.02
0-3 (downwind)	6	1.03	0.46	0.02	7.68
3-5 (downwind)	4	1.29	0.78	0.04	13.03
5-10 (downwind)	4	0.35	0.35	0.02	5.85
10-15 (downwind)	4	0.35	0.35	0.02	5.85
15-20 (downwind)	6	0.62	0.40	0.02	6.68

TABLE 5 (Continued)

West Zone

Range (miles)	Number of Samples Collected	Maximum Concentration (10^{-14} $\mu c/cc$)	Average Concentration[a] (10^{-14} $\mu c/cc$)	Percent of Polonium RCG[b] for Average	Percent of Plutonium RCG[b] for Average
0-3 (upwind)	4	1.09	0.66	0.03	11.02
0-3 (downwind)	6	0.35	0.35	0.02	5.85
3-5 (downwind)	4	0.35	0.35	0.02	5.85
5-10 (downwind)	4	2.49	0.89	0.04	14.86
10-15 (downwind)	4	0.76	0.45	0.02	7.52
15-20 (downwind)	6	2.30	0.73	0.04	12.19
Northwest Zone					
0-3 (upwind)	4	0.35	0.35	0.02	5.85
0-3 (downwind)	6	0.35	0.35	0.02	5.85
3-5 (downwind)	4	0.35	0.35	0.02	5.85
5-10 (downwind)	4	0.95	0.50	0.03	8.35
10-15 (downwind)	4	1.59	0.66	0.03	11.02
15-20 (downwind)	6	0.35	0.35	0.02	5.85

[a] Lowest detectable limit for long lived alpha activity in air is 0.35×10^{-14} $\mu c/cc$. All values which were not detectable were set equal to this value when average values were calculated.

[b] RCG - Radioactivity Concentration Guide

TABLE 6

1966 YEARLY SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-PLUTONIUM

Range (miles)	Number of Samples	Maximum Concentration (10^{-14} $\mu c/cc$)	Average Concentration[a] (10^{-14} $\mu c/cc$)	Percent of Polonium RCG[b] for Average	Percent of Plutonium RCG[b] for Average
I. First Half of 1966, Jan.-June, All Zones					
0-3 (upwind)	25	0.35	0.35	0.02	5.85
0-3 (downwind)	50	2.46	0.54	0.03	9.02
3-5 (downwind)	29	1.03	0.43	0.02	7.18
5-10 (downwind)	29	1.34	0.40	0.02	6.68
10-15 (downwind)	34	2.32	0.55	0.03	9.19
15-20 (downwind)	45	11.12	0.69	0.03	11.52
II. Second Half of 1966, July-Dec., All Zones					
0-3 (upwind)	52	1.68	0.41	0.02	6.85
0-3 (downwind)	77	53.42	1.48	0.07	24.72
3-5 (downwind)	53	1.29	0.43	0.02	7.18
5-10 (downwind)	53	5.46	0.56	0.03	9.35
10-15 (downwind)	53	2.21	0.47	0.02	7.85
15-20 (downwind)	78	2.75	0.49	0.02	8.18
III. Entire Year 1966, Jan.-Dec., All Zones					
0-3 (upwind)	77	1.68	0.39	0.02	6.51
0-3 (downwind)	127	53.42	1.11	0.06	18.54
3-5 (downwind)	82	1.29	0.43	0.02	7.18
5-10 (downwind)	82	5.46	0.50	0.03	8.35
10-15 (downwind)	87	2.32	0.50	0.03	8.35
15-20 (downwind)	123	11.12	0.56	0.03	9.35

[a]Lowest detectable limit for long lived alpha activity in air is 0.35×10^{-14} $\mu c/cc$. All values which were not detectable were set equal to this value when average values were calculated.

[b]RCG - Radioactivity Concentration Guide

TABLE 7

SUMMARY OF AIR SAMPLING LOCATIONS

North Zone

Location		Range
1.	Cincinnati - Dayton Pike and Crains Run Rd. (Miamisburg, Ohio)	0-3 miles upwind
2.	Mound Rd. and Benner Rd. (Miamisburg, Ohio)	0-3 miles upwind
3.	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles downwind
4.	Upper River Rd. and Soldiers Home - Miamisburg Rd.	0-3 miles downwind
5.	One mile north on Upper River Rd. from previous sample (No. 4)	0-3 miles downwind
6.	Farmersville-West Carrollton Rd. and Soldiers Home-West Carrollton Rd.	3-5 miles downwind
7.	Union Rd. and Bear Creek Rd.	3-5 miles downwind
8.	Dayton Speedway (near intersection of State Route 4 and Liberty Dayton Rd.)	5-10 miles downwind
9.	Union Rd. and Liberty Dayton Rd.	5-10 miles downwind
10.	Siebenthaler Ave. and North Dixie Dr. (Dayton, Ohio)	10-15 miles downwind
11.	Trotwood, Ohio	10-15 miles downwind
12.	Murlin Heights on North Dixie Dr. (Dayton, Ohio)	15-20 miles downwind
13.	Meeker St. and Heathcliffe Rd. (Dayton, Ohio)	15-20 miles downwind
14.	State Route 49 at Clayton, Ohio	15-20 miles downwind

South Zone

1.	West off State Route 725 between river bridge and railroad (Miamisburg, Ohio)	0-3 miles upwind
2.	First St. and Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
3.	Crains Run Rd. and Medlar Rd.	0-3 miles downwind
4.	Chautauqua, Ohio	0-3 miles downwind
5.	Cincinnati-Dayton Pike at south city limits of Miamisburg, Ohio	0-3 miles downwind
6.	State Route 73 and Interstate 75	3-5 miles downwind
7.	State Route 123 and Dayton-Oxford Rd.	3-5 miles downwind
8.	Red Lion, Ohio	5-10 miles downwind
9.	Blue Ball, Ohio	5-10 miles downwind
10.	Lebanon, Ohio	10-15 miles downwind

TABLE 7 (continued)

South Zone

Location		Range
11.	Monroe, Ohio	10-15 miles downwind
12.	South Lebanon, Ohio	15-20 miles downwind
13.	Bethany Rd. and Mason Montgomery Rd.	15-20 miles downwind
14.	Bethany, Ohio	15-20 miles downwind

East Zone

1.	Riverview Ave. and Lower Miamisburg Rd. (Miamisburg, Ohio)	0-3 miles upwind
2.	Lower Miamisburg Rd. and Union Rd.	0-3 miles upwind
3.	Maue Rd. and Linden Ave. (Miamisburg, Ohio)	0-3 miles downwind
4.	Byers Rd. and Belvo Rd.	0-3 miles downwind
5.	State Route 725 and Interstate 75	0-3 miles downwind
6.	Yankee St. and State Route 725	3-5 miles downwind
7.	Waldruhe Park on Springboro Pike	3-5 miles downwind
8.	Clyo Rd. and Franklin St. (Centerville, Ohio)	5-10 miles downwind
9.	State Route 48 and Social Row Rd.	5-10 miles downwind
10.	Bellbrook, Ohio	10-15 miles downwind
11.	State Route 725 and U.S. 42	10-15 miles downwind
12.	Xenia, Ohio	15-20 miles downwind
13.	Spring Valley Rd. and Paintersville Rd.	15-20 miles downwind
14.	Mt. Holly, Ohio	15-20 miles downwind

West Zone

1.	Belvo Rd. and Gebhart Church Rd.	0-3 miles upwind
2.	Maue Rd. and Miamisburg-Springboro Rd.	0-3 miles upwind
3.	Cincinnati-Dayton Pike at south city limits of Miamisburg	0-3 miles downwind
4.	Lower Miamisburg Rd. and Union Rd.	0-3 miles downwind
5.	Lower Miamisburg Rd. and Jamaica Rd.	0-3 miles downwind
6.	State Route 725 and State Route 4	3-5 miles downwind
7.	Germantown, Ohio	3-5 miles downwind
8.	Manning Rd. and Farmersville-Johnsville Rd.	5-10 miles downwind
9.	Oxford Rd. and Browns Run Rd.	5-10 miles downwind
10.	Gratis, Ohio	10-15 miles downwind

TABLE 7 (continued)

West Zone

Location		Range
11.	Greenbush Rd. and State Route 122	10-15 miles downwind
12.	Eaton, Ohio	15-20 miles downwind
13.	Camden, Ohio	15-20 miles downwind
14.	Somerville, Ohio	15-20 miles downwind

Northeast Zone

1.	Cincinnati-Dayton Pike and Benner Rd.	0-3 miles upwind
2.	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles upwind
3.	Harmon Field (Miamisburg, Ohio)	0-3 miles downwind
4.	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles downwind
5.	Elm St. and Cincinnati-Dayton Pike (West Carrollton, Ohio)	0-3 miles downwind
6.	Woody's Market on Cincinnati-Dayton Pike (West Carrollton, Ohio)	3-5 miles downwind
7.	Yankee St. and Mad River Rd.	3-5 miles downwind
8.	Springboro Pike and Dryden Rd. (Village of Moraine, Ohio)	5-10 miles downwind
9.	State Route 48 and Stroop Rd.- Town and Country Shopping Center- (Kettering, Ohio)	5-10 miles downwind
10.	Interstate 75 and Wagner - Ford Rd.	10-15 miles downwind
11.	Belmont Auto Theater-Patterson Rd. and County Line Rd. (Kettering, Ohio)	10-15 miles downwind
12.	State Route 201 and Chambersburg Rd.	15-20 miles downwind
13.	State Route 235 (Fairborn, Ohio)	15-20 miles downwind
14.	Germany Trebein Rd. and Fairground Rd.-approximately 3 miles south of previous sample No. 13	15-20 miles downwind

Northwest Zone

1.	Mound Ave. and Benner Rd.	0-3 miles upwind
2.	Medlar Rd. and Miamisburg-Springboro Pike	0-3 miles upwind
3.	Cincinnati-Dayton Pike and Mound Ave. (Miamisburg, Ohio)	0-3 miles downwind
4.	Union Rd. and State Route 725	0-3 miles downwind
5.	Union Rd. and Manning Rd.	0-3 miles downwind
6.	State Route 4 Manning Rd.	3-5 miles downwind
7.	State Route 4 and Farmersville-West Carrollton Pike	3-5 miles downwind
8.	Diamond Mill Rd. and Mile Rd.	5-10 miles downwind

TABLE 7 (continued)

Northwest Zone

Location		Range
9.	Farmersville, Ohio	5-10 miles downwind
10.	Clayton Rd. and Amity Rd.	10-15 miles downwind
11.	Farmersville-West Alexandria Pike and DeChant Rd.	10-15 miles downwind
12.	Brookville, Ohio	15-20 miles downwind
13.	Lexington Salem Rd. and Preble County Line Rd.	15-20 miles downwind
14.	Lexington Salem Rd. and Engle Rd.	15-20 miles downwind

Southeast Zone

1.	Fifth St. and Central Ave. (Miamisburg, Ohio)	0-3 miles upwind
2.	Union Rd. and State Route 725	0-3 miles upwind
3.	Mound Ave. and Benner Rd.	0-3 miles downwind
4.	Medlar Rd. and Miamisburg-Springboro Pike	0-3 miles downwind
5.	Wood Rd. and Pennyroyal Rd.	3-5 miles downwind
6.	South Montgomery County Airport on State Route 741 at Austin Pike	3-5 miles downwind
7.	Springboro, Ohio	5-10 miles downwind
8.	At T.V. Tower on Lytle-Five Points Rd.	5-10 miles downwind
9.	State Route 122 and Utica Rd.	10-15 miles downwind
10.	Waynesville, Ohio	10-15 miles downwind
11.	Oregonia, Ohio	15-20 miles downwind
12.	Wilmington Rd. and Corwin Rd.	15-20 miles downwind
13.	Harveysburg, Ohio	15-20 miles downwind

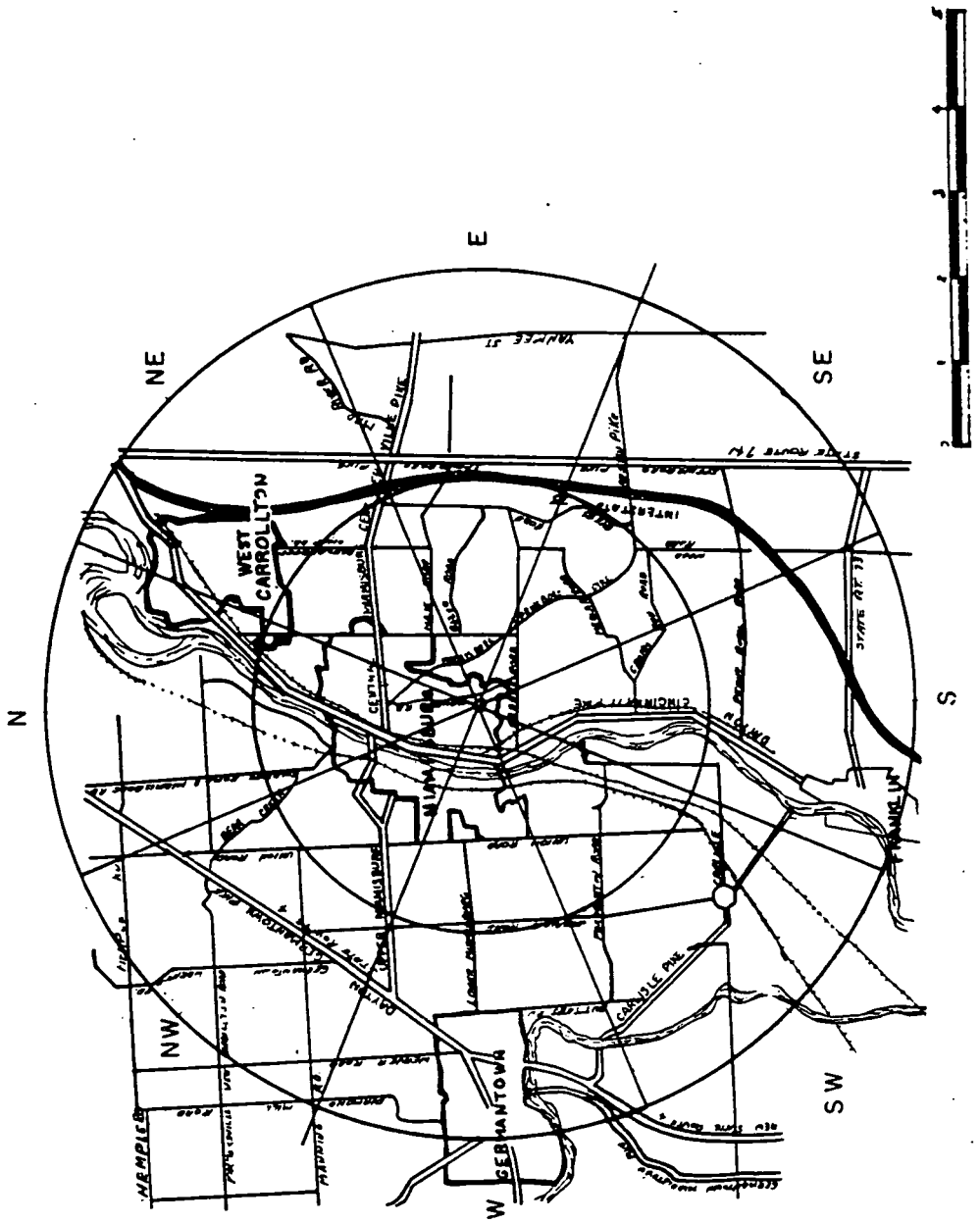
Southwest Zone

1.	State Route 725 and Alexanderville Rd.	0-3 miles upwind
2.	State Route 725 and Heincke Rd. (Miamisburg, Ohio)	0-3 miles upwind
3.	Miami Drive-In Theater on Cincinnati-Dayton Pike (Miamisburg, Ohio)	0-3 miles downwind
4.	Farmington Rd. and Chautauqua Rd.	0-3 miles downwind
5.	Farmington Rd. and Union Rd.	0-3 miles downwind
6.	Farmington Rd. and Butler St.	3-5 miles downwind
7.	Carlisle, Ohio	3-5 miles downwind
8.	Miami River Park on State Route 73 (Middletown, Ohio)	5-10 miles downwind
9.	Hetzler Rd. and Hinkle Rd.	5-10 miles downwind
10.	State Route 4 and State Route 73	10-15 miles downwind

TABLE 7 (continued)

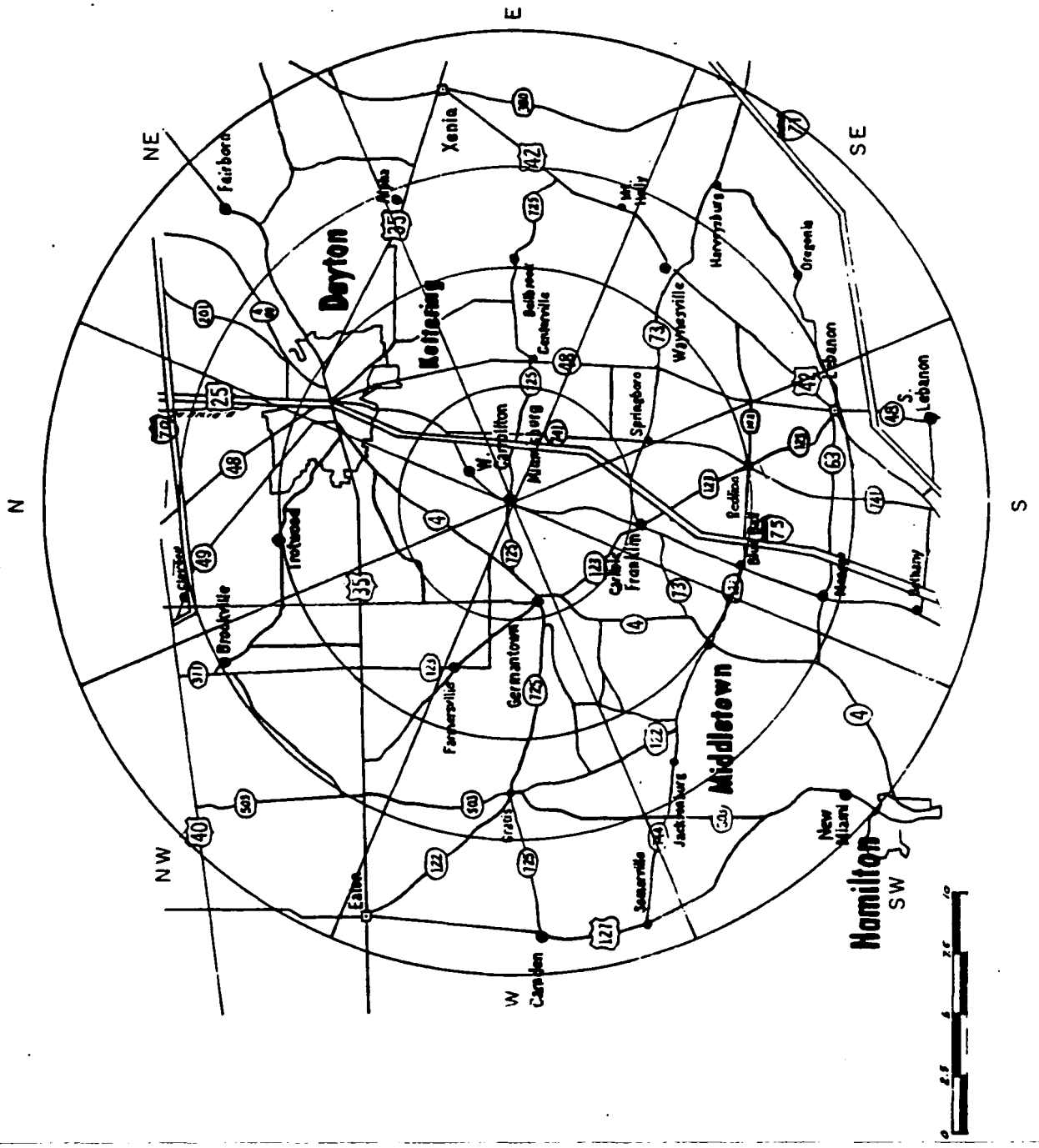
Southwest Zone

Location		Range
11.	Jacksonburg, Ohio	10-15 miles downwind
12.	State Route 4 and State Route 747	15-20 miles downwind
13.	New Maimi, Ohio	15-20 miles downwind
14.	West Elkton Rd. and Tolbert Rd.	15-20 miles downwind



MAP 2

PROXIMITY AIR SAMPLE ZONES



MAP 3

DISTANT AIR SAMPLE ZONES

ENVIRONMENTAL MONITORING REPORT

1965

1965

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

MLM-1275

ENVIRONMENTAL MONITORING REPORT:

JANUARY thru JUNE, 1965

P. C. Adams and H. E. Meyer

AEC Research and Development REPORT

MONSANTO RESEARCH CORPORATION

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UC-41 Health and Safety

ENVIRONMENTAL MONITORING REPORT: JANUARY-JUNE, 1965

Prepared by: P. C. Adams
Approved by: H. E. Meyer

Date: July 16, 1965
Issued: October 1, 1965

MONSANTO RESEARCH CORPORATION
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U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

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SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio is presented for the first half of 1965. The concentration of radionuclides from Mound Laboratory in the Great Miami River was within the maximum permissible concentration recommended by the National Committee on Radiation Protection and Measurements. The concentration of radionuclides in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements.

INTRODUCTION

This report is a summary of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program considers all of the projects at Mound Laboratory, and all of the radioisotopes which could be released in the environment. The monitoring procedures are those best suited for the detection and measurement of these radioactive materials.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U.S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 2×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

ENVIRONMENTAL MONITORING

During the period covered by this report, radioactive materials from Mound Laboratory did not contribute any measurable penetrating radiation, such as gamma or hard beta, to the environment. Of the radioisotopes in use at Mound Laboratory, only polonium, plutonium, and tritium are possible air and water contaminants. Water sampling and air sampling are discussed below in detail.

WATER SAMPLING

Liquid radioactive waste materials from polonium and plutonium work at the Laboratory are processed in special waste disposal plants to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Helium-3 being purified at Mound Laboratory contains small quantities of tritium. Liquid waste from this work, small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity is within the maximum permissible concentration before discharge to the Great Miami River.

Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries all storm sewer water and is discharged into the river. The treated liquid tritium waste is discharged into the storm sewers; the polonium waste disposal plant effluent is discharged directly into the river via a closed sewer line; and the treated plutonium effluent is discharged into the drainage ditch. Samples collected from the river are analyzed for polonium concentration. The drainage ditch samples are analyzed for tritium and plutonium con-

Data of off-site water monitoring are presented in Table I, "Summary of Off-Site Water Monitoring for Radioactivity, January through June, 1965." The data presented in Table I indicate that the average concentration of polonium, plutonium, and tritium in the Great Miami River is within the maximum permissible continuous concentration.

AIR SAMPLING

Monitoring of the environmental air for tritium concentration, by means of an air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. During this period a total of 319 evaluations were made at 90 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been immeasurable to date.

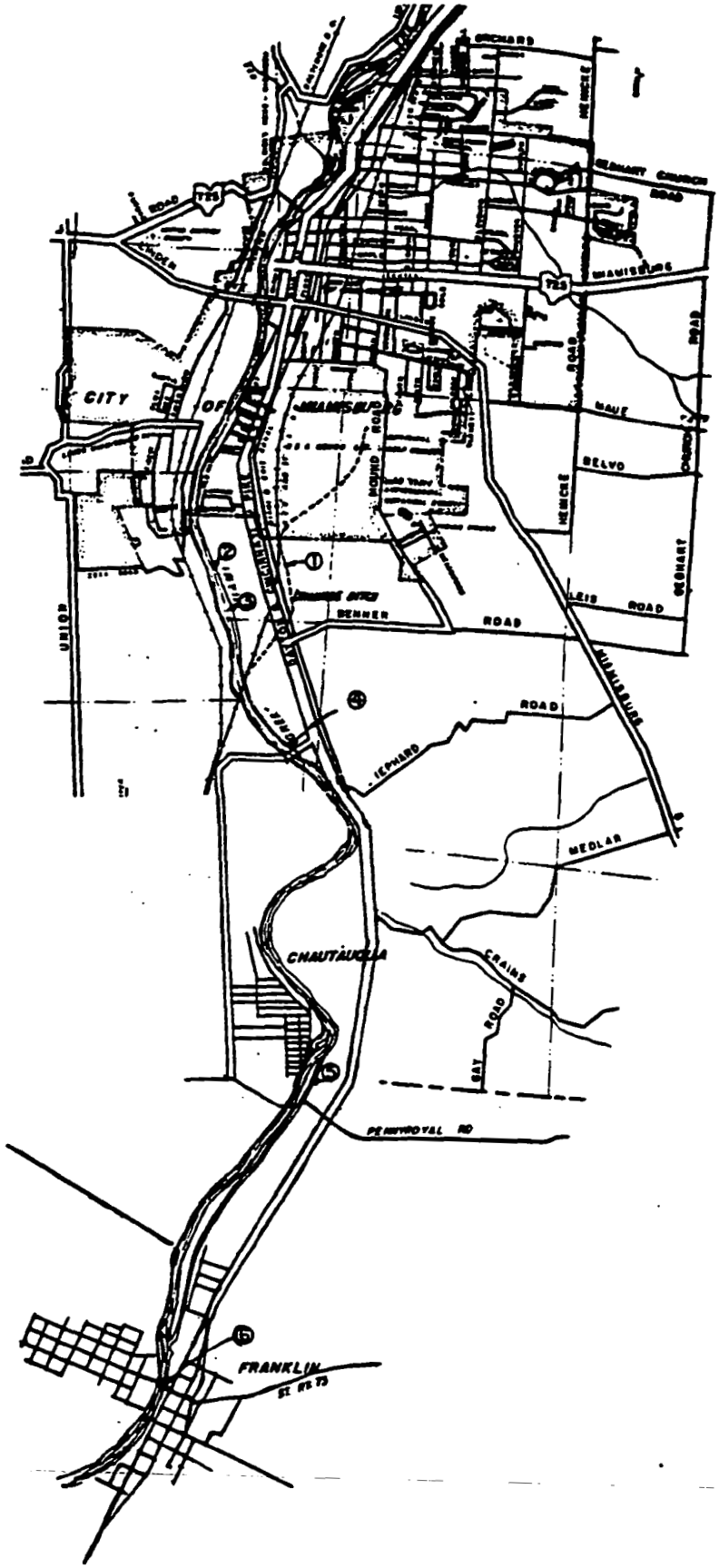
Possible polonium and plutonium in the environment is monitored by particulate air sampling equipment also mounted in the one-ton panel truck. During this period, a total of 311 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At these low concentrations, the isotopes of polonium and plutonium are not distinguishable from each other, or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table 2) to the maximum permissible continuous concentration of polonium in the environment, and assume that all alpha detected is polonium, we find that the average polonium concentration is only 0.014 percent of the permissible concentration. The effluent stack monitoring program for this period indicated that polonium should not be detectable in the environmental air from the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table 2) to the maximum permissible continuous concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, the average plutonium concentration is well within the maximum permissible continuous concentration. In order to determine the impact of Mound Laboratory's plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of, and occasionally exceeds, the very low permissible concentration for plutonium. (See Table 2, Section B).

The impact of plutonium work at Mound Laboratory is also placed in proper focus by referring to our stack monitoring data. During the first half of 1965, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200-foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium and/or polonium operations have not contributed a significant burden to radioactivity normally present in the atmosphere.

In Table 3, "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, January through June, 1965," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of percent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends on the wind direction on the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the different wind directions. Since the sampling location is dependent on the wind direction, it is unlikely that all sites will be sampled during the reporting period.



MAP 1
GREAT MIAMI RIVER SAMPLE LOCATIONS

Table I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

Table I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

January Through June, 1965

I. Polonium (River Samples)

Sampling Locations	Map I Code Number	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Per Cent of MPC for Average[b]
Mound Lab Effluent	2	21	0.45×10^{-7}	0.72×10^{-8}	1.0
250 Yards Downstream	3	21	1.62×10^{-8}	0.18×10^{-8}	0.25
Chautauqua Road Bridge	4	21	0.18×10^{-8}	0.04×10^{-8}	0.05
Chautauqua Dam	5	21	0.72×10^{-8}	0.14×10^{-8}	0.20
Franklin, Ohio	6	21	0.45×10^{-8}	0.09×10^{-8}	0.12
Trenton, Ohio		2	0.09×10^{-8}	0.04×10^{-8}	0.05
New Miami, Ohio		2	0.18×10^{-7}	0.09×10^{-8}	0.12
7 Miles North of New Baltimore, Ohio		2	0.18×10^{-8}	0.09×10^{-8}	0.12
New Baltimore, Ohio		2	0.18×10^{-8}	0.09×10^{-8}	0.12
Miamitown, Ohio		2	0.0	0.0	0.0
Elizabethtown, Ohio		2	0.09×10^{-8}	0.04×10^{-8}	0.05
OVER ALL		117	0.45×10^{-7}	0.21×10^{-8}	0.30

II. Tritium (River Samples and Drainage Ditch)

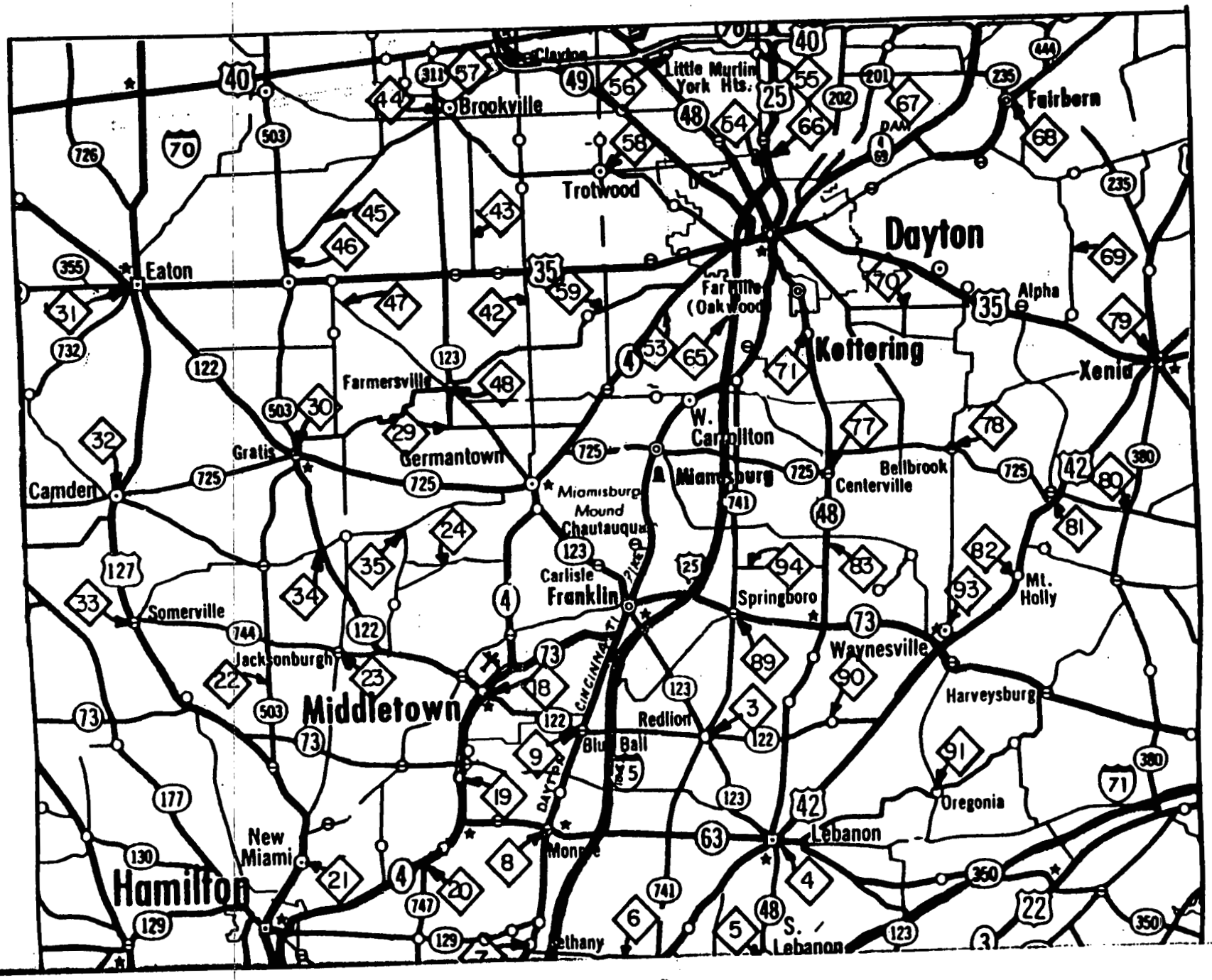
Mound Lab Drainage Ditch	1	21	2×10^{-3}	0.3×10^{-3}	6.0
Mound Lab Effluent	2	21	0.0	0.0	0.0
Chautauqua Road Bridge	4	21	0.0	0.0	0.0
OVER ALL		63	2×10^{-3}	0.1×10^{-3}	2.0

III. Plutonium

Mound Lab Drainage Ditch	1	22	1.57×10^{-6}	2.08×10^{-7}	0.415

[a]All concentrations are in microcuries per cubic centimeter.

[b]MPC - Maximum Permissible Continuous Concentration.



MAP 2
DISTANT
AIR SAMPLE
LOCATIONS
AND ROAD MAP

LOCATION ◇→

Table 2

COMPOSITE - AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

January Through June, 1965

Sampling Locations	Samples Collected	Maximum Concentration[a]	Average Concentration[a]	Per Cent of Polonium MPC for Average[b]	Per Cent of Plutonium MPC for Average[b]
A. Downwind Sampling					
83	311	3.87×10^{-14}	0.28×10^{-14}	0.014	4.6
B. Upwind Sampling					
14	52	2.70×10^{-14}	0.36×10^{-14}	0.018	6.0
C. Difference					
		1.17×10^{-14}	---	--	-

[a]All concentrations are in microcuries per cubic centimeter.

[b]MPC - Maximum Permissible Continuous Concentration.

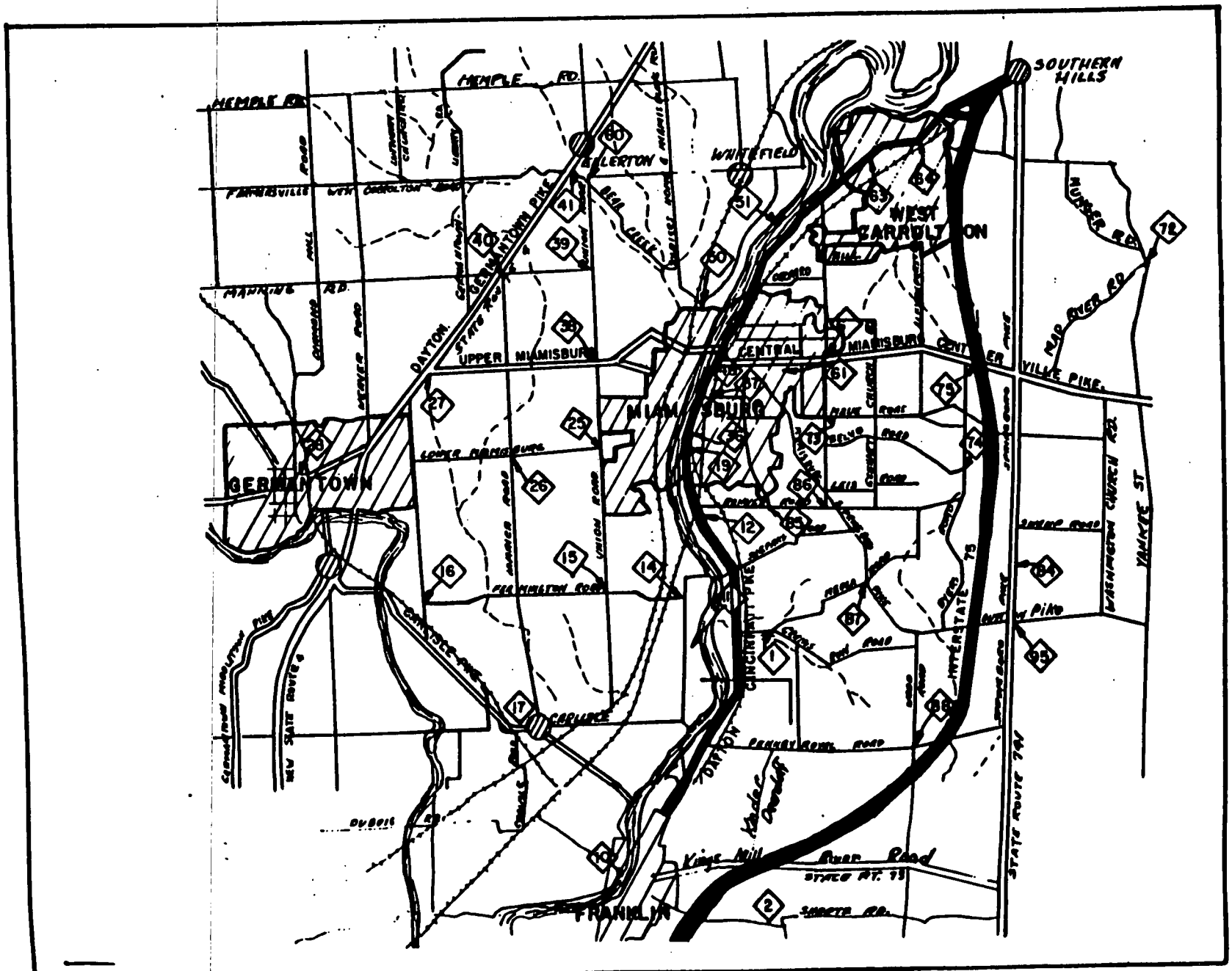

SOUTHERN HILLS
MEMPLE RD.
WHITEFIELD
WEST CARROLLTON
CENTRAL
MIAMISBURG
UPPER MIAMISBURG
GERMANTOWN
CARLISLE
FRANKLIN
DAYTON
STATE ROUTE 741
YANKEE ST
WASHINGTON CHURCH RD.
MAP 3
PROXIMITY
AIR SAMPLE
LOCATION
AND ROAD MAP
LOCATIONS

Table 3

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FROM LONG-LIVED ALPHA EMITTERS

January Through June, 1965

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Per Cent of Polonium MPC for Average[b]	Per Cent of Plutonium MPC for Average[b]
1. Junction of Crains Run Rd. & Mediar Rd.	1	–	0.0	0.0	0.0
2. Junction of SR 73 & I 75	1	–	0.0	0.0	0.0
3. Red Lion, Ohio	1	–	0.72×10^{-14}	0.036	12.0
4. Lebanon, Ohio	1	–	0.0	0.0	0.0
5. South Lebanon, Ohio	1	–	0.0	0.0	0.0
6. Junction of Bethany Rd. & Mason-Montgomery Rd.	1	–	0.0	0.0	0.0
7. Bethany, Ohio	1	–	0.36×10^{-14}	0.018	6.0
8. Monroe, Ohio	1	–	0.0	0.0	0.0
9. Blue Ball, Ohio	1	–	0.0	0.0	0.0
10. Junction of SR 123 & Dayton-Oxford Rd.	1	–	0.14×10^{-14}	0.007	2.3
11. Chautauqua, Ohio	1	–	0.0	0.0	0.0
12. Junction of Benner Rd. & US 25	1	–	0.0	0.0	0.0
13. Miami Drive-in Theatre in Miamisburg (US 25)	5	0.32×10^{-14}	0.05×10^{-14}	0.002	0.8
14. Junction of Farmington Rd. & Chautauqua Rd.	5	0.63×10^{-14}	0.14×10^{-14}	0.007	2.3
15. Junction of Farmington Rd. & Union Rd.	5	1.80×10^{-14}	0.41×10^{-14}	0.020	6.8
16. Junction of Farmington Rd. & Butter St.	5	0.36×10^{-14}	0.09×10^{-14}	0.004	1.5
17. Carlisle, Ohio	5	0.67×10^{-14}	0.05×10^{-14}	0.002	0.8
18. Middletown, Ohio	5	0.05×10^{-14}	0.01×10^{-14}	0.001	0.1
19. Junction of SR 4 & SR 73	5	0.14×10^{-14}	0.05×10^{-14}	0.002	0.8
20. Junction of SR 4 & SR 747	5	0.77×10^{-14}	0.14×10^{-14}	0.007	2.3
21. New Miami, Ohio	5	2.48×10^{-14}	0.50×10^{-14}	0.025	8.3
22. Junction of West Elkton Rd. & Tolbert Rd.	5	0.0	0.0	0.0	0.0
23. Jacksonburg, Ohio	5	0.18×10^{-14}	0.04×10^{-14}	0.002	0.8
24. Junction of Hetzler Rd. & Hinkle Rd.	5	0.0	0.0	0.0	0.0

(Table 4 continued)

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Per Cent of Polonium MPC for Average[b]	Per Cent of Plutonium MPC for Average[b]
25. Junction of Lower Miamisburg Rd. & Union Rd.		No samples were collected at Locations 25 through 36 during this quarter because the wind direction was not toward that area at the prescribed sampling times.			
26. Junction of Lower Miamisburg Rd. & Jamaica Rd.					
27. Junction of SR 725 & SR 4					
28. Germantown, Ohio					
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.					
30. Gratis, Ohio					
31. Eaton, Ohio					
32. Camden, Ohio					
33. Sommerville, Ohio					
34. Junction of Greenbush Rd. & SR 122					
35. Junction of Oxford Rd. & Browns Run Rd.					
36. Miamisburg South City Limit & US 25					
37. Junction of Mound Ave. & US 25	2	1.23×10^{-14}	0.61×10^{-14}	0.030	10.1
38. Junction of Union Rd. & SR 725	2	0.0	0.0	0.0	0.0
39. Junction of Union Rd. & Manning Rd.	2	0.76×10^{-14}	0.38×10^{-14}	0.019	6.3
40. Junction of Manning Rd. & SR 4	2	1.53×10^{-14}	0.76×10^{-14}	0.038	12.6
41. Junction of SR 4 & Farmersville-West Carrollton Rd.	2	0.0	0.0	0.0	0.0
42. Junction of Diamond Mill Rd. & Mile Rd.	2	0.85×10^{-14}	0.42×10^{-14}	0.021	7.0
43. Junction of Clayton Rd. & Amity Rd.	2	0.0	0.0	0.0	0.0
44. Brookville, Ohio	2	0.0	0.0	0.0	0.0
45. Junction of Lexington Salem Rd. & Preble County Line Rd.	2	0.0	0.0	0.0	0.0
46. Junction of Lexington Salem Rd. & Engle Rd	2	1.57×10^{-14}	0.85×10^{-14}	0.042	14.3
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.	2	0.45×10^{-14}	0.23×10^{-14}	0.011	3.8
48. Farmersville, Ohio	2	0.0	0.0	0.0	0.0
49. Fifth St. & Central Ave. in Miamisburg, Ohio	3	0.27×10^{-14}	0.09×10^{-14}	0.004	1.5

(Table continued)

(Table 3 continued)

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Per Cent of Polonium MPC for Average[b]	Per Cent of Plutonium MPC for Average[b]
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	3	0.76×10^{-14}	0.49×10^{-14}	0.024	8.1
51. One mile north on Upper River Rd. from Sample No. 50	3	1.17×10^{-14}	0.36×10^{-14}	0.018	6.0
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	3	0.36×10^{-14}	0.12×10^{-14}	0.006	2.0
53. Dayton Speedway	3	0.0	0.0	0.0	0.0
54. Dayton, Ohio	3	0.0	0.0	0.0	0.0
55. Murlin Heights	3	0.0	0.0	0.0	0.0
56. Little York	3	0.0	0.0	0.0	0.0
57. Clayton, Ohio	3	1.62×10^{-14}	0.63×10^{-14}	0.0031	10.5
58. Trotwood, Ohio	3	0.36×10^{-14}	0.12×10^{-14}	0.006	2.0
59. Union Rd. & Liberty Dayton Rd.	3	0.0	0.0	0.0	0.0
60. Union Rd. & Bear Creek Rd.	3	0.18×10^{-14}	0.06×10^{-14}	0.003	1.0
61. Harmon Field in Miamisburg	12	2.52×10^{-14}	0.36×10^{-14}	0.018	6.0
62. Junction of SR 725 & Heincke Rd.	12	2.88×10^{-14}	0.90×10^{-14}	0.045	15.0
63. Junction of Elm St. & US 25 in West Carrollton	12	2.03×10^{-14}	0.45×10^{-14}	0.022	7.5
64. Woody's Market in West Carrollton	12	2.03×10^{-14}	0.49×10^{-14}	0.028	8.1
65. Junction of South Broadway & Dryden Rd.	12	0.90×10^{-14}	0.09×10^{-14}	0.004	1.5
66. Junction of I 75 & Wagoner Ford Rd.	12	1.70×10^{-14}	0.18×10^{-14}	0.009	3.0
67. Junction of SR 201 & Chambersburg Rd	12	1.94×10^{-14}	0.54×10^{-14}	0.027	9.0
68. Fairborn, Ohio	12	0.95×10^{-14}	0.27×10^{-14}	0.013	4.5
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	12	2.97×10^{-14}	0.72×10^{-14}	0.036	12.0
70. Belmont Auto Theatre	12	1.17×10^{-14}	0.05×10^{-14}	0.002	0.8
71. Town & Country Shopping Center in Kettering, Ohio	12	3.87×10^{-14}	0.85×10^{-14}	0.042	14.1
72. Junction of Yankee St. & Mad River Rd.	12	0.27×10^{-14}	0.05×10^{-14}	0.002	0.8
73. Junction of Maue Rd. & Linden Ave.	2	0.0	0.0	0.0	0.0
74. Junction of Byers Rd. & Belvo Rd.	2	0.0	0.0	0.0	0.0

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Per Cent of Polonium MPC for Average[b]	Per Cent of Plutonium MPC for Average[b]
75. Junction of SR 725 & I 75	2	0.0	0.0	0.0	0.0
76. Junction of Yankee St. & SR 725	2	0.14×10^{-14}	0.07×10^{-14}	0.003	1.1
77. Centerville, Ohio	2	0.0	0.0	0.0	0.0
78. Bellbrook, Ohio	2	0.36×10^{-14}	0.18×10^{-14}	0.009	3.0
79. Xenia, Ohio	2	1.26×10^{-14}	0.63×10^{-14}	0.031	10.5
80. Junction of Spring Valley-Paintersville Rd. & SR 380	2	0.95×10^{-14}	0.47×10^{-14}	0.023	7.8
81. Spring Valley, Ohio	2	0.0	0.0	0.0	0.0
82. Mt. Holly, Ohio	2	0.0	0.0	0.0	0.0
83. Junction of SR 48 & Social Row Rd.	2	2.38×10^{-14}	1.19×10^{-14}	0.059	19.8
84. Waldruhe Park	2	0.0	0.0	0.0	0.0
85. Junction of Mound Rd. & Benner Rd.	1	–	0.0	0.0	0.0
86. Junction of Benner Rd. & Miamisburg Springboro Rd.	1	–	0.0	0.0	0.0
87. Junction of Mediar Rd. & Miamisburg Springboro Rd.	1	–	0.14×10^{-14}	0.007	2.3
88. Junction of Woods Rd. & Pennyroyal Rd.	1	–	0.0	0.0	0.0
89. Springboro, Ohio	1	–	0.0	0.0	0.0
90. Junction of SR 122 & Utica Rd	1	–	0.27×10^{-14}	0.013	4.5
91. Oregonia, Ohio	1	–	0.0	0.0	0.0
92. Harversburg, Ohio	1	–	0.0	0.0	0.0
93. Waynesville, Ohio	1	–	0.40×10^{-14}	0.020	6.6
94. By TV Tower on Lytle-Five Points Rd.	1	–	0.0	0.0	0.0
95. South Montgomery County Airpoty	1	–	1.53×10^{-14}	0.076	25.5

[a]All concentrations are in microcuries per cubic centimeter.

[b]MPC - Maximum Permissible Continuous Concentration.

MLM-1335

ENVIRONMENTAL MONITORING REPORT: JULY-DECEMBER, 1965 AND 1965 SUMMARY

P. C. Adams, H. F. Anderson and H. E. Meyer

AEC Research and Development REPORT

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

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MLM-1335
TID-4500
UC-41 Health and Safety

ENVIRONMENTAL MONITORING REPORT: JULY-DECEMBER, 1965 AND 1965 SUMMARY

Prepared by: P. C. Adams
H. F. Anderson
Approved by: H. E. Meyer

Date: February 28, 1966
Issued: August 3, 1966

MONSANTO RESEARCH CORPORATION
A SUBSIDIARY OF MONSANTO COMPANY

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SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio is presented for the second half of 1965 and a summary is presented for the entire year. The concentration of radionuclides from Mound Laboratory in the Great Miami River and in the environmental air was within the Radioactivity Concentration Guides recommended by the Federal Radiation Council.

INTRODUCTION

This report is a summary of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program considers all of the projects at Mound Laboratory, and all of the radioisotopes which could be released in the environment. The monitoring procedures are those best suited for the detection and measurement of these radioactive materials.

The Radioactivity Concentration Guide (RCG) values in air and in water for the radionuclides in use at Mound Laboratory are taken from the USAEC Manual, Chapter 0524. The Radioactivity Concentration Guides for environmental air and water for the materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 2×10^{-7} microcuries per cubic centimeter

Water - 3×10^{-3} microcuries per cubic centimeter

ENVIRONMENTAL MONITORING

During the period covered by this report, radioactive materials from Mound Laboratory did not contribute any measurable penetrating radiation, such as gamma or hard beta, to the environment. Of the radioisotopes in use at Mound Laboratory, only polonium, plutonium, and tritium are possible air and water contaminants. Water sampling and air sampling are discussed below in detail.

WATER SAMPLING

Liquid radioactive waste materials from polonium and plutonium work at the Laboratory are processed in special waste disposal plants to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Helium-3 being purified at Mound Laboratory contains small quantities of tritium. Liquid waste from this work, small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity is within the maximum permissible concentration before discharge to the Great Miami River.

Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries all storm sewer water and is discharged into the river. The treated liquid tritium waste is discharged into the storm sewers; the polonium waste disposal plant effluent is discharged directly into the river via a closed sewer line; and the treated plutonium effluent is discharged into the drainage ditch. Samples collected from the river are analyzed for polonium concentration. The drainage ditch samples are analyzed for tritium and plutonium concentrations.

Data of off-site water monitoring are presented in Table I, "Summary of Off-Site Water Monitoring for Radioactivity, July through December, 1965." The data presented in Table I indicate that the average concentration of polonium, plutonium, and tritium in the Great Miami River is within the Radioactivity Concentration Guides.

AIR SAMPLING

Monitoring of the environmental air for tritium concentration, by means of an air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. During this period a total of 328 evaluations were made at 96 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been unmeasurable to date.

Possible polonium and plutonium in the environment is monitored by particulate air sampling equipment also mounted in the one-ton panel truck. During this period, a total of 309 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At these low concentrations, the isotopes of polonium and plutonium are not distinguishable from each other, or from the natural

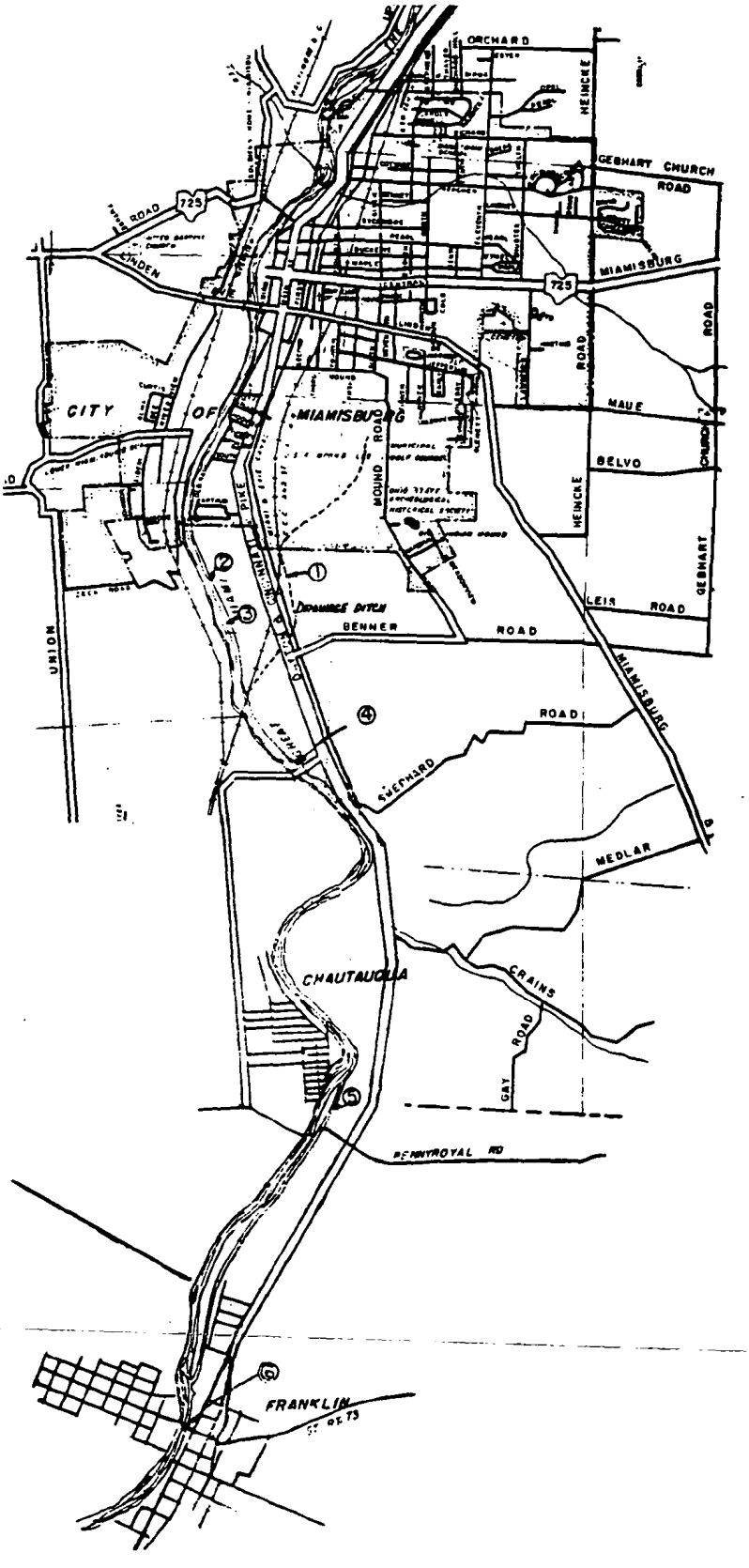
background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table 2) to the Radioactivity Concentration Guide for polonium in the environment, and assume that all alpha detected is polonium, we find that the average polonium concentration is only 0.012 percent of the RCG.

If we compare the gross alpha detected in the environment (see Table 2) to the Radioactivity Concentration Guide for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration is only 4.2 percent of the RCG. It is noted that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of, and occasionally exceeds, the very low permissible concentration for plutonium. (See Table 2, Section B).

The results of the routine stack monitoring program considered with standard meteorological dilution factors are consistent with the results of the environmental monitoring program. There was no indication during the last half of 1965 that radioelements discharged from Mound Laboratory stacks have contributed a significant burden to the environmental atmosphere.

In Table 3, "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, July through December, 1965," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration, and the average concentration in terms of percent of the RCG for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends on the wind direction on the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the different wind directions. Since the sampling location is dependent on the wind direction, it is possible that all sites will not be sampled during the reporting period.

Table 4 contains a yearly summary of data obtained for polonium, plutonium and tritium off-site water monitoring. Table 5 contains a yearly summary of data obtained from the environmental air monitoring program for long-lived alpha emitters.



MAP 1
GREAT MIAMI RIVER SAMPLE LOCATIONS

Table I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

July Through December, 1965

I. Polonium (River Samples)

Sampling Locations	Map I Code Number	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Percent of RCG for Average[b]
Mound Lab Effluent	2	24	46.8×10^{-8}	8.38×10^{-8}	11.97
250 Yards Downstream	3	24	0.18×10^{-8}	0.02×10^{-8}	0.03
Chautauqua Road Bridge	4	24	0.18×10^{-8}	0.04×10^{-8}	0.05
Chautauqua Dam	5	24	0.18×10^{-8}	0.02×10^{-8}	0.03
Franklin, Ohio	6	24	0.18×10^{-8}	0.01×10^{-8}	0.02
Trenton, Ohio		2	0.0	0.0	0.0
New Miami, Ohio		2	0.27×10^{-8}	0.14×10^{-8}	0.19
7 Miles North of New Baltimore, Ohio		2	0.0	0.0	0.0
New Baltimore, Ohio		2	0.0	0.0	0.0
Miamitown, Ohio		2	0.0	0.0	0.0
Elizabethtown, Ohio		2	0.0	0.0	0.0
OVER ALL		132	46.8×10^{-8}	1.54×10^{-8}	2.2

II. Tritium (River Samples and Drainage Ditch)[c]

Mound Lab Drainage Ditch	1	25	1.76×10^{-3}	0.32×10^{-3}	10.7
Mound Lab Effluent	2	25	2.32×10^{-3}	0.43×10^{-3}	14.3
Chautauqua Road Bridge	4	24	0.07×10^{-3}	0.05×10^{-3}	1.7
OVER ALL		74	2.32×10^{-3}	0.27×10^{-3}	9.0

III. Plutonium

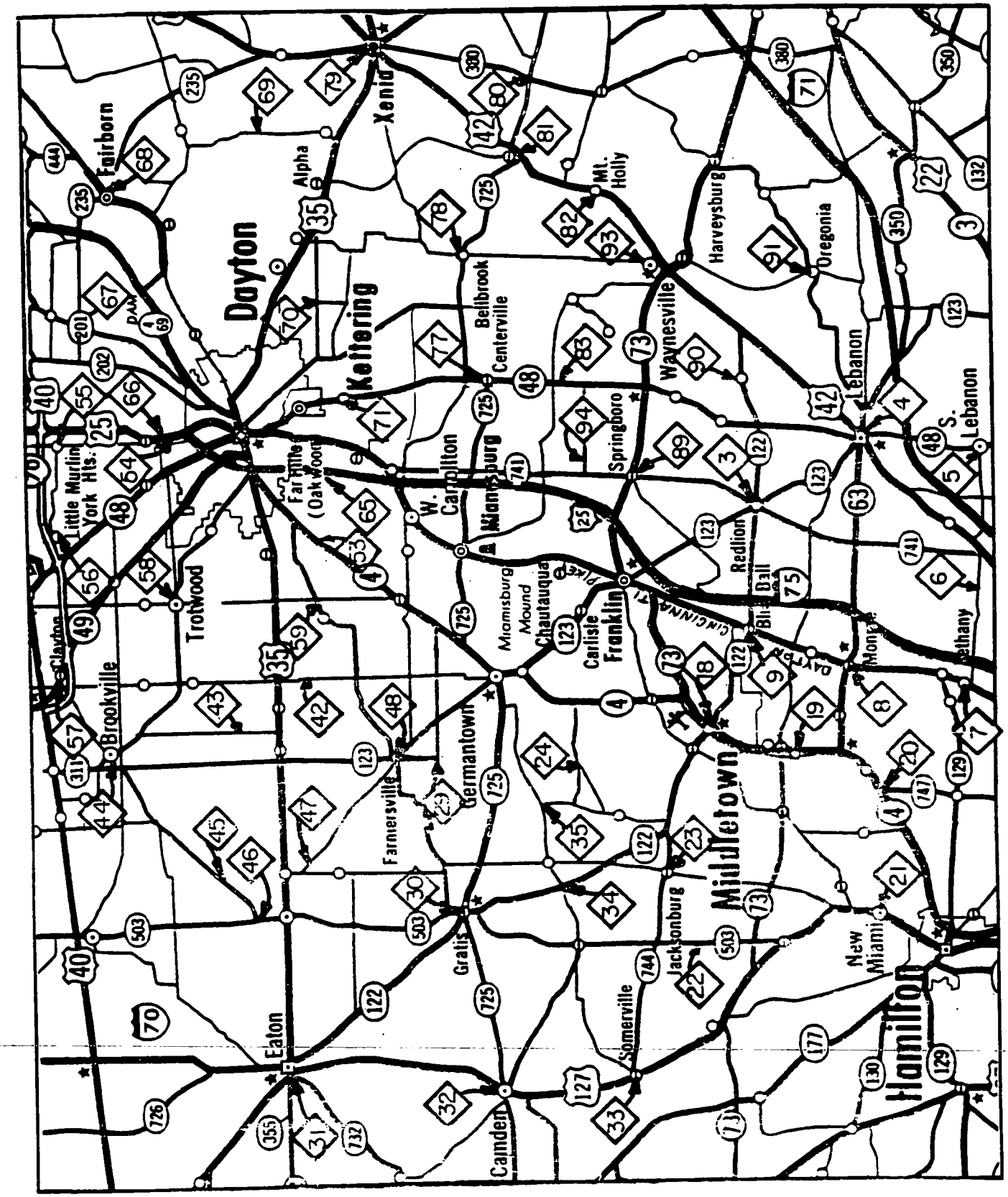
Mound Lab Drainage Ditch	1	25	3.33×10^{-6}	0.16×10^{-6}	3.25

[a] All concentrations are in microcuries per cubic centimeter.

[b] RCG - Radioactivity Concentration Guide

[c] Lowest detectable limit for tritium in water is 50 picocuries per cubic centimeter.

LOCATION



MAP 2
DISTANT AIR SAMPLE LOCATIONS AND ROAD MAP

Table 2

COMPOSITE AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

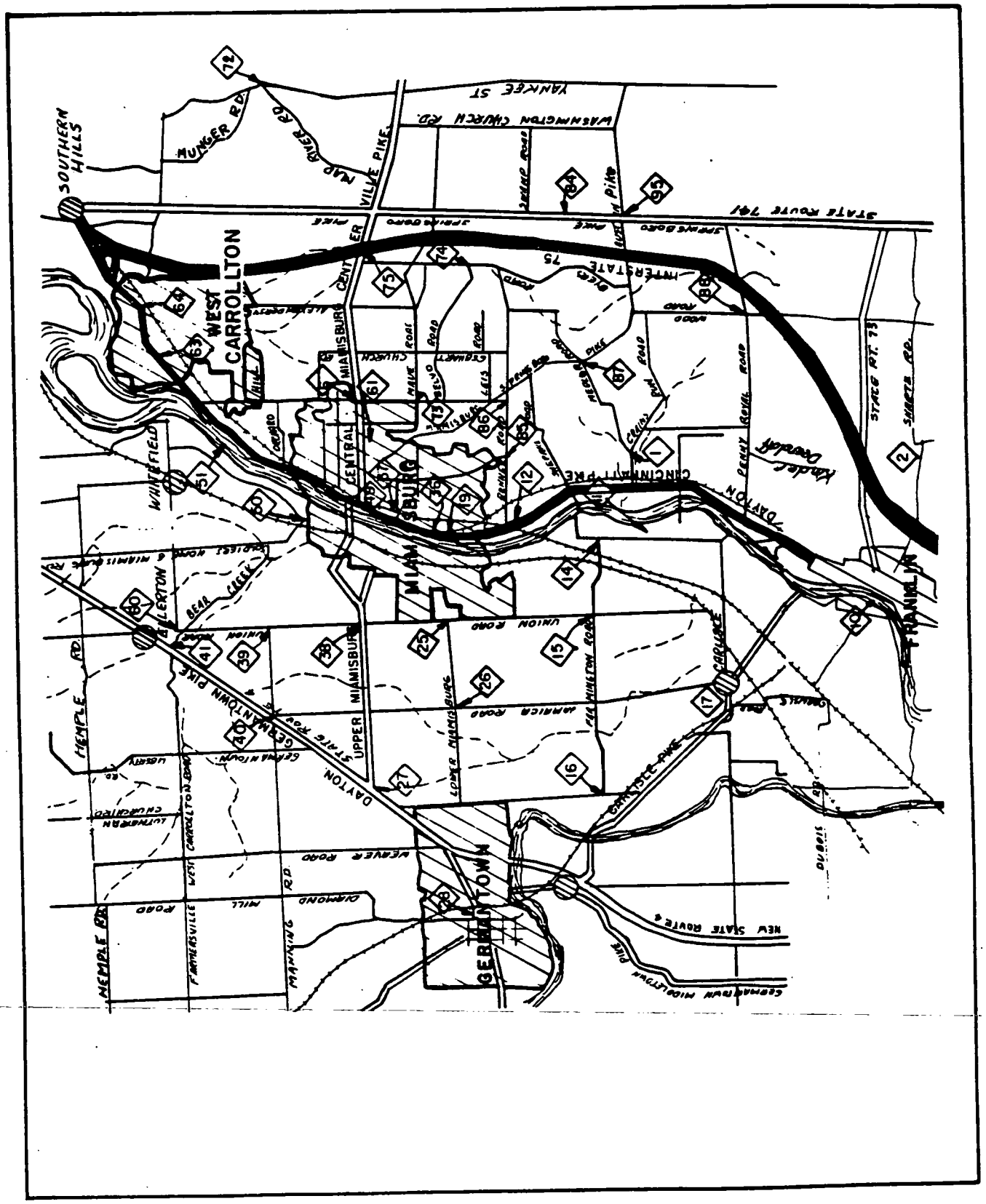
July Through December, 1965

Sampling Locations	Samples Collected	Maximum Concentration[a]	Average Concentration[a]	Percent of Polonium RCG for Average[b]	Percent of Plutonium RCG for Average[b]
A. Downwind Sampling					
95	309	8.28×10^{-14}	0.25×10^{-14}	0.012	4.2
B. Upwind Sampling					
16	52	2.25×10^{-14}	0.14×10^{-14}	0.007	2.3
C. Difference					
		6.03×10^{-14}	0.11×10^{-14}	0.005	1.9

[a]All concentrations are in microcuries per cubic centimeter.

[b]RCG - Radioactivity Concentration Guide.

LOCATION



MAP 3
PROXIMITY AIR SAMPLE LOCATION AND ROAD MAP

Table 3

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FROM LONG-LIVED ALPHA EMITTERS

July Through December, 1965

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Percent of Polonium RCG for Average[b]	Percent of Plutonium RCG for Average[b]
1. Junction of Crains Run Rd. & Medlar Rd.	2	0.32×10^{-14}	0.18×10^{-14}	0.009	3.00
2. Junction of SR 73 & I 75	2	0.0	0.0	0.0	0.0
3. Red Lion, Ohio	2	0.22×10^{-14}	0.11×10^{-14}	0.005	1.83
4. Lebanon, Ohio	2	2.02×10^{-14}	1.01×10^{-14}	0.050	16.84
5. South Lebanon, Ohio	2	0.0	0.0	0.0	0.0
6. Junction of Bethany Rd. & Mason-Montgomery Rd.	2	0.63×10^{-14}	0.32×10^{-14}	0.016	5.25
7. Bethany, Ohio	2	0.0	0.0	0.0	0.0
8. Monroe, Ohio	2	0.0	0.0	0.0	0.0
9. Blue Ball, Ohio	2	0.0	0.0	0.0	0.0
10. Junction of SR 123 & Dayton-Oxford Rd.	2	0.0	0.0	0.0	0.0
11. Chautauqua, Ohio	2	0.0	0.0	0.0	0.0
12. Junction of Benner Rd. & US 25	2	0.0	0.0	0.0	0.0
13. Miami Drive-In Theatre in Miamisburg (US 25)	5	2.07×10^{-14}	0.41×10^{-14}	0.021	6.83
14. Junction of Farmington Rd. & Chautauqua Rd.	5	0.45×10^{-14}	0.09×10^{-14}	0.004	1.50
15. Junction of Farmington Rd. & Union Rd.	5	0.0	0.0	0.0	0.0
16. Junction of Farmington Rd. & Butter St.	5	0.23×10^{-14}	0.08×10^{-14}	0.004	1.33
17. Carlisle, Ohio	5	0.0	0.0	0.0	0.0
18. Middletown, Ohio	5	0.09×10^{-14}	0.02×10^{-14}	0.001	0.33
19. Junction of SR 4 & SR 73	5	0.0	0.0	0.0	0.0
20. Junction of SR 4 & SR 747	5	0.72×10^{-14}	0.24×10^{-14}	0.012	4.00

Table 3 (continued)

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Percent of Polonium RCG for Average[b]	Percent of Plutonium RCG for Average[b]
21. New Miami, Ohio	5	1.53×10^{-14}	0.41×10^{-14}	0.020	6.83
22. Junction of West Elkton Rd. & Tolbert Rd.	5	0.59×10^{-14}	0.12×10^{-14}	0.006	2.00
23. Jacksonburg, Ohio	5	1.67×10^{-14}	0.33×10^{-14}	0.016	5.50
24. Junction of Hetzler Rd. & Hinkle Rd.	5	1.35×10^{-14}	0.27×10^{-14}	0.013	4.50
25. Junction of Lower Miamisburg Rd. & Union Rd.	4	0.0	0.0	0.0	0.0
26. Junction of Lower Miamisburg Rd. & Jamaica Rd.	4	0.0	0.0	0.0	0.0
27. Junction of SR 725 & SR 4	4	0.45×10^{-14}	0.20×10^{-14}	0.010	3.30
28. Germantown, Ohio	4	0.54×10^{-14}	0.22×10^{-14}	0.011	3.70
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.	4	0.0	0.0	0.0	0.0
30. Gratis, Ohio	4	1.13×10^{-14}	0.38×10^{-14}	0.019	6.30
31. Eaton, Ohio	4	0.0	0.0	0.0	0.0
32. Camden, Ohio	4	0.14×10^{-14}	0.03×10^{-14}	0.002	0.50
33. Sommerville, Ohio	4	1.84×10^{-14}	0.90×10^{-14}	0.045	15.00
34. Junction of Greenbush Rd. & SR 122	4	0.0	0.0	0.0	0.0
35. Junction of Oxford Rd. & Browns Run Rd.	4	0.0	0.0	0.0	0.0
36. Miamisburg South City Limit & US 25	4	1.67×10^{-14}	0.42×10^{-14}	0.021	7.00
37. Junction of Mound Ave. & US 25	1	0.0	0.0	0.0	0.0
38. Junction of Union Rd. & SR 725	1	0.0	0.0	0.0	0.0
39. Junction of Union Rd. & Manning Rd.	1	0.0	0.0	0.0	0.0
40. Junction of Manning Rd. & SR 4	1	0.0	0.0	0.0	0.0
41. Junction of SR 4 & Farmersville-West Carrollton Rd.	1	0.0	0.0	0.0	0.0

Table 3 (continued)

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Percent of Polonium RCG for Average[b]	Percent of Plutonium RCG for Average[b]
42. Junction of Diamond Mill Rd. & Mile Rd.	1	0.0	0.0	0.0	0.0
43. Junction of Clayton Rd. & Amity Rd.	1	0.0	0.0	0.0	0.0
44. Brookville, Ohio	1	0.32×10^{-14}	0.32×10^{-14}	0.016	5.33
45. Junction of Lexington Salem Rd. & Preble County Line Rd.	1	0.0	0.0	0.0	0.0
46. Junction of Lexington Salem Rd. & Engle Rd.	1	0.68×10^{-14}	0.68×10^{-14}	0.034	11.34
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.	1	0.0	0.0	0.0	0.0
48. Farmersville, Ohio	1	0.0	0.0	0.0	0.0
49. Fifth St. & Central Ave. in Miamisburg, Ohio	3	1.44×10^{-14}	0.59×10^{-14}	0.030	9.83
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	3	0.45×10^{-14}	0.15×10^{-14}	0.007	2.50
51. One mile north on Upper River Rd. from Sample No. 50	3	2.93×10^{-14}	0.99×10^{-14}	0.050	16.50
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	3	2.57×10^{-14}	0.86×10^{-14}	0.043	14.34
53. Dayton Speedway	3	0.0	0.0	0.0	0.0
54. Dayton, Ohio	3	0.0	0.0	0.0	0.0
55. Murlin Heights	3	0.72×10^{-14}	0.24×10^{-14}	0.012	4.00
56. Little York	3	0.0	0.0	0.0	0.0
57. Clayton, Ohio	3	0.0	0.0	0.0	0.0
58. Trotwood, Ohio	3	1.44×10^{-14}	0.59×10^{-14}	0.030	9.83
59. Union Rd. & Liberty Dayton Rd.	3	0.59×10^{-14}	0.35×10^{-14}	0.017	5.83
60. Union Rd. & Bear Creek Rd.	3	0.81×10^{-14}	0.35×10^{-14}	0.017	5.83

Table 3 (continued)

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Percent of Polonium RCG for Average[b]	Percent of Plutonium RCG for Average[b]
61. Harmon Field in Miamisburg	5	0.54×10^{-14}	0.14×10^{-14}	0.007	2.33
62. Junction of SR 725 & Heincke Rd.	5	0.0	0.0	0.0	0.0
63. Junction of Elm St. & US 25 in West Carrollton	5	0.0	0.0	0.0	0.0
64. Woody's Market in West Carrollton	5	0.09×10^{-14}	0.02×10^{-14}	0.001	0.33
65. Junction of South Broadway & Dryden Rd.	5	0.0	0.0	0.0	0.0
66. Junction of I 75 & Wagoner Ford Rd.	5	3.02×10^{-14}	0.60×10^{-14}	0.030	10.00
67. Junction of SR 201 & Chambersburg Rd.	5	1.17×10^{-14}	0.23×10^{-14}	0.012	3.90
68. Fairborn, Ohio	5	0.22×10^{-14}	0.04×10^{-14}	0.002	0.75
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	5	2.25×10^{-14}	0.48×10^{-14}	0.024	7.95
70. Belmont Auto Theatre	5	1.04×10^{-14}	0.28×10^{-14}	0.014	4.67
71. Town & Country Shopping Center in Kettering, Ohio	5	1.84×10^{-14}	0.86×10^{-14}	0.043	14.34
72. Junction of Yankee St. & Mad River Rd.	5	1.12×10^{-14}	0.25×10^{-14}	0.013	4.20
73. Junction of Maue Rd. & Linden Ave.	3	1.44×10^{-14}	0.96×10^{-14}	0.048	16.00
74. Junction of Byers Rd. & Belvo Rd.	3	0.0	0.0	0.0	0.0
75. Junction of SR 725 & I 75	3	0.41×10^{-14}	0.14×10^{-14}	0.007	2.33
76. Junction of Yankee St. & SR 725	3	0.05×10^{-14}	0.01×10^{-14}	0.001	0.17
77. Centerville, Ohio	3	0.27×10^{-14}	0.09×10^{-14}	0.004	1.50
78. Bellbrook, Ohio	3	0.32×10^{-14}	0.10×10^{-14}	0.005	1.67
79. Xenia, Ohio	3	0.0	0.0	0.0	0.0
80. Junction of Spring Valley-Paintersville Rd. & SR 380	3	1.31×10^{-14}	0.44×10^{-14}	0.022	7.33

Table 3 (continued)

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Percent of Polonium RCG for Average[b]	Percent of Plutonium RCG for Average[b]
81. Spring Valley, Ohio	3	0.05×10^{-14}	0.01×10^{-14}	0.001	0.17
82. Mt. Holly, Ohio	3	8.28×10^{-14}	2.76×10^{-14}	0.138	46.00
83. Junction of SR 48 & Social Row Rd.	3	0.0	0.0	0.0	0.0
84. Waldruhe Park	3	0.76×10^{-14}	0.37×10^{-14}	0.018	6.17
85. Junction of Mound Rd. & Benner Rd.	3	0.0	0.0	0.0	0.0
86. Junction of Benner Rd. & Miamisburg-Springboro Rd.	3	0.0	0.0	0.0	0.0
87. Junction of Medlar Rd. & Miamisburg-Springboro Rd.	3	1.35×10^{-14}	0.51×10^{-14}	0.025	8.50
88. Junction of Woods Rd. & Pennyroyal Rd.	3	0.0	0.0	0.0	0.0
89. Springboro, Ohio	3	0.0	0.0	0.0	0.0
90. Junction of SR 122 & Utica Rd.	3	0.27×10^{-14}	0.09×10^{-14}	0.004	1.50
91. Oregonia, Ohio	3	1.89×10^{-14}	0.63×10^{-14}	0.031	10.50
92. Harveysburg, Ohio	3	2.43×10^{-14}	1.17×10^{-14}	0.060	19.50
93. Waynesville, Ohio	3	0.99×10^{-14}	0.33×10^{-14}	0.016	5.50
94. By TV Tower on Lytle-Five Points Rd.	3	1.44×10^{-14}	0.72×10^{-14}	0.036	12.00
95. South Montgomery County Airport	3	2.52×10^{-14}	0.84×10^{-14}	0.042	14.00

[a]All concentrations are in microcuries per cubic centimeter.

[b]RCG - Radioactivity Concentration Guide.

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ENVIRONMENTAL MONITORING REPORT

1964

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

Monsanto

ATOMIC ENERGY COMMISSION · UNITED STATES OF AMERICA

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

1964

MLM-1210

ENVIRONMENTAL MONITORING SEMI-ANNUAL REPORT:

JANUARY THROUGH JUNE, 1964

P. C. Adams and H. E. Meyer

AEC Research and Development REPORT

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO COMPANY

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U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

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Prepared by: P. C. Adams
Approved by: H. E. Meyer

Date: July 24, 1964
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MONSANTO RESEARCH CORPORATION
A SUBSIDIARY OF MONSANTO COMPANY

MOUND LABORATORY
MIAMISBURG, OHIO
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SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the first half of 1964 is presented. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during this period.

INTRODUCTION

This report presents in summary form the findings of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program is planned and coordinated with regards to all of the various projects performed therein. The monitoring procedures used are those best suited for the detection and measurement of radioactive materials which Mound Laboratory could contribute to the environment.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U.S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

ENVIRONMENTAL MONITORING

During the period covered by this report, radioactive materials from Mound Laboratory have not contributed any measurable penetrating radiation, such as gamma or hard beta, to the environment. Of the radioisotopes in use at Mound Laboratory, only polonium, plutonium and tritium are possible air contaminants. Only polonium and tritium are possible water contaminants. Water sampling and air sampling are discussed below in detail.

WATER SAMPLING

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume and is handled separately as a packaged waste rather than being discharged to the river. Helium-3 being purified at Mound Laboratory contains small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries off all storm sewer water and eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and certain river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table 1, "Summary of Off-Site Water Monitoring for Radioactivity, January Through June, 1964." The data presented in Table 1 indicate that the concentration of polonium and tritium in the Great Miami River is within the maximum permissible continuous concentration.

AIR SAMPLING

Monitoring of the environmental air for tritium concentration, by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. During this period a total of 246 evaluations were made at 104 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been immeasurable to date.

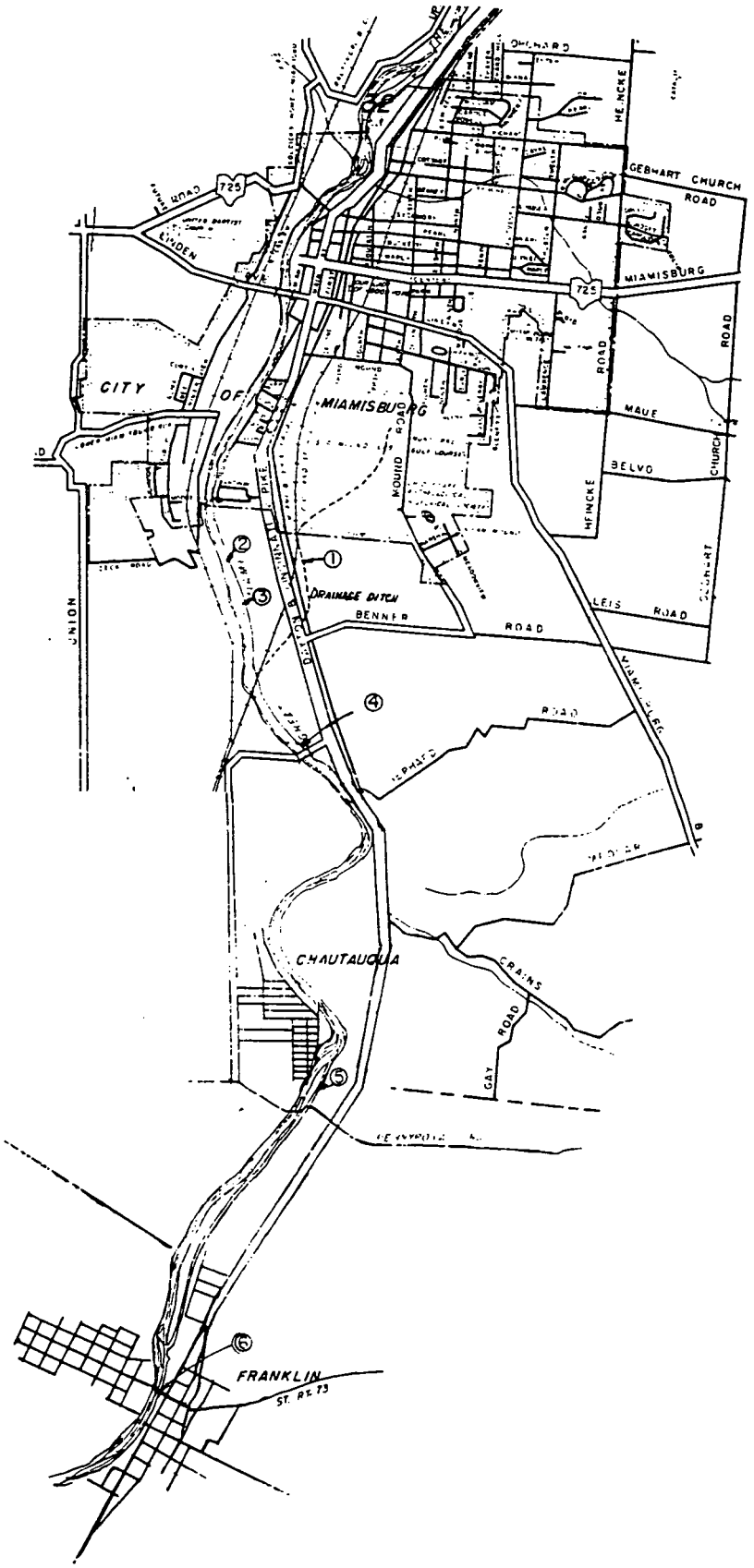
Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for air sampling. During this period, a total of 243 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table 2) to the maximum permissible continuous concentration of polonium in the environment, and assume that all alpha detected is polonium, we find that the average polonium concentration is only 0.014 per cent of the permissible. Our effluent stack monitoring program for this period had indicated that we should expect essentially no detectable polonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table 2 again) to the maximum permissible continuous concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration is well within the permissible; however, it is a significant 4.6 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and occasionally exceeds the very low permissible concentration for plutonium. (See Table 2, Section B.)

The impact of plutonium work at Mound Laboratory is also placed in proper focus by referring to our stack monitoring data. During the first half of 1964, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium and/or polonium operations have contributed an insignificant burden to radioactivity normally present in the atmosphere.

In Table 3, "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, January Through June, 1964," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends on the wind direction of the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the different wind directions. Since the sampling location is dependent on wind direction, it is unlikely that all sites will be sampled during either reporting period.



MAP 1
GREAT MIAMI RIVER SAMPLE LOCATIONS

Table 1

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

January Through June, 1964

I. Polonium (River Samples)

Sampling Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	2	16	1.6×10^{-8}	0.27×10^{-8}	0.38
250 Yards Downstream	3	15	0.7×10^{-8}	0.09×10^{-8}	0.13
Chautauqua Road Bridge	4	16	1.9×10^{-8}	0.23×10^{-8}	0.33
Chautauqua Dam	5	16	0.7×10^{-8}	0.09×10^{-8}	0.13
Franklin, Ohio	6	15	1.1×10^{-8}	0.18×10^{-8}	0.26
Trenton, Ohio		1	0.0	0.0	0.0
New Miami, Ohio		1	0.0	0.0	0.0
7 Miles North of New Baltimore, Ohio		1	0.0	0.0	0.0
New Baltimore, Ohio		1	0.0	0.0	0.0
Miamitown, Ohio		1	0.0	0.0	0.0
Elizabethtown, Ohio		1	0.0	0.0	0.0
OVER ALL		84	1.9×10^{-8}	0.17×10^{-8}	0.24

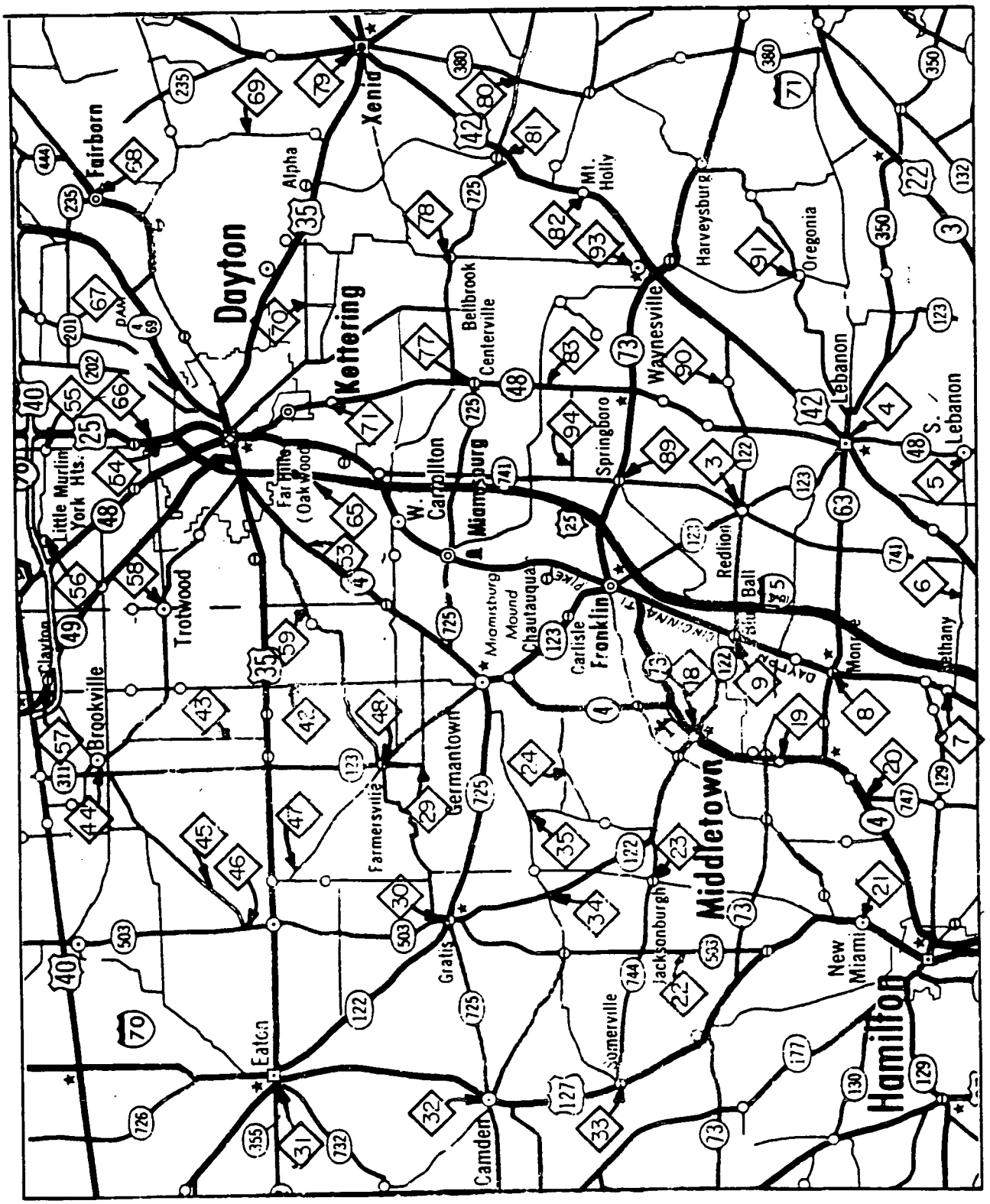
II. Tritium (River Samples and Drainage Ditch)

Mound Lab Drainage Ditch	1	17	2.0×10^{-3}	0.3×10^{-3}	6.0
Mound Lab Effluent	2	15	- -	0.0	0.0
Chautauqua Road Bridge	4	15	1.0×10^{-3}	0.07×10^{-3}	1.4
OVER ALL		47	2.0×10^{-3}	0.12×10^{-3}	2.6

* All concentrations are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration

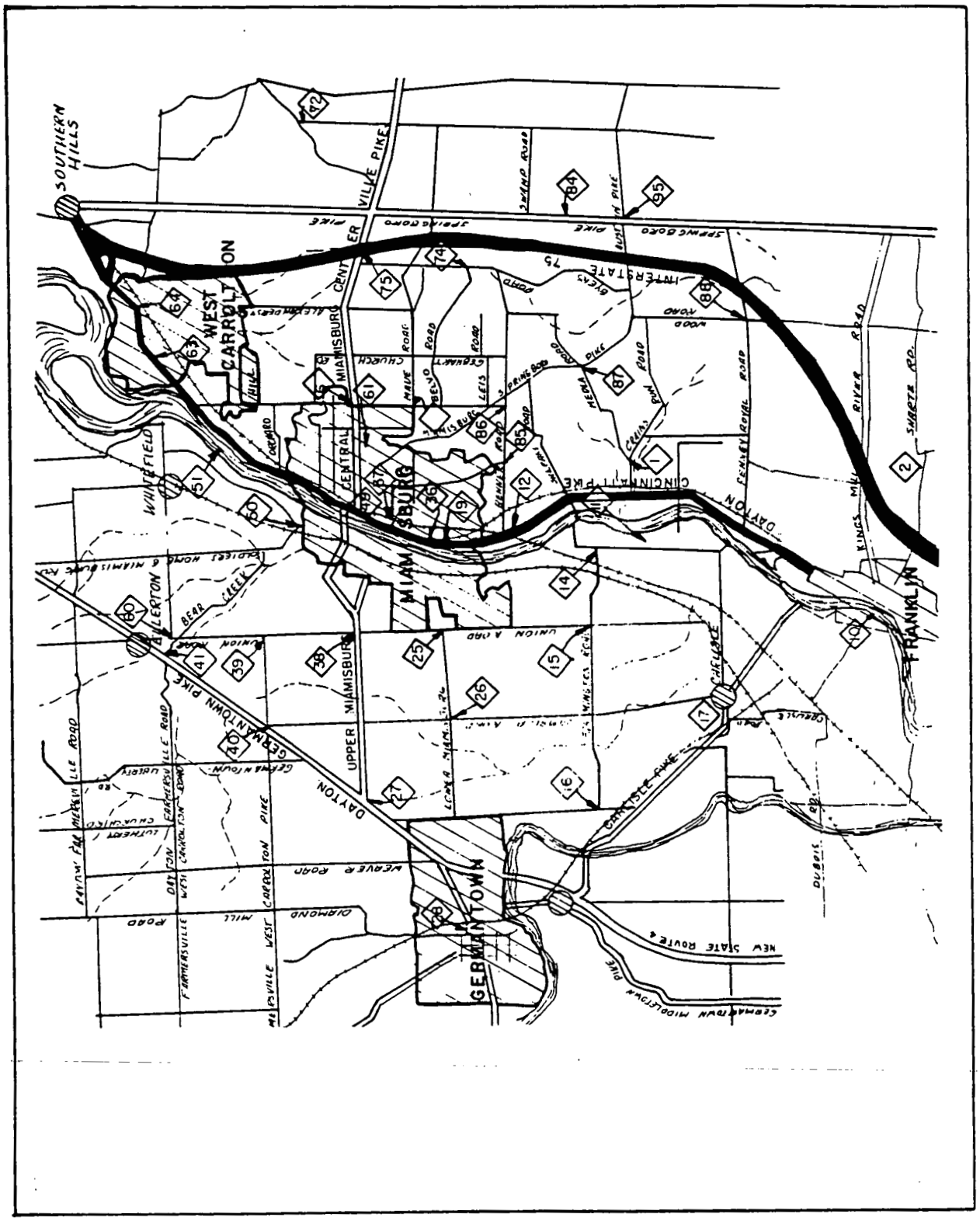
LOCATION



MAP 2

DISTANT AIR SAMPLE LOCATIONS AND ROAD MAP

LOCATION



MAP 3

PROXIMITY AIR SAMPLE LOCATION AND ROAD MAP

Table 2

COMPOSITE - AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

January Through June, 1964

Sampling Locations	Samples Collected	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
A. Downwind Sampling					
83	243	2.03×10^{-14}	0.25×10^{-14}	0.014	4.6
B. Upwind Sampling					
14	40	4.37×10^{-14}	0.24×10^{-14}	0.012	3.0
C. Difference					
		2.34×10^{-14}	0.01×10^{-14}	0.002	1.6

* All concentrations are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration

Table 3

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FROM LONG-LIVED ALPHA EMITTERS

January Through June, 1964

Sampling Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.	3	0.05×10^{-14}	0.01×10^{-14}	0.001	0.1
2. Junction of Route 73 & Interstate 75	3	0.09×10^{-14}	0.03×10^{-14}	0.002	0.5
3. Red Lion, Ohio	3	0.14×10^{-14}	0.05×10^{-14}	0.003	0.8
4. Lebanon, Ohio	3	0.45×10^{-14}	0.23×10^{-14}	0.012	3.8
5. South Lebanon, Ohio	3	0.32×10^{-14}	0.09×10^{-14}	0.005	1.5
6. Junction of Bethany Rd. & Mason-Montgomery Rd.	3	0.32×10^{-14}	0.18×10^{-14}	0.009	3.0
7. Bethany, Ohio	3	0.45×10^{-14}	0.18×10^{-14}	0.009	3.0
8. Monroe, Ohio	3	0.23×10^{-14}	0.09×10^{-14}	0.005	1.5
9. Blue Ball, Ohio	3	0.0	0.0	0.0	0.0
10. Junction of Route 123 & Dayton-Oxford Rd.	3	0.0	0.0	0.0	0.0
11. Chautauqua, Ohio	3	0.0	0.0	0.0	0.0
12. Junction of Benner Rd. & Route 25	3	0.05×10^{-14}	0.01×10^{-14}	0.001	0.1
13. Miami Drive-In Theatre in Miamisburg (on Route 25)	4	0.63×10^{-14}	0.23×10^{-14}	0.012	3.8
14. Junction of Farmington Rd. & Chautauqua Rd.	4	1.08×10^{-14}	0.41×10^{-14}	0.021	6.8
15. Junction of Farmington Rd. & Union Rd.	4	0.77×10^{-14}	0.18×10^{-14}	0.009	3.0
16. Junction of Farmington Rd. & Butler St.	4	1.35×10^{-14}	0.50×10^{-14}	0.025	8.3
17. Carlisle, Ohio	4	0.27×10^{-14}	0.09×10^{-14}	0.005	1.5
18. Middletown, Ohio	4	0.63×10^{-14}	0.18×10^{-14}	0.009	3.0
19. Junction of Route 4 & Route 73	4	0.54×10^{-14}	0.23×10^{-14}	0.012	3.8
20. Junction of Route 4 & Route 747	4	0.77×10^{-14}	0.32×10^{-14}	0.016	5.3

(Table 3 continued)

Sampling Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
21. New Miami, Ohio	4	0.77×10^{-14}	0.18×10^{-14}	0.009	3.0
22. Junction of West Elkton Rd. & Tolbert Rd.	4	0.13×10^{-14}	0.05×10^{-14}	0.003	0.8
23. Jacksonburg, Ohio	4	0.68×10^{-14}	0.27×10^{-14}	0.014	4.5
24. Junction of Hetzler Rd. & Hinkle Rd.	4	0.77×10^{-14}	0.18×10^{-14}	0.009	3.0
25. Junction of Lower Miamisburg Rd. & Union Rd.	1	0.0	0.0	0.0	0.0
26. Junction of Lower Miamisburg Rd. & Jamaica Rd.	1	0.0	1.22×10^{-14}	0.061	20.3
27. Junction of Route 725 & Route 4	1	0.0	0.0	0.0	0.0
28. Germantown, Ohio	1	0.0	0.95×10^{-14}	0.048	15.8
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.	1	0.0	0.23×10^{-14}	0.012	3.8
30. Gratis, Ohio	1	0.0	0.41×10^{-14}	0.021	6.8
31. Eaton, Ohio	1	0.0	0.36×10^{-14}	0.018	6.0
32. Camden, Ohio	1	0.0	0.0	0.0	0.0
33. Sommerville, Ohio	1	0.0	0.0	0.0	0.0
34. Junction of Greenbush Rd. & Route 122	1	0.0	2.34×10^{-14}	0.117	39.0
35. Junction of Oxford Rd. & Browns Run Rd.	1	0.0	0.81×10^{-14}	0.041	13.5
36. Miamisburg South City Limit on Route 25	1	0.0	0.0	0.0	0.0
37. Junction of Mound Ave. & Route 25	1	0.0	0.0	0.0	0.0
38. Junction of Union Rd. & Route 725	1	0.0	1.35×10^{-14}	0.068	22.5
39. Junction of Union Rd. & Manning Rd.	1	0.0	0.0	0.0	0.0
40. Junction of Manning Rd. & Route 4	1	0.0	0.23×10^{-14}	0.012	3.8
41. Junction of Route 4 & Farmersville-West Carrollton Rd.	1	0.0	0.0	0.0	0.0
42. Junction of Diamond Mill Rd. & Mile Rd.	1	0.0	0.27×10^{-14}	0.014	4.5
43. Junction of Clayton Rd. & Amity Rd.	1	0.0	0.0	0.0	0.0

(Table 3 continued)

Sampling Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
44. Brookville, Ohio	1	0.0	0.0	0.0	0.0
45. Junction of Lexington Salem Rd. & Preble County Line Rd.	1	0.0	0.18×10^{-14}	0.009	3.0
46. Junction of Lexington Salem Rd. & Engle Rd.	1	0.0	0.0	0.0	0.0
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.	1	0.0	0.0	0.0	0.0
48. Farmersville, Ohio	1	0.0	0.36×10^{-14}	0.018	6.0
49. Fifth St. & Central Ave. in Miamisburg, Ohio	No samples were collected at locations 49 through 60 during this period due to lack of wind direction toward that area at the prescribed sampling times.				
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.					
51. One mile north on Upper River Rd. from Sample No. 50					
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.					
53. Dayton Speedway					
54. Dayton, Ohio					
55. Murlin Heights					
56. Little York					
57. Clayton, Ohio					
58. Trotwood, Ohio					
59. Union Rd. & Liberty Dayton Rd.					
60. Union Rd. & Bear Creek Rd.					
61. Harmon Field in Miamisburg	7	2.48×10^{-14}	0.63×10^{-14}	0.032	10.5
62. Junction of Route 725 & Heincke Rd.	7	0.77×10^{-14}	0.18×10^{-14}	0.009	3.0
63. Junction of Elm St. & Route 25 in West Carrollton	7	1.80×10^{-14}	0.27×10^{-14}	0.014	4.5
64. Woody's Market in West Carrollton	7	1.76×10^{-14}	0.45×10^{-14}	0.023	7.5
65. Junction of South Broadway & Dryden Rd.	7	2.03×10^{-14}	0.54×10^{-14}	0.027	9.0
66. Junction of Route 75 & Wagoner Ford Rd.	7	1.26×10^{-14}	0.32×10^{-14}	0.016	5.3

(Table 3 continued)

Sampling Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
67. Junction of Route 201 & Chambersburg Rd.	7	0.72×10^{-14}	0.14×10^{-14}	0.007	2.3
68. Fairborn, Ohio	6	0.41×10^{-14}	0.09×10^{-14}	0.005	1.5
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	6	1.62×10^{-14}	0.27×10^{-14}	0.014	4.5
70. Belmont Auto Theatre	6	0.86×10^{-14}	0.23×10^{-14}	0.012	3.8
71. Town & Country Shopping Center in Kettering, Ohio	6	0.59×10^{-14}	0.18×10^{-14}	0.009	3.0
72. Junction of Yankee St. & Mad River Rd.	6	0.45×10^{-14}	0.09×10^{-14}	0.005	1.5
73. Junction of Maue Rd. & Linden Ave.	2	2.75×10^{-14}	1.58×10^{-14}	0.079	26.3
74. Junction of Byers Rd. & Belvo Rd.	2	1.71×10^{-14}	0.86×10^{-14}	0.043	14.3
75. Junction of Route 725 & Route 75	2	0.0	0.27×10^{-14}	0.014	4.5
76. Junction of Yankee St. & Route 725	2	1.89×10^{-14}	1.31×10^{-14}	0.066	21.8
77. Centerville, Ohio	2	0.95×10^{-14}	0.54×10^{-14}	0.027	9.0
78. Bellbrook, Ohio	2	0.63×10^{-14}	0.32×10^{-14}	0.016	5.3
79. Xenia, Ohio	2	0.23×10^{-14}	0.18×10^{-14}	0.009	3.0
80. Junction of Spring Valley-Paintersville Rd. & Route 380	2	0.81×10^{-14}	0.41×10^{-14}	0.021	6.8
81. Spring Valley, Ohio	1	0.0	0.14×10^{-14}	0.007	2.3
82. Mt. Holly, Ohio	2	0.81×10^{-14}	0.41×10^{-14}	0.021	6.8
83. Junction of Route 48 & Social Row Rd.	2	0.0	0.0	0.0	0.0
84. Waldruhe Park	2	0.32×10^{-14}	0.14×10^{-14}	0.007	2.3
85. Junction of Mound Rd. & Benner Rd.	3	0.99×10^{-14}	0.32×10^{-14}	0.016	5.3
86. Junction of Benner Rd. & Miamisburg-Springboro Rd.	3	0.14×10^{-14}	0.05×10^{-14}	0.003	0.8
87. Junction of Medlar Rd. & Miamisburg-Springboro Rd.	3	0.0	0.0	0.0	0.0
88. Junction of Wood Rd. & Pennyroyal Rd.	3	0.77×10^{-14}	0.27×10^{-14}	0.014	4.5
89. Springboro, Ohio	3	0.0	0.0	0.0	0.0

(Table 3 continued)

Sampling Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
90. Junction of Route 122 & Utica Rd.	3	0.36×10^{-14}	0.23×10^{-14}	0.012	3.8
91. Orgonia, Ohio	3	0.18×10^{-14}	0.05×10^{-14}	0.003	0.8
92. Harveysburg, Ohio	3	0.27×10^{-14}	0.04×10^{-14}	0.005	1.5
93. Waynesville, Ohio	3	0.14×10^{-14}	0.04×10^{-14}	0.002	0.7
94. By TV Tower on Lytle-Five Points Rd.	3	0.04×10^{-14}	0.01×10^{-14}	0.001	0.1
95. South Montgomery County Airport	3	0.0	0.0	0.0	0.0

* All concentrations are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration.

MLM-1241

ENVIRONMENTAL MONITORING REPORT: JULY - DECEMBER, 1964 AND 1964 SUMMARY

P. C. Adams and H. E. Meyer

AEC Research and Development REPORT

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

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UC-41 Health
and Safety

ENVIRONMENTAL MONITORING REPORT: JULY - DECEMBER, 1964 AND 1964 SUMMARY

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MONSANTO RESEARCH CORPORATION
A SUBSIDIARY OF MONSANTO COMPANY

MOUND LABORATORY
MIAMISBURG, OHIO
OPERATED FOR
UNITED STATES ATOMIC ENERGY COMMISSION
U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

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SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, is presented for the second half of 1964 and a summary is presented for the entire year. The concentration of tritium in the Great Miami River was within the maximum permissible concentration recommended by the National Committee on Radiation Protection and Measurements. The average concentration of polonium released did not exceed the maximum permissible continuous concentration. The concentration of polonium and plutonium in the environmental air was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during this period.

INTRODUCTION

This report is a summary of the Environmental Monitoring Program conducted by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program considers all of the projects at Mound Laboratory, and all of the radioisotopes which could be released in the environment. The monitoring procedures are those best suited for the detection and measurement of these radioactive materials.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U.S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 2×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

ENVIRONMENTAL MONITORING

During the period covered by this report, radioactive materials from Mound Laboratory have not contributed any measurable penetrating radiation, such as gamma or hard beta, to the environment. Of the radioisotopes in use at Mound Laboratory, only polonium, plutonium and tritium are possible air contaminants. Only polonium and tritium are possible water contaminants. Water sampling and air sampling are discussed below in detail.

WATER SAMPLING

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume and is handled separately as a packaged waste rather than being discharged to the river. Helium-3 being purified at Mound Laboratory contains small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries off all storm sewer water and eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and certain river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table 1, "Summary of Off-Site Water Monitoring for Radioactivity, July Through December, 1964." The data presented in Table 1 indicate that the average concentration of polonium and tritium in the Great Miami River is within the maximum permissible continuous concentration.

AIR SAMPLING

Monitoring of the environmental air for tritium concentration, by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. During this period a total of 298 evaluations were made at 84 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for air sampling. During this period, a total of 323 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table 2)

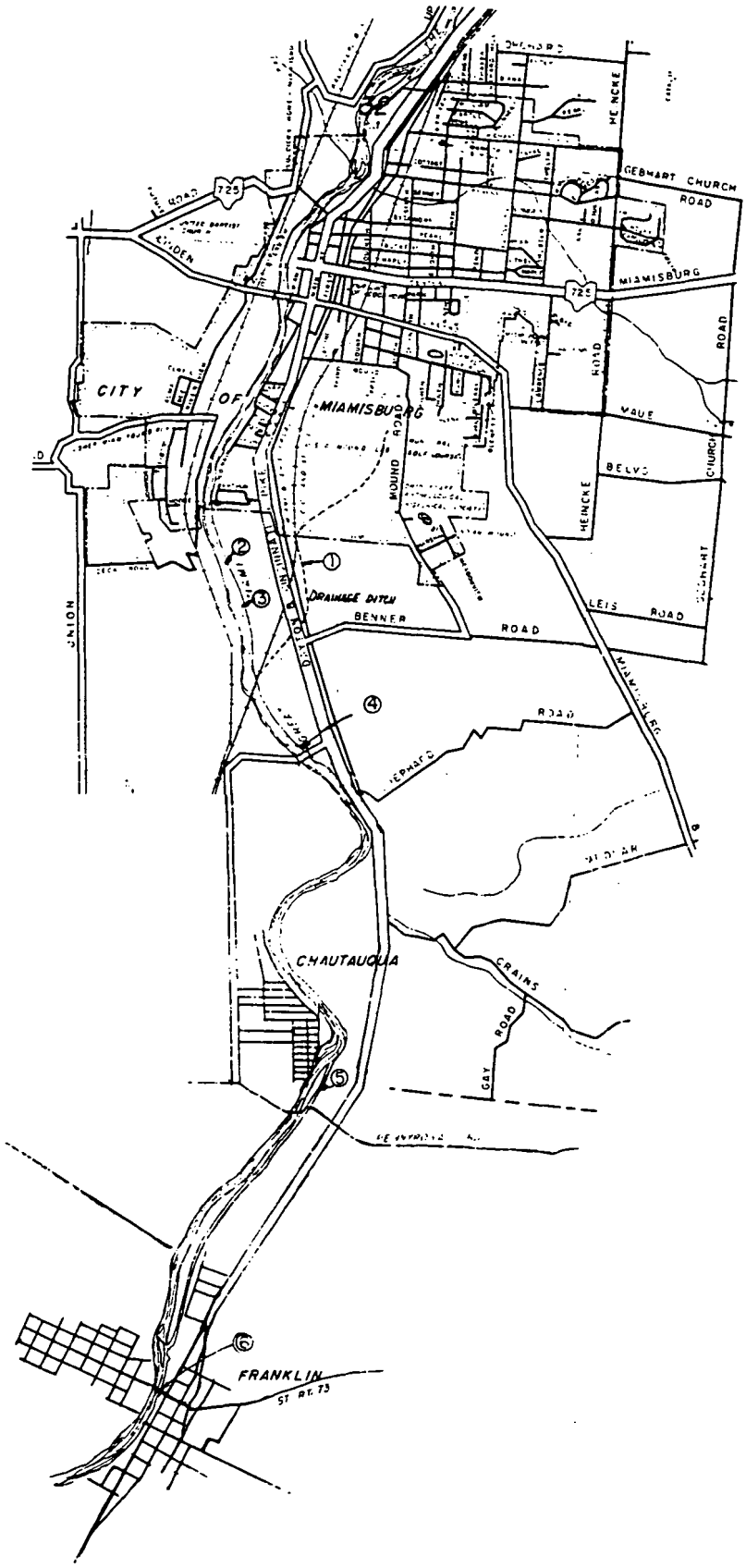
to the maximum permissible continuous concentration of polonium in the environment, and assume that all alpha detected is polonium, we find that the average polonium concentration is only 0.021 per cent of the permissible. Our effluent stack monitoring program for this period had indicated that we should expect essentially no detectable polonium in the environment from the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table 2 again) to the maximum permissible continuous concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration is well within the maximum permissible continuous concentration. In order to determine the impact of Mound Laboratory's plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and occasionally exceeds the very low permissible concentration for plutonium. (See Table 2, Section B.)

The impact of plutonium work at Mound Laboratory is also placed in proper focus by referring to our stack monitoring data. During the second half of 1964, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium and/or polonium operations have not contributed a significant burden to radioactivity normally present in the atmosphere.

In Table 3, "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, July Through December, 1964," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends on the wind direction on the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the different wind directions.

Table 4 contains a yearly summary of data obtained for polonium and tritium off-site water monitoring. Table 5 contains a yearly summary of data obtained from the environmental air monitoring program for long-lived alpha emitters.



MAP 1
GREAT MIAMI RIVER SAMPLE LOCATIONS

Table I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

July Through December, 1964

I. Polonium (River Samples)

Sampling Locations	Map I Code Number	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Per Cent of MPC for Average[b]
Mound Lab Effluent	2	28	8.05×10^{-6} [c]	5.58×10^{-7} [c]	79.71
250 Yards Downstream	3	28	1.35×10^{-6} [c]	0.85×10^{-7} [c]	12.14
Chautauqua Road Bridge	4	28	0.14×10^{-7}	0.18×10^{-8}	0.26
Chautauqua Dam	5	28	0.72×10^{-7}	0.54×10^{-8}	0.77
Franklin, Ohio	6	28	1.13×10^{-8}	0.09×10^{-8}	0.12
Trenton, Ohio		2	0.27×10^{-8}	0.13×10^{-8}	0.18
New Miami, Ohio		2	0.0	0.0	0.0
7 Miles North of New Baltimore, Ohio		2	0.0	0.0	0.0
New Baltimore, Ohio		2	0.0	0.0	0.0
Miamitown, Ohio		2	0.0	0.0	0.0
Elizabethtown, Ohio		2	0.0	0.0	0.0
OVER ALL		152	8.05×10^{-6}	1.20×10^{-7}	17.14

II. Tritium (River Samples and Drainage Ditch)

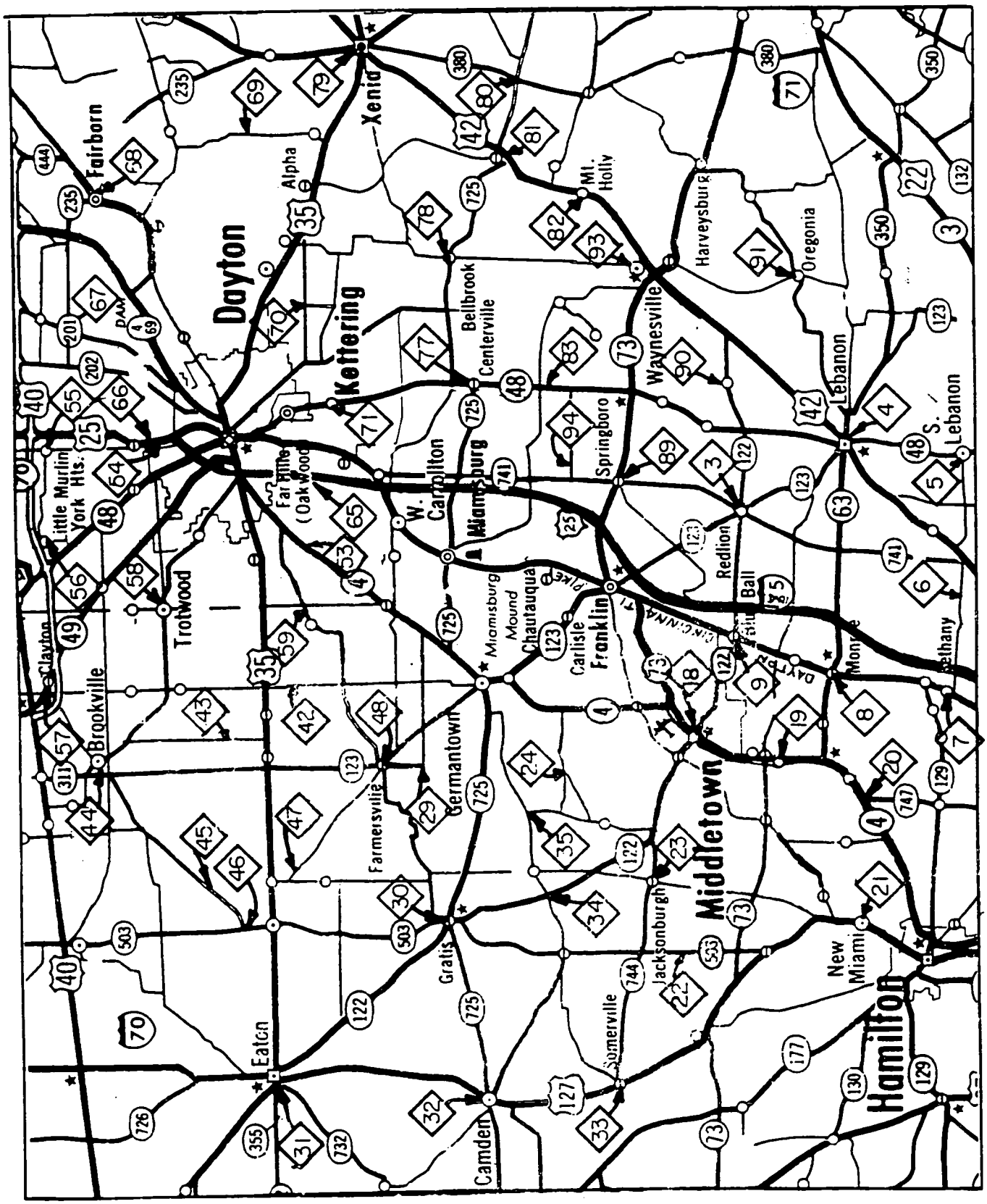
Mound Lab Drainage Ditch	1	26	18.9×10^{-3}	1.1×10^{-3}	22.0
Mound Lab Effluent	2	26	0.0	0.0	0.0
Chautauqua Road Bridge	4	26	0.0	0.0	0.0
OVER ALL		78	18.9×10^{-3}	0.37×10^{-3}	7.4

[a] All concentrations are in microcuries per cubic centimeter.

[b] MPC - Maximum Permissible Continuous Concentration.

[c] High concentration attributed to leak in waste disposal inlet pipe which was promptly located and repaired.

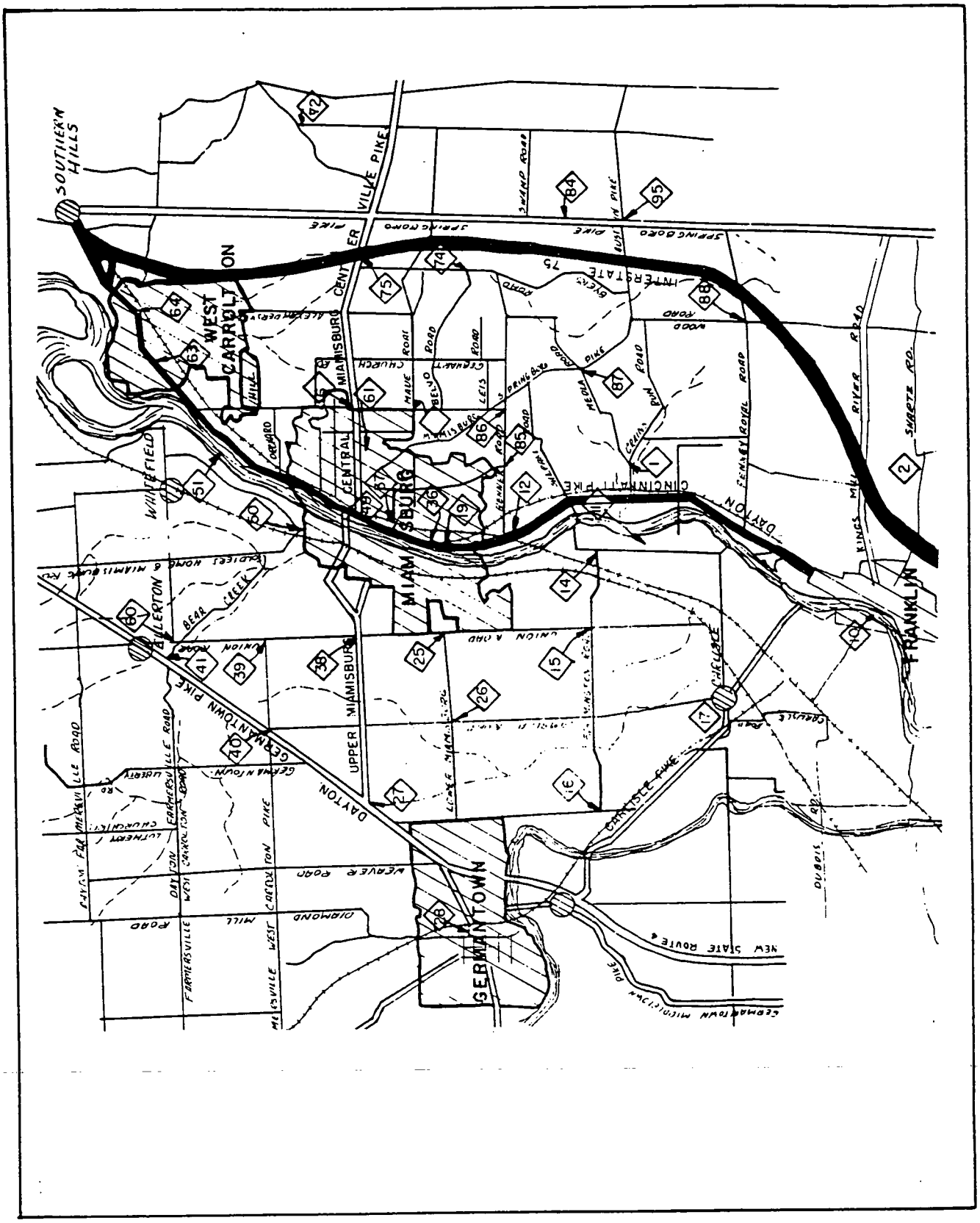
LOCATION



MAP 2

DISTANT AIR SAMPLE LOCATIONS AND ROAD MAP

LOCATION ◇→



MAP 3

PROXIMITY AIR SAMPLE LOCATION AND ROAD MAP

Table 2

COMPOSITE - AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

July Through December, 1964

Sampling Locations	Samples Collected	Maximum Concentration[a]	Average Concentration[a]	Per Cent of Polonium MPC for Average[b]	Per Cent of Plutonium MPC for Average[b]
A. Downwind Sampling					
95	323	1.44×10^{-13}	0.42×10^{-14}	0.021	7.0
B. Upwind Sampling					
16	54	2.29×10^{-14}	0.27×10^{-14}	0.014	4.5
C. Difference		12.11×10^{-14}	0.15×10^{-14}	0.007	2.5

[a] All concentrations are in microcuries per cubic centimeter.

[b] MPC - Maximum Permissible Continuous Concentration.

Table 3

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FROM LONG-LIVED ALPHA EMITTERS

July Through December, 1964

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Per Cent of Polonium MPC for Average[b]	Per Cent of Plutonium MPC for Average[b]
1. Junction of Crains Run Rd. & Medlar Rd.	2	1.26×10^{-14}	0.63×10^{-14}	0.032	10.5
2. Junction of Route 73 & Interstate 75	2	1.63×10^{-14}	0.81×10^{-14}	0.041	13.5
3. Red Lion, Ohio	2	0.0	0.0	0.0	0.0
4. Lebanon, Ohio	2	0.18×10^{-14}	0.09×10^{-14}	0.005	1.5
5. South Lebanon, Ohio	2	0.67×10^{-14}	0.33×10^{-14}	0.016	5.5
6. Junction of Bethany Rd. & Mason-Montgomery Rd.	2	0.0	0.0	0.0	0.0
7. Bethany, Ohio	2	0.0	0.0	0.0	0.0
8. Monroe, Ohio	2	0.0	0.0	0.0	0.0
9. Blue Ball, Ohio	2	1.17×10^{-14}	0.58×10^{-14}	0.029	9.6
10. Junction of Route 123 & Dayton-Oxford Rd.	2	0.0	0.0	0.0	0.0
11. Chautauqua, Ohio	2	0.36×10^{-14}	0.18×10^{-14}	0.009	3.0
12. Junction of Benner Rd. & Route 25	2	0.18×10^{-14}	0.09×10^{-14}	0.005	1.5
13. Miami Drive-In Theatre in Miamisburg (on Route 25)	6	1.96×10^{-14}	0.99×10^{-14}	0.049	16.5
14. Junction of Farmington Rd. & Chautauqua Rd.	6	0.75×10^{-14}	0.36×10^{-14}	0.018	6.0
15. Junction of Farmington Rd. & Union Rd.	6	0.32×10^{-14}	0.05×10^{-14}	0.003	0.8
16. Junction of Farmington Rd. & Butter St.	6	1.80×10^{-14}	0.59×10^{-14}	0.029	9.8

(Table 3 continued)

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Per Cent of Polonium MPC for Average[b]	Per Cent of Plutonium MPC for Average[b]
17. Carlisle, Ohio	6	0.86×10^{-14}	0.14×10^{-14}	0.007	2.3
18. Middletown, Ohio	6	1.35×10^{-14}	0.41×10^{-14}	0.020	6.8
19. Junction of Route 4 & Route 73	6	1.04×10^{-14}	0.23×10^{-14}	0.012	3.8
20. Junction of Route 4 & Route 747	6	2.07×10^{-14}	0.54×10^{-14}	0.027	9.0
21. New Miami, Ohio	6	0.27×10^{-14}	0.04×10^{-14}	0.002	0.6
22. Junction of West Elkton Rd. & Tolbert Rd.	6	2.75×10^{-14}	0.72×10^{-14}	0.036	12.0
23. Jacksonburg, Ohio	6	1.89×10^{-14}	0.41×10^{-14}	0.020	6.8
24. Junction of Hetzler Rd. & Hinkle Rd.	6	0.95×10^{-14}	0.41×10^{-14}	0.020	6.8
25. Junction of Lower Miamisburg Rd. & Union Rd.	5	1.80×10^{-14}	0.63×10^{-14}	0.032	10.5
26. Junction of Lower Miamisburg Rd. & Jamaica Rd.	5	0.95×10^{-14}	0.27×10^{-14}	0.014	4.5
27. Junction of Route 725 & Route 4	5	1.44×10^{-13}	2.56×10^{-14}	0.128	42.6
28. Germantown, Ohio	5	1.09×10^{-14}	0.18×10^{-14}	0.009	3.0
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.	5	1.36×10^{-14}	0.32×10^{-14}	0.016	5.3
30. Gratis, Ohio	5	1.89×10^{-14}	0.50×10^{-14}	0.025	4.3
31. Eaton, Ohio	5	0.50×10^{-14}	0.18×10^{-14}	0.009	3.0
32. Camden, Ohio	5	0.36×10^{-14}	0.14×10^{-14}	0.007	2.3
33. Sommerville, Ohio	5	1.75×10^{-14}	0.45×10^{-14}	0.022	7.5
34. Junction of Greenbush Rd. & Route 122	5	4.36×10^{-14}	0.99×10^{-14}	0.049	16.5
35. Junction of Oxford Rd. & Browns Run Rd.	5	0.0	0.0	0.0	0.0
36. Miamisburg South City Limit & Route 25	5	1.39×10^{-14}	0.54×10^{-14}	0.027	9.0

(Table 3 continued)

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Per Cent of Polonium MPC for Average[b]	Per Cent of Plutonium MPC for Average[b]
37. Junction of Mound Ave. & Route 25	5	2.07×10^{-14}	0.41×10^{-14}	0.020	6.8
38. Junction of Union Rd. & Route 725	5	0.54×10^{-14}	0.14×10^{-14}	0.007	2.3
39. Junction of Union Rd. & Manning Rd.	5	0.72×10^{-14}	0.14×10^{-14}	0.007	2.3
40. Junction of Manning Rd. & Route 4	5	1.12×10^{-14}	0.45×10^{-14}	0.022	7.5
41. Junction of Route 4 & Farmersville-West Carrollton Rd.	5	2.79×10^{-14}	0.58×10^{-14}	0.029	9.6
42. Junction of Diamond Mill Rd. & Mile Rd.	5	0.36×10^{-14}	0.09×10^{-14}	0.005	1.5
43. Junction of Clayton Rd. & Amity Rd.	5	0.45×10^{-14}	0.09×10^{-14}	0.005	1.5
44. Brookville, Ohio	5	0.32×10^{-14}	0.09×10^{-14}	0.005	1.5
45. Junction of Lexington Salem Rd. & Preble County Line Rd.	5	2.47×10^{-14}	0.49×10^{-14}	0.025	8.1
46. Junction of Lexington Salem Rd. & Engle Rd.	5	0.94×10^{-14}	0.18×10^{-14}	0.009	3.0
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.	5	0.22×10^{-14}	0.04×10^{-14}	0.002	0.6
48. Farmersville, Ohio	5	0.63×10^{-14}	0.13×10^{-14}	0.007	2.1
49. Fifth St. & Central Ave. in Miamisburg, Ohio	1	- -	0.0	0.0	0.0
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	1	- -	0.0	0.0	0.0
51. One mile north on Upper River Rd. from Sample No. 50	1	- -	0.49×10^{-14}	0.025	8.1
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	1	- -	0.0	0.0	0.0
53. Dayton Speedway	1	- -	0.0	0.0	0.0

(Table 3 continued)

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Per Cent of Polonium MPC for Average[b]	Per Cent of Plutonium MPC for Average[b]
54. Dayton, Ohio	1	- -	0.0	0.0	0.0
55. Murlin Heights	1	- -	0.63×10^{-14}	0.032	10.5
56. Little York	1	- -	0.85×10^{-14}	0.043	14.3
57. Clayton, Ohio	1	- -	1.48×10^{-14}	0.074	24.6
58. Trotwood, Ohio	1	- -	0.04×10^{-14}	0.002	0.6
59. Union Rd. & Liberty Dayton Rd.	1	- -	0.0	0.0	0.0
60. Union Rd. & Bear Creek Rd.	1	- -	0.0	0.0	0.0
61. Harmon Field in Miamisburg	6	1.89×10^{-14}	0.54×10^{-14}	0.027	9.0
62. Junction of Route 725 & Heincke Rd.	6	2.16×10^{-14}	0.72×10^{-14}	0.036	12.0
63. Junction of Elm St. & Route 25 in West Carrollton	6	0.45×10^{-14}	0.09×10^{-14}	0.005	1.5
64. Woody's Market in West Carrollton	6	2.29×10^{-14}	0.81×10^{-14}	0.040	13.5
65. Junction of South Broadway & Dryden Rd.	6	3.06×10^{-14}	0.67×10^{-14}	0.034	11.1
66. Junction of Route 75 & Wagoner Ford Rd.	6	0.72×10^{-14}	0.27×10^{-14}	0.014	4.5
67. Junction of Route 201 & Chambersburg Road	6	0.62×10^{-14}	0.22×10^{-14}	0.011	3.6
68. Fairborn, Ohio	6	2.70×10^{-14}	0.85×10^{-14}	0.043	14.1
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	6	2.29×10^{-14}	0.45×10^{-14}	0.022	7.5
70. Belmont Auto Theatre	6	0.85×10^{-14}	0.13×10^{-14}	0.006	2.1
71. Town & Country Shopping Center in Kettering, Ohio	6	1.57×10^{-14}	0.54×10^{-14}	0.027	9.0
72. Junction of Yankee St. & Mad River Rd.	6	0.76×10^{-14}	0.18×10^{-14}	0.009	3.0
73. Junction of Maue Rd. & Linden Ave.	1	- -	1.66×10^{-14}	0.083	27.6
74. Junction of Byers Rd. & Belvo Rd.	1	- -	1.89×10^{-14}	0.094	31.5
75. Junction of Route 725 & Route 75	1	- -	1.39×10^{-14}	0.070	23.1
76. Junction of Yankee St. & Route 725	1	- -	0.04×10^{-14}	0.002	0.6

(Table 3 continued)

Sampling Locations	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	Per Cent of Polonium MPC for Average[b]	Per Cent of Plutonium MPC for Average[b]
77. Centerville, Ohio	1	- -	0.72×10^{-14}	0.036	12.0
78. Bellbrook, Ohio	1	- -	0.0	0.0	0.0
79. Xenia, Ohio	1	- -	1.17×10^{-14}	0.059	19.5
80. Junction of Spring Valley-Paintersville Rd. & Route 380	1	- -	0.0	0.0	0.0
81. Spring Valley, Ohio	1	- -	1.53×10^{-14}	0.073	25.5
82. Mt. Holly, Ohio	1	- -	0.0	0.0	0.0
83. Junction of Route 48 & Social Row Rd.	1	- -	3.46×10^{-14}	0.173	57.6
84. Waldruhe Park	1	- -	0.0	0.0	0.0
85. Junction of Mound Rd. & Benner Rd.	1	- -	0.0	0.0	0.0
86. Junction of Benner Rd. & Miamisburg Springboro Rd.	1	- -	1.98×10^{-14}	0.099	33.0
87. Junction of Medlar Rd. & Miamisburg-Springboro Rd.	1	- -	0.0	0.0	0.0
88. Junction of Wood Rd. & Pennyroyal Rd.	1	- -	0.90×10^{-14}	0.045	15.0
89. Springboro, Ohio	1	- -	0.0	0.0	0.0
90. Junction of Route 122 & Utica Rd.	1	- -	0.04×10^{-14}	0.002	0.6
91. Oregonia, Ohio	1	- -	0.85×10^{-14}	0.043	14.1
92. Harveysburg, Ohio	1	- -	0.36×10^{-14}	0.018	6.0
93. Waynesville, Ohio	1	- -	0.0	0.0	0.0
94. By TV Tower on Lytle-Five Points Rd.	1	- -	0.49×10^{-14}	0.025	8.1
95. South Montgomery County Airport	1	- -	0.0	0.0	0.0

[a]All concentrations are in microcuries per cubic centimeter.

[b]MPC - Maximum Permissible Continuous Concentration.

Table 4

YEARLY SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

I. POLONIUM (RIVER SAMPLES)

Period	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	% of MPC for Average[b]
1st Half	84	1.9×10^{-8}	0.17×10^{-8}	0.2
2nd Half	152	8.0×10^{-6}	1.20×10^{-7}	17.1
Total	236	8.0×10^{-6}	6.08×10^{-8}	8.7

II. TRITIUM (RIVER & DRAINAGE DITCH SAMPLES)

Period	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	% of MPC for Average[b]
1st Half	47	2.0×10^{-3}	0.12×10^{-3}	2.0
2nd Half	78	18.9×10^{-3}	0.37×10^{-3}	7.4
Total	125	18.9×10^{-3}	0.24×10^{-3}	4.8

[a]All concentrations are in microcuries per cubic centimeter.

[b]MPC - Maximum Permissible Continuous Concentration.

Table 5

YEARLY SUMMARY OF ENVIRONMENTAL MONITORING FOR LONG-LIVED ALPHA EMITTERS

I. DOWNWIND SAMPLING

Period	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	% of Po MPC for Average[b]	% of Pu MPC for Average[b]
1st Half	243	2.03×10^{-14}	0.25×10^{-14}	0.013	4.0
2nd Half	323	1.44×10^{-13}	0.42×10^{-14}	0.021	7.0
Total	566	1.44×10^{-13}	0.36×10^{-14}	0.018	6.0

II. UPWIND SAMPLING

Period	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	% of Po MPC for Average[b]	% of Pu MPC for Average[b]
1st Half	40	4.37×10^{-14}	0.24×10^{-14}	0.012	4.0
2nd Half	54	2.29×10^{-14}	0.27×10^{-14}	0.014	4.5
Total	94	4.37×10^{-14}	0.255×10^{-14}	0.013	4.25

III. SUMMARY

	Number of Samples	Maximum Concentration[a]	Average Concentration[a]	% of Po MPC for Average[b]	% of Pu MPC for Average[b]
	660	1.44×10^{-13}	0.105×10^{-14}	0.005	1.75

[a]All concentrations are in microcuries per cubic centimeter.

[b]MPC - Maximum Permissible Continuous Concentration.

ENVIRONMENTAL MONITORING REPORT

1963

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

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MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

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S U M M A R Y

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the first half of 1963 is presented. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the first half of 1963.

INTRODUCTION

Monitoring capability for this program was greatly reduced during this period due to replacement of the old monitoring vehicle with a new one plus improved monitoring techniques. As a result of this equipment modification only sporadic monitoring was performed during May and June.

This report presents in summary form the findings of the Environmental Monitoring Program conducted by the Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program is planned and coordinated with regards to all of the various projects performed therein. The monitoring procedures used are those best suited for the detection and measurement of radioactive materials which Mound Laboratory could contribute to the environment.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

ENVIRONMENTAL MONITORING

During the period covered by this report, radioactive materials from Mound Laboratory have not contributed any measurable penetrating radiation, such as gamma or hard beta, to the environment. Of the radioisotopes in use at Mound Laboratory, only polonium, plutonium and tritium are possible air contaminants. Only polonium and tritium are possible water contaminants. Water sampling and air sampling are discussed below in detail.

WATER SAMPLING

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume and is handled separately as a packaged waste rather than being discharged to the river. Helium-3 being purified at Mound Laboratory contains small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries off all storm sewer water and eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and certain river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I, "Summary of Off-Site Water Monitoring for Radioactivity, January Through June, 1963."

The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is within the maximum permissible continuous concentration.

AIR SAMPLING

Monitoring of the environmental air for tritium concentration, by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. During this period a total of 180 evaluations were made at 84 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for air sampling. During this period, a total of 154 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table II) to the maximum permissible continuous concentration of polonium in the environment, and assume that all alpha detected is polonium, we find that the average polonium concentration is only 0.015 per cent of the permissible. Our effluent stack monitoring program for this period had indicated that we should expect essentially no detectable polonium in the environment due to the operations at Mound Laboratory.

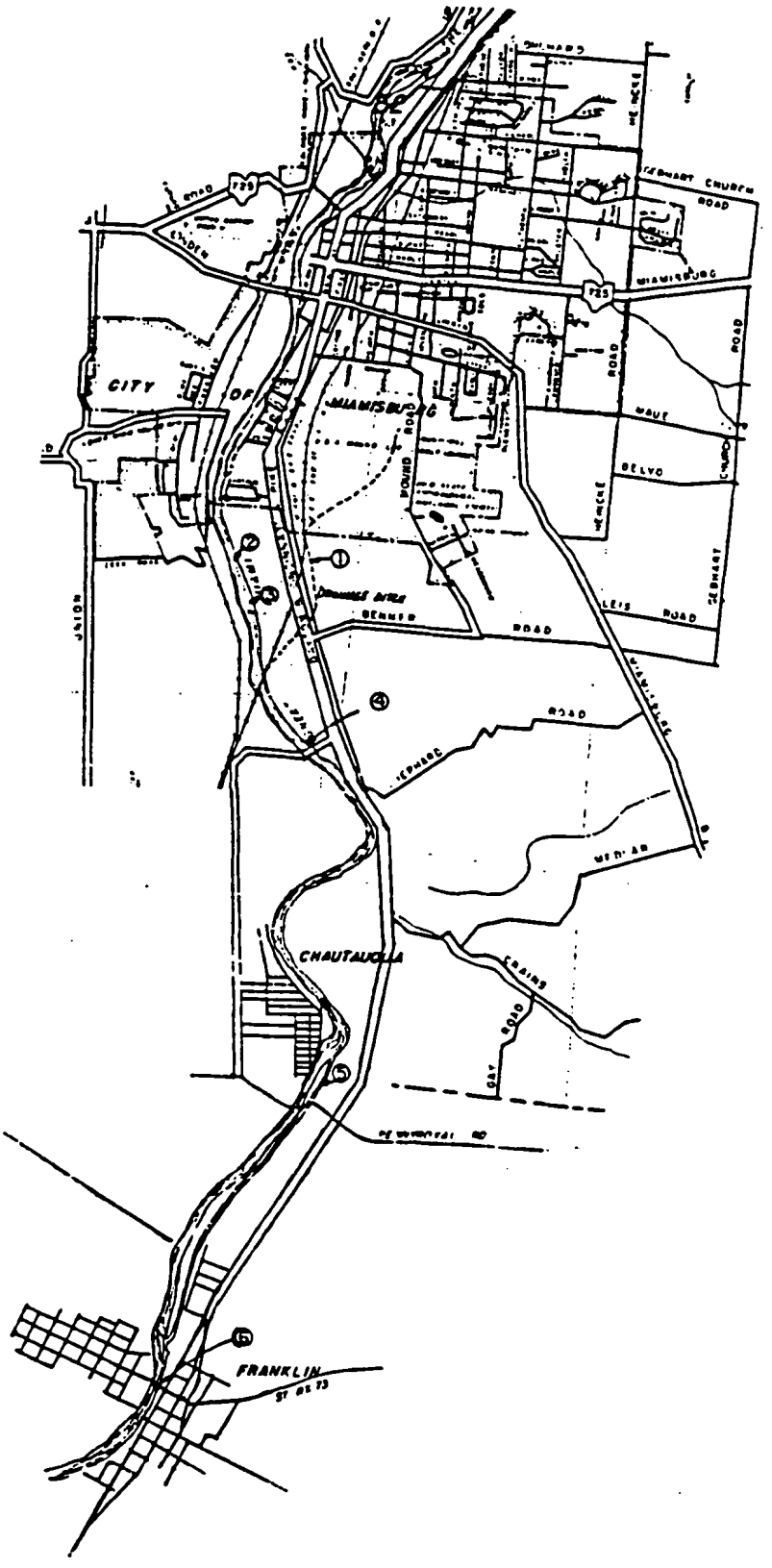
If we compare the gross alpha detected in the environment (see Table II again) to the maximum permissible continuous concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration is well within the permissible; however, it is a significant 5.0 per cent of the

permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and occasionally exceeds the very low permissible concentration for plutonium. (See Table II, Section B.)

The impact of plutonium work at Mound Laboratory is also placed in proper focus by referring to our stack monitoring data. During the first half of 1963, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium and/or polonium operations have contributed an insignificant burden to radioactivity normally presented in the atmosphere.

In Table III, "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, January Through June, 1963," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends on the wind direction of the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the different wind directions. Since the sampling location is dependent on wind direction, it is unlikely that all sites will be sampled during either reporting period.

A P P E N D I X



MAP 1
GREAT MIAMI RIVER SAMPLE LOCATIONS

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

JANUARY THROUGH JUNE, 1963

I. Polonium (River Samples)

Sampling Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	2	15	1.8×10^{-7}	4.50×10^{-8}	6.42
250 Yards Downstream	3	15	0.5×10^{-8}	0.11×10^{-8}	0.15
Chautauqua Road Bridge	4	15	0.7×10^{-8}	0.09×10^{-8}	0.13
Chautauqua Dam	5	15	0.5×10^{-8}	0.04×10^{-8}	0.06
Franklin, Ohio	6	15	0.0	0.0	0.0
Over-all		75	1.8×10^{-7}	0.95×10^{-8}	1.35

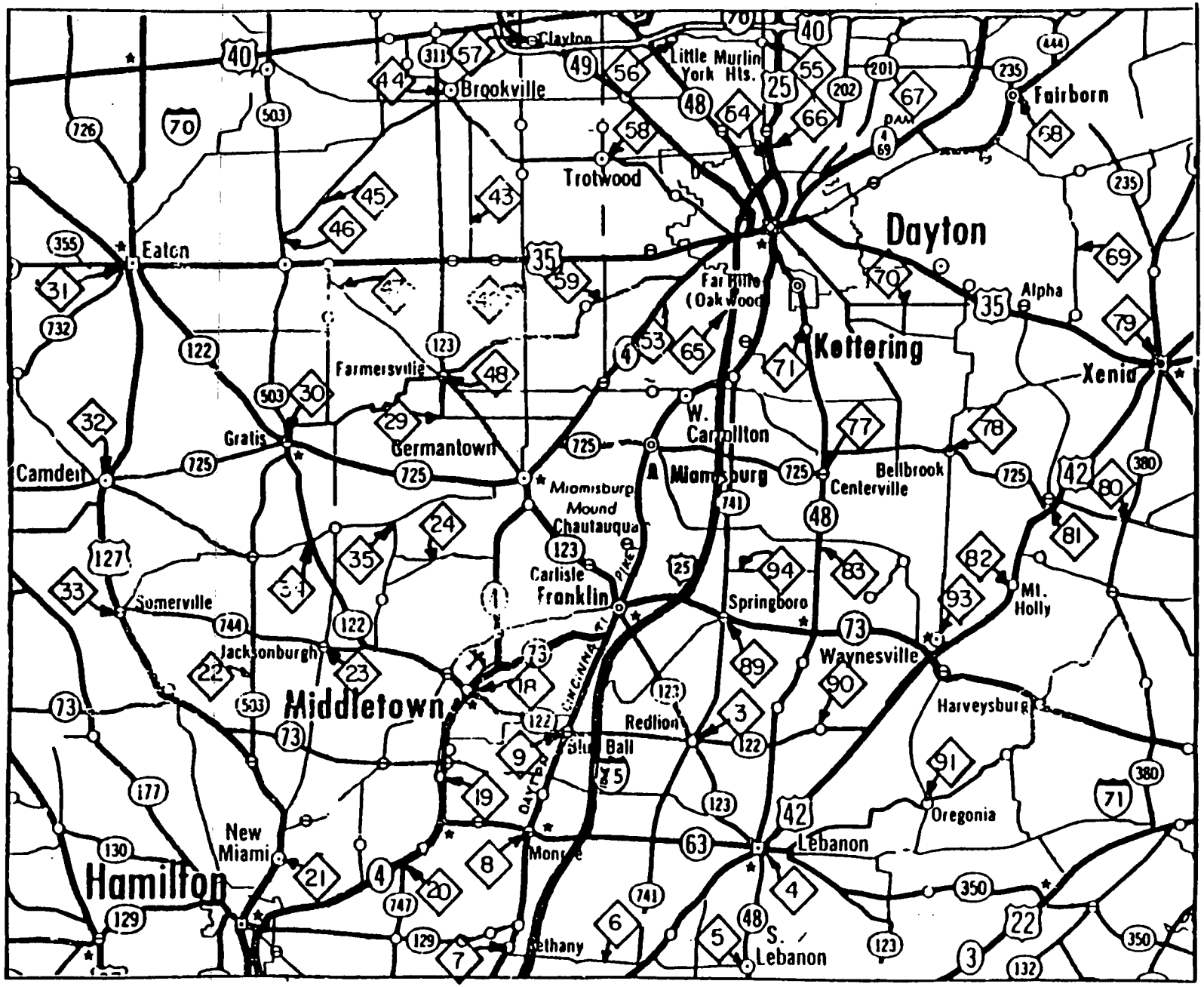
II. Tritium (River Samples, Except Drainage Ditch)

Sampling Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Drainage Ditch	1	14	1.0×10^{-3}	0.7×10^{-4}	1.4
Mound Lab Effluent	2	14	—	0.0	0.0

II. Tritium (Continued)

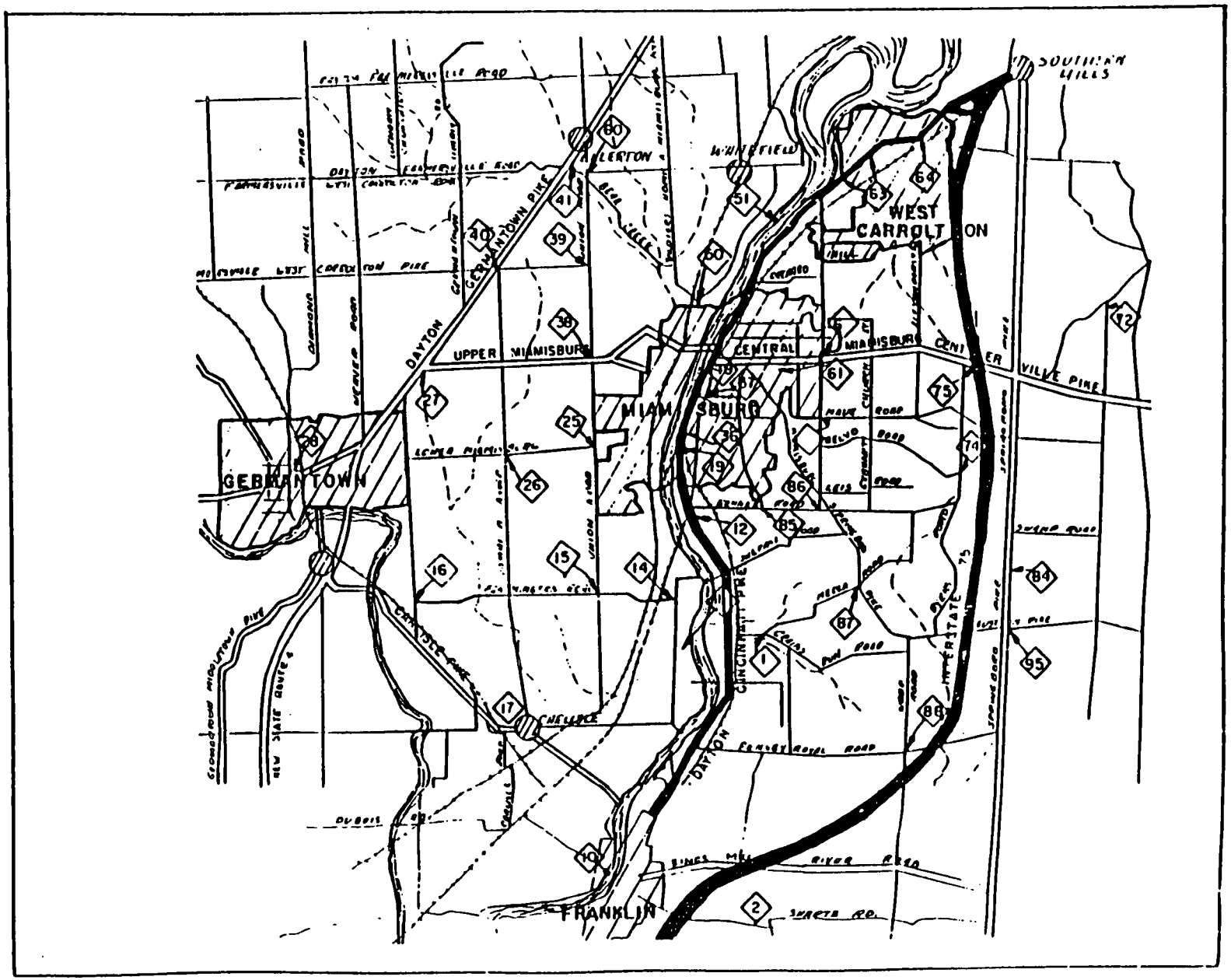
Sampling Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MP for Average**
Chautauqua Road Bridge	4	14	—	0.0	0.0
Over-all		42	1.0×10^{-3}	0.2×10^{-4}	0.4

* All concentrations are in microcuries per cubic centimeter
** MPC - Maximum Permissible Continuous Concentration



MAP 2
DISTANT
AIR SAMPLE
LOCATIONS
AND ROAD MAP

LOCATION



MAP 3
PROXIMITY
AIR SAMPLE
LOCATION
AND ROAD MAP

LOCATIONS

TABLE II

COMPOSITE - AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

JANUARY THROUGH JUNE, 1963

	Sampling Locations	Samples Collected	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
A. Downwind Sampling						
	47	154	4.18×10^{-14}	0.30×10^{-14}	0.015	5.0
B. Upwind Sampling						
	8	26	2.07×10^{-14}	0.34×10^{-14}	0.017	5.6
C. Difference						
			2.11×10^{-14}	—	—	—

* All concentrations in Tables II and III are in microcuries per cubic centimeter
** MPC - Maximum Permissible Continuous Concentration

TABLE III

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FROM LONG-LIVED ALPHA EMITTERS

JANUARY THROUGH JUNE, 1963

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.		No samples were collected at locations 1 through 48 during this period due to the lack of wind direction toward that area at the prescribed sampling times.			
2. Junction of Route 73 & Interstate 75					
3. Red Lion, Ohio					
4. Lebanon, Ohio					
5. South Lebanon, Ohio					
6. Junction of Bethany Rd. & Mason-Montgomery Rd.					
7. Bethany, Ohio					
8. Monroe, Ohio					
9. Blue Ball, Ohio					
10. Junction of Route 123 & Dayton-Oxford Rd.					
11. Chautauqua, Ohio					

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
12. Junction of Benner Rd. & Route 25					
13. Miami Drive In Theatre in Miamisburg (on Route 25)					
14. Junction of Farmington Rd. & Chautauqua Rd.					
15. Junction of Farmington Rd. & Union Rd.					
16. Junction of Farmington & Butter St.					
17. Carlisle, Ohio					
18. Middletown, Ohio					
19. Junction of Route 4 & Route 73					
20. Junction of Route 4 & Route 747					
21. New Miami, Ohio					
22. Junction of West Elkton Rd. & Tolbert Rd.					
23. Jacksonburg, Ohio					

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
24. Junction of Hetzler Rd. & Hinkel Rd.					
25. Junction of Lower Miamisburg Rd. & Union Rd.					
26. Junction of Lower Miamisburg Rd. & Jamica Rd.					
27. Junction of Route 725 & Route 4					
28. Germantown, Ohio					
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.					
30. Gratis, Ohio					
31. Eaton, Ohio					
32. Camden, Ohio					
33. Somerville, Ohio					
34. Junction of Greenbush Rd. & Route 122					
35. Junction of Oxford Rd. & Browns Run Rd.					

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
36. Miamisburg South City Limit on Route 25					
37. Junction of Mound Ave. & Route 25					
38. Junction of Union Rd. & Route 725					
39. Junction of Union Rd. & Manning Rd.					
40. Junction of Manning Rd. & Route 4					
41. Junction of Route 4 & Farmersville-West Carrollton Rd.					
42. Junction of Diamond Mill Rd. & Mile Rd.					
43. Junction of Clayton Rd. & Amity Rd.					
44. Brookville, Ohio					
45. Junction of Lexington Salem Rd. & Prebel County Line Rd.					
46. Junction of Lexington Salem Rd. & Engle Rd.					

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.					
48. Farmersville, Ohio					
49. Fifth St. & Central Ave. in Miamisburg, Ohio	2	—	0.0	0.0	0.0
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	2	—	0.0	0.0	0.0
51. One mile north on Upper River Rd. from Sample # 50	2	—	0.0	0.0	0.0
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	2	—	0.0	0.0	0.0
53. Dayton Speedway	2	0.23×10^{-14}	0.14×10^{-14}	0.007	2.3
54. Dayton, Ohio	2	—	0.0	0.0	0.0
55. Murlin Heights	2	0.05×10^{-14}	0.02×10^{-14}	0.001	0.3
56. Little York	2	—	0.0	0.0	0.0
57. Clayton, Ohio	2	—	0.0	0.0	0.0
58. Trotwood, Ohio	2	—	0.0	0.0	0.0

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
59. Union Rd. & Liberty-Dayton Rd.	2	—	0.0	0.0	0.0
60. Union Rd. & Bear Creek Rd.	2	—	0.0	0.0	0.0
61. Harmon Field in Miamisburg	8	2.34×10^{-14}	0.36×10^{-14}	0.018	6.0
62. Junction of Route 725 & Heincke Rd.	8	2.88×10^{-14}	0.59×10^{-14}	0.029	9.0
63. Junction of Elm St. & Route 25 in West Carrollton	8	4.18×10^{-14}	0.67×10^{-14}	0.033	11.0
64. Woody's Market in West Carrollton	8	3.19×10^{-14}	0.85×10^{-14}	0.042	14.0
65. Junction of South Broadway & Dryden Rd.	8	2.02×10^{-14}	0.45×10^{-14}	0.022	7.5
66. Junction of Route 75 & Wagoner Ford Rd.	8	0.63×10^{-14}	0.18×10^{-14}	0.009	3.0
67. Junction of Route 201 & Chambersburg Rd.	8	2.16×10^{-14}	0.50×10^{-14}	0.025	8.3
68. Fairborn, Ohio	8	1.58×10^{-14}	0.36×10^{-14}	0.018	6.0
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	8	1.31×10^{-14}	0.32×10^{-14}	0.016	5.3
70. Belmont Auto Theatre	8	0.23×10^{-14}	0.05×10^{-14}	0.003	0.8

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
71. Town & Country Shopping Center in Kettering, Ohio	8	0.41×10^{-14}	0.09×10^{-14}	0.004	1.5
72. Junction of Yankee St. & Mad River Rd.	8	0.86×10^{-14}	0.23×10^{-14}	0.011	3.8
73. Junction of Maue Rd. & Linden Ave.	1	—	0.68×10^{-14}	0.034	11.3
74. Junction of Byers Rd. & Belvo Rd.	1	—	0.0	0.0	0.0
75. Junction Route 725 & Route 75	1	—	0.0	0.0	0.0
76. Junction of Yankee	1	—	0.09×10^{-14}	0.004	1.5
77. Centerville, Ohio	1	—	0.23×10^{-14}	0.011	3.8
78. Bellbrook, Ohio	1	—	0.0	0.0	0.0
79. Xenia, Ohio	1	—	0.0	0.0	0.0
80. Junction of Spring Valley-Paintersville	1	—	0.0	0.0	0.0
81. Spring Valley, Ohio	1	—	0.0	0.0	0.0
82. Mt. Holly, Ohio	1	—	0.0	0.0	0.0
83. Junction of Route 48 & Social Row Rd.	1	—	0.0	0.0	0.0

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
84. Waldruhe Park	1	—	0.50×10^{-14}	0.025	8.3
85. Junction of Mound Rd. & Benner Rd.	2	1.67×10^{-14}	0.81×10^{-14}	0.040	13.5
86. Junction of Benner Rd. & Miamisburg-Springboro Rd.	2	—	0.0	0.0	0.0
87. Junction of Medlar Rd. & Miamisburg-Springboro Pike	2	0.77×10^{-14}	0.36×10^{-14}	0.018	6.0
88. Junction of Wood Rd. & Pennyroyal Rd.	2	0.68×10^{-14}	0.31×10^{-14}	0.015	5.1
89. Springboro, Ohio	2	0.41×10^{-14}	0.18×10^{-14}	0.009	3.0
90. Junction of Route 122 & Utica Rd.	2	0.09×10^{-14}	0.05×10^{-14}	0.003	0.8
91. Orgonia, Ohio	2	0.18×10^{-14}	0.09×10^{-14}	0.005	1.5
92. Harveysburg, Ohio	2	—	0.0	0.0	0.0
93. Waynesville, Ohio	2	0.05×10^{-14}	0.02×10^{-14}	0.001	0.3
94. By TV Tower on Lytle-Five Points Rd.	2	0.27×10^{-14}	0.14×10^{-14}	0.007	2.3
95. South Montgomery County Airport	2	1.26×10^{-14}	0.63×10^{-14}	0.031	10.5

* All concentrations are in microcuries per cubic centimeter
** MPC - Maximum Permissible Continuous Concentration

MLM-MU-64-61-0006

ENVIRONMENTAL MONITORING SEMI-ANNUAL REPORT - July - December, 1963

Prepared by P. C. Adams
Approved by H. E. Meyer

Date: January 24, 1964
Issued: February 5, 1964

MONSANTO RESEARCH CORPORATION
A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY
MIAMISBURG, OHIO
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S U M M A R Y

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the second half of 1963 is presented. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the second half of 1963.

INTRODUCTION

This report presents in summary form the findings of the Environmental Monitoring Program conducted by the Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program is planned and coordinated with regards to all of the various projects performed therein. The monitoring procedures used are those best suited for the detection and measurement of radioactive materials which Mound Laboratory could contribute to the environment.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

ENVIRONMENTAL MONITORING

During the period covered by this report, radioactive materials from Mound Laboratory have not contributed any measurable penetrating radiation, such as gamma or hard beta, to the environment. Of the radioisotopes in use at Mound Laboratory, only polonium, plutonium and tritium are possible air contaminants. Only polonium and tritium are possible water contaminants. Water sampling and air sampling are discussed below in detail.

WATER SAMPLING

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume and is handled separately as a packaged waste rather than being discharged to the river. Helium-3 being purified at Mound Laboratory contains small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries off all storm sewer water and eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and certain river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I, "Summary of Off-Site Water Monitoring for Radioactivity, July Through December, 1963." The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is within the maximum permissible continuous concentration.

AIR SAMPLING

Monitoring of the environmental air for tritium concentration, by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. During this period a total of 144 evaluations were made at 72 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been immeasurable to date.

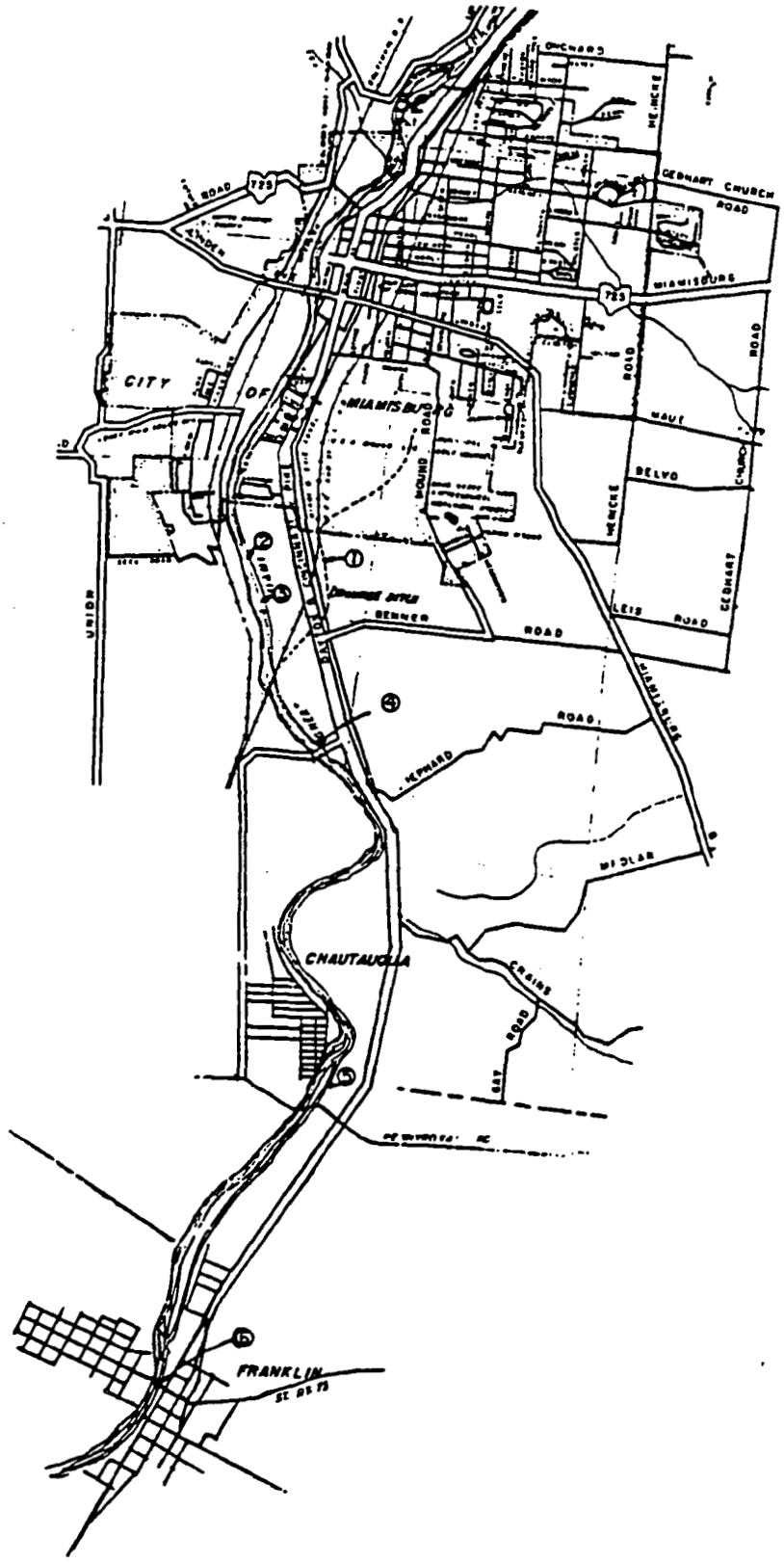
Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for air sampling. During this period, a total of 250 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table II) to the maximum permissible continuous concentration of polonium in the environment, and assume that all alpha detected is polonium, we find that the average polonium concentration is only 0.027 per cent of the permissible. Our effluent stack monitoring program for this period had indicated that we should expect essentially no detectable polonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table II again) to the maximum permissible continuous concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration is well within the permissible; however, it is a significant 9.2 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of occasionally exceeds the very low permissible concentration for plutonium. (See Table II, Section B.)

In Table III, "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, July Through December, 1963," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends on the wind direction of the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the different wind directions. Since the sampling location is dependent on wind direction, it is unlikely that all sites will be sampled during either reporting period.

APPENDIX



MAP 1
GREAT MIAMI RIVER SAMPLE LOCATIONS

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

JULY THROUGH DECEMBER, 1963

I. Polonium (River Samples)

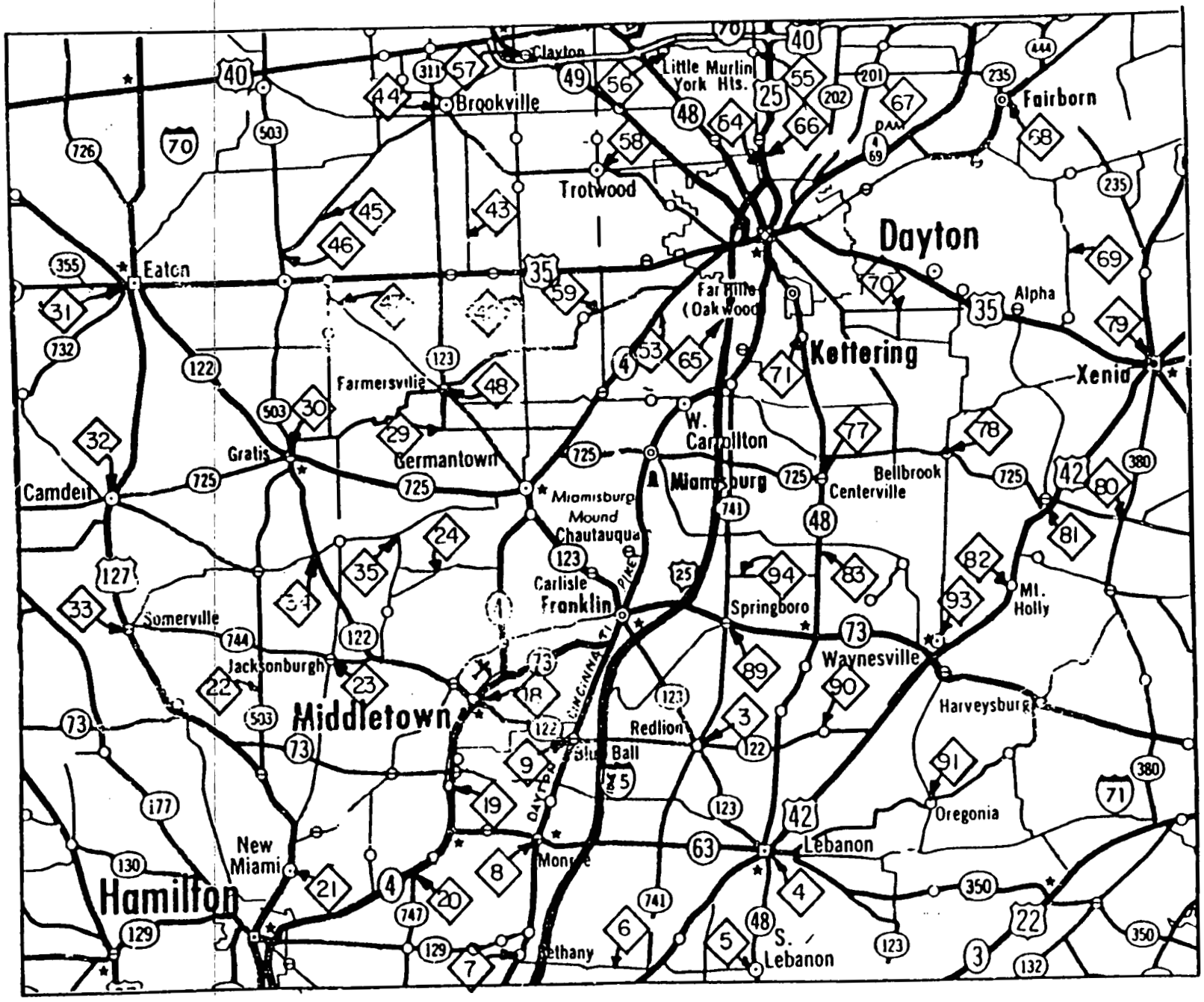
Sampling Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	2	17	1.2×10^{-7}	1.12×10^{-8}	1.60
250 Yards Downstream	3	17	3.7×10^{-8}	0.22×10^{-8}	0.31
Chautauqua Road Bridge	4	17	4.0×10^{-8}	0.27×10^{-8}	0.38
Chautauqua Dam	5	17	3.4×10^{-8}	0.22×10^{-8}	0.31
Franklin, Ohio	6	17	4.0×10^{-8}	0.27×10^{-8}	0.38
Trenton, Ohio	___	1	0.0	0.0	0.0
New Miami, Ohio	___	1	0.0	0.0	0.0
7 Miles North of New Baltimore, Ohio	___	1	0.0	0.0	0.0
New Baltimore, Ohio	___	1	0.0	0.0	0.0
Miamitown, Ohio	___	1	0.0	0.0	0.0
Elizabethtown, Ohio	___	1	0.0	0.0	0.0
OVER-ALL		91	1.2×10^{-7}	0.39×10^{-8}	0.55

II. Tritium (River Samples, Except Drainage Ditch)

Sampling Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Drainage Ditch	1	17	3.0×10^{-3}	0.5×10^{-3}	10.0
Mound Lab Effluent	2	17	1.0×10^{-3}	0.05×10^{-3}	1.0
Chautauqua Road Bridge	4	17	1.0×10^{-3}	0.05×10^{-3}	1.0
OVER-ALL		51	3.0×10^{-3}	0.2×10^{-3}	0.4

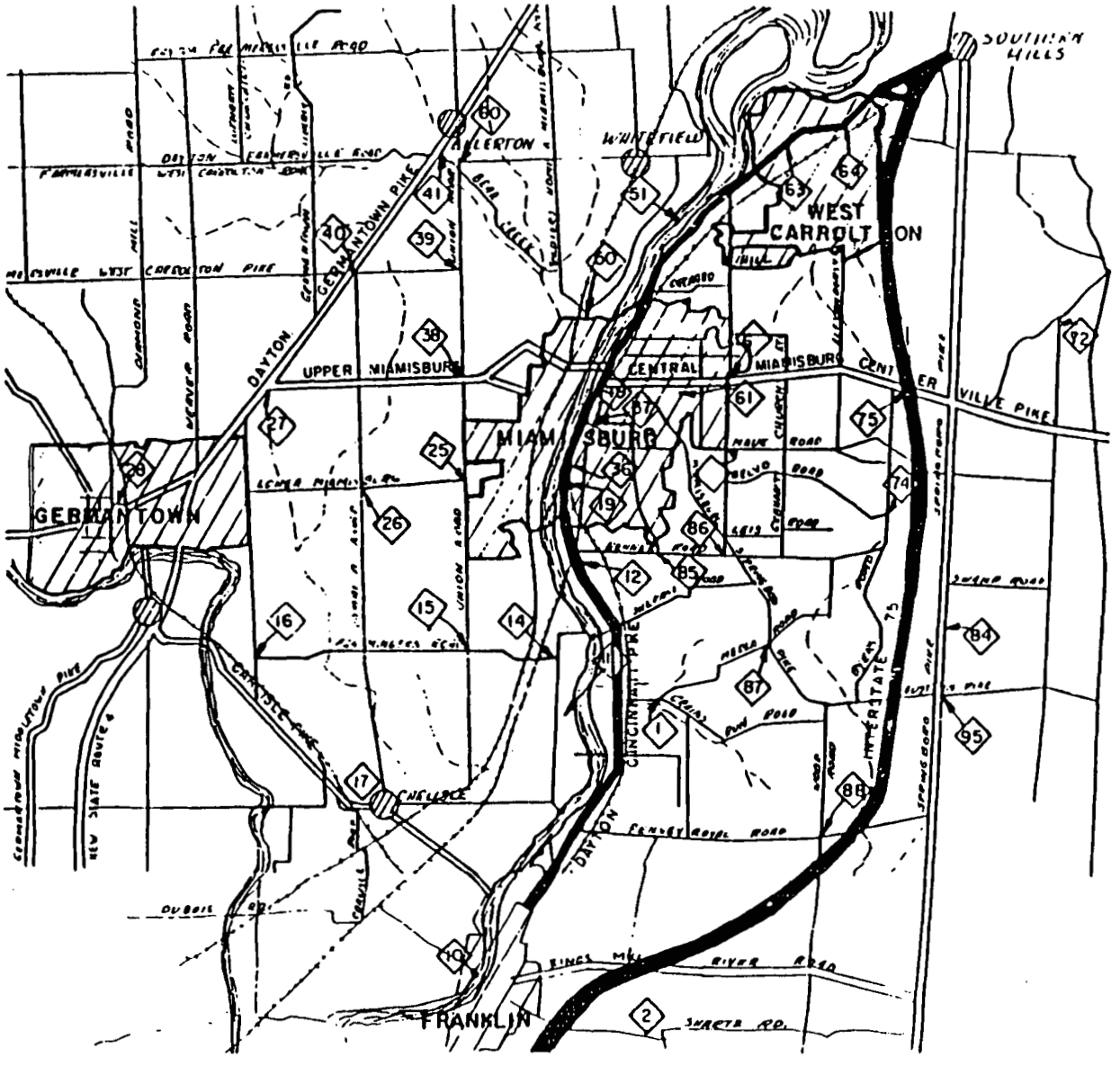
* All concentrations are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration



MAP 2
DISTANT
AIR SAMPLE
LOCATIONS
AND ROAD MAP

LOCATION



MAP 3
PROXIMITY
AIR SAMPLE
LOCATION
AND ROAD MAP

LOCATIONS

TABLE II

COMPOSITE - AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

JULY THROUGH DECEMBER, 1963

	Sampling Locations	Samples Collected	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
A. Downwind Sampling						
	83	250	2.52×10^{-13}	0.55×10^{-14}	0.027	9.2
B. Upwind Sampling						
	14	41	1.62×10^{-14}	0.27×10^{-14}	0.013	4.5
C. Difference						
			2.35×10^{-13}	0.28×10^{-14}	0.014	4.7

* All concentrations in Tables II and III are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration

TABLE III

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FROM LONG-LIVED ALPHA EMITTERS

JULY THROUGH DECEMBER, 1963

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.	2	0.05×10^{-14}	0.02×10^{-14}	0.001	0.3
2. Junction of Route 73 & Interstate 75	2	0.67×10^{-14}	0.33×10^{-14}	0.016	5.5
3. Red Lion, Ohio	2	0.0	0.0	0.0	0.0
4. Lebanon, Ohio	2	0.0	0.0	0.0	0.0
5. South Lebanon, Ohio	2	1.57×10^{-14}	0.78×10^{-14}	0.039	13.0
6. Junction of Bethany Rd. & Mason-Montgomery Rd.	2	6.75×10^{-14}	3.78×10^{-14}	0.189	63.0
7. Bethany, Ohio	2	2.52×10^{-13}	1.26×10^{-13}	0.630	210.0
8. Monroe, Ohio	2	2.70×10^{-14}	1.35×10^{-14}	0.067	22.5
9. Blue Ball, Ohio	2	3.15×10^{-14}	1.75×10^{-14}	0.087	29.1
10. Junction of Route 123 & Dayton-Oxford Rd.	2	4.50×10^{-14}	2.88×10^{-14}	0.144	48.0
11. Chautauqua, Ohio	2	0.0	0.0	0.0	0.0

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
12. Junction of Benner Rd. & Route 25	2	16.65×10^{-14}	9.31×10^{-14}	0.465	155.0
13. Miami Drive-In Theatre in Miamisburg (on Route 25)	3	0.54×10^{-14}	0.18×10^{-14}	0.009	3.0
14. Junction of Farmington Rd. & Chautauqua Rd.	3	0.0	0.0	0.0	0.0
15. Junction of Farmington Rd. & Union Rd.	3	1.26×10^{-14}	0.61×10^{-14}	0.030	10.1
16. Junction of Farmington Rd. & Butter St.	3	0.0	0.0	0.0	0.0
17. Carlisle, Ohio	3	0.76×10^{-14}	0.36×10^{-14}	0.018	6.0
18. Middletown, Ohio	3	0.09×10^{-14}	0.03×10^{-14}	0.001	0.5
19. Junction of Route 4 & Route 73	3	0.90×10^{-14}	0.61×10^{-14}	0.030	10.1
20. Junction of Route 4 & Route 747	3	0.0	0.0	0.0	0.0
21. New Miami, Ohio	3	1.35×10^{-14}	0.45×10^{-14}	0.022	7.5
22. Junction of West Elkton Rd. & Tolbert Rd.	3	0.72×10^{-14}	0.37×10^{-14}	0.018	6.1
23. Jacksonburg, Ohio	3	0.54×10^{-14}	0.36×10^{-14}	0.018	6.0

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
24. Junction of Hetzler Rd. & Hinkle Rd.	3	0.36×10^{-14}	0.12×10^{-14}	0.006	2.0
25. Junction of Lower Miamisburg Rd. & Union Rd.		No Samples were collected at locations 25 through 36 during this period due to the lack of wind direction toward that area at the prescribed sampling times.			
26. Junction of Lower Miamisburg Rd. & Jamica Rd.					
27. Junction of Route 725 & Route 4					
28. Germantown, Ohio					
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.					
30. Gratis, Ohio					
31. Eaton, Ohio					
32. Camden, Ohio					
33. Sommerville, Ohio					
34. Junction of Greenbush Rd. & Route 122					
35. Junction of Oxford Rd. & Browns Run Rd.					

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
36. Miamisburg South City Limit on Route 25					
37. Junction of Mound Ave. & Route 25	3	1.57×10^{-14}	0.90×10^{-14}	0.045	15.0
38. Junction of Union Rd. & Route 725	3	2.25×10^{-14}	1.08×10^{-14}	0.054	18.0
39. Junction of Union Rd. & Manning Rd.	3	0.58×10^{-14}	0.19×10^{-14}	0.009	3.3
40. Junction of Manning Rd. & Route 4	3	0.0	0.0	0.0	0.0
41. Junction of Route 4 & Farmersville-West Carrollton Rd.	3	0.77×10^{-14}	0.26×10^{-14}	0.011	3.6
42. Junction of Diamond Mill Rd. & Mile Rd.	3	3.96×10^{-14}	1.32×10^{-14}	0.066	22.0
43. Junction of Clayton Rd. & Amity Rd.	3	0.27×10^{-14}	0.09×10^{-14}	0.004	1.5
44. Brookville, Ohio	3	0.27×10^{-14}	0.16×10^{-14}	0.008	2.7
45. Junction of Lexington Salem Rd. & Prebel County Line Rd.	3	0.67×10^{-14}	0.27×10^{-14}	0.013	4.5
46. Junction of Lexington Salem Rd. & Engle Rd.	3	0.09×10^{-14}	0.03×10^{-14}	0.001	0.5

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.	3	0.0	0.0	0.0	0.0
48. Farmersville, Ohio	3	0.09×10^{-14}	0.03×10^{-14}	0.001	0.5
49. Fifth St. & Central Ave. in Miamisburg, Ohio	5	0.67×10^{-14}	0.27×10^{-14}	0.013	4.5
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	5	3.73×10^{-14}	1.53×10^{-14}	0.076	25.5
51. One mile north on Upper River Rd. from Sample #50	5	2.11×10^{-14}	0.76×10^{-14}	0.038	12.6
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	5	2.65×10^{-14}	0.72×10^{-14}	0.036	12.0
53. Dayton Speedway	5	1.98×10^{-14}	0.40×10^{-14}	0.020	6.6
54. Dayton, Ohio	5	1.57×10^{-14}	0.63×10^{-14}	0.031	10.5
55. Murlin Heights	5	7.83×10^{-14}	1.37×10^{-14}	0.068	22.9
56. Little York	5	0.40×10^{-14}	0.09×10^{-14}	0.004	1.5
57. Clayton, Ohio	5	0.58×10^{-14}	0.18×10^{-14}	0.009	3.0
58. Trotwood, Ohio	5	0.67×10^{-14}	0.17×10^{-14}	0.008	2.9

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
59. Union Rd. & Liberty Dayton Rd.	5	0.63×10^{-14}	0.13×10^{-14}	0.006	2.1
60. Union Rd. & Bear Creek Rd.	5	0.22×10^{-14}	0.09×10^{-14}	0.004	1.5
61. Harmon Field in Miamisburg	3	0.31×10^{-14}	0.10×10^{-14}	0.005	1.6
62. Junction of Route 725 & Heincke Rd.	3	1.30×10^{-14}	0.49×10^{-14}	0.024	8.1
63. Junction of Elm St. & Route 25 in West Carrollton	3	1.03×10^{-14}	0.49×10^{-14}	0.024	8.1
64. Woody's Market in West Carrollton	3	0.63×10^{-14}	0.27×10^{-14}	0.013	4.5
65. Junction of South Broadway & Dryden Rd.	3	0.36×10^{-14}	0.22×10^{-14}	0.011	3.6
66. Junction of Route 75 & Wagoner Ford Rd.	3	0.36×10^{-14}	0.12×10^{-14}	0.006	2.0
67. Junction of Route 201 & Chambersburg Rd.	3	0.18×10^{-14}	0.09×10^{-14}	0.004	1.5
68. Fairborn, Ohio	3	0.58×10^{-14}	0.19×10^{-14}	0.009	3.1
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	3	0.72×10^{-14}	0.24×10^{-14}	0.012	4.0

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
70. Belmont Auot Theatre	3	0.27×10^{-14}	0.25×10^{-14}	0.012	4.1
71. Town & Country Shopping Center in Kettering, Ohio	3	0.18×10^{-14}	0.06×10^{-14}	0.003	1.0
72. Junction of Yankee St. & Mad River Rd.	3	0.09×10^{-14}	0.03×10^{-14}	0.001	0.5
73. Junction of Maue Rd. & Linden Ave.	3	—	0.0	0.0	0.0
74. Junction of Byers Rd. & Belvo Rd.	3	0.76×10^{-14}	0.31×10^{-14}	0.015	5.1
75. Junction of Route 725 & Route 75	3	0.31×10^{-14}	0.10×10^{-14}	0.005	1.6
76. Junction of Yankee St. & Route 725	3	0.27×10^{-14}	0.13×10^{-14}	0.006	2.1
77. Centerville, Ohio	3	0.81×10^{-14}	0.49×10^{-14}	0.024	8.1
78. Bellbrook, Ohio	3	0.58×10^{-14}	0.36×10^{-14}	0.018	6.0
79. Xenia, Ohio	3	0.13×10^{-14}	0.09×10^{-14}	0.004	1.5
80. Junction of Spring Valley Paintersville Rd. & Route 380	3	0.67×10^{-14}	0.40×10^{-14}	0.020	6.6
81. Spring Valley, Ohio	3	—	0.0	0.0	0.0

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
82. Mt. Holly, Ohio	3	0.36×10^{-14}	0.22×10^{-14}	0.011	3.6
83. Junction of Route 48 & Social Row Rd.	3	0.76×10^{-14}	0.40×10^{-14}	0.020	6.6
84. Waldruhe Park	3	0.31×10^{-14}	0.13×10^{-14}	0.006	2.1
85. Junction of Mound Rd. & Benner Rd.	2	0.22×10^{-14}	0.11×10^{-14}	0.005	1.8
86. Junction of Benner Rd. & Miamisburg-Springboro Rd.	2	0.40×10^{-14}	0.20×10^{-14}	0.010	3.3
87. Junction of Medlar Rd. & Miamisburg-Springboro Pike	2	0.09×10^{-14}	0.04×10^{-14}	0.002	0.6
88. Junction of Wood Rd. & Pennyroyal Rd.	2	—	0.0	0.0	0.0
89. Springboro, Ohio	2	0.67×10^{-14}	0.58×10^{-14}	0.029	9.6
90. Junction of Route 122 & Utica Rd.	2	0.86×10^{-14}	0.43×10^{-14}	0.021	7.1
91. Orgonia, Ohio	2	0.18×10^{-14}	0.09×10^{-14}	0.005	1.5
92. Harveysburg, Ohio	2	0.04×10^{-14}	0.02×10^{-14}	0.001	0.3
93. Waynesville, Ohio	2	—	0.0	0.0	0.0
94. By TV Tower on Lytle-Five Points Rd.	2	0.76×10^{-14}	0.38×10^{-14}	0.019	6.3

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
95. South Montgomery County Airport	2	0.76×10^{-14}	0.38×10^{-14}	0.019	6.3

* All concentrations are in microcuries per cubic centimeter.
** MPC - Maximum Permissible Continuous Concentration

1962

ENVIRONMENTAL MONITORING REPORT

1962

Health Physics Department

P. C. Adams

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

MLM-MU-62-64-0009

ENVIRONMENTAL MONITORING REPORT

FIRST QUARTER 1962

Health Physics Department

P. C. Adams

Date Issued: April 25, 1962

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I. SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the first quarter of 1962 is presented. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the quarter.

II. INTRODUCTION

This report presents in summary form the findings of the Environmental Monitoring Program conducted by the Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program is planned and coordinated with regards to all of the various projects performed therein. The monitoring procedures used are those best suited for the detection and measurement of appropriate radioactive materials which Mound Laboratory could contribute to the environment.

During the period covered by this report, no radioactive materials have been used which have contributed any measurable penetrating radiation such as gamma or hard beta to the environment.

Polonium, plutonium and tritium are possible air contaminants; polonium and tritium are possible river water contaminants.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

III. WATER SAMPLING

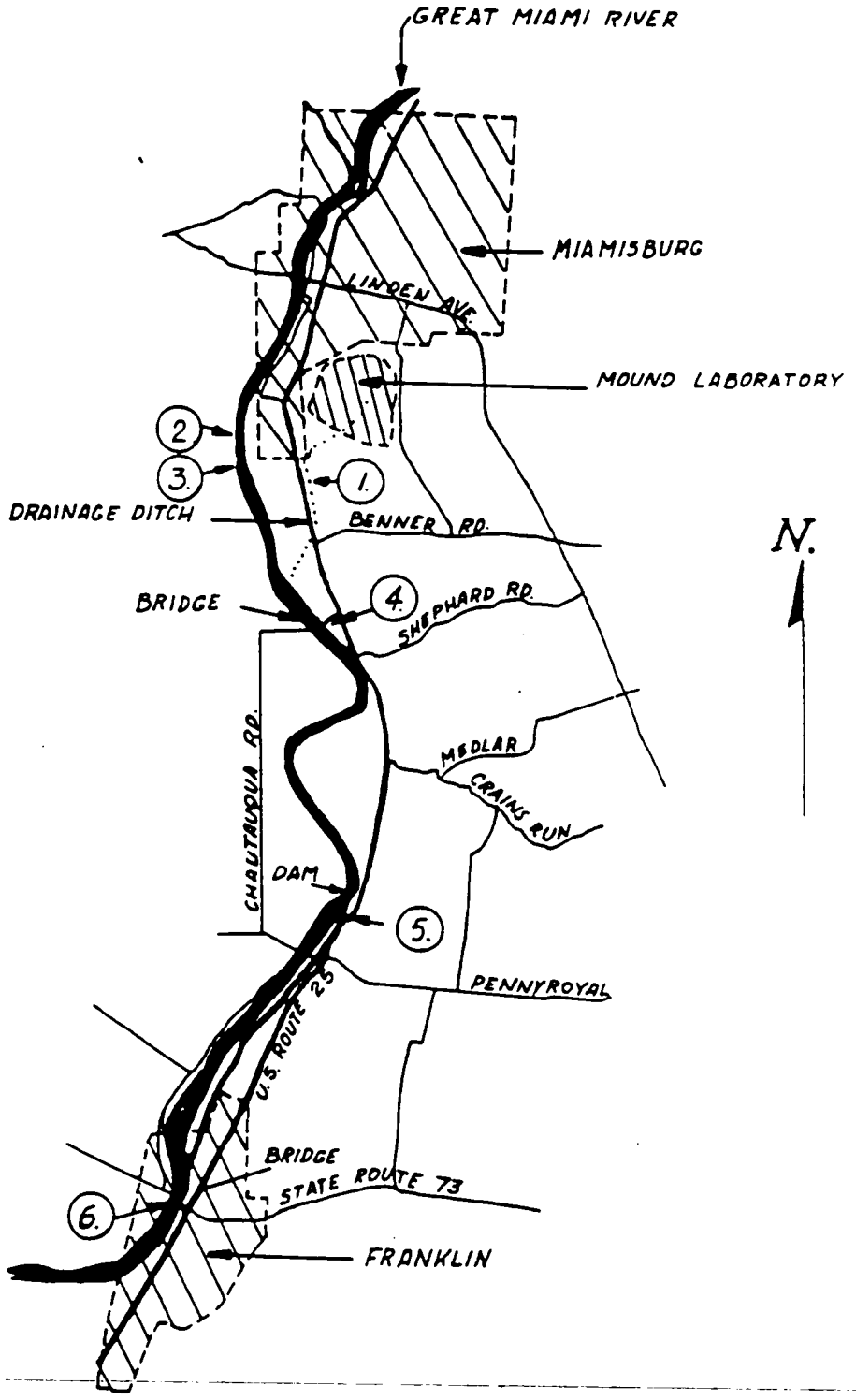
Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume and is handled separately as a packaged waste rather than being discharged to the river. Helium-3 being purified at Mound Laboratory yields small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs

through the plant site. This ditch carries off all storm sewer water and eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and certain river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I "Summary of Off-Site Water Monitoring For Radioactivity, January Through March, 1962."

The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is within the maximum permissible continuous concentration.



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GREAT MIAMI RIVER WATER SAMPLE LOCATIONS

MAP I.

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

JANUARY THROUGH MARCH, 1962

I. Polonium (River Samples)

Sample Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	2	9	1.8×10^{-9}	3.96×10^{-10}	0.056
250 Yards Downstream	3	8	1.8×10^{-9}	2.25×10^{-10}	0.032
Chautauqua Road Bridge	4	8	3.6×10^{-9}	4.5×10^{-10}	0.064
Chautauqua Dam	5	9	1.8×10^{-9}	1.98×10^{-10}	0.029
Franklin, Ohio	6	9	3.6×10^{-9}	3.96×10^{-10}	0.056
Over-all		43	3.6×10^{-9}	3.33×10^{-10}	0.047

II. Tritium (River Samples, Except Drainage Ditch)

Mound Lab Drainage Ditch	1	9	0.5×10^{-3}	0.7×10^{-4}	1.4
Mound Lab Effluent	2	9	0.3×10^{-3}	0.4×10^{-4}	0.8
Chautauqua Road Bridge	4	8	1.0×10^{-3}	0.13×10^{-4}	0.3
Over-all		26	1.0×10^{-3}	0.4×10^{-4}	0.8

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

IV. AIR SAMPLING

Monitoring of the environmental air for tritium concentration by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. A total of 171 evaluations were made at 87 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for tritium air sampling. During this quarter, a total of 178 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

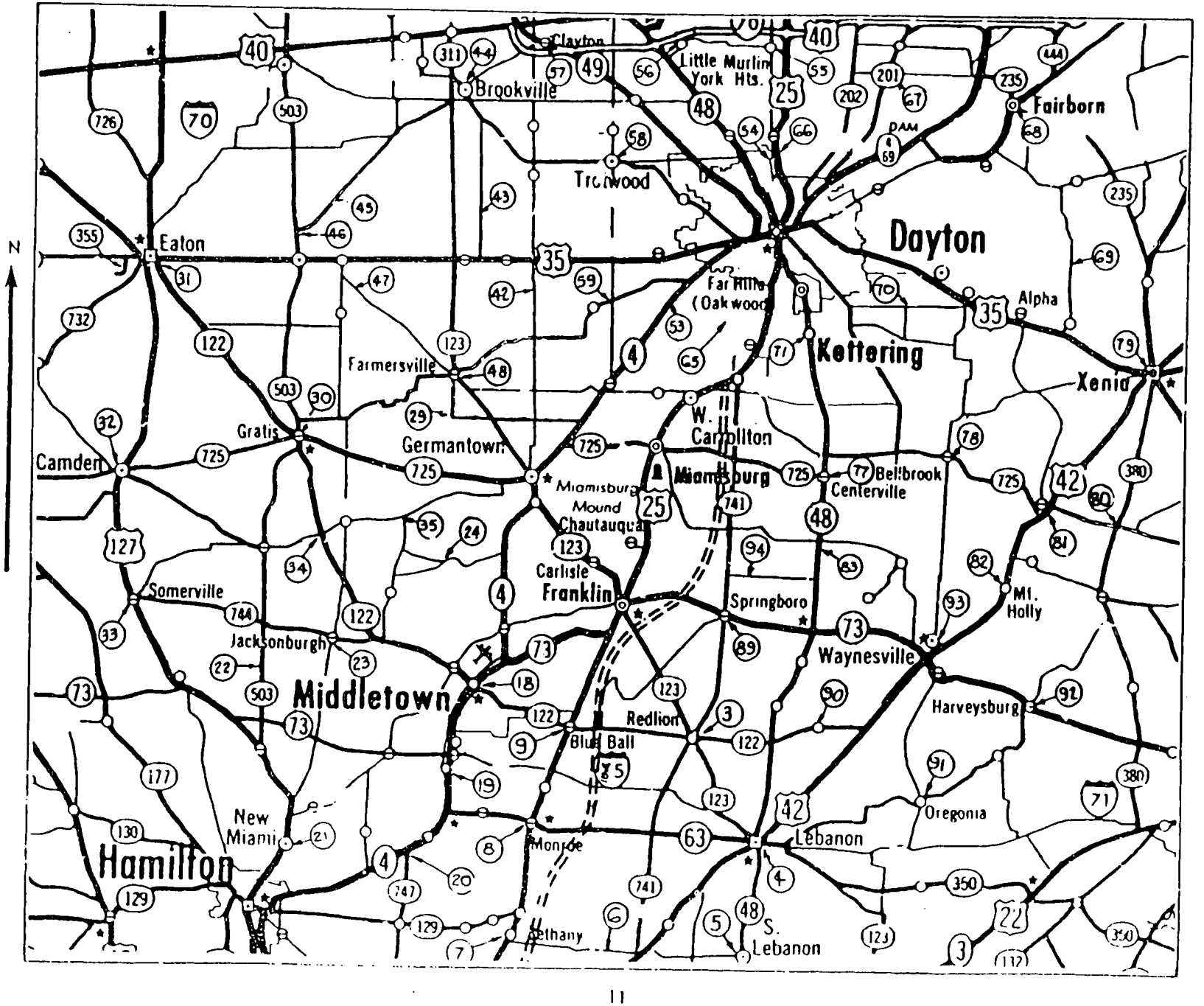
The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the

isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table II) to the Maximum Permissible Continuous Concentration for polonium in the environment, and assume that all alpha activity detected is polonium, we find that the average polonium concentration is only 0.014 per cent of the permissible. Our effluent stack monitoring program for this quarter had indicated that we should expect essentially no detectable polonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table II again) to the Maximum Permissible Continuous Concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration is well within the permissible; however it is a significant 4.8 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and frequently exceeds the very low permissible concentration for plutonium. This month's results are a good example of this condition (see Table II) - Average Concentration - upwind versus downwind sampling.

The impact of plutonium work at Mound Laboratory is also placed in proper focus by referring to our stack monitoring data. During the first quarter of 1962, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium and/or polonium operations have contributed an insignificant burden to the radioactivity normally present in the atmosphere.

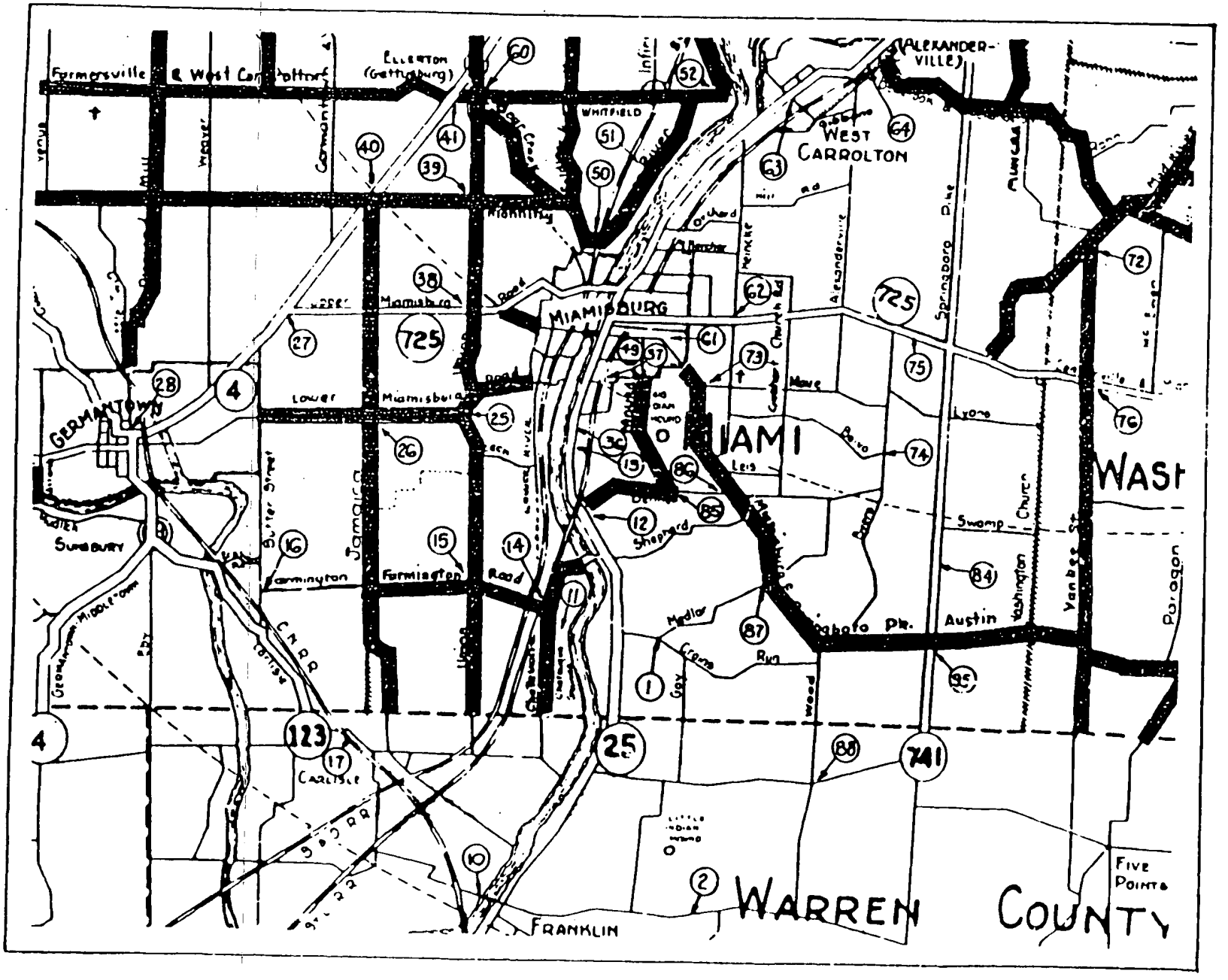
In Table III "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, January Through March, 1962," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends upon the wind direction on the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the different wind directions. Depending upon wind direction, it is likely that all sites will not be sampled during any one quarter.



MAP 2

AIR SAMPLE LOCATIONS AND ROAD MAP

LOCATION O→



MAP 3

AIR SAMPLE
LOCATION
AND ROAD MA

LOCATIONS O—

TABLE II

COMPOSITE - AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

JANUARY THROUGH MARCH, 1962

A. Downwind Sampling

Sampling Locations	Samples Collected	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
60	178	4.50×10^{-14}	0.29×10^{-14}	0.014	4.8

B. Upwind Sampling

10	30	0.99×10^{-14}	0.33×10^{-14}	0.016	5.5

C. Difference

		3.51×10^{-14}	———	———	———

* All Concentrations in Tables II and III are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

TABLE III

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FOR LONG-LIVED ALPHA EMITTERS

JANUARY THROUGH MARCH, 1962

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.	3	0.27×10^{-14}	0.09×10^{-14}	0.004	1.5
2. Junction of Route 73 & Interstate 75	3	0.27×10^{-14}	0.09×10^{-14}	0.004	1.5
3. Red Lion, Ohio	3	4.5×10^{-14}	1.48×10^{-14}	0.074	24.3
4. Lebanon, Ohio	3	0.81×10^{-14}	0.27×10^{-14}	0.013	4.5
5. South Lebanon, Ohio	3	0.72×10^{-14}	0.36×10^{-14}	0.018	6.0
6. Junction of Bethany Rd. & Mason-Montgomery Rd.	3	——	0.0	0.0	0.0
7. Bethany, Ohio	3	1.53×10^{-14}	0.51×10^{-14}	0.025	8.5
8. Monroe, Ohio	3	0.27×10^{-14}	0.09×10^{-14}	0.004	1.5
9. Blue Ball, Ohio	3	0.81×10^{-14}	0.27×10^{-14}	0.013	4.5
10. Junction of Route 123 & Dayton-Oxford Rd.	3	2.34×10^{-14}	0.78×10^{-14}	0.039	13.0
11. Chautauqua, Ohio	3	0.99×10^{-14}	0.39×10^{-14}	0.019	6.5

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
12. Junction of Benner Rd. & Route 25	3	1.08×10^{-14}	0.36×10^{-14}	0.018	6.0
13. Miami Drive In Theatre in Miamisburg (on Route 25)	No samples were collected at locations 13 through 36 during this quarter due to the lack of wind direction toward that area at the prescribed sampling times.				
14. Junction of Farmington Rd. & Chautauqua Rd.					
15. Junction of Farmington Rd. & Union Rd.					
16. Junction of Farmington Rd. & Butter St.					
17. Carlisle, Ohio					
18. Middletown, Ohio					
19. Junction of Route 4 & Route 73					
20. Junction of Route 4 & Route 747					
21. New Miami, Ohio					
22. Junction of West Elkton Rd. & Tolbert Rd.					
23. Jacksonburg, Ohio					

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
24. Junction of Hetzler Rd. & Hinkle Rd.					
25. Junction of Lower Miamisburg Rd. & Union Rd.					
26. Junction of Lower Miamisburg Rd. & Jamaica Rd.					
27. Junction of Route 725 & Route 4					
28. Germantown, Ohio					
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.					
30. Gratis, Ohio					
31. Eaton, Ohio					
32. Camden, Ohio					
33. Somerville, Ohio					
34. Junction of Greenbush Rd. & Route 122					
35. Junction of Oxford Rd. & Browns Run Rd.					

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
36. Miamisburg South City Limit on Route 25					
37. Junction of Mound Ave. & Route 25	1	____	0.0	0.0	0.0
38. Junction of Union Rd. & Route 725	1	____	0.0	0.0	0.0
39. Junction of Union Rd. & Manning Rd.	1	____	$.090 \times 10^{-14}$	0.004	1.5
40. Junction of Manning Rd. & Route 4	1	____	0.0	0.0	0.0
41. Junction of Route 4 & Farmersville-West Carrollton Rd.	1	____	0.0	0.0	0.0
42. Junction of Diamond Mill Rd. & Mile Rd.	1	____	0.0	0.0	0.0
43. Junction of Clayton Rd. & Amity Rd.	1	____	$.18 \times 10^{-14}$	0.009	3.0
44. Brookville, Ohio	1	____	0.0	0.0	0.0
45. Junction of Lexington Salem Rd. & Preble County Line Rd.	1	____	$.18 \times 10^{-14}$	0.009	3.0
46. Junction of Lexington Salem Rd. & Engle Rd.	1	____	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.	1	___	0.0	0.0	0.0
48. Farmersville, Ohio	1	___	0.0	0.0	0.0
49. Fifth St. & Central Ave. in Miamisburg, Ohio	No samples were collected at locations 49 through 60 during this quarter due to the lack of wind direction toward that area at the prescribed sampling times.				
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.					
51. One mile north on Upper River Rd. from sample #50					
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.					
53. Dayton Speedway					
54. Dayton, Ohio					
55. Murlin Heights					
56. Little York					
57. Clayton, Ohio					

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
58. Trotwood, Ohio					
59. Union Rd. & Liberty-Dayton Rd.					
60. Union Rd. & Bear Creek Rd.					
61. Harmon Field in Miamisburg	4	3.24×10^{-14}	0.81×10^{-14}	0.040	13.5
62. Junction of Route 725 & Heincke Rd.	4	0.36×10^{-14}	0.13×10^{-14}	0.006	2.1
63. Junction of Elm St. & Route 25 in West Carrollton	4	0.54×10^{-14}	0.25×10^{-14}	0.012	4.1
64. Woody's Market in West Carrollton	4	____	0.0	0.0	0.0
65. Junction of South Broadway & Dryden Rd.	4	____	0.0	0.0	0.0
66. Junction of Route 75 & Wagner Ford Rd.	4	0.27×10^{-14}	0.09×10^{-14}	0.004	1.5
67. Junction of Route 201 & Chambersburg Rd.	4	1.62×10^{-14}	0.63×10^{-14}	0.031	10.5
68. Fairborn, Ohio	4	1.98×10^{-14}	1.19×10^{-14}	0.059	19.8

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	4	0.99×10^{-14}	0.38×10^{-14}	0.019	6.3
70. Belmont Auto Theatre	4	0.27×10^{-14}	0.07×10^{-14}	0.003	1.3
71. Town & Country Shopping Center in Kettering, Ohio	4	0.45×10^{-14}	0.11×10^{-14}	0.005	1.8
72. Junction of Yankee St. & Mad River Rd.	4	——	0.0	0.0	0.0
73. Junction of Maue Rd. & Linden Ave.	5	0.54×10^{-14}	0.16×10^{-14}	0.008	2.6
74. Junction of Byers Rd. & Belvo Rd.	5	2.34×10^{-14}	0.54×10^{-14}	0.027	9.0
75. Junction of Route 725 & Route 75	5	0.09×10^{-14}	0.02×10^{-14}	0.001	0.3
76. Junction of Yankee St. & Route 725	5	——	0.0	0.0	0.0
77. Centerville, Ohio	5	1.71×10^{-14}	0.38×10^{-14}	0.019	6.3
78. Bellbrook, Ohio	5	0.54×10^{-14}	0.11×10^{-14}	0.005	1.8
79. Xenia, Ohio	5	3.33×10^{-14}	0.85×10^{-14}	0.042	14.1

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
80. Junction of Spring Valley-Paintersville Rd. & Route 380	5	4.05×10^{-14}	1.44×10^{-14}	0.072	24.0
81. Spring Valley, Ohio	5	0.90×10^{-14}	0.18×10^{-14}	0.009	3.0
82. Mt. Holly, Ohio	5	0.54×10^{-14}	0.11×10^{-14}	0.005	1.8
83. Junction of Route 48 & Social Row Rd.	5	1.35×10^{-14}	0.27×10^{-14}	0.013	4.5
84. Waldruhe Park	5	0.45×10^{-14}	0.09×10^{-14}	0.004	1.5
85. Junction of Mound Rd. & Benner Rd.	2	0.81×10^{-14}	0.40×10^{-14}	0.020	6.6
86. Junction of Benner Rd. & Miamisburg-Springboro Pike	2	—	0.0	0.0	0.0
87. Junction of Medlar Rd. & Miamisburg-Springboro Pike	2	—	0.0	0.0	0.0
88. Junction of Wood Rd. & Pennyroyal Rd.	2	0.18×10^{-14}	0.09×10^{-14}	0.004	1.5
89. Springboro, Ohio	2	—	0.0	0.0	0.0
90. Junction of Route 122 & Utica Rd.	2	—	0.0	0.0	0.0
91. Orgonia	2	0.63×10^{-14}	0.31×10^{-14}	0.015	5.1

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
92. Harveysburg, Ohio	2	0.09×10^{-14}	0.04×10^{-14}	0.002	0.6
93. Waynesville, Ohio	2	____	0.0	0.0	0.0
94. By TV Tower on Lytle-Five Points Rd.	2	____	0.0	0.0	0.0
95. South Montgomery County Airport	2	____	0.0	0.0	0.0

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

MLM-MU-62-68-0004

ENVIRONMENTAL MONITORING REPORT

SECOND QUARTER 1962

Health Physics Department

P. C. Adams

Date Issued: August 4, 1962

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

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UNITED STATES ATOMIC ENERGY COMMISSION

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I. SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the second quarter of 1962 is presented. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and measurements. There was no detectable concentration of tritium in the environmental air during the quarter.

II. INTRODUCTION

This report presents in summary form the findings of the Environmental Monitoring Program conducted by the Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program is planned and coordinated with regards to all of the various projects performed therein. The monitoring procedures used are those best suited for the detection and measurement of appropriate radioactive materials which Mound Laboratory could contribute to the environment.

During the period covered by this report, no radioactive materials have been used which have contributed any measurable penetrating radiation such as gamma or hard beta to the environment.

Polonium, plutonium and tritium are possible air contaminants; polonium and tritium are possible river water contaminants.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentration for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

III. WATER SAMPLING

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume and is handled separately as a package waste rather than being discharged to the river. Helium-3 being pruified at Mound Laboratory yields small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

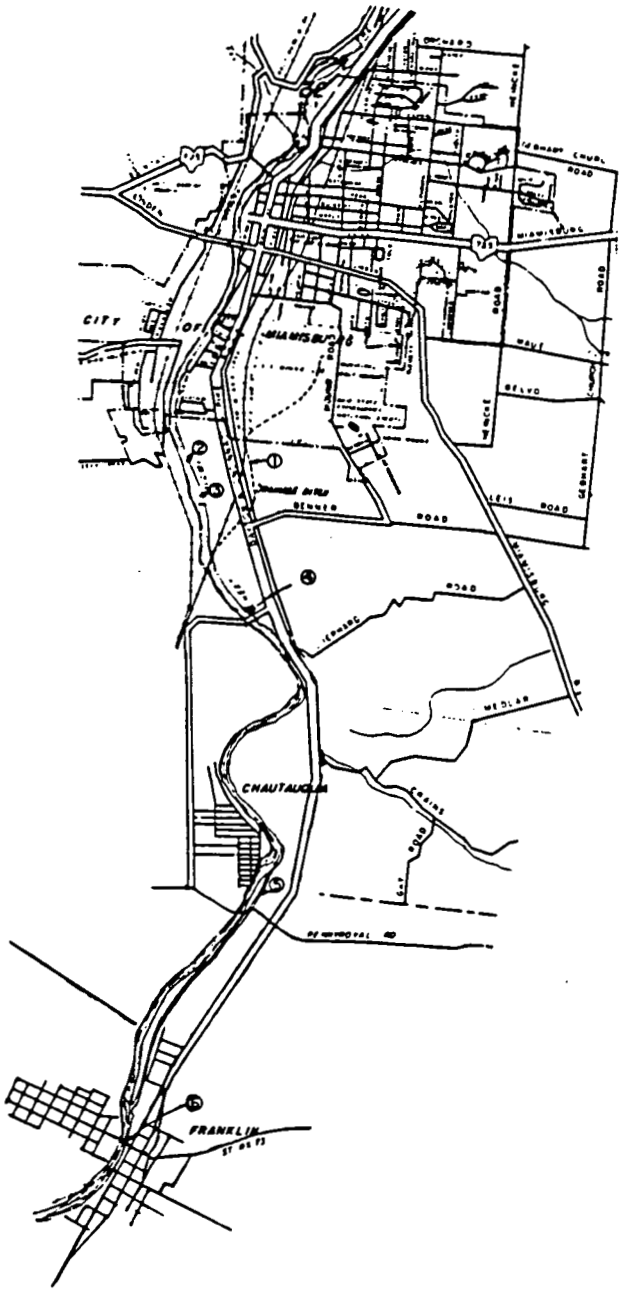
Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries off all storm sewer water and eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration.

The drainage ditch sample and certain river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I "Summary of Off-Site Water Monitoring For Radioactivity, April Through June, 1962."

The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is within the maximum permissible continuous concentration.

In addition to the river sample locations indicated on Map I, samples are collected on a quarterly basis farther downstream at Trenton, New Miami, New Baltimore, Miamitown and Elizabethtown, Ohio



GREAT MIAMI RIVER WATER SAMPLE LOCATIONS

MAP 1

TABLE 1

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

APRIL THROUGH JUNE, 1962

I. Polonium (River Samples)

Sample Locations	Map 1 Code Number	Number of Samples	Maximum Concentration *	Average Concentration *	Per Cent of MPC for Average **
Mound Lab Effluent	2	9	7.0×10^{-8}	1.57×10^{-8}	2.24
250 Yards Downstream	3	11	5.4×10^{-9}	6.3×10^{-10}	0.090
Chautauqua Road Bridge	4	11	1.8×10^{-9}	3.15×10^{-10}	0.045
Chautauqua Dam	5	11	4.5×10^{-8}	4.95×10^{-9}	0.707
Franklin, Ohio	6	11	3.6×10^{-9}	6.30×10^{-10}	0.090
Trenton, Ohio	—	1	0.0	0.0	0.0
New Miami, Ohio	—	1	0.0	0.0	0.0
7 miles north of New Baltimore, Ohio	—	1	0.0	0.0	0.0
New Baltimore, Ohio	—	1	—	3.6×10^{-9}	0.514
Miamitown, Ohio	—	1	0.0	0.0	0.0
Elizabethtown, Ohio	—	1	0.0	0.0	0.0
Over-all		59	7.0×10^{-8}	3.6×10^{-9}	0.514

* All concentrations are in microcuries per cubic centimeter

**MPC - Maximum Permissible Continuous Concentration

II. Tritium (River Samples, Except Drainage Ditch)

Sample Locations		Map 1 Code Number	Number of Samples	Maximum Concentration *	Average Concentration *	Per Cent of MPC for Average **
Mound Lab	Drainage Ditch	1	11	0.5×10^{-3}	0.5×10^{-4}	1.0
Mound Lab	Effluent	2	9	0.6×10^{-4}	0.3×10^{-4}	0.6
Chautauqua	Road Bridge	4	11	0.7×10^{-4}	0.4×10^{-4}	0.8
	Over-all		31	0.5×10^{-3}	0.4×10^{-4}	0.8

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

IV. AIR SAMPLING

Monitoring of the environmental air for tritium concentration by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. A total of 173 evaluations were made by 86 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for tritium air sampling. During this quarter, a total of 137 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

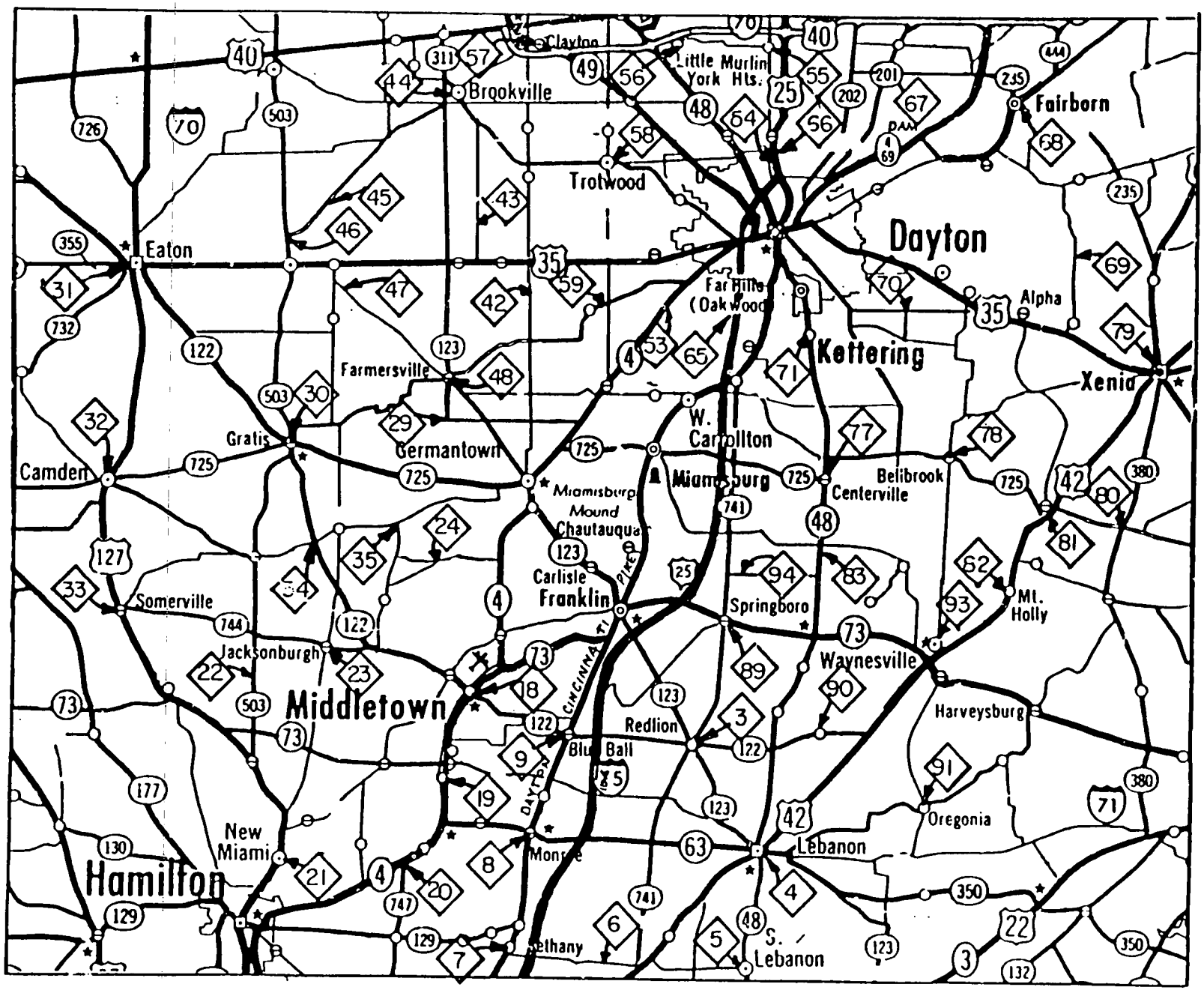
The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table II) to the Maximum Permissible Continuous Concentration for polonium in the environment, and assume that all

alpha detected is polonium, we find that the average polonium concentration is only 0.007 per cent of the permissible. Our effluent stack monitoring program for this quarter had indicated that we should expect essentially no detectable polonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table II again) to the Maximum Permissible Continuous Concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration is well within the permissible; however it is significant 2.3 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and frequently exceeds the very low permissible concentration for plutonium.

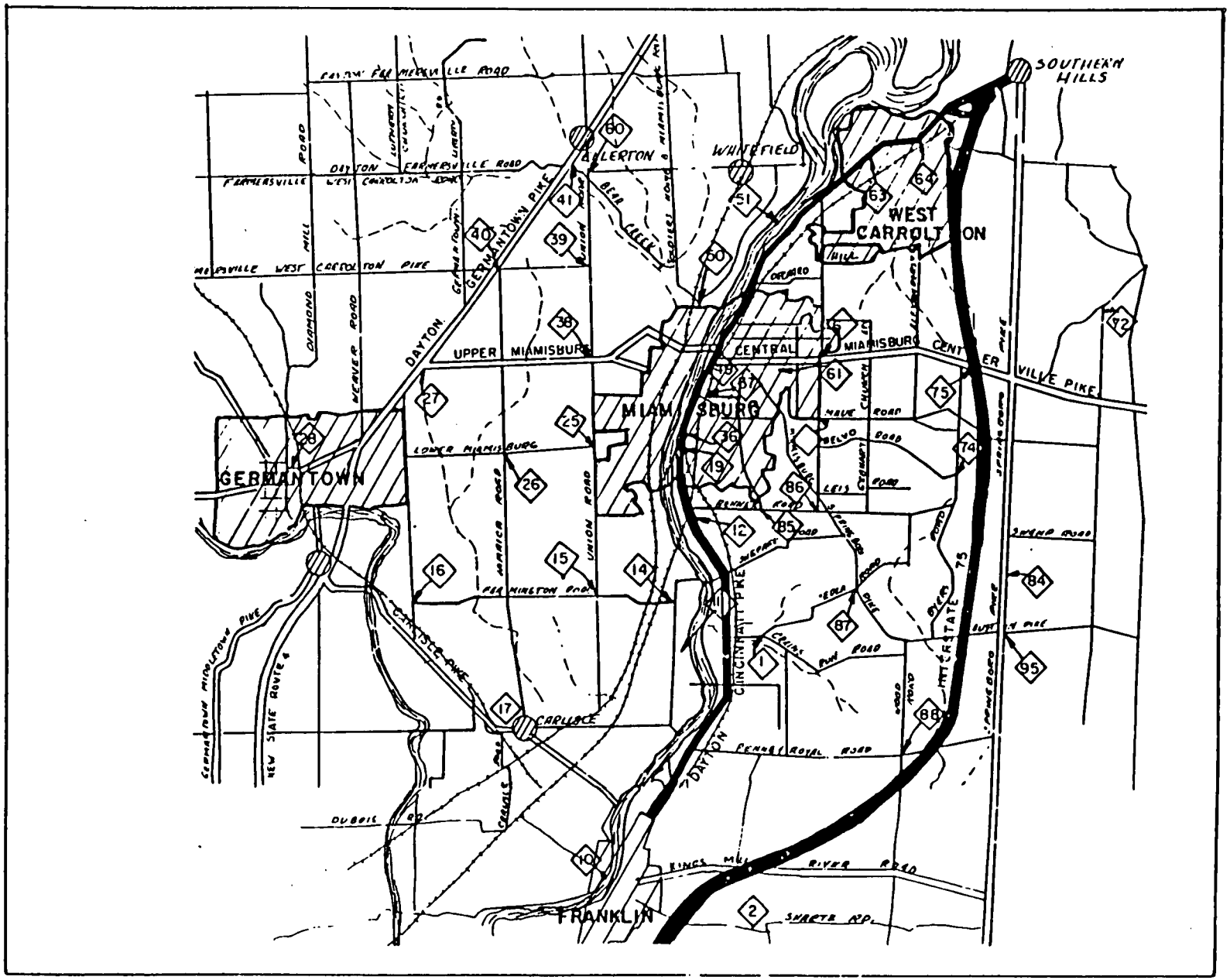
The impact of plutonium work at Mound Laboratory is also placed in proper focus by referring to our stack monitoring data. During the second quarter of 1962, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium and/or polonium operations have contributed an insignificant burden to the radioactivity normally present in the atmosphere.

In Table III "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, April Through June, 1962," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends upon the wind direction on the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the diffrent wind directions. Since the sampling location is dependent on wind direction, it is unlikely that all sites will be sampled during any one quarter.



MAP 2
DISTAN
AIR SAMPL
LOCATION
AND ROAD M

LOCATION



MAP 3
PROXIMITY
AIR SAMPLE
LOCATION
AND ROAD MAP

LOCATIONS O→

TABLE II

COMPOSITE - AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

APRIL THROUGH JUNE, 1962

	Sampling Locations	Samples Collected	Maximum Concentration *	Average Concentration *	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
A. Downwind Sampling						
	72	137	4.95×10^{-14}	0.14×10^{-14}	0.007	2.3
B. Upwind Sampling						
	9	17	0.36×10^{-14}	0.05×10^{-14}	0.0025	0.8
C. Difference						
			4.59×10^{-14}	0.09	0.0045	1.5

* All Concentrations in Tables II and III are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

TABLE III

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FOR LONG-LIVED ALPHA EMITTERS

APRIL THROUGH JUNE, 1962

Sample Location	Number of Samples	Maximum Concentration *	Average Concentration *	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.		No samples were collected at locations 1 through 12 during this quarter due to the lack of wind direction toward that area at the prescribed sampling times.			
2. Junction of Route 73 & Interstate 75					
3. Red Lion, Ohio					
4. Lebanon, Ohio					
5. South Lebanon, Ohio					
6. Junction of Bethany Rd. & Mason-Montgomery Rd.					
7. Bethany, Ohio					
8. Monroe, Ohio					
9. Blue Ball, Ohio					
10. Junction of Route 123 & Dayton-Oxford Rd.					
11. Chautauqua, Ohio					
12. Junction of Benner Rd. & Route 25					
13. Miami Drive In Theatre in Miamisburg (on Route 25)	1	----	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration *	Average Concentration *	Per Cent of Polonium MPC for Average **	Per Cent of Plutonium MPC for Average **
14. Junction of Farmington Rd. & Chautauqua Rd.	1	—	0.13×10^{-14}	0.006	2.1
15. Junction of Farmington Rd. & Union Rd.	0	—	—	—	—
16. Junction of Farmington & Butter St.	0	—	—	—	—
17. Carlisle, Ohio	1	—	0.13×10^{-14}	0.006	2.1
18. Middletown, Ohio	0	—	—	—	—
19. Junction of Route 4 & Route 73	1	—	0.13×10^{-14}	0.006	2.1
20. Junction of Route 4 & Route 747	1	—	0.13×10^{-14}	0.006	2.1
21. New Miami, Ohio	0	—	—	—	—
22. Junction of West Elkton Rd. & Tolbert Rd.	0	—	—	—	—
23. Jacksonburg, Ohio	0	—	—	—	—
24. Junction of Hetzler Rd. & Hinkle Rd.	0	—	—	—	—
25. Junction of Lower Miamisburg Rd. & Union Rd.	1	—	0.13×10^{-14}	0.006	2.1
26. Junction of Lower Miamisburg Rd. & Jamica Rd.	1	—	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration *	Average Concentration *	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
27. Junction of Route 725 & Route 4	1	—	0.0	0.0	0.0
28. Germantown, Ohio	1	—	0.0	0.0	0.0
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.	1	—	0.0	0.0	0.0
30. Gratis, Ohio	1	—	0.0	0.0	0.0
31. Eaton, Ohio	1	—	0.0	0.0	0.0
32. Camden, Ohio	1	—	0.36×10^{-14}	0.018	6.0
33. Somerville, Ohio	1	—	0.0	0.0	0.0
34. Junction of Greenbush Rd. & Route 122	1	—	0.0	0.0	0.0
35. Junction of Oxford Rd. & Browns Run Rd.	1	—	0.0	0.0	0.0
36. Miamisburg South City Limit on Route 25	1	—	2.07×10^{-14}	0.103	33.3
37. Junction of Mound Ave. & Route 25	1	—	0.0	0.0	0.0
38. Junction of Union Rd. & Route 725	1	—	0.0	0.0	0.0
39. Junction of Union Rd. & Manning Rd.	0	—	—	—	—
40. Junction of Manning Rd. & Route 4	0	—	—	—	—

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average **
41. Junction of Route 4 & Farmersville-West Carrollton Rd.	0	—	—	—	—
42. Junction of Diamond Mill Rd. & Mile Rd.	1	—	0.0	0.0	0.0
43. Junction of Clayton Rd. & Amity Rd.	1	—	1.35×10^{-14}	0.067	22.5
44. Brookville, Ohio	0	—	—	—	—
45. Junction of Lexington Salem Rd. & Prebel County Line Rd.	0	—	—	—	—
46. Junction of Lexington Salem Rd. & Engle Rd.	1	—	4.95×10^{-14}	0.25	82.5
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.	0	—	—	—	—
48. Farmersville, Ohio	1	—	0.0	0.0	0.0
49. Fifth St. & Central Ave. in Miamisburg, Ohio	3	—	0.0	0.0	0.0
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	3	0.45×10^{-14}	0.15×10^{-14}	0.007	2.5
51. One mile north on Upper River Rd. from Sample number 50	2	—	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	2	—	0.0	0.0	0.0
53. Dayton Speedway	3	—	0.0	0.0	0.0
54. Dayton, Ohio	2	0.99×10^{-14}	0.49×10^{-14}	0.024	8.1
55. Murlin Heights	3	—	0.0	0.0	0.0
56. Little York	3	—	0.0	0.0	0.0
57. Clayton, Ohio	2	—	0.0	0.0	0.0
58. Trotwood, Ohio	2	—	0.0	0.0	0.0
59. Union Rd. & Liberty-Dayton Rd.	2	—	0.0	0.0	0.0
60. Union Rd. & Bear Creek Rd.	3	—	0.0	0.0	0.0
61. Harmon Field in Miamisburg	5	0.31×10^{-14}	0.09×10^{-14}	0.004	1.5
62. Junction of Route 725 & Heincke Rd.	5	—	0.0	0.0	0.0
63. Junction of Elm St. & Route 25 in West Carrollton	5	0.27×10^{-14}	0.04×10^{-14}	0.002	0.66
64. Woody's Market in West Carrollton	5	0.58×10^{-14}	0.13	0.006	2.1

Sample Location	Number of Samples	Maximum Concentration *	Average Concentration *	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
65. Junction of South Broadway & Dryden Rd.	5	—	0.0	0.0	0.0
66. Junction of Route 75 & Wagner Ford Rd.	5	0.63×10^{-14}	0.09×10^{-14}	0.004	1.5
67. Junction of Route 201 & Chambersburg Rd.	5	—	0.0	0.0	0.0
68. Fairborn, Ohio	5	—	0.0	0.0	0.0
69. Junction of Fair-ground Rd. & New Germany-Trebein Rd.	5	—	0.0	0.0	0.0
70. Belmont Auto Theatre	5	1.26×10^{-14}	0.29×10^{-14}	0.014	4.8
71. Town & Country Shopping Center in Kettering, Ohio	5	1.48×10^{-14}	0.36×10^{-14}	0.018	6.0
72. Junction of Yankee St. & Mad River Rd.	5	—	0.0	0.0	0.0
73. Junction of Maue Rd. & Linden Ave.	1	—	0.27×10^{-14}	0.013	4.5
74. Junction of Byers Rd. & Belvo Rd.	1	—	0.0	0.0	0.0
75. Junction of Route 725 & Route 75	1	—	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration *	Average Concentration *	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
76. Junction of Yankee St.& Route 725	1	___	0.54×10^{-14}	0.027	9.0
77. Centerville, Ohio	1	___	0.0	0.0	0.0
78. Bellbrook, Ohio	1	___	0.90×10^{-14}	0.045	15.0
79. Xenia, Ohio	1	___	0.0	0.0	0.0
80. Junction of Spring Valley-Paintersville Rd. & Route 380	1	___	0.0	0.0	0.0
81. Spring Valley, Ohio	1	___	0.0	0.0	0.0
82. Mt. Holly, Ohio	1	___	0.09×10^{-14}	0.045	1.5
83. Junction of Route 48 & Social Row Rd.	1	___	0.0	0.0	0.0
84. Waldruhe Park	1	___	0.0	0.0	0.0
85. Junction of Mound Rd. & Benner Rd.	1	___	0.0	0.0	0.0
86. Junction of Benner Rd. & Miamisburg-Springboro Pike	1	___	0.0	0.0	0.0
87. Junction of Medlar Rd. & Miamisburg-Springboro Pike	1	___	0.0	0.0	0.0
88. Junction of Wood Rd. & Pennyroyal Rd.	1	___	0.0	0.0	0.0
89. Springboro, Ohio	1	___	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration *	Average Concentration *	Per Cent of Polonium MPC for Average **	Per Cent of Plutonium MPC for Average **
90. Junction of Route 122 & Utica Rd.	1	___	0.0	0.0	0.0
91. Orgonia	1	___	0.0	0.0	0.0
92. Harveysburg, Ohio	1	___	0.0	0.0	0.0
93. Waynesville, Ohio	1	___	0.0	0.0	0.0
94. By TV Tower on Lytle-Five Points Rd.	1	___	0.0	0.0	0.0
95. South Montgomery County Airport	1	___	0.13×10^{-14}	0.006	2.1

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

MLM-MU-62-70-0007

Environmental Monitoring Report - Third Quarter, 1962

Prepared by P. C. Adams
Approved by H. E. Meyer

Date: October 5, 1962
Issued: October 15, 1962

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

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S U M M A R Y

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the third quarter of 1962 is presented. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the quarter.

INTRODUCTION

This report presents in summary form the findings of the Environmental Monitoring Program conducted by the Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program is planned and coordinated with regards to all of the various projects performed therein. The monitoring procedures used are those best suited for the detection and measurement of the radioactive materials which Mound Laboratory could contribute to the environment.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentration for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

ENVIRONMENTAL MONITORING

During the period covered by this report, radioactive materials from Mound Laboratory have not contributed any measurable penetrating radiation, such as gamma or hard beta, to the environment. Of the radioisotopes in use at Mound Laboratory, only polonium, plutonium and tritium are possible air contaminants. Only polonium and tritium are possible water contaminants. Water sampling and air sampling are discussed below in detail:

WATER SAMPLING

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume and is handled separately as a package waste rather than being discharged to the river. Helium-3 being purified at Mound Laboratory contains small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carried off all storm sewer water and eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and certain river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I, "Summary of Off-Site Water Monitoring For Radioactivity, July Through September, 1962"

The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is within the maximum permissible continuous concentration.

In addition to the river sample locations indicated on Map I, samples are collected on a quarterly basis farther downstream at Trenton, New Miami, New Baltimore, Miamitown and Elizabethtown, Ohio.

AIR SAMPLING

Monitoring of the environmental air for tritium concentration by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. A total of 156 evaluations were made at 84 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for tritium air sampling. During this quarter, a total of 131 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

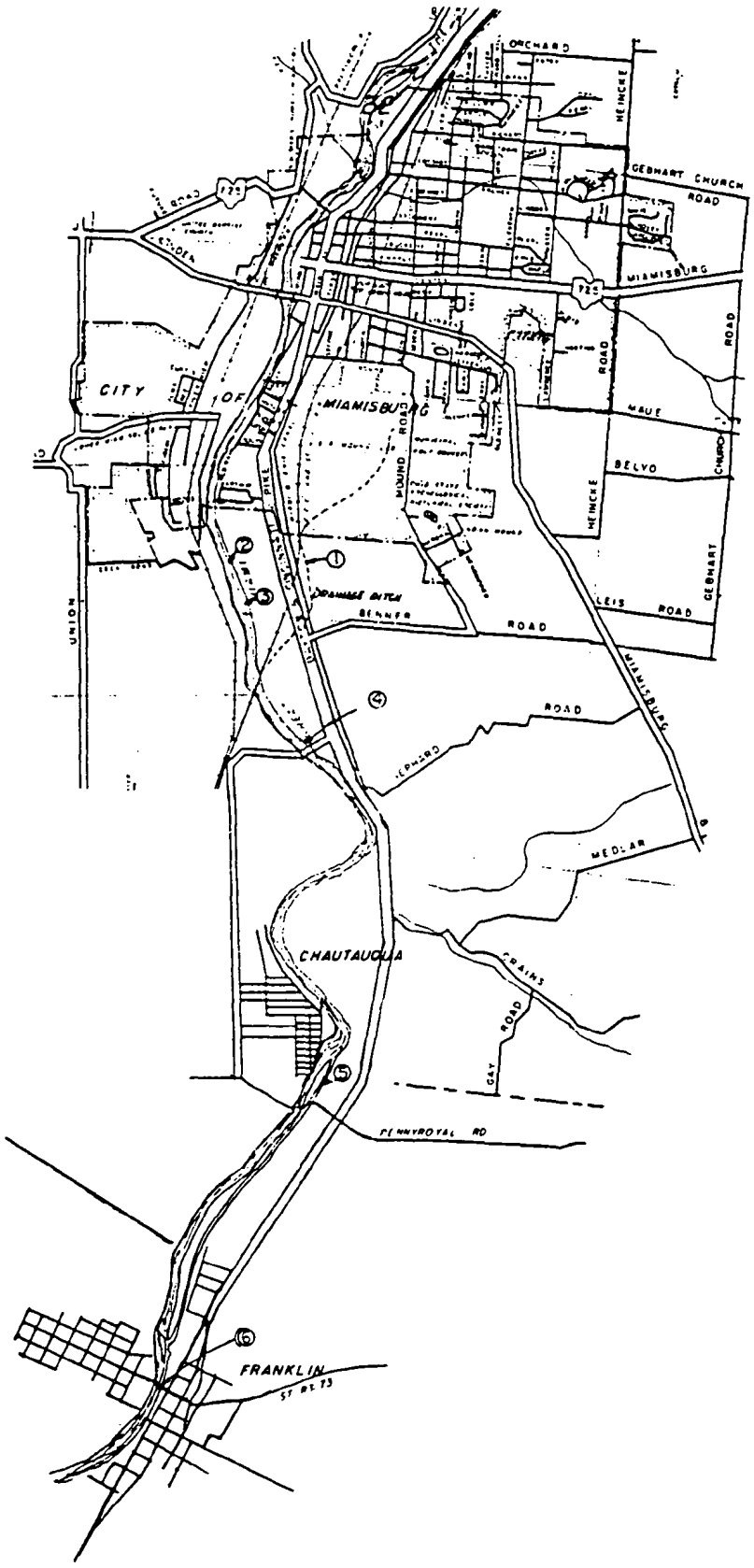
The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table II) to the Maximum Permissible Continuous Concentration for polonium in the environment, and assume that all alpha detected is polonium, we find that the average polonium concentration is only 0.014 per cent of the permissible. Our effluent stack monitoring program for this quarter had indicated that we should expect essentially no detectable polonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table II again) to the Maximum Permissible Continuous Concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration is well within the permissible; however, it is significant 4.8 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and occasionally exceeds the very low permissible concentration for plutonium. (see Table II, Section B)

The impact of plutonium work at Mound Laboratory is also placed in proper focus by referring to our stack monitoring data. During the third quarter of 1962, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yeild a high dilution factor, we can say that the plutonium and/or polonium operations have contributed an insignificant burden to radioactivity normally present in the atmosphere.

In Table III, "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, July Through September 1962," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends upon the wind direction on the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the different wind directions. Since the sampling location is dependent on wind direction, it is unlikely that all sites will be sampled during any one quarter.

APPENDIX



MAP 1
GREAT MIAMI RIVER SAMPLE LOCATIONS

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

JULY THROUGH SEPTEMBER, 1962

I. Polonium (River Samples)

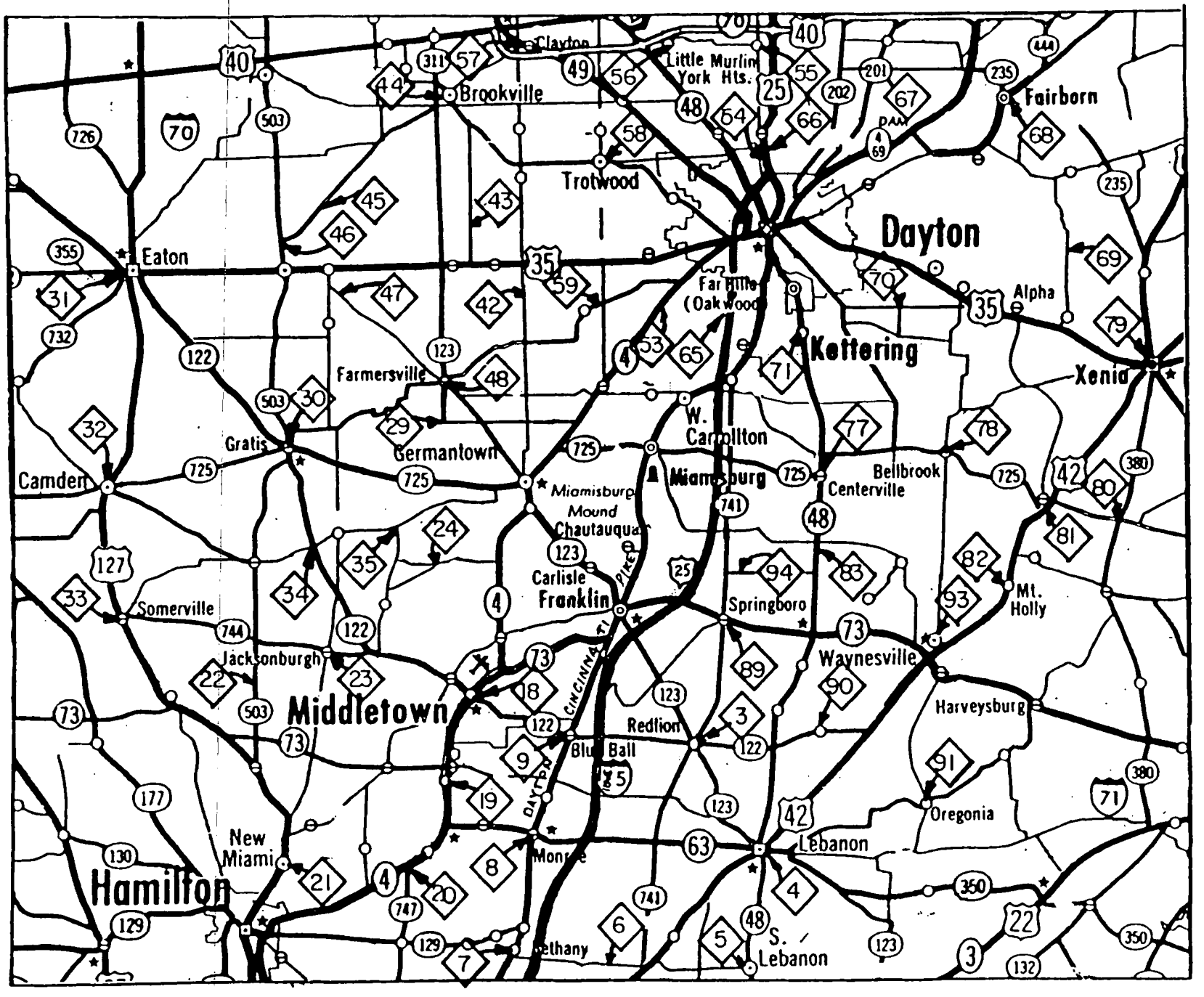
Sample Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	2	9	3.6×10^{-9}	7.05×10^{-10}	0.100
250 Yards Downstream	3	9	7.2×10^{-9}	1.98×10^{-9}	0.282
Chautauqua Road Bridge	4	9	7.2×10^{-9}	1.62×10^{-9}	0.231
Chautauqua Dam	5	9	5.4×10^{-9}	9.90×10^{-10}	0.141
Franklin, Ohio	6	9	7.2×10^{-9}	1.80×10^{-9}	0.257
Trenton, Ohio	___	1	0.0	0.0	0.0
New Miami, Ohio	___	1	0.0	0.0	0.0
7 miles north of New Baltimore, Ohio	___	1	0.0	0.0	0.0
New Baltimore, Ohio	___	1	0.0	0.0	0.0
Miamitown, Ohio	___	1	0.0	0.0	0.0
Elizabethtown, Ohio	___	1	0.0	0.0	0.0
Over-all		51	7.2×10^{-9}	1.25×10^{-9}	0.178

II. Tritium (River Samples, Except Drainage Ditch)

Sample Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Drainage Ditch	1	9	0.0	0.0	0.0
Mound Lab Effluent	2	9	1.5×10^{-3}	2.7×10^{-4}	5.4
Chautauqua Road Bridge	4	9	1.7×10^{-3}	1.8×10^{-4}	3.6
Over-all		27	1.7×10^{-3}	1.5×10^{-4}	3.0

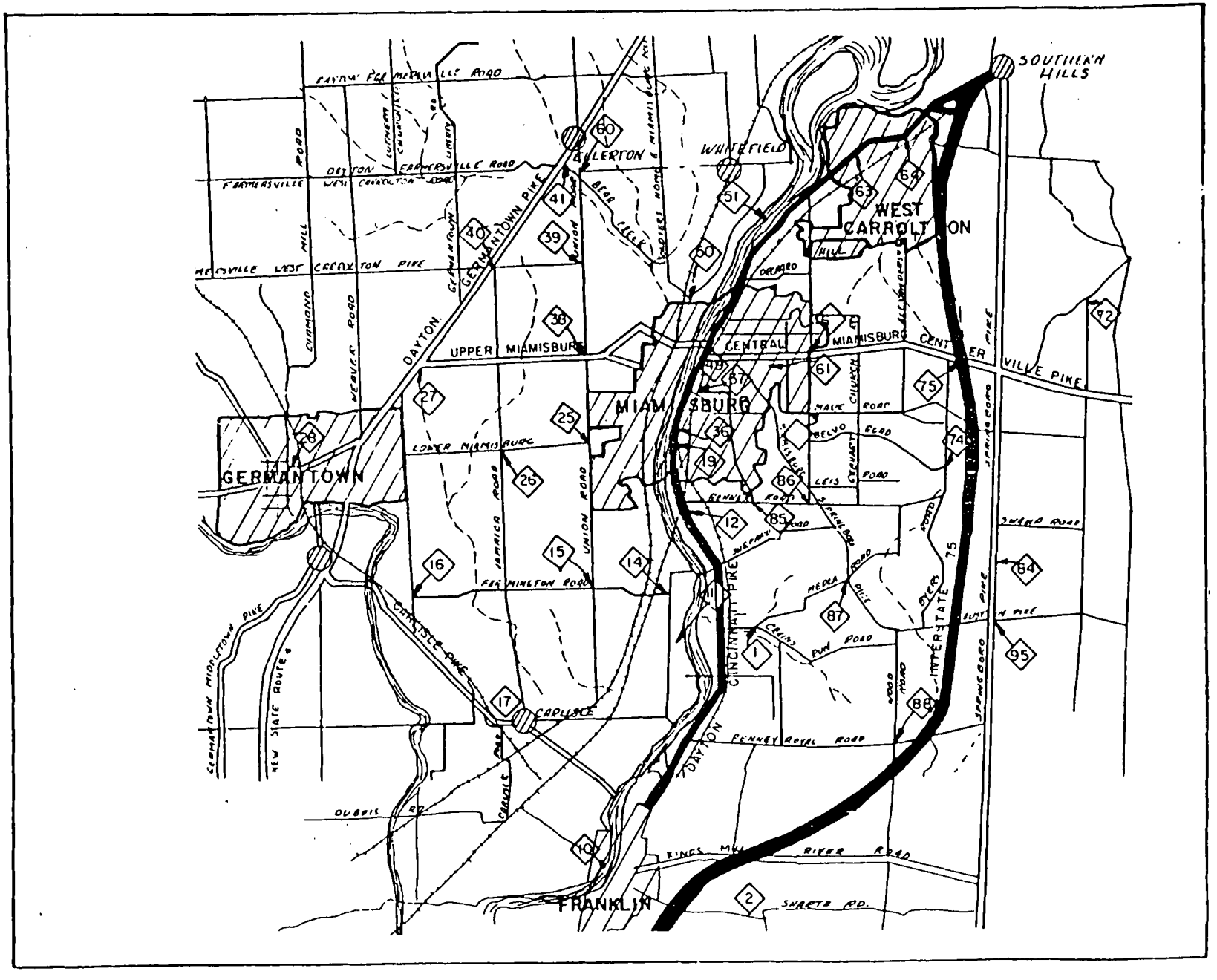
* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration



MAP 2
DISTANT
AIR SAMPLE
LOCATION
AND ROAD MAP

LOCATION ◇→



MAP 3
PROXIMITY
AIR SAMPLE
LOCATION
AND ROAD MAP

LOCATIONS ◇→

TABLE II

COMPOSITE - AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

JULY THROUGH SEPTEMBER, 1962

	Sampling Locations	Samples Collected	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
A. Downwind Sampling						
	40	131	5.13×10^{-14}	0.29×10^{-14}	0.014	4.8
B. Upwind Sampling						
	9	18	1.58×10^{-14}	0.14×10^{-14}	0.007	2.3
C. Difference						
			3.55×10^{-14}	0.15×10^{-14}	0.007	2.5

* All Concentrations in Tables II and III are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

TABLE III

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FROM LONG-LIVED ALPHA EMITTERS

JULY THROUGH SEPTEMBER, 1962

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.		No samples were collected at locations 1 through 12 during this quarter due to the lack of wind direction toward that area at the prescribed sampling times.			
2. Junction of Route 73 & Interstate 75					
3. Red Lion, Ohio					
4. Lebanon, Ohio					
5. South Lebanon, Ohio					
6. Junction of Bethany Rd. & Mason-Montgomery Rd.					
7. Bethany, Ohio					
8. Monroe, Ohio					
9. Blue Ball, Ohio					
10. Junction of Route 123 & Dayton-Oxford Rd.					
11. Chautauqua, Ohio					
12. Junction of Benner Rd. & Route 25					

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
13. Miami Drive In Theatre in Miamisburg (on Route 25)	1	___	0.0	0.0	0.0
14. Junction of Farmington Rd. & Chautauqua Rd.	1	___	1.35×10^{-14}	0.067	22.5
15. Junction of Farmington & Union Rd.	1	___	0.36×10^{-14}	0.018	6.0
16. Junction of Farmington & Butter St.	1	___	0.36×10^{-14}	0.018	6.0
17. Carlisle, Ohio	1	___	0.0	0.0	0.0
18. Middletown, Ohio	1	___	0.58×10^{-14}	0.029	9.6
19. Junction of Route 4 & Route 73	1	___	0.0	0.0	0.0
20. Junction of Route 4 & Route 747	1	___	1.44×10^{-14}	0.072	24.0
21. New Miami, Ohio	1	___	0.0	0.0	0.0
22. Junction of West Elkton Rd. & Tolbert Rd.	1	___	0.0	0.0	0.0
23. Jacksonburg, Ohio	1	___	0.0	0.0	0.0
24. Junction of Hetzler Rd. & Hinkle Rd.	1	___	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
25. Junction of Lower Miamisburg Rd. & Union Rd.		No samples were collected at locations 25 through 60 during this quarter due to the lack of wind direction toward that area at the prescribed sampling times.			
26. Junction of Lower Miamisburg Rd. & Jamica Rd.					
27. Junction of Route 725 & Route 4					
28. Germantown, Ohio					
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.					
30. Gratis, Ohio					
31. Eaton, Ohio					
32. Camden, Ohio					
33. Somerville, Ohio					
34. Junction of Greenbush Rd. & Route 122					
35. Junction of Oxford Rd. & Browns Run Rd.					
36. Miamisburg South City Limit on Route 25					

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average***
37. Junction of Mound Ave. & Route 25					
38. Junction of Union Rd. & Route 725					
39. Junction of Union Rd. & Manning Rd.					
40. Junction of Manning Rd. & Route 4					
41. Junction of Route 4 & Farmersville-West Carrollton Rd.					
42. Junction of Diamond Mill Rd. & Mile Rd.					
43. Junction of Clayton Rd. & Amity Rd.					
45. Junction of Lexington Salem Rd. & Prebel County Line Rd.					
46. Junction of Lexington Salem Rd. & Engle Rd.					
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.					
48. Farmersville, Ohio					

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
49. Fifth St. & Central Ave. in Miamisburg, Ohio					
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.					
51. One mile north on Upper River Rd. from Sample # 50					
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.					
53. Dayton Speedway					
54. Dayton, Ohio					
55. Murlin Heights					
56. Little York					
57. Clayton, Ohio					
58. Trotwood, Ohio					
59. Union Rd. & Liberty-Dayton Rd.					
60. Union Rd. & Bear Creek Rd.					

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
61. Harmon Field in Miamisburg	5	0.67×10^{-14}	0.13×10^{-14}	0.006	2.1
62. Junction of Route 725 & Heincke Rd.	5	2.29×10^{-14}	0.59×10^{-14}	0.029	9.8
63. Junction of Elm St. & Route 25 in West Carrollton	5	1.31×10^{-14}	0.54×10^{-14}	0.027	9.0
64. Woody's Market in West Carrollton	5	0.77×10^{-14}	0.18×10^{-14}	0.009	3.0
65. Junction of South Broadway & Dryden Rd.	5	0.27×10^{-14}	0.05×10^{-14}	0.002	0.8
66. Junction of Route 75 & Wagoner Ford Rd.	5	0.09×10^{-14}	0.02×10^{-14}	0.001	0.3
67. Junction of Route 201 & Chambersburg Rd.	5	0.23×10^{-14}	0.05×10^{-14}	0.002	0.8
68. Fairborn, Ohio	5	—	0.0	0.0	0.0
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	5	0.45×10^{-14}	0.14×10^{-14}	0.007	2.3
70. Belmont Auto Theatre	5	0.36×10^{-14}	0.09×10^{-14}	0.004	1.5
71. Town & Country Shopping Center in Kettering, Ohio	5	0.36×10^{-14}	0.09×10^{-14}	0.004	1.5

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
72. Junction of Yankee St. & Mad River Rd.	5	0.45×10^{-14}	0.18×10^{-14}	0.009	3.0
73. Junction of Maue Rd. & Linden Ave.	1	—	0.0	0.0	0.0
74. Junction of Byers Rd. & Belvo Rd.	1	—	0.0	0.0	0.0
75. Junction of Route 725 & Route 75	0	—	—	—	—
76. Junction of Yankee St. & Route 725	0	—	—	—	—
77. Centerville, Ohio	0	—	—	—	—
78. Bellbrook, Ohio	1	—	0.0	0.0	0.0
79. Xenia, Ohio	1	—	0.0	0.0	0.0
80. Junction of Spring Valley-Paintersville Rd. & Route 380	0	—	—	—	—
81. Spring Valley, Ohio	0	—	—	—	—
82. Mt. Holly, Ohio	0	—	—	—	—
83. Junction of Route 48 & Social Row Rd.	0	—	—	—	—
84. Waldruhe Park	1	—	0.0	0.0	0.0
85. Junction of Mound Rd. & Benner Rd.	5	5.13×10^{-14}	1.04×10^{-14}	0.052	17.3

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
86. Junction of Benner Rd. & Miamisburg-Springboro Pike	5	0.81×10^{-14}	0.36×10^{-14}	0.018	6.0
87. Junction of Medlar Rd. & Miamisburg-Springboro Pike	5	1.94×10^{-14}	0.63×10^{-14}	0.031	10.6
88. Junction of Wood Rd. & Pennyroyal Rd.	5	3.15×10^{-14}	0.81×10^{-14}	0.040	13.5
89. Springboro, Ohio	5	1.22×10^{-14}	0.59×10^{-14}	0.030	13.5
90. Junction of Route 122 & Utica Rd.	5	0.77×10^{-14}	0.14×10^{-14}	0.007	2.3
91. Orgonia	5	0.54×10^{-14}	0.14×10^{-14}	0.007	2.3
92. Harveysburg, Ohio	5	2.70×10^{-14}	0.59×10^{-14}	0.029	9.8
93. Waynesville, Ohio	5	0.32×10^{-14}	0.09×10^{-14}	0.004	1.5
94. By TV Tower on Lytle-Five Points Rd.	4	1.13×10^{-14}	0.36×10^{-14}	0.018	6.0
95. South Montgomery County Airport	5	0.09×10^{-14}	0.02×10^{-14}	0.001	0.3

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

MLM-1111-63-61-0006

Environmental Monitoring Report - Fourth Quarter and Year 1962

Prepared by P. C. Adams
Approved by H. E. Meyer

Date: January 11, 1963
Issued: January 21, 1963

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

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U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

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S U M M A R Y

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the fourth quarter and the entire year of 1962 is presented. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the quarter and the entire year of 1962.

INTRODUCTION

This report presents in summary form the findings of the Environmental Monitoring Program conducted by the Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program is planned and coordinated with regards to all of the various projects performed therein. The monitoring procedures used are those best suited for the detection and measurement of radioactive materials which Mound Laboratory could contribute to the environment.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

ENVIRONMENTAL MONITORING

During the period covered by this report, radioactive materials from Mound Laboratory have not contributed any measurable penetrating radiation, such as gamma or hard beta, to the environment. Of the radioisotopes in use at Mound Laboratory, only polonium, plutonium and tritium are possible air contaminants. Only polonium and tritium are possible water contaminants. Water sampling and air sampling are discussed below in detail:

WATER SAMPLING

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume and is handled separately as a packaged waste rather than being discharged to the river. Helium-3 being purified at Mound Laboratory contains small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carried off all storm sewer water and eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and certain river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I, "Summary of Off-Site Water Monitoring for Radioactivity, October through December, 1962."

The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is within the maximum permissible continuous concentration.

In addition to the River sample locations indicated on Map I, samples are collected on a quarterly basis farther downstream at Trenton, New Miami, New Baltimore, Miamitown and Elizabethtown, Ohio.

AIR SAMPLING

Monitoring of the environmental air for tritium concentration, by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. During this quarter a total of 112 evaluations were made at 60 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for air sampling. During this quarter, a total of 115 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

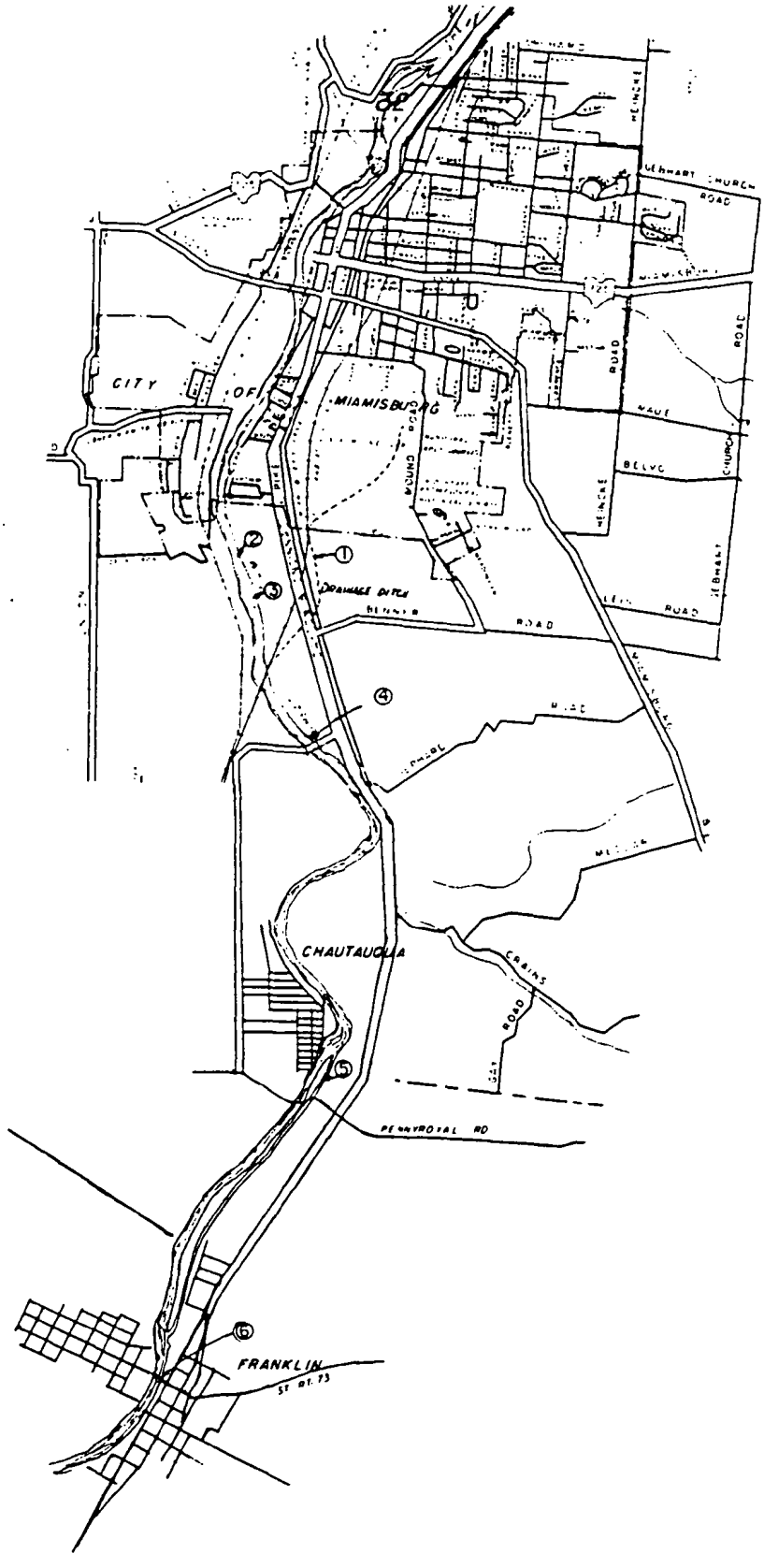
The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table II) to the Maximum Permissible Continuous Concentration for polonium in the environment, and assume that all alpha detected is polonium, we find that the average polonium concentration is only 0.009 per cent of the permissible. Our effluent stack monitoring program for this quarter had indicated that we should expect essentially no detectable polonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table II again) to the Maximum Permissible Continuous Concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration is well within the permissible; however, it is significant 3.1 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and occasionally exceeds the very low permissible concentration for plutonium. (see Table II Section B)

The impact of plutonium work at Mound Laboratory is also placed in proper focus by referring to our stack monitoring data. During the fourth quarter of 1962, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium and/or polonium operations have contributed an insignificant burden to radioactivity normally presented in the atmosphere.

In Table III, "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, October Through December 1962," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends upon the wind direction of the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the different wind directions. Since the sampling location is dependent on wind direction, it is unlikely that all sites will be sampled during any one quarter.

A P P E N D I X



MAP 1
GREAT MIAMI RIVER SAMPLE LOCATIONS

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

OCTOBER THROUGH DECEMBER, 1962

I. Polonium (River Samples)

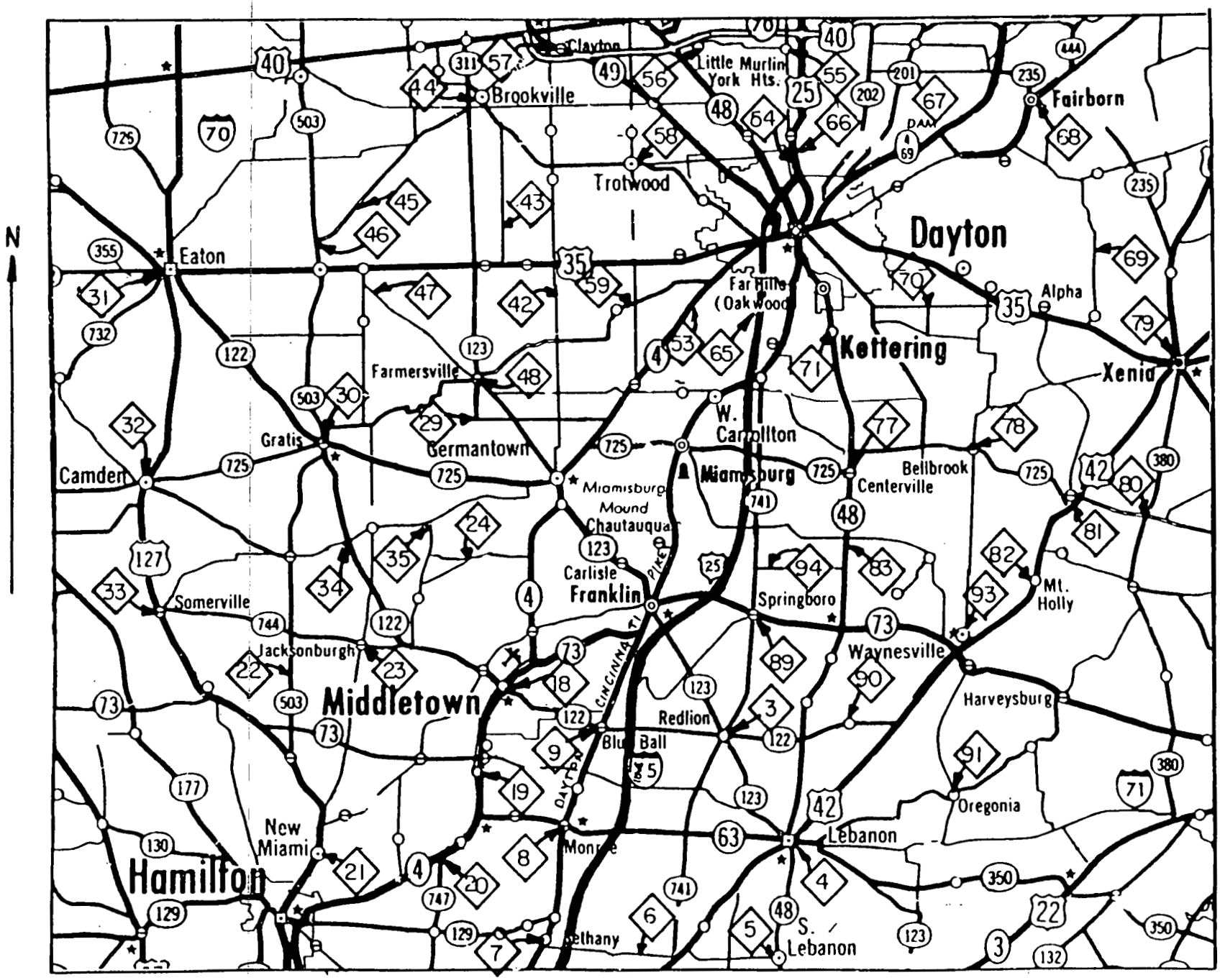
Sample Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	2	8	1.4×10^{-7}	3.13×10^{-8}	4.471
250 Yards Downstream	3	8	2.5×10^{-8}	0.65×10^{-8}	0.928
Chautauqua Road Bridge	4	8	1.1×10^{-8}	0.29×10^{-8}	0.414
Chautauqua Dam	5	8	0.0	0.0	0.0
Franklin, Ohio	6	8	0.5×10^{-8}	0.07×10^{-8}	0.100
Trenton, Ohio	___	1	0.0	0.0	0.0
New Miami, Ohio	___	1	0.0	0.0	0.0
7 miles north of New Baltimore, Ohio	___	1	___	1.26×10^{-8}	0.180
New Baltimore, Ohio	___	1	0.0	0.0	0.0
Miamitown, Ohio	___	1	0.0	0.0	0.0
Elizabethtown, Ohio	___	1	0.0	0.0	0.0
Over-all		46	1.4×10^{-7}	0.75×10^{-8}	1.053

II. Tritium (River Samples, Except Drainage Ditch)

Sample Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Drainage Ditch	1	8	6.2×10^{-4}	1.3×10^{-4}	2.6
Mound Lab Effluent	2	8	1.4×10^{-3}	2.5×10^{-4}	5.0
Chautauqua Road Bridge	4	8	1.2×10^{-3}	2.6×10^{-4}	5.2
Over-all		24	1.4×10^{-3}	2.1×10^{-4}	4.2

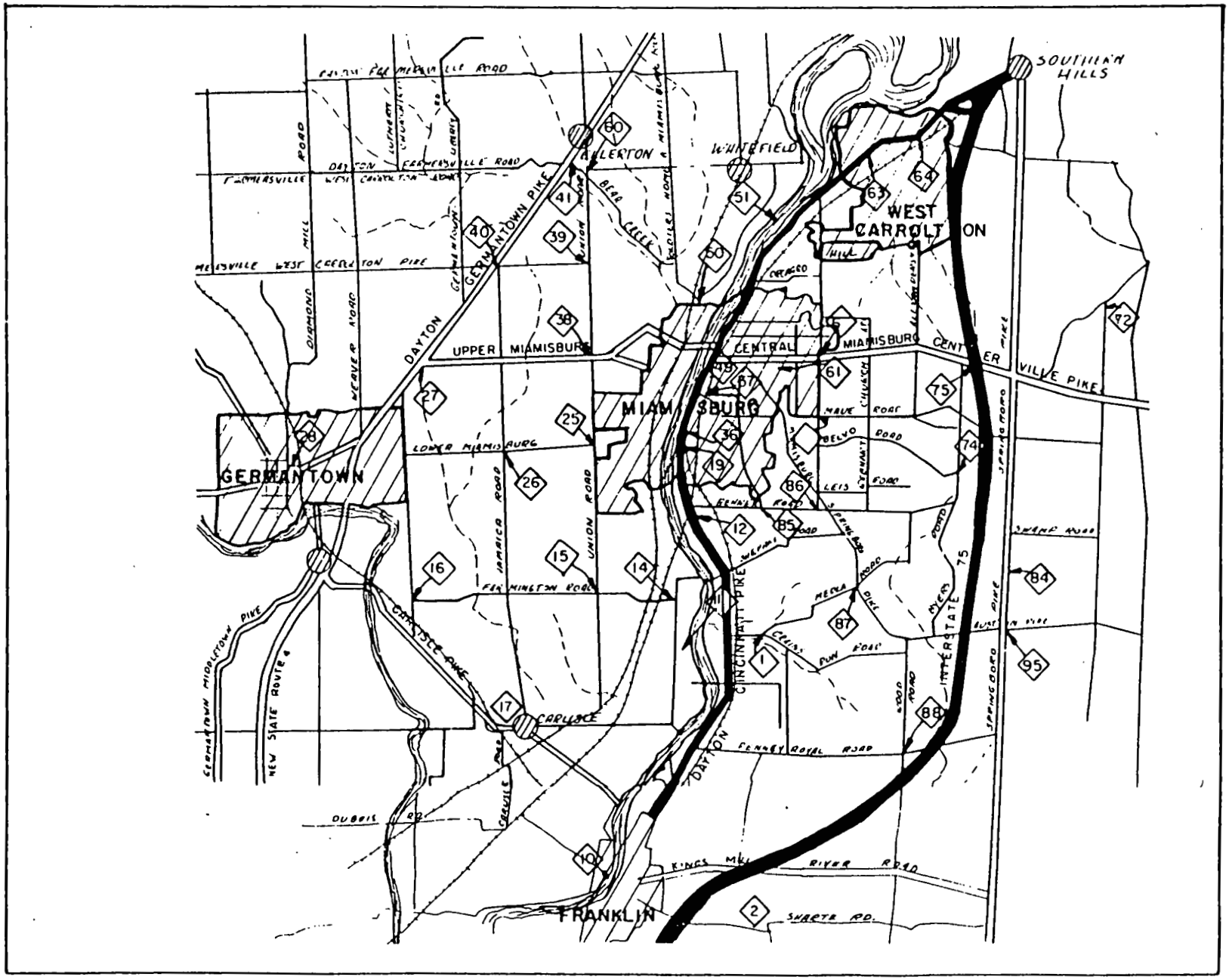
* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration



MAP 2
DISTANT
AIR SAMPLE
LOCATIONS
AND ROAD MAP

LOCATION ◇→



MAP 3
PROXIMITY
AIR SAMPLE
LOCATION
AND ROAD MAP

LOCATIONS ◇→

TABLE II

COMPOSITE - AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

OCTOBER THROUGH DECEMBER, 1962

	Sampling Locations	Samples Collected	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
A. Downwind Sampling	48	115	6.07×10^{-14}	0.19×10^{-14}	0.009	3.1
B. Upwind Sampling	8	18	0.94×10^{-14}	0.11×10^{-14}	0.005	1.8
C. Difference			5.13×10^{-14}	0.08×10^{-14}	0.004	1.3

* All concentrations in Tables II and III are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

TABLE III

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FROM LONG-LIVED ALPHA EMITTERS

OCTOBER THROUGH DECEMBER, 1962

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.	4	1.53×10^{-14}	0.54×10^{-14}	0.027	9.0
2. Junction of Route 73 & Interstate 75	4	0.31×10^{-14}	0.11×10^{-14}	0.005	1.8
3. Red Lion, Ohio	4	—	0.0	0.0	0.0
4. Lebanon, Ohio	4	0.54×10^{-14}	0.13×10^{-14}	0.006	2.1
5. South Lebanon, Ohio	4	—	0.0	0.0	0.0
6. Junction of Bethany Rd. & Mason-Montgomery Rd.	4	0.09×10^{-14}	0.04×10^{-14}	0.002	0.6
7. Bethany, Ohio	4	0.90×10^{-14}	0.27×10^{-14}	0.013	4.5
8. Monroe, Ohio	4	0.22×10^{-14}	0.05×10^{-14}	0.002	0.8
9. Blue Ball, Ohio	4	0.04×10^{-14}	0.01×10^{-14}	0.0005	0.1
10. Junction of Route 123 & Dayton-Oxford Rd.	4	—	0.0	0.0	0.0
11. Chautauqua, Ohio	4	—	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
12. Junction of Benner Rd. & Route 25	4	0.45×10^{-14}	0.20×10^{-14}	0.010	3.3
13. Miami Drive In Theatre in Miamisburg (on Route 25)	2	0.04×10^{-14}	0.02×10^{-14}	0.001	0.3
14. Junction of Farmington Rd. & Chautauqua Rd.	2	___	0.0	0.0	0.0
15. Junction of Farmington & Union Rd.	2	___	0.0	0.0	0.0
16. Junction of Farmington & Butter St.	2	0.25×10^{-14}	0.11×10^{-14}	0.005	1.8
17. Carlisle, Ohio	2	1.03×10^{-14}	0.54×10^{-14}	0.027	9.0
18. Middletown, Ohio	2	0.13×10^{-14}	0.06×10^{-14}	0.003	1.0
19. Junction of Route 4 & Route 73	2	0.36×10^{-14}	0.18×10^{-14}	0.009	3.0
20. Junction of Route 4 & Route 747	1	___	0.0	0.0	0.0
21. New Miami, Ohio	1	___	0.22×10^{-14}	0.011	3.6
22. Junction of West Elkton Rd. & Tolbert Rd.	1	___	0.0	0.0	0.0
23. Jacksonburg, Ohio	1	___	0.0	0.0	0.0

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
24. Junction of Hetzler Rd. & Hinkel Rd.	1	—	0.27×10^{-14}	0.013	4.5
25. Junction of Lower Miamisburg Rd. & Union Rd.					
26. Junction of Lower Miamisburg Rd. & Jamica Rd.					
27. Junction of Route 725 & Route 4					
28. Germantown, Ohio					
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.					
30. Gratis, Ohio					
31. Eaton, Ohio					
32. Camden, Ohio					
33. Somerville, Ohio					
34. Junction of Greenbush Rd. & Route 122					
35. Junction of Oxford Rd. & Browns Run Rd.					

No samples were collected at locations 25 through 48 during this quarter due to the lack of wind direction toward that area at the prescribed sampling times.

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
36. Miamisburg South City Limit on Route 25					
37. Junction of Mound Ave. & Route 25					
38. Junction of Union Rd. & Route 725					
39. Junction of Union Rd. & Manning Rd.					
40. Junction of Manning Rd. & Route 4					
41. Junction of Route 4 & Farmersville-West Carrollton Rd.					
42. Junction of Diamond Mill Rd. & Mile Rd.					
43. Junction of Clayton Rd. & Amity Rd.					
44. Brookville, Ohio					
45. Junction of Lexington Salem Rd. & Prebel County Line Rd.					
46. Junction of Lexington Salem Rd. & Engle Rd.					

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.					
48. Farmersville, Ohio					
49. Fifth St. & Central Ave. in Miamisburg, Ohio	1	___	4.14×10^{-14}	0.207	69.0
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	1	___	0.36×10^{-14}	0.018	6.0
51. One mile north on Upper River Rd. from Sample #50	1	___	0.0	0.0	0.0
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	1	___	0.0	0.0	0.0
53. Dayton Speedway	1	___	0.0	0.0	0.0
54. Dayton, Ohio	1	___	0.05×10^{-14}	0.025	0.8
55. Murlin Heights	1	___	0.0	0.0	0.0
56. Little York	1	___	0.0	0.0	0.0
57. Clayton, Ohio	1	___	1.31×10^{-14}	0.065	21.7
58. Trotwood, Ohio	1	___	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
59. Union Rd. & Liberty-Dayton Rd.	1	___	0.0	0.0	0 0
60. Union Rd. & Bear Creek Rd.	1	___	1.21×10^{-14}	0.060	20 1
61. Harmon Field in Miamisburg		No samples were collected at locations 61 through 72 during this quarter due to the lack of wind direction toward that area at the prescribed sampling times.			
62. Junction of Route 725 & Heincke Rd.					
63. Junction of Elm St. & Route 25 in West Carrollton					
64. Woody's Market in West Carrollton					
65. Junction of South Broadway & Dryden Rd.					
66. Junction of Route 75 & Wagoner Ford Rd.					
67. Junction of Route 201 & Chambersburg Rd.					
68. Fairborn, Ohio					
69. Junction of Fairground Rd. & New Germany-Trebein Rd.					
70. Belmont Auto Theatre					

Sample Locations	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
71. Town & Country Shopping Center in Kettering, Ohio					
72. Junction of Yankee St. & Mad River Rd.					
73. Junction of Maue Rd. & Linden Ave.	3	—	0.0	0.0	0.0
74. Junction of Byers Rd. & Belvo Rd.	3	0.40×10^{-14}	0.13×10^{-14}	0.006	2.2
75. Junction Route 725 & Route 75	3	0.27×10^{-14}	0.09×10^{-14}	0.004	1.5
76. Junction of Yankee St. & Route 725	3	0.18×10^{-14}	0.10×10^{-14}	0.005	1.7
77. Centerville, Ohio	3	6.07×10^{-14}	2.02×10^{-14}	0.101	33.6
78. Bellbrook, Ohio	3	—	0.0	0.0	0.0
79. Xenia, Ohio	3	—	0.0	0.0	0.0
80. Junction of Spring Valley-Paintersville Rd. & Route 380	3	0.22×10^{-14}	0.07×10^{-14}	0.003	1.1
81. Spring Valley, Ohio	3	0.18×10^{-14}	0.06×10^{-14}	0.003	1.0
82. Mt. Holly, Ohio	3	—	0.0	0.0	0.0
83. Junction of Route 48 & Social Row Rd.	3	0.54×10^{-14}	0.18×10^{-14}	0.009	3.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
84. Waldruhe Park	3	0.49×10^{-14}	0.15×10^{-14}	0.007	2.5
85. Junction of Mound Rd. & Benner Rd.		No samples were collected at locations 85 through 95 during this quarter due to the lack of wind direction toward that area at the prescribed sampling times.			
86. Junction of Benner Rd. & Miamisburg-Springboro Pike					
87. Junction of Medlar Rd. & Miamisburg-Springboro Pike					
88. Junction of Wood Rd. & Pennyroyal Rd.					
89. Springboro, Ohio					
90. Junction of Route 122 & Utica Rd.					
91. Orgonia					
92. Harveysburg, Ohio					
93. Waynesville, Ohio					
94. By TV Tower on Lytle-Five Points Rd.					
95. South Montgomery County Airport					

* All concentrations are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration

V. Annual Monitoring Data

Table IV contains a summary of data obtained for polonium and tritium off-site water monitoring and Table V contains a summary of data obtained from the environmental air monitoring program for long-lived alpha emitters, both for the year 1962.

TABLE IV

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

1962

I. Polonium

Period	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
First Quarter	43	3.6×10^{-9}	3.33×10^{-10}	0.056
Second Quarter	59	7.0×10^{-8}	3.60×10^{-9}	0.514
Third Quarter	51	7.2×10^{-9}	1.25×10^{-9}	0.178
Fourth Quarter	46	1.4×10^{-7}	0.75×10^{-8}	1.053
Total for Year	199	1.4×10^{-7}	2.23×10^{-9}	0.454

II. Tritium

Period	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
First Quarter	26	1.0×10^{-3}	0.4×10^{-4}	0.8
Second Quarter	31	0.5×10^{-3}	0.4×10^{-4}	0.8

Period	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Third Quarter	27	1.7×10^{-3}	1.5×10^{-4}	3.0
Fourth Quarter	24	1.4×10^{-3}	2.1×10^{-4}	4.2
Total for Year	108	1.7×10^{-3}	1.0×10^{-4}	2.1

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

TABLE V

YEARLY SUMMARY OF ENVIRONMENTAL MONITORING FOR LONG-LIVED

ALPHA EMITTERS

1962

Period	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
First Quarter	178	4.50×10^{-14}	0.29×10^{-14}	0.014	4.8
Second Quarter	137	4.29×10^{-14}	0.14×10^{-14}	0.007	2.3
Third Quarter	131	5.13×10^{-14}	0.29×10^{-14}	0.014	4.8
Fourth Quarter	115	6.07×10^{-14}	0.19×10^{-14}	0.009	3.1
Total for Year	561	6.07×10^{-14}	0.23×10^{-14}	0.011	3.6

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

ENVIRONMENTAL MONITORING REPORT

1961

Health Physics Department

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

1961

MLM-1111-61-61-000

SUMMARY OF ENVIRONMENTAL MONITORING FOR FIRST QUARTER 1961

Health Physics Department

Date: April 28, 1961

Issued: MAY 1 1 1961

MONSANTO RESEARCH CORPORATION

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I. Summary

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the first quarter of 1961 is presented. The concentration of polonium and tritium in the Great Miami River was well within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also well within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the quarter.

II. Introduction

This report presents in summary form the concentration of radioactive materials detected in the environment around Mound Laboratory. The monitoring procedures used are those best suited to the determination in air and river water samples of those radioactive materials which Mound Laboratory could contribute to the environment.

During the period covered by this report, no radioactive materials have been used which have contributed any measurable penetrating radiation such as gamma or hard beta to the environment.

Polonium, plutonium and tritium are possible air contaminants; polonium and tritium are possible river water contaminants.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

III. Water Sampling

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume. It is handled separately as a packaged waste and not discharged to the river. Helium-3 being purified at Mound Laboratory yields small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

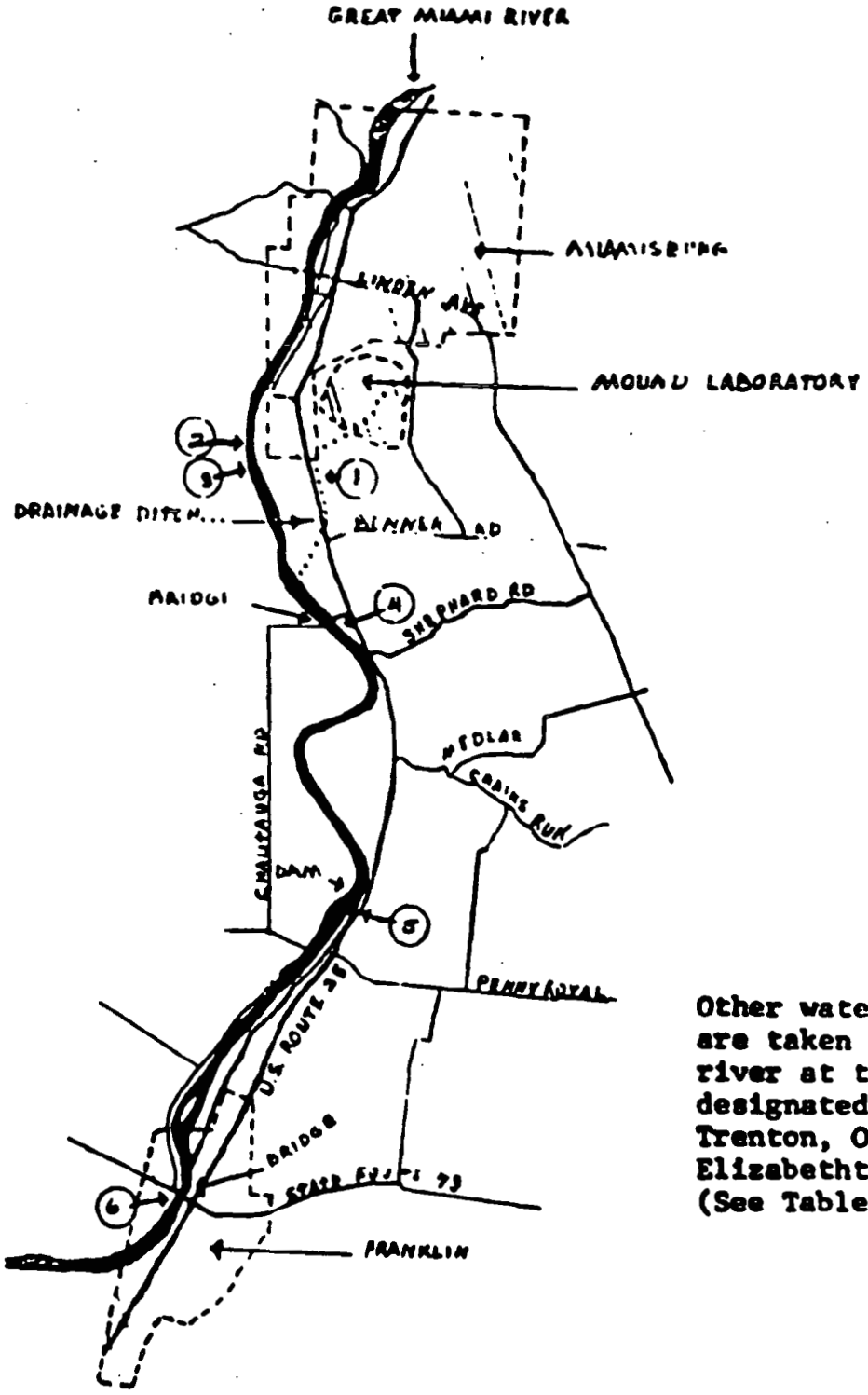
Aliquots of the waters of the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to the Great Miami River, to a distance of five miles downstream. Once each quarter, river water

samples are collected at various locations between Franklin, Ohio, and Elizabethtown, Ohio, near where the Great Miami River enters into the Ohio River. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries off all storm sewer water, which eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and part of the river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I "Summary of Off-Site Water Monitoring for Radioactivity, January Through March, 1961."

The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is well within the maximum permissible continuous concentration.

Refer to the "Water Sample Locations" Map 1 on the following page to determine the location of the data presented in Table I mentioned above.



Other water samples are taken from the river at the cities designated from Trenton, Ohio, to Elizabethtown, Ohio. (See Table I)

GREAT MIAMI RIVER WATER SAMPLE LOCATIONS

MAP 1

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

JANUARY THROUGH MARCH, 1961

I. Polonium (All River Samples)

Sample Location	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	2	9	6.67×10^{-8}	9.60×10^{-9}	1.37
250 Yards Downstream	3	9	3.60×10^{-9}	1.21×10^{-9}	0.17
Chautauqua Road Bridge	4	9	1.80×10^{-9}	2.00×10^{-10}	0.03
Chautauqua Dam	5	9	9.01×10^{-9}	1.60×10^{-9}	0.23
Franklin, Ohio	6	9	1.44×10^{-8}	1.80×10^{-9}	0.26
7 Miles North of New Baltimore, Ohio	None	1	0.0	0.0	0.00
New Baltimore	None	1	0.0	0.0	0.00
Miamitown, Ohio	None	1	0.0	0.0	0.00
5 Miles North of Elizabethtown, Ohio	None	1	0.0	0.0	0.00
Elizabethtown, Ohio	None	1	0.0	0.0	0.00
Over-all		50	6.67×10^{-8}	2.59×10^{-9}	0.37

II. Tritium (All River Samples, Except Drainage Ditch)

Sample Location	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Drainage Ditch	1	9	2.0×10^{-3}	2.22×10^{-4}	4.4
Mound Lab Effluent	2	7	0.0	0.0	0.0
Chautauqua Road Bridge	4	7	0.0	0.0	0.0
Over-all		23	2.0×10^{-3}	8.70×10^{-5}	1.7

* All concentrations are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration

IV. Air Sampling

Monitoring of the environmental air for tritium concentration by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. A total of 108 evaluations were made at 71 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environment has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for tritium air sampling. During this quarter, a total of 154 air samples were collected and analyzed. A long-lived gross alpha determination on filter paper samples collected was made only after sufficient time had elapsed after collection to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

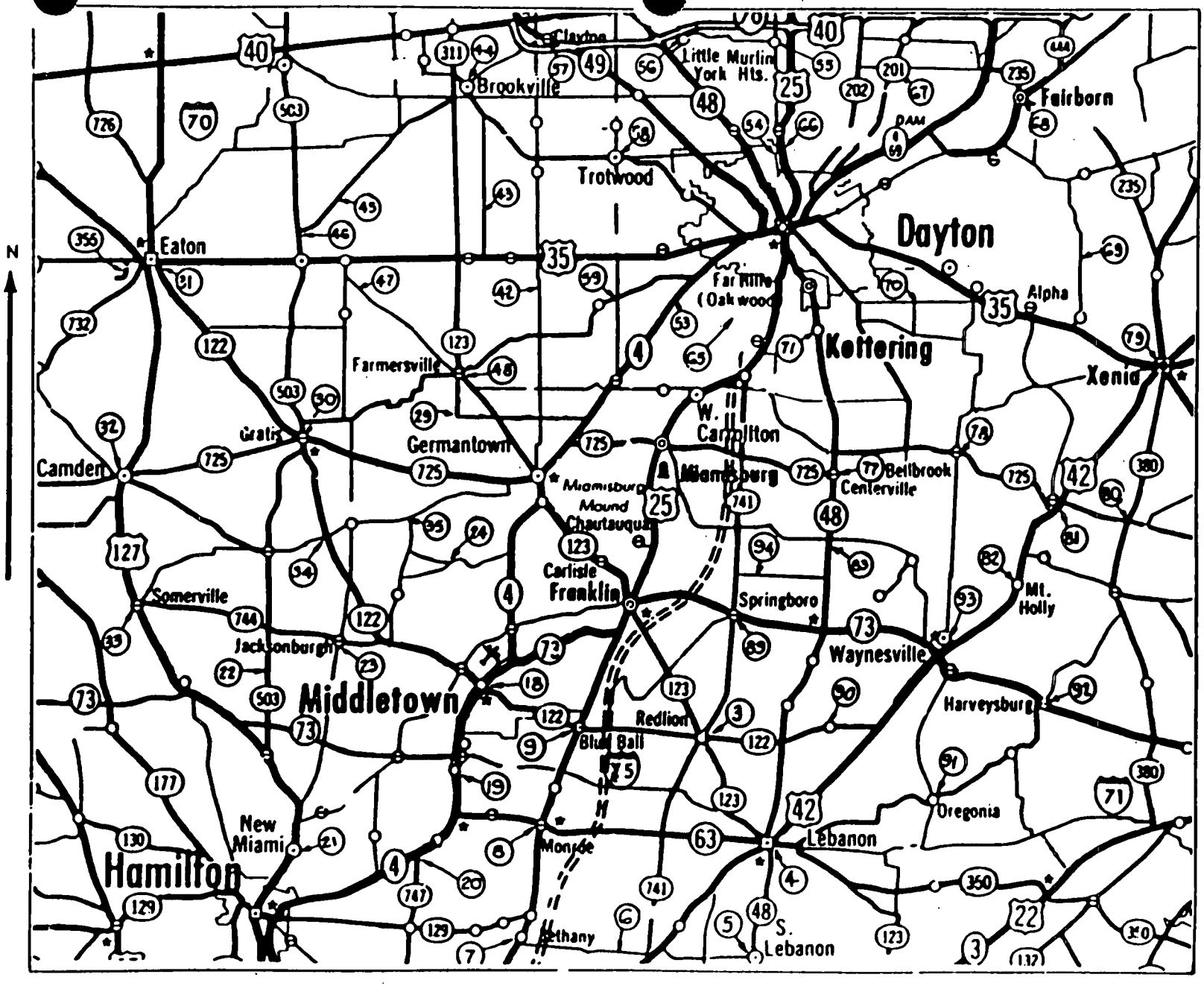
The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision.

At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table II) to the Maximum Permissible Continuous Concentration for polonium in the environment, and assume that all alpha activity detected is polonium, we find that the average polonium concentration would be only 0.047 per cent of the permissible. Our polonium effluent stack monitoring program for this quarter has shown that we should expect essentially no detectable polonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table II again) to the Maximum Permissible Continuous Concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration would be well within the permissible; however, it would be a significant 15.5 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and frequently exceeds the very low permissible concentration for plutonium. That is to say the normal gross alpha (long-lived) count in the environment is usually a very significant per cent of and

frequently exceeds the permitted alpha count for plutonium if the total count were attributed to plutonium. The impact of plutonium work at Mound Laboratory is also placed in proper focus be referring to our plutonium stack monitoring data. During the first quarter of 1961, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium operations (as well as the polonium work) has contributed during this quarter, an insignificant burden to the radioactivity normally present in the atmosphere.

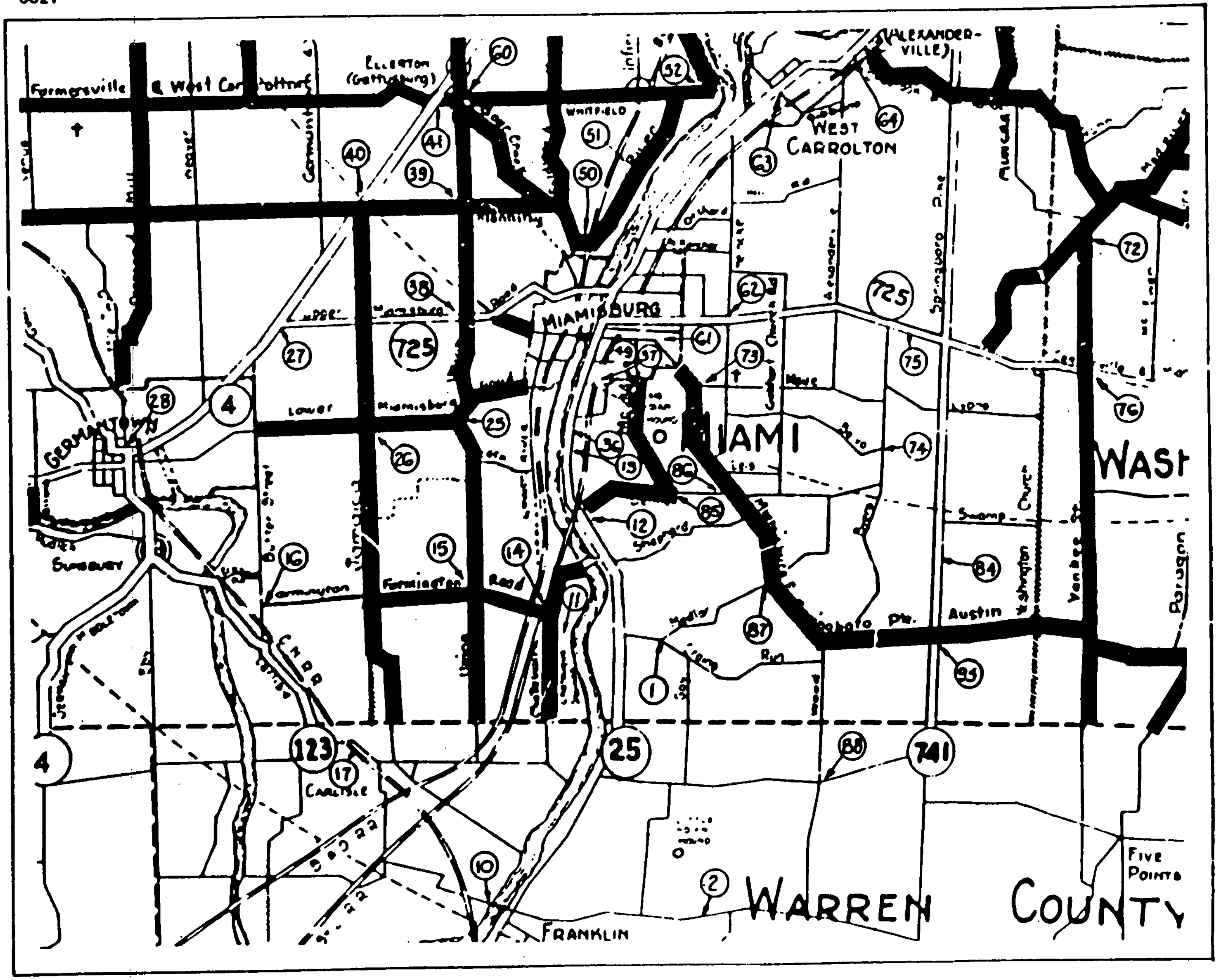
In Table II "Summary of Environmental Air Monitoring for Long-Lived Alpha Emitters," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends upon the wind direction on the days that samples are collected. Samples are collected downwind from the plant according to routes drawn up for the different wind directions. Depending upon wind direction, it is likely that all sites will not be sampled during any one quarter.



MAP 2

AIR SAMPLE LOCATIONS AND ROAD MAP

LOCATION O→



MAP 3

AIR SAMPLE LOCATION AND ROAD MA

LOCATIONS O

N

TABLE II

SUMMARY OF ENVIRONMENTAL MONITORING FOR LONG-LIVED ALPHA EMITTERS

JANUARY THROUGH MARCH, 1961

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.	No samples taken at Locations 1 through 12 during this quarter.				
2. Junction of Route 73 & Interstate Route 75					
3. Red Lion, Ohio					
4. Lebanon, Ohio					
5. South Lebanon, Ohio					
6. Junction of Bethany Rd. & Mason-Montgomery Rd.					
7. Bethany, Ohio					
8. Monroe, Ohio					
9. Blue Ball, Ohio					
10. Junction of Route 123 & Dayton-Oxford Rd.					
11. Chautauqua, Ohio					
12. Junction of Berner Rd. & Route 75					

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
13. Miami Drive In Theatre in Miamisburg (on Route 25)	No samples taken at Locations 13 through 24 during this quarter.				
14. Junction of Farmington Rd. & Chautauqua Rd.					
15. Junction of Farmington Rd. & Union Rd.					
16. Junction of Farmington Rd. & Butter St.					
17. Carlisle, Ohio					
18. Middletown, Ohio					
19. Junction of Route 4 & Route 73					
20. Junction of Route 4 & Route 747					
21. New Miami, Ohio					
22. Junction of West Elkton Rd. & Tolbert Rd.					
23. Jacksonburg, Ohio					
24. Junction of Hetzler Rd. & Hinkle Rd.					

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
25. Junction of Lower Miamisburg Rd. & Union Rd.	3	3.15×10^{-14}	2.07×10^{-14}	0.104	34.5
26. Junction of Lower Miamisburg Rd. & Jamaica Rd.	3	3.15×10^{-14}	1.44×10^{-14}	0.072	24.0
27. Junction of Route 725 & Route 4	3	4.95×10^{-14}	3.15×10^{-14}	0.157	52.5
28. Germantown, Ohio	3	0.27×10^{-14}	0.09×10^{-14}	0.005	1.5
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.	3	0.54×10^{-14}	0.36×10^{-14}	0.018	6.0
30. Gratis, Ohio	3	3.15×10^{-14}	1.08×10^{-14}	0.054	18.0
31. Eaton, Ohio	3	2.70×10^{-14}	0.90×10^{-14}	0.045	15.0
32. Camden, Ohio	3	5.41×10^{-14}	3.42×10^{-14}	0.171	57.0
33. Somerville, Ohio	3	3.15×10^{-14}	1.17×10^{-14}	0.059	19.5
34. Junction of Greenbush Rd. & Route 122	3	5.41×10^{-14}	3.24×10^{-14}	0.162	54.0
35. Junction of Oxford Rd. & Browns Run Rd.	3	1.62×10^{-14}	0.54×10^{-14}	0.027	9.0
36. Miamisburg South City limit on Route 25	3	1.62×10^{-14}	0.72×10^{-14}	0.036	12.0
37. Junction of Mound Ave. & Route 25		—	0.63×10^{-14}	0.032	10.5

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
38. Junction of Union Rd. & Route 725	1	—	0.0	0.0	0.0
39. Junction of Union Rd. & Manning Rd.	1	—	0.0	0.0	0.0
40. Junction of Manning Rd. & Route 4	1	—	0.45×10^{-14}	0.023	7.5
41. Junction of Route 4 & Farmersville-West Carrollton Rd.	1	—	0.0	0.0	0.0
42. Junction of Diamond Mill Rd. & Mile Rd.	1	—	0.45×10^{-14}	0.023	7.5
43. Junction of Clayton Rd. & Amity Rd.	1	—	0.0	0.0	0.0
44. Brookville, Ohio	1	—	0.0	0.0	0.0
45. Junction of Lexington Salem Rd. & Preble County Line Rd.	1	—	0.0	0.0	0.0
46. Junction of Lexington Salem Rd. & Engle Rd.	1	—	0.0	0.0	0.0
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.	1	—	0.0	0.0	0.0
48. Farmersville, Ohio	[illegible]	—	0.0	0.0	0.0
49. Fifth St. & Central Ave. in Miamisburg, Ohio	[illegible]	—	0.18×10^{-14}	0.009	3.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	1	—	0.0	0.0	0.0
51. One mile north on Upper River Rd. from sample #50	1	—	0.0	0.0	0.0
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	1	—	0.99×10^{-14}	0.050	16.5
53. Dayton Speedway	1	—	0.45×10^{-14}	0.023	7.5
54. Dayton, Ohio	1	—	0.45×10^{-14}	0.023	7.5
55. Murlin Heights	1	—	0.0	0.0	0.0
56. Little York	1	—	0.0	0.0	0.0
57. Clayton, Ohio	1	—	0.0	0.0	0.0
58. Trotwood, Ohio	1	—	0.0	0.0	0.0
59. Union Rd. & Liberty-Dayton Rd.	1	—	0.0	0.0	0.0
60. Union Rd. & Bear Creek Rd.	1	—	0.0	0.0	0.0
61. Harmon Field in Miamisburg	4	1.53×10^{-14}	0.54×10^{-14}	0.027	9.0
62. Junction of Route 725 & Heinecke Rd.	4	0.72×10^{-14}	0.36×10^{-14}	0.018	6.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
63. Junction of Elm St. & Route 25 in West Carrollton	4	1.80×10^{-14}	0.45×10^{-14}	0.023	7.5
64. Woody's Market in West Carrollton	4	1.80×10^{-14}	0.99×10^{-14}	0.050	16.5
65. Junction of South Broadway & Dryden Rd.	4	0.36×10^{-14}	0.18×10^{-14}	0.009	3.0
66. Junction of Route 75 & Wagner Ford Rd.	4	4.05×10^{-14}	1.89×10^{-14}	0.095	31.5
67. Junction of Route 201 & Chambersburg Rd.	4	4.95×10^{-14}	1.35×10^{-14}	0.068	22.5
68. Fairborn, Ohio	4	4.95×10^{-14}	1.62×10^{-14}	0.081	27.0
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	4	4.05×10^{-14}	1.53×10^{-14}	0.077	25.5
70. Belmont Auto Theatre	4	1.17×10^{-14}	0.27×10^{-14}	0.014	4.5
71. Town & Country Shopping Center in Kettering, Ohio	4	2.16×10^{-14}	0.81×10^{-14}	0.041	13.5
72. Junction of Yankee Street & Mad River Rd.	4	3.60×10^{-14}	0.90×10^{-14}	0.045	15.0
73. Junction of Maue Rd. & Linden Ave.	2	1.80×10^{-14}	0.90×10^{-14}	0.045	15.0
74. Junction of Byers Rd. & Belvo Rd.	2	2.25×10^{-14}	1.13×10^{-14}	0.057	18.8
75. Junction of Route 725 & Route 75	2	0.45×10^{-14}	0.23×10^{-14}	0.012	3.8

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
76. Junction of Yankee St. & Route 725	2	2.70×10^{-14}	1.35×10^{-14}	0.068	22.5
77. Centerville, Ohio	2	0.45×10^{-14}	0.41×10^{-14}	0.021	6.8
78. Bellbrook, Ohio	2	3.15×10^{-14}	1.58×10^{-14}	0.079	26.3
79. Xenia, Ohio	2	9.01×10^{-14}	4.51×10^{-14}	0.226	75.2
80. Junction of Spring Valley-Paintersville Rd. & Route 380	2	1.80×10^{-14}	0.90×10^{-14}	0.045	15.0
81. Spring Valley, Ohio	2	2.70×10^{-14}	1.35×10^{-14}	0.068	22.5
82. Mt. Holly, Ohio	2	0.45×10^{-14}	0.23×10^{-14}	0.012	3.8
83. Junction of Route 48 & Social Row Rd.	2	5.40×10^{-14}	2.70×10^{-14}	0.135	45.0
84. Waldruhe Park	2	—	0.0	0.0	0.0
85. Junction of Mound Rd. & Benner Rd.	2	1.35×10^{-14}	1.35×10^{-14}	0.068	22.5
86. Junction of Benner Rd. & Miamisburg-Springboro Pike	2	0.27×10^{-14}	0.14×10^{-14}	0.007	2.3
87. Junction of Medlar Rd. & Miamisburg-Springboro Pike	2	0.0	0.0	0.0	0.0
88. Junction of Wood Rd. & Pennyroyal Rd.	2	0.0	0.0	0.0	0.0
89. Springboro, Ohio	2	0.0	0.0	0.0	0.0
90. Junction of Route 123 & Urica Rd.	2	0.0	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
91. Orgonia	2	0.0	0.0	0.0	0.0
92. Harveysburg, Ohio	2	3.60×10^{-14}	2.25×10^{-14}	0.113	37.5
93. Waynesville, Ohio	2	1.17×10^{-14}	0.59×10^{-14}	0.030	9.8
94. By TV Tower on Lytle-Five Points Rd.	2	2.70×10^{-14}	1.35×10^{-14}	0.068	22.5
95. South Montgomery County Airport	2	0.0	0.0	0.0	0.0
Over-all	154	9.01×10^{-14}	0.93×10^{-14}	0.047	15.5

* All concentrations are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration

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SUMMARY OF ENVIRONMENTAL MONITORING FOR SECOND QUARTER 1961

Health Physics Department

Date: August 4, 1961

Issued:

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I. SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the second quarter of 1961 is presented. The concentration of polonium and tritium in the Great Miami River was well within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also well within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the quarter.

II. INTRODUCTION

This report presents in summary form the concentration of radioactive materials detected in the environment around Mound Laboratory. The monitoring procedures used are those best suited to the determination in air and river water samples of those radioactive materials which Mound Laboratory could contribute to the environment.

During the period covered by this report, no radioactive materials have been used which have contributed any measurable penetrating radiation such as gamma or hard beta to the environment.

Polonium, plutonium and tritium are possible air contaminants; polonium and tritium are possible river water contaminants.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

III. WATER SAMPLING

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume. It is handled separately as a packaged waste and not discharged to the river. Helium-3 being purified at Mound Laboratory yields small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

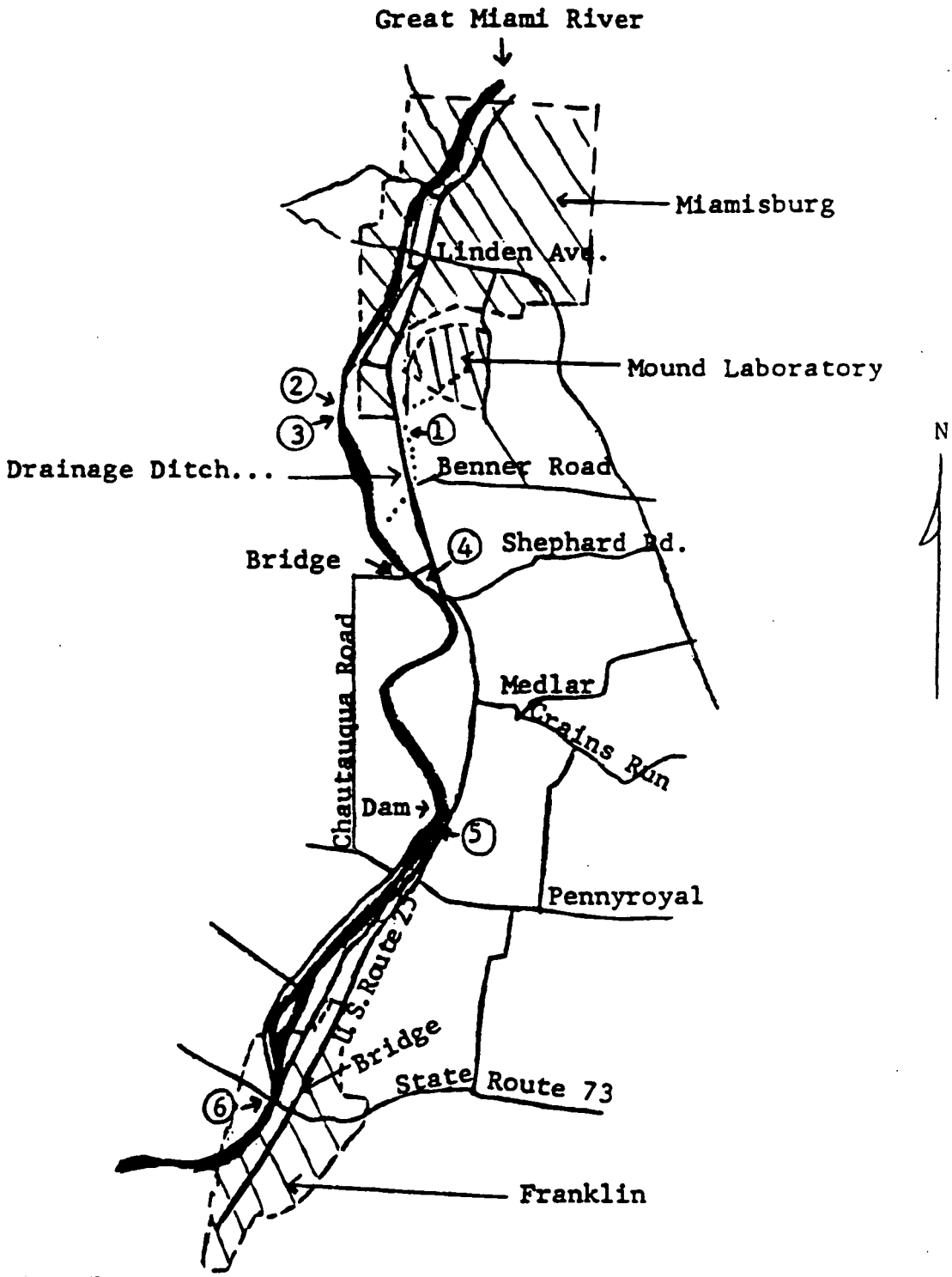
Aliquots of the waters of the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to the Great Miami River, to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries off all storm sewer water, which eventually empties into the river. The treated liquid tritium waste is discharged directly into the river via a closed sewer line.

All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and part of the river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I "Summary of Off-Site Water Monitoring For Radioactivity, April Through June, 1961."

The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is well within the maximum permissible continuous concentration.

Refer to the "Water Sample Locations" Map 1 on the following page to determine the location of the data presented in Table I mentioned above.



GREAT MIAMI RIVER WATER SAMPLE LOCATIONS

MAP 1

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

APRIL THROUGH JUNE, 1961

I. Polonium (All River Samples)

Sample Location	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	2	13	4.32×10^{-8}	8.59×10^{-9}	1.23
250 Yards Downstream	3	13	1.98×10^{-8}	1.66×10^{-9}	0.24
Chautauqua Road Bridge	4	13	7.21×10^{-9}	1.39×10^{-9}	0.20
Chautauqua Dam	5	13	7.21×10^{-9}	1.53×10^{-9}	0.22
Franklin, Ohio	6	13	1.44×10^{-8}	1.53×10^{-9}	0.22
Over-all		65	4.32×10^{-8}	2.94×10^{-9}	0.42
II. Tritium (All River Samples, Except Drainage Ditch)					
Mound Lab Drainage Ditch	1	13	6.0×10^{-3}	1.23×10^{-3}	24.6
Mound Lab Effluent	2	13	9.0×10^{-3}	6.92×10^{-4}	13.8
Chautauqua Road Bridge	4	13	1.0×10^{-2}	7.69×10^{-4}	15.3
Over-all		39	1.0×10^{-2}	5.64×10^{-4}	11.3

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

IV. AIR SAMPLING

Monitoring of the environmental air for tritium concentration by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. A total of 123 evaluations were made at 68 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environment has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for tritium air sampling. During this quarter, a total of 124 air samples were collected and analyzed. A long-lived gross alpha determination on filter paper samples collected was made only after sufficient time had elapsed after collection to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the isotopes of polonium and

plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table II) to the Maximum Permissible Continuous Concentration for polonium in the environment, and assume that all alpha activity detected is polonium, we find that the average polonium concentration would be only 0.051 per cent of the permissible. Our polonium effluent stack monitoring program for this quarter has shown that we should expect essentially no detectable polonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table II again) to the Maximum Permissible Continuous Concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration would be well within the permissible; however, it would be a significant 16.8 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and frequently exceeds the very low permissible concentration for plutonium. That is to say the normal gross alpha (long-lived) count in the environment is usually a very significant per cent of and frequently exceeds the permitted alpha count for plutonium if the

total count were attributed to plutonium. The impact of plutonium work at Mound Laboratory is also placed in proper focus by referring to our plutonium stack monitoring data. During the second quarter of 1961, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium operations (as well as the polonium work) has contributed during this quarter, an insignificant burden to the radioactivity normally present in the atmosphere.

In Table II "Summary of Environmental Air Monitoring for Long-Lived Alpha Emitters," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends upon the wind direction on the days that samples are collected. Samples are collected downwind from the plant according to routes drawn up for the different wind directions. Depending upon wind direction, it is likely that all sites will not be sampled during any one quarter.

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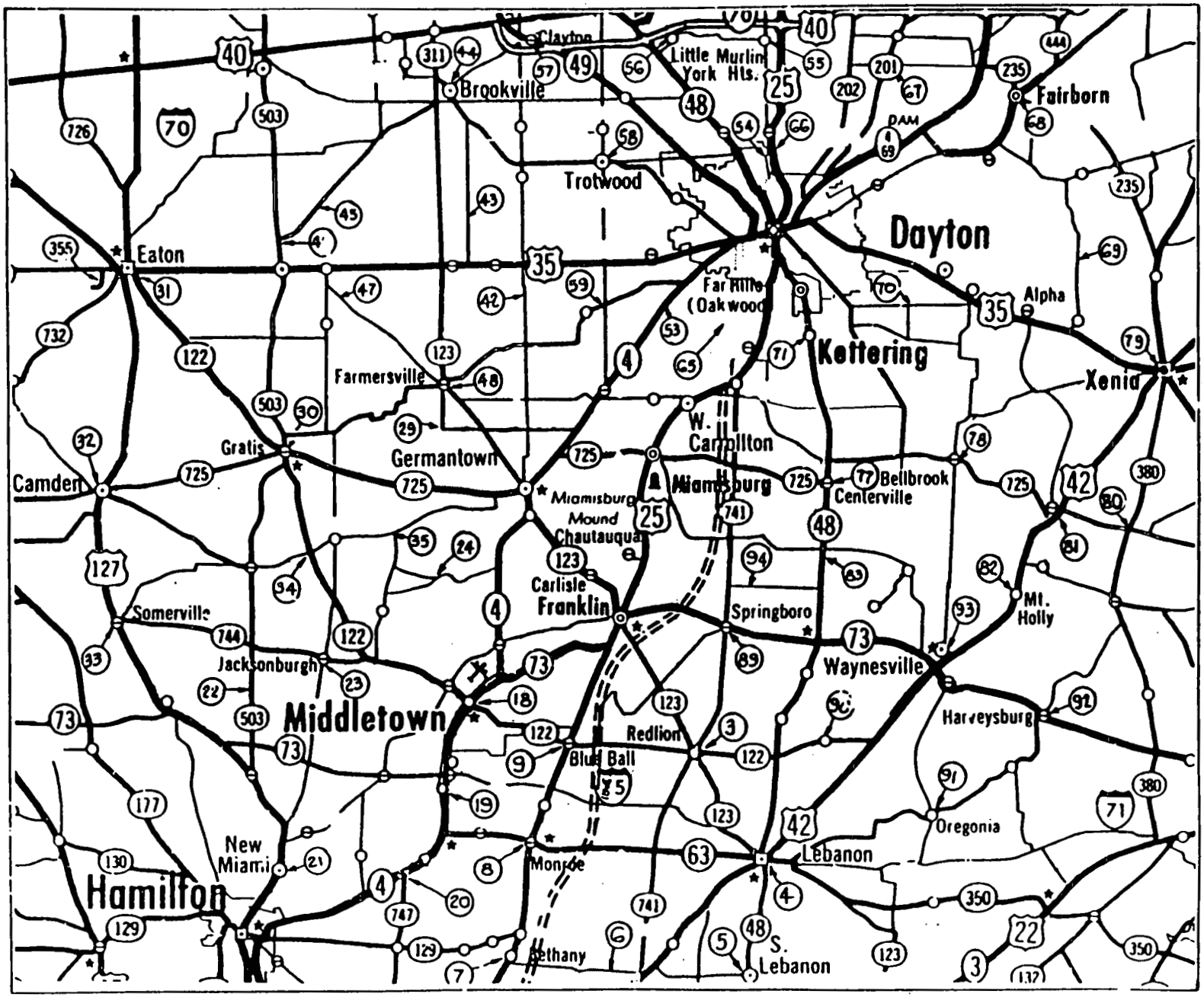
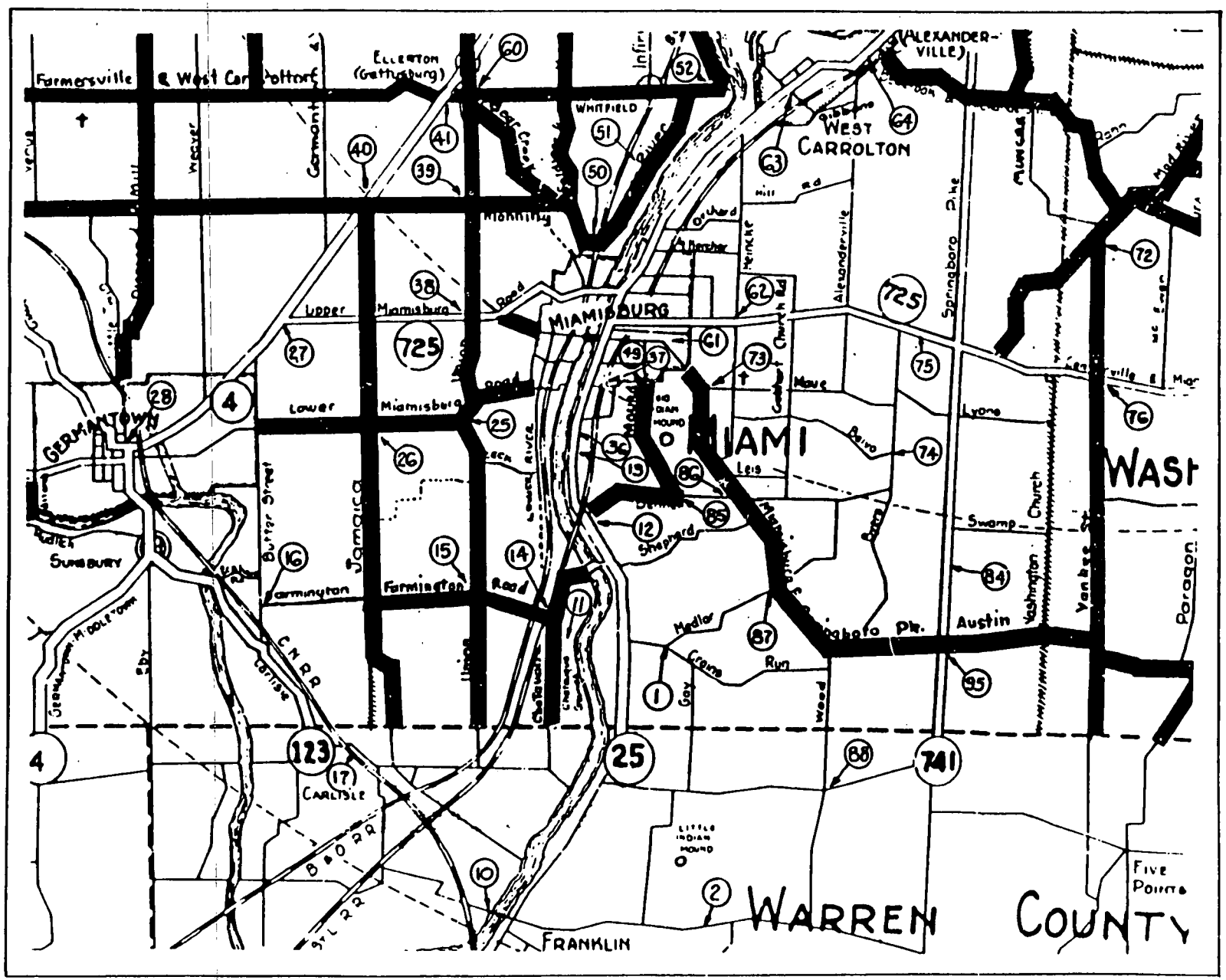


MAP 2

AIR SAMPLE
LOCATIONS
AND ROAD MAP

LOCATION O→



MAP 3

AIR SAMPLE LOCATION AND ROAD MAP

LOCATIONS O→

TABLE II

SUMMARY OF ENVIRONMENTAL MONITORING FOR LONG-LIVED ALPHA EMITTERS

APRIL THROUGH JUNE, 1961

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.	1	___	0.18×10^{-14}	0.009	3.0
2. Junction of Route 73 & Interstate 75	1	___	0.72×10^{-14}	0.036	12.0
3. Red Lion, Ohio	1	___	0.0	0.0	0.0
4. Lebanon, Ohio	1	___	0.0	0.0	0.0
5. South Lebanon, Ohio	1	___	0.45×10^{-14}	0.023	7.5
6. Junction of Bethany Rd. & Mason-Montgomery Rd.	1	___	0.0	0.0	0.0
7. Bethany, Ohio	1	___	4.59×10^{-14}	0.230	76.5
8. Monroe, Ohio	1	___	0.0	0.0	0.0
9. Blue Ball, Ohio	1	___	0.0	0.0	0.0
10. Junction of Route 123 & Dayton-Oxford Rd.	1	___	0.0	0.0	0.0
11. Chautauqua, Ohio	1	___	0.0	0.0	0.0
12. Junction of Beamer Rd. & Route 28	1	___	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
13. Miami Drive In Theatre in Miamisburg (on Route 25)	1	___	0.99×10^{-14}	0.050	16.5
14. Junction of Farmington Rd. & Chautauqua Rd.	1	___	3.60×10^{-14}	0.180	60.0
15. Junction of Farmington Rd. & Union Rd.	1	___	4.50×10^{-14}	0.225	75.0
16. Junction of Farmington Rd. & Butter St.	1	___	0.0	0.0	0.0
17. Carlisle, Ohio	1	___	0.0	0.0	0.0
18. Middletown, Ohio	1	___	3.15×10^{-14}	0.158	52.5
19. Junction of Route 4 & Route 73	1	___	0.63×10^{-14}	0.032	10.5
20. Junction of Route 4 & Route 747	1	___	5.86×10^{-14}	0.293	97.7
21. New Miami, Ohio	1	___	0.54×10^{-14}	0.027	9.0
22. Junction of West Elkton Rd. & Tolbert Rd.	1	___	0.0	0.0	0.0
23. Jacksonburg, Ohio	1	___	3.15×10^{-14}	0.158	52.5
24. Junction of Hetzler Rd. & Hinkle Rd.	No Sample taken at this location during this quarter.				
25. Junction of Lower Miamisburg Rd. & Union Rd.	2	1.17×10^{-14}	1.08×10^{-14}	0.054	18.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
26. Junction of Lower Miamisburg Rd. & Jamaica Rd.	2	0.90×10^{-14}	0.45×10^{-14}	0.023	7.5
27. Junction of Route 725 & Route 4	2	—	0.0	0.0	0.0
28. Germantown, Ohio	2	5.22×10^{-14}	2.61×10^{-14}	0.131	43.5
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.	2	1.26×10^{-14}	0.63×10^{-14}	0.032	10.5
30. Gratis, Ohio	2	1.17×10^{-14}	0.72×10^{-14}	0.036	12.0
31. Eaton, Ohio	2	2.70×10^{-14}	1.71×10^{-14}	0.086	28.5
32. Camden, Ohio	2	0.99×10^{-14}	0.86×10^{-14}	0.043	14.3
33. Somerville, Ohio	2	1.89×10^{-14}	1.13×10^{-14}	0.057	18.8
34. Junction of Greenbush Rd. & Route 122	2	3.78×10^{-14}	2.34×10^{-14}	0.117	39.7
35. Junction of Oxford Rd. & Browns Run Rd.	2	0.18×10^{-14}	0.09×10^{-14}	0.005	1.5
36. Miamisburg South City Limit on Route 25	2	1.89×10^{-14}	0.95×10^{-14}	0.048	15.8
37. Junction of Mound Ave. & Route 25	2	1.17×10^{-14}	0.63×10^{-14}	0.032	10.5
38. Junction of Union Rd. & Route 725	2	—	0.0	0.0	0.0
39. Junction of Union Rd. & Manning Rd.	2	1.98×10^{-14}	0.99×10^{-14}	0.050	16.5

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
40. Junction of Manning Rd. & Route 4	2	—	0.0	0.0	0.0
41. Junction of Route 4 & Farmersville-West Carrollton Rd.	2	0.81×10^{-14}	0.42×10^{-14}	0.021	7.0
42. Junction of Diamond Mill Rd. & Mile Rd.	2	0.09×10^{-14}	0.05×10^{-14}	0.003	0.8
43. Junction of Clayton Rd. & Amity Rd.	2	0.45×10^{-14}	0.27×10^{-14}	0.014	4.5
44. Brookville, Ohio	2	5.86×10^{-14}	2.93×10^{-14}	0.147	48.8
45. Junction of Lexington Salem Rd. & Preble County Line Rd.	2	0.18×10^{-14}	0.09×10^{-14}	0.005	1.5
46. Junction of Lexington Salem Rd. & Engle Rd.	2	4.95×10^{-14}	4.05×10^{-14}	0.203	67.5
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.	2	—	0.0	0.0	0.0
48. Farmersville, Ohio	2	0.27×10^{-14}	0.23×10^{-14}	0.012	3.8
49. Fifth St. & Central Ave. in Miamisburg, Ohio	2	0.54×10^{-14}	0.27×10^{-14}	0.014	4.5
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	2	—	0.0	0.0	0.0
51. One mile north on Upper River Rd. from sample #50	2	5.85×10^{-14}	2.75×10^{-14}	0.138	45.8

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	2	0.90×10^{-14}	0.45×10^{-14}	0.023	7.5
53. Dayton Speedway	2	—	0.0	0.0	0.0
54. Dayton, Ohio	2	—	0.0	0.0	0.0
55. Murlin Heights	2	15.23×10^{-14}	8.33×10^{-14}	0.417	138.9
56. Little York	2	—	0.0	0.0	0.0
57. Clayton, Ohio	2	0.45×10^{-14}	0.23×10^{-14}	0.012	3.8
58. Trotwood, Ohio	2	0.72×10^{-14}	0.36×10^{-14}	0.018	6.0
59. Union Rd. & Liberty-Dayton Rd.	2	5.40×10^{-14}	2.97×10^{-14}	0.149	49.5
60. Union Rd. & Bear Creek Rd.	2	0.99×10^{-14}	0.50×10^{-14}	0.025	8.3
61. Harmon Field in Miamisburg	1	—	0.27×10^{-14}	0.014	4.5
62. Junction of Route 725 & Heincke Rd.	1	—	0.90×10^{-14}	0.045	15.0
63. Junction of Elm St. & Route 25 in West Carrollton	1	—	0.0	0.0	0.0
64. Woody's Market in West Carrollton	1	—	0.0	0.0	0.0
65. Junction of South Broadway & Dryden Rd.	1	—	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
66. Junction of Route 75 & Wagner Ford Rd.	1	—	4.50×10^{-14}	0.225	75.0
67. Junction of Route 201 & Chambersburg Rd.	1	—	0.0	0.0	0.0
68. Fairborn, Ohio	1	—	2.25×10^{-14}	0.113	37.5
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	1	—	0.90×10^{-14}	0.045	15.0
70. Belmont Auto Theatre	1	—	3.15×10^{-14}	0.158	52.5
71. Town & Country Shopping Center in Kettering, Ohio	1	—	0.0	0.0	0.0
72. Junction of Yankee Street & Mad River Rd.	1	—	0.0	0.0	0.0
73. Junction of Maue Rd. & Linden Ave.	1	—	1.35×10^{-14}	0.068	22.5
74. Junction of Byers Rd. & Belvo Rd.	1	—	0.0	0.0	0.0
75. Junction of Route 725 & Route 75	1	—	2.07×10^{-14}	0.103	34.5
76. Junction of Yankee St. & Route 725	1	—	0.0	0.0	0.0
77. Centerville, Ohio	1	—	1.53×10^{-14}	0.076	25.5
78. Bellbrook, Ohio	1	—	0.0	0.0	0.0
79. Xenia, Ohio	1	—	0.45×10^{-14}	0.023	7.5

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
80. Junction of Spring Valley-Paintersville Rd. & Route 380	1	—	2.34×10^{-14}	0.117	39.0
81. Spring Valley, Ohio	1	—	0.0	0.0	0.0
82. Mt. Holly, Ohio	1	—	0.0	0.0	0.0
83. Junction of Route 48 & Social Row Rd.	1	—	0.18×10^{-14}	0.009	3.0
84. Waldruhe Park	1	—	0.0	0.0	0.0
85. Junction of Mound Rd. & Benner Rd.	1	—	0.81×10^{-14}	0.041	13.5
86. Junction of Benner Rd. & Miamisburg-Springboro Pike	1	—	0.0	0.0	0.0
87. Junction of Medlar Rd. & Miamisburg-Springboro Pike	1	—	0.0	0.0	0.0
88. Junction of Wood Rd. & Pennyroyal Rd.	1	—	0.0	0.0	0.0
89. Springboro, Ohio	1	—	0.0	0.0	0.0
90. Junction of Route 122 & Utica Rd.	No samples taken at locations 90 through 95 during this quarter.				
91. Orgonia					
92. Harveysburg, Ohio					
93. Waynesville, Ohio					
94. By TV Tower on Lytle-Five Points Rd.					

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
95. South Montgomery County Airport					
Over-all	124	15.23×10^{-14}	1.01×10^{-14}	0.051	16.8

* All concentrations are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration

MLM-MU-61-71-CCC9

ENVIRONMENTAL MONITORING REPORT
THIRD QUARTER 1961

Health Physics Department

P. C. Adams

Date Issued: November 15, 1961

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

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I. SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the third quarter of 1961 is presented. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the quarter.

II. INTRODUCTION

This report presents in summary form the findings of the Environmental Monitoring Program conducted by the Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program is planned and coordinated with regards to all of the various projects performed therein. The monitoring procedures used are those best suited for the detection and measurement of appropriate radioactive materials which Mound Laboratory could contribute to the environment.

During the period covered by this report, no radioactive materials have been used which have contributed any measurable penetrating radiation such as gamma or hard beta to the environment.

Polonium, plutonium and tritium are possible air contaminants; polonium and tritium are possible river water contaminants.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

III. WATER SAMPLING

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume and is handled separately as a packaged waste rather than being discharged to the river. Helium-3 being purified at Mound Laboratory yields small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

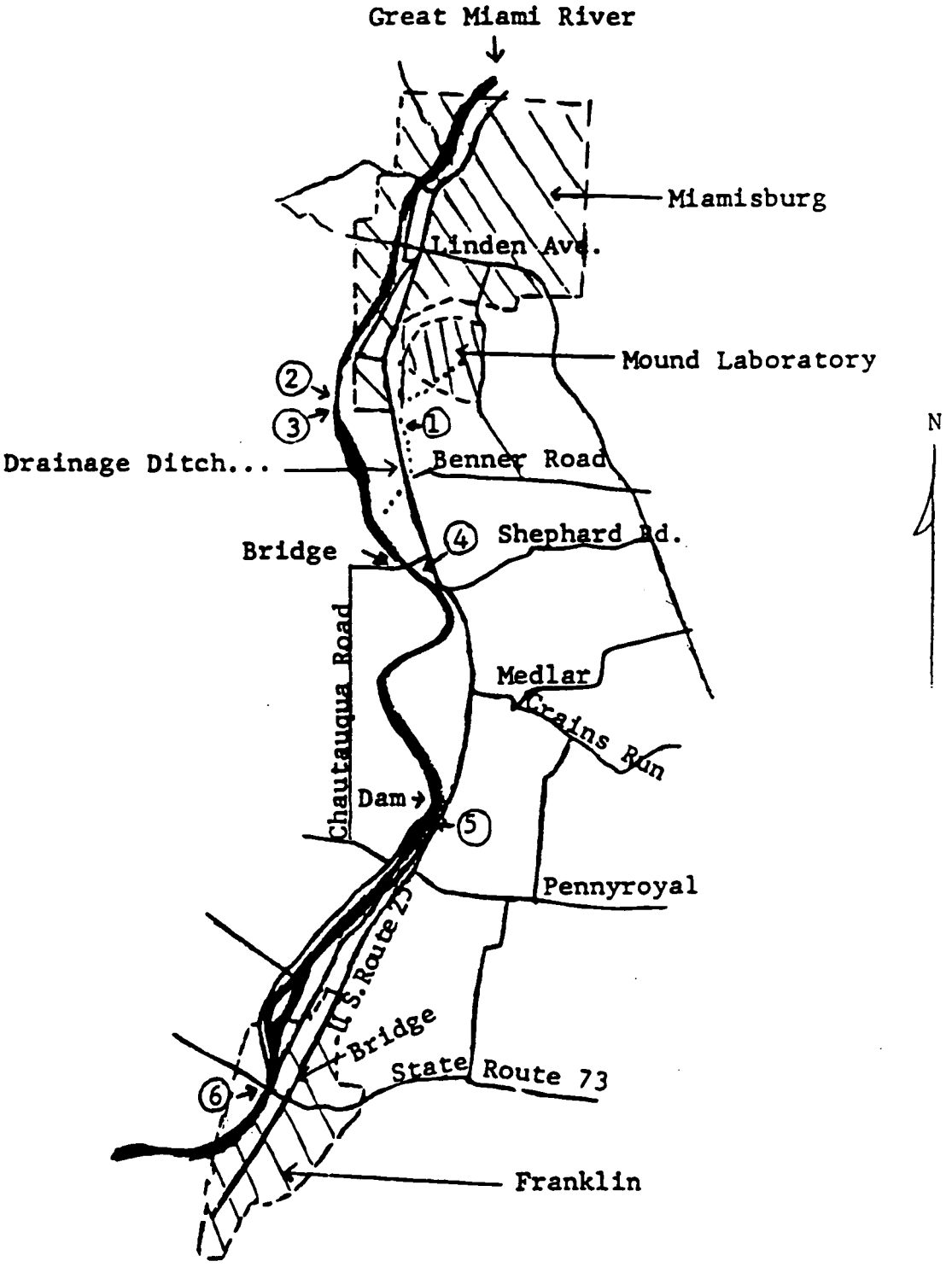
Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries off all storm sewer water and

eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and part of the river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I "Summary of Off-Site Water Monitoring For Radioactivity, July Through September, 1961."

The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is within the maximum permissible continuous concentration.

Refer to the "Water Sample Locations" Map 1 on the following page to determine the location of the data presented in Table I mentioned above.



GREAT MIAMI RIVER WATER SAMPLE LOCATIONS

MAP 1

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

JULY THROUGH SEPTEMBER, 1961

I. Polonium (River Samples)

Sample Location	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	2	10	2.1×10^{-8}	9.4×10^{-9}	1.34
250 Yards Downstream	3	10	3.62×10^{-9}	3.6×10^{-10}	0.052
Chautauqua Road Bridge	4	10	1.99×10^{-8}	2.53×10^{-9}	0.361
Chautauqua Dam	5	10	3.62×10^{-9}	5.43×10^{-10}	0.077
Franklin, Ohio	6	10	7.24×10^{-9}	7.24×10^{-10}	0.103
Over-all		50	2.1×10^{-8}	2.71×10^{-9}	0.387

II. Tritium (River Samples, Except Drainage Ditch)

Mound Lab Drainage Ditch	1	9	1.7×10^{-2}	3.7×10^{-3}	74.0
Mound Lab Effluent	2	9	9.0×10^{-3}	2.6×10^{-3}	52.0
Chautauqua Road Bridge	4	9	6.0×10^{-3}	1.4×10^{-3}	28.0
Over-all		27	1.7×10^{-2}	2.56×10^{-3}	51.2

* All concentrations are in microcuries per cubic centimeter

** MPC = Maximum Permissible Continuous Concentration

IV. AIR SAMPLING

Monitoring of the environmental air for tritium concentration by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. A total of 129 evaluations were made at 88 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for tritium air sampling. During this quarter, a total of 155 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the

gross alpha detected in the environment (see Table III) to the Maximum Permissible Continuous Concentration for polonium in the environment, and assume that all alpha activity detected is polonium, we find that the average polonium concentration would be only 0.060 per cent of the permissible. Our effluent stack monitoring program for this quarter had indicated that we should expect essentially no detectable polonium or plutonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table III again) to the Maximum Permissible Continuous Concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration would be well within the permissible; however, it would be a significant 5.7 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and frequently exceeds the very low permissible concentration for plutonium. That is to say the normal gross alpha (long-lived) count in the environment is usually a very significant per cent of and frequently exceeds the permitted alpha count for plutonium if the total count were attributed to plutonium. The impact of plutonium

work at Mound Laboratory is also placed in proper focus by referring to our stack monitoring data. During the third quarter of 1961, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium and/or polonium operations have contributed an insignificant burden to the radioactivity normally present in the atmosphere.

In Table III "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, July Through September, 1961," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends upon the wind direction on the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the different wind directions. Depending upon wind direction, it is likely that all sites will not be sampled during any one quarter.

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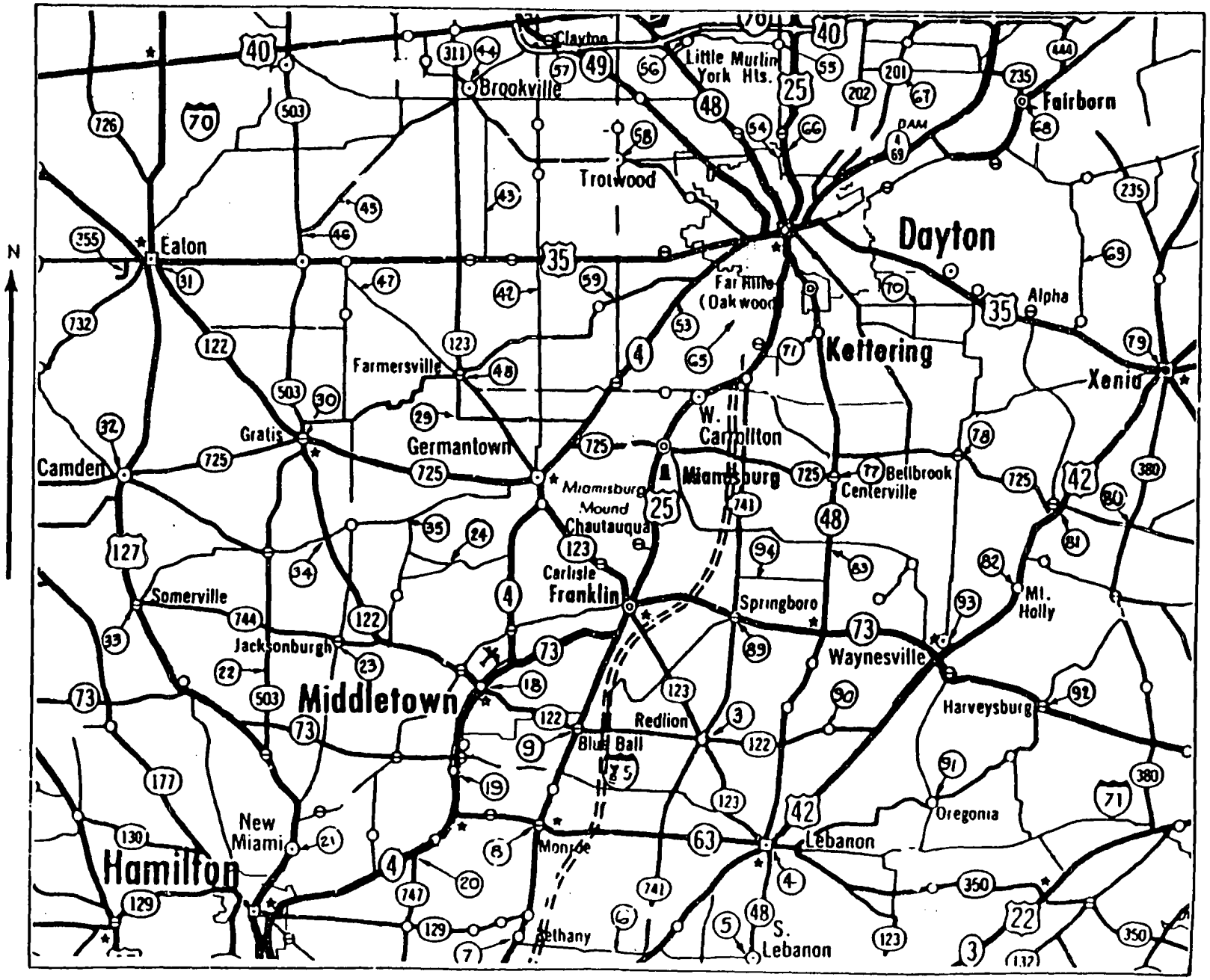
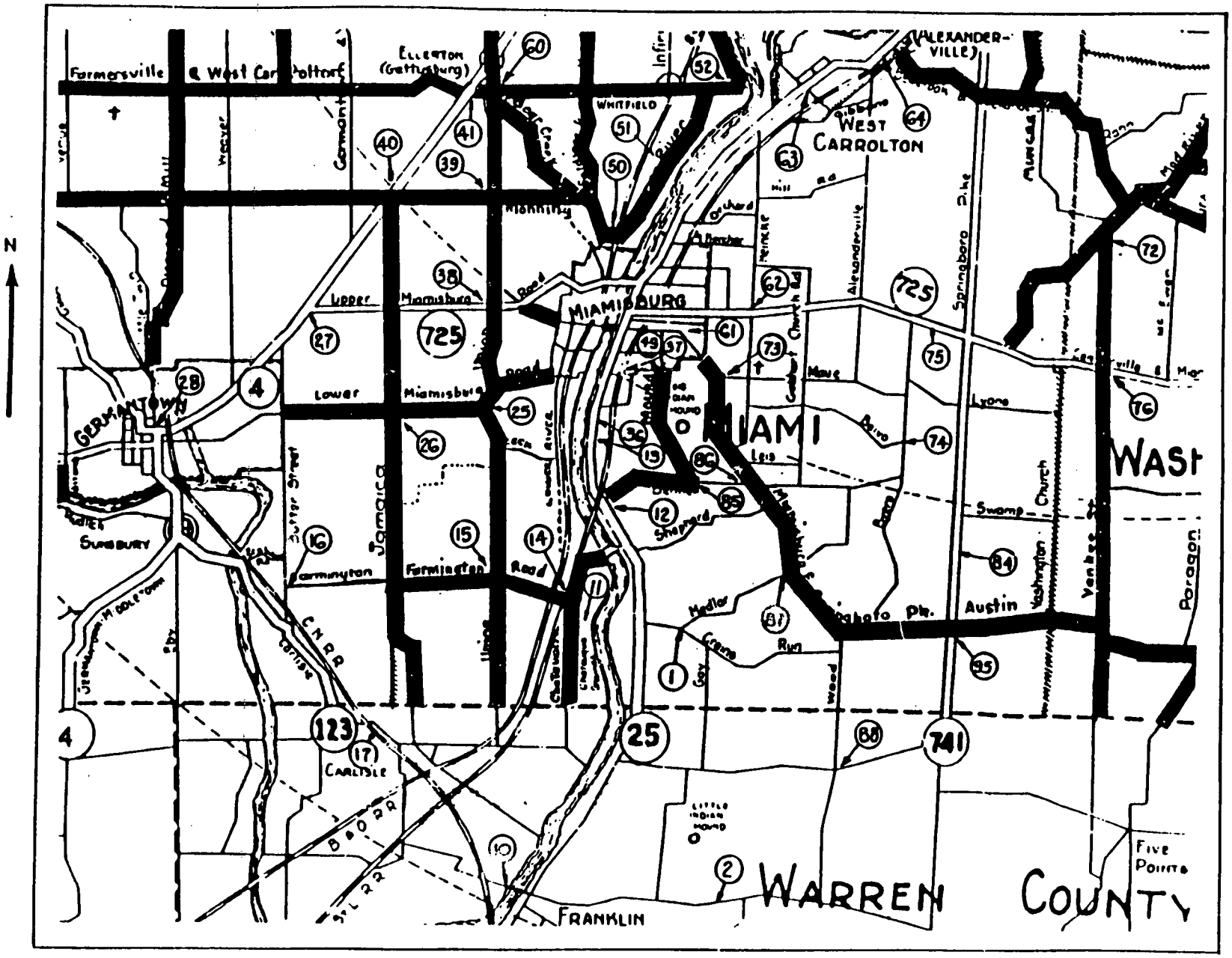


MAP 2

AIR SAMPLE
LOCATIONS
AND ROAD MA

LOCATION O



MAP 3

AIR SAMPLE LOCATION AND ROAD MAP

LOCATIONS O→

TABLE II

COMPOSITE - AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

JULY THROUGH SEPTEMBER, 1961

	Sampling Locations	Samples Collected	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
A. Downwind Sampling	84	155	5.4×10^{-14}	1.20×10^{-14}	0.060	20.0
B. Upwind Sampling	14	24	5.4×10^{-14}	0.86×10^{-14}	0.043	14.3
C. Difference			____	0.34×10^{-14}	0.017	5.7

* All concentrations in Tables II and III are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

TABLE III

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FOR LONG-LIVED ALPHA EMITTERS

JULY THROUGH SEPTEMBER, 1961

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.	1	____	0.0	0.0	0.0
2. Junction of Route 73 & Interstate 75	1	____	0.0	0.0	0.0
3. Red Lion, Ohio	1	____	0.0	0.0	0.0
4. Lebanon, Ohio	1	____	0.0	0.0	0.0
5. South Lebanon, Ohio	1	____	0.18×10^{-14}	0.009	3.0
6. Junction of Bethany Rd. & Mason-Montgomery Rd.	1	____	0.0	0.0	0.0
7. Bethany, Ohio	1	____	0.0	0.0	0.0
8. Monroe, Ohio	1	____	0.0	0.0	0.0
9. Blue Ball, Ohio	1	____	0.0	0.0	0.0
10. Junction of Route 123 & Dayton-Oxford Rd.	1	____	0.18×10^{-14}	0.009	3.0
11. Chautauqua, Ohio	1	____	0.0	0.0	0.0
12. Junction of Benner Rd. & Route 25	1	____	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
13. Miami Drive In Theatre in Miamisburg (on Route 25)	2	3.15×10^{-14}	1.58×10^{-14}	0.079	26.3
14. Junction of Farmington Rd. & Chautauqua Rd.	2	3.6×10^{-14}	3.15×10^{-14}	0.157	52.5
15. Junction of Farmington Rd. & Union Rd.	2	4.05×10^{-14}	3.37×10^{-14}	0.168	56.1
16. Junction of Farmington Rd. & Butter St.	2	1.35×10^{-14}	0.67×10^{-14}	0.033	11.1
17. Carlisle, Ohio	2	0.45×10^{-14}	0.22×10^{-14}	0.011	3.6
18. Middletown, Ohio	2	3.15×10^{-14}	2.02×10^{-14}	0.101	33.6
19. Junction of Route 4 & Route 73	2	0.63×10^{-14}	0.54×10^{-14}	0.027	9.0
20. Junction of Route 4 & Route 747	2	5.85×10^{-14}	3.37×10^{-14}	0.168	56.1
21. New Miami, Ohio	2	0.54×10^{-14}	0.22×10^{-14}	0.011	3.6
22. Junction of West Elkton Rd. & Tolbert Rd.	2	0.45×10^{-14}	0.22×10^{-14}	0.011	3.6
23. Jacksonburg, Ohio	2	3.15×10^{-14}	2.52×10^{-14}	0.126	42.0
24. Junction of Hetzler Rd. & Hinkle Rd.	1	———	4.05×10^{-14}	0.202	67.5
25. Junction of Lower Miamisburg Rd. & Union Rd.	2	5.67×10^{-14}	2.92×10^{-14}	0.146	48.6

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
26. Junction of Lower Miamisburg Rd. & Jamaica Rd.	2	____	0.0	0.0	0.0
27. Junction of Route 725 & Route 4	2	0.45×10^{-14}	0.22×10^{-14}	0.011	3.6
28. Germantown, Ohio	2	5.85×10^{-14}	3.15×10^{-14}	0.157	52.5
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.	2	4.07×10^{-14}	3.37×10^{-14}	0.168	56.1
30. Gratis, Ohio	2	4.05×10^{-14}	2.22×10^{-14}	0.111	37.0
31. Eaton, Ohio	2	5.40×10^{-14}	3.24×10^{-14}	0.162	54.0
32. Camden, Ohio	2	5.58×10^{-14}	3.24×10^{-14}	0.162	54.0
33. Somerville, Ohio	2	4.05×10^{-14}	2.16×10^{-14}	0.108	36.0
34. Junction of Greenbush Rd. & Route 122	2	5.85×10^{-14}	2.92×10^{-14}	0.146	48.6
35. Junction of Oxford Rd. & Browns Run Rd.	2	5.85×10^{-14}	4.95×10^{-14}	0.247	82.5
36. Miamisburg South City Limit on Route 25	2	4.05×10^{-14}	2.47×10^{-14}	0.123	41.1
37. Junction of Mound Ave. & Route 25	2	____	0.0	0.0	0.0
38. Junction of Union Rd. & Route 725	2	0.27×10^{-14}	0.18×10^{-14}	0.009	3.0
39. Junction of Union Rd. & Manning Rd.	2	0.90×10^{-14}	0.81×10^{-14}	0.040	13.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
40. Junction of Manning Rd. & Route 4	2	1.26×10^{-14}	0.63×10^{-14}	0.031	10.5
41. Junction of Route 4 & Farmersville-West Carrollton Rd.	2	0.36×10^{-14}	0.18×10^{-14}	0.009	3.0
42. Junction of Diamond Mill Rd. & Mile Rd.	2	___	0.0	0.0	0.0
43. Junction of Clayton Rd. & Amity Rd.	2	1.08×10^{-14}	0.67×10^{-14}	0.033	11.1
44. Brookville, Ohio	2	0.09×10^{-14}	0.04×10^{-14}	0.002	0.66
45. Junction of Lexington Salem Rd. & Preble County Line Rd.	2	___	0.0	0.0	0.0
46. Junction of Lexington Salem Rd. & Engle Rd.	2	___	0.0	0.0	0.0
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.	2	0.63×10^{-14}	0.31×10^{-14}	0.015	5.1
48. Farmersville, Ohio	2	0.54×10^{-14}	0.31×10^{-14}	0.015	5.1
49. Fifth St. & Central Ave. in Miamisburg, Ohio	2	4.50×10^{-14}	3.10×10^{-14}	0.150	51.1
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	2	3.33×10^{-14}	1.84×10^{-14}	0.092	30.6
51. One mile north on Upper River Rd. from sample #50	2	0.45×10^{-14}	0.22×10^{-14}	0.011	3.6

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	2	3.60×10^{-14}	3.24×10^{-14}	0.162	54.0
53. Dayton Speedway	2	3.15×10^{-14}	3.06×10^{-14}	0.153	51.0
54. Dayton, Ohio	2	0.36×10^{-14}	0.18×10^{-14}	0.009	3.0
55. Murlin Heights	2	____	0.0	0.0	0.0
56. Little York	2	5.4×10^{-14}	3.73×10^{-14}	0.186	62.1
57. Clayton, Ohio	2	0.45×10^{-14}	0.23×10^{-14}	0.012	3.8
58. Trotwood, Ohio	2	1.17×10^{-14}	0.76×10^{-14}	0.038	12.6
59. Union Rd. & Liberty-Dayton Rd.	2	____	0.0	0.0	0.0
60. Union Rd. & Bear Creek Rd.	2	0.09×10^{-14}	0.04×10^{-14}	0.002	0.66
61. Harmon Field in Miamisburg	3	4.50×10^{-14}	1.65×10^{-14}	0.082	27.5
62. Junction of Route 725 & Heincke Rd.	3	3.60×10^{-14}	1.35×10^{-14}	0.067	22.5
63. Junction of Elm St. & Route 25 in West Carrollton	3	4.50×10^{-14}	1.50×10^{-14}	0.075	25.0
64. Woody's Market in West Carrollton	3	5.85×10^{-14}	1.95×10^{-14}	0.097	32.5
65. Junction of South Broadway & Dryden Rd.	3	4.95×10^{-14}	2.37×10^{-14}	0.118	39.5
66. Junction of Route 75 & Wagner Ford Rd.	3	0.18×10^{-14}	0.06×10^{-14}	0.003	1.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
67. Junction of Route 201 & Chambersburg Rd.	3	2.34×10^{-14}	0.87×10^{-14}	0.043	14.5
68. Fairborn, Ohio	3	3.60×10^{-14}	1.20×10^{-14}	0.060	20.0
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	3	0.18×10^{-14}	0.06×10^{-14}	0.003	1.0
70. Belmont Auto Theatre	3	5.40×10^{-14}	2.83×10^{-14}	0.141	47.1
71. Town & Country Shopping Center in Kettering, Ohio	3	2.70×10^{-14}	0.90×10^{-14}	0.045	15.0
72. Junction of Yankee Street & Mad River Rd.	3	0.63×10^{-14}	0.36×10^{-14}	0.018	6.0
73. Junction of Maue Rd. & Linden Ave.	1	____	0.72×10^{-14}	0.036	12.0
74. Junction of Byers Rd. & Belvo Rd.	1	____	0.0	0.0	0.0
75. Junction of Route 725 & Route 75	1	____	0.18×10^{-14}	0.009	3.0
76. Junction of Yankee St. & Route 725	1	____	0.18×10^{-14}	0.009	3.0
77. Centerville, Ohio	1	____	1.44×10^{-14}	0.072	24.0
78. Bellbrook, Ohio	1	____	4.95×10^{-14}	0.247	82.5
79. Xenia, Ohio	1	____	0.0	0.0	0.0
80. Junction of Spring Valley-Paintersville Rd. & Route 380	1	____	0.36×10^{-14}	0.018	6.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
81. Spring Valley, Ohio	1	____	0.09×10^{-14}	0.005	1.5
82. Mt. Holly, Ohio	1	____	0.18×10^{-14}	0.009	3.0
83. Junction of Route 48 & Social Row Rd.	1	____	5.40×10^{-14}	0.270	90.0
84. Waldruhe Park	1	____	0.18×10^{-14}	0.009	3.0
85. Junction of Mound Rd. & Benner Rd.	No samples taken at locations 85 through 95 during this quarter.				
86. Junction of Benner Rd. & Miamisburg-Springboro Pike					
87. Junction of Medlar Rd. & Miamisburg-Springboro Pike					
88. Junction of Wood Rd. & Pennyroyal Rd.					
89. Springboro, Ohio					
90. Junction of Route 122 & Utica Rd.					
91. Orgonia					
92. Harveysburg, Ohio					
93. Waynesville, Ohio					
94. By TV Tower on Lytle-Five Points Rd.					
95. South Montgomery County Airport					

* All concentrations are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration

MLM-MU-62-61-0012

ENVIRONMENTAL MONITORING REPORT

FOURTH QUARTER 1961

Health Physics Department

P. C. Adams

Date Issued: January 15, 1962

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

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I. SUMMARY

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the fourth quarter of 1961 is presented. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the quarter.

II. INTRODUCTION

This report presents in summary form the findings of the Environmental Monitoring Program conducted by the Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio. The program is planned and coordinated with regards to all of the various projects performed therein. The monitoring procedures used are those best suited for the detection and measurement of appropriate radioactive materials which Mound Laboratory could contribute to the environment.

During the period covered by this report, no radioactive materials have been used which have contributed any measurable penetrating radiation such as gamma or hard beta to the environment.

Polonium, plutonium and tritium are possible air contaminants; polonium and tritium are possible river water contaminants.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

III. WATER SAMPLING

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume and is handled separately as a packaged waste rather than being discharged to the river. Helium-3 being purified at Mound Laboratory yields small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

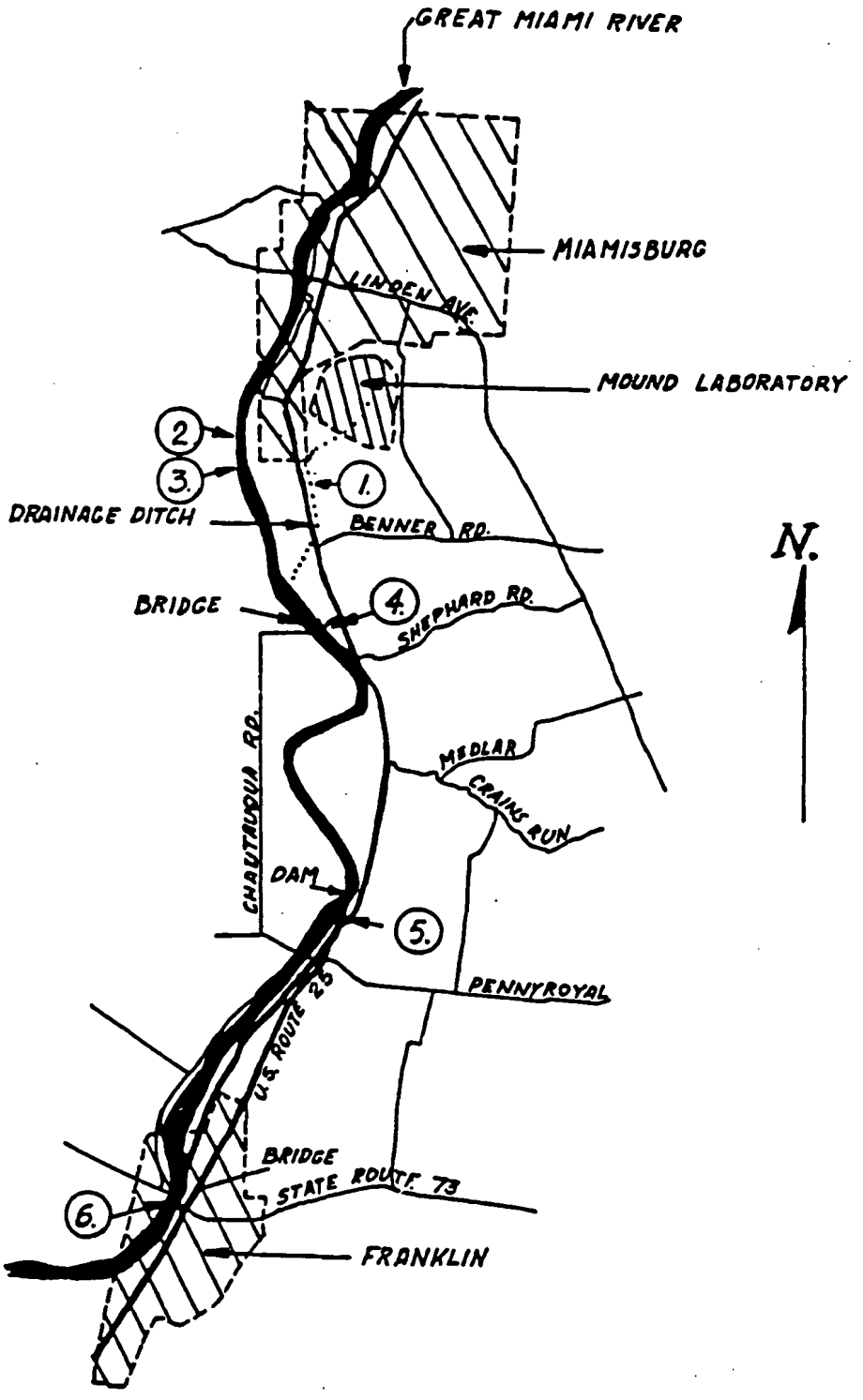
Aliquots from the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to a distance of five miles downstream. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries off all storm sewer water and

eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and part of the river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I "Summary of Off-Site Water Monitoring For Radioactivity, October Through December, 1961."

The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is within the maximum permissible continuous concentration.

In addition to the water sample locations identified on Map I, samples are collected on a quarterly basis farther downstream at Trenton, Ohio, New Miami, Ohio, New Baltimore, Ohio, Miamitown, Ohio and Elizabethtown, Ohio.



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GREAT MIAMI RIVER WATER SAMPLE LOCATIONS

MAP I.

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

OCTOBER THROUGH DECEMBER, 1961

I. Polonium (River Samples)

Sample Locations	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	5	11	7.74×10^{-8}	9.36×10^{-9}	1.33
250 Yards Downstream	6	11	1.8×10^{-9}	1.62×10^{-10}	0.023
Chautauqua Road Bridge	7	11	1.8×10^{-9}	3.2×10^{-10}	0.045
Chautauqua Dam	8	11	3.6×10^{-9}	6.48×10^{-10}	0.092
Franklin, Ohio	9	11	0.0	0.0	0.0
Trenton, Ohio	None	1	0.0	0.0	0.0
New Miami, Ohio	None	1	0.0	0.0	0.0
New Baltimore, Ohio	None	1	0.0	0.0	0.0
Miamitown, Ohio	None	1	0.0	0.0	0.0
Elizabethtown, Ohio	None	1	0.0	0.0	0.0
Over-all		60	7.74×10^{-8}	1.92×10^{-9}	0.27
II. Tritium (River Samples, Except Drainage Ditch)					
Mound Lab Drainage Ditch	1	11	5.0×10^{-3}	6.3×10^{-4}	12.6
Mound Lab Effluent	5	11	2.0×10^{-3}	1.8×10^{-4}	3.6
Chautauqua Road Bridge	7	11	2.0×10^{-3}	2.7×10^{-4}	5.4
Over-all		33	5.0×10^{-3}	3.6×10^{-4}	7.2

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

IV. AIR SAMPLING

Monitoring of the environmental air for tritium concentration by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. A total of 181 evaluations were made at 59 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environmental air has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for tritium air sampling. During this quarter, a total of 159 air samples were collected and analyzed. A long-lived gross alpha determination was made on filter paper samples after sufficient time had elapsed to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

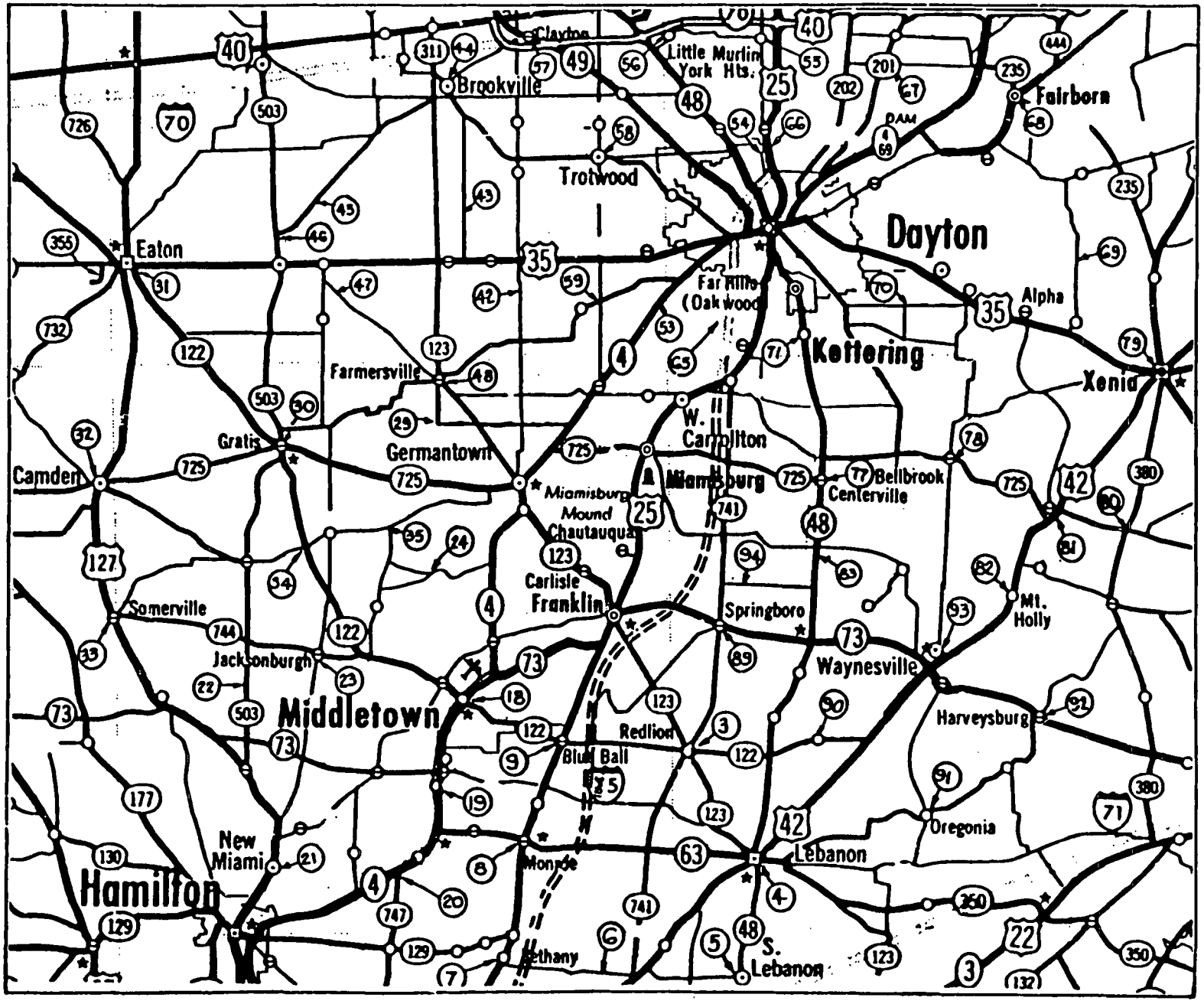
The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha

detected in the environment (see Table II) to the Maximum Permissible Continuous Concentration for polonium in the environment, and assume that all alpha activity detected is polonium, we find that the average polonium concentration would be only 0.045 per cent of the permissible. Our effluent stack monitoring program for this quarter had indicated that we should expect essentially no detectable polonium or plutonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table II again) to the Maximum Permissible Continuous Concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration would be well within the permissible; however, it would be a significant 14.8 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and frequently exceeds the very low permissible concentration for plutonium. That is to say the normal gross alpha (long-lived) count in the environment is usually a very significant per cent of and frequently exceeds the permitted alpha count for plutonium if the total count were attributed to plutonium. The impact of plutonium work at Mound Laboratory is also placed in proper

focus by referring to our stack monitoring data. During the fourth quarter of 1961, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium and/or polonium operations have contributed an insignificant burden to the radioactivity normally present in the atmosphere.

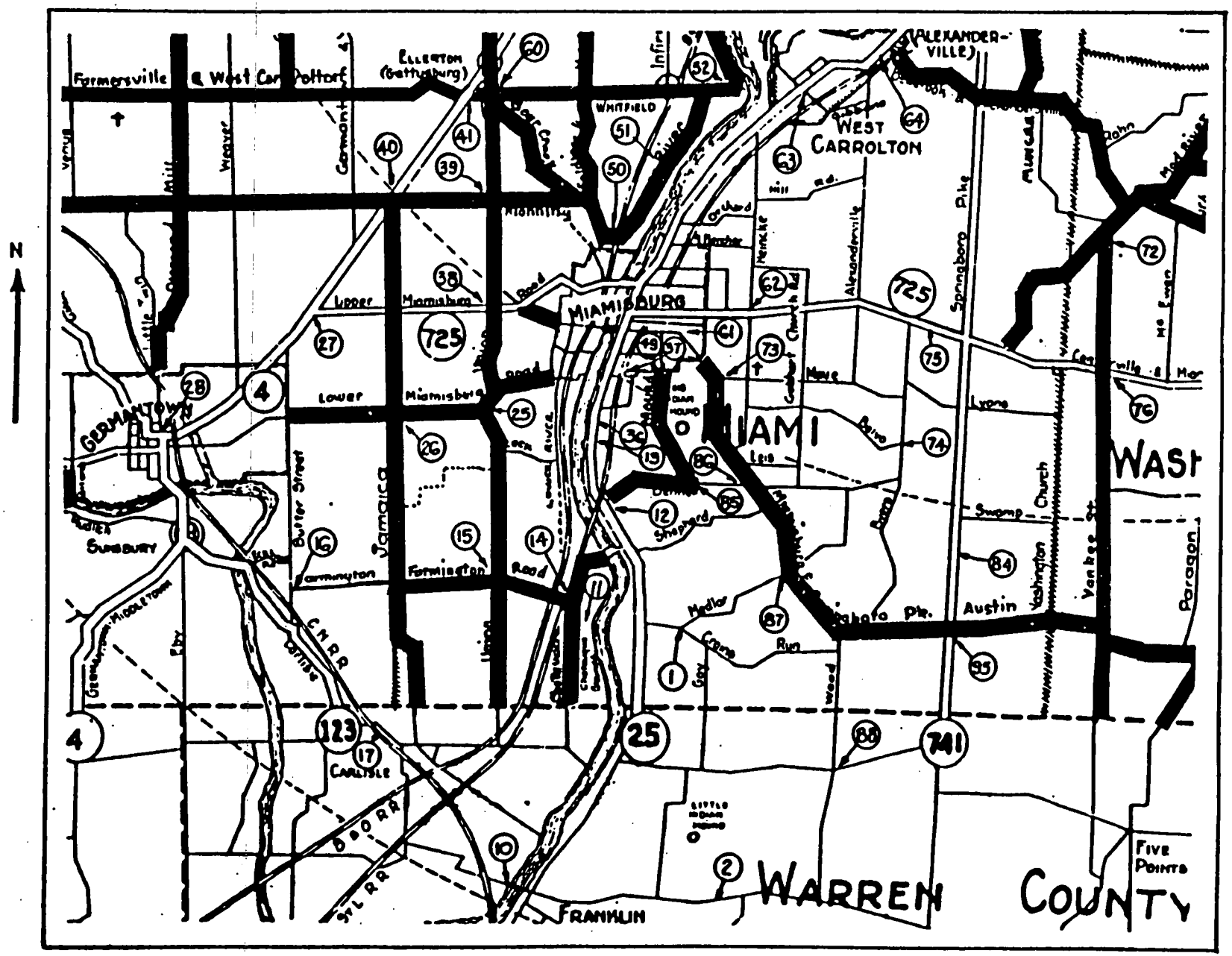
In Table III "Environmental Monitoring Locations and Results for Long-Lived Alpha Emitters, October Through December, 1961," we have listed for each sampling site the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 show the location of sampling sites relative to Mound Laboratory. The selection of sites to be sampled depends upon the wind direction on the days that samples are collected. Samples are collected upwind and downwind from the plant according to routes drawn up for the different wind directions. Depending upon wind direction, it is likely that all sites will not be sampled during any one quarter.



MAP 2

AIR SAMPLE LOCATIONS AND ROAD MAP

LOCATION O→



MAP 3

AIR SAMPLE LOCATION AND ROAD MAP

LOCATIONS O→

TABLE II

COMPOSITE - AIR SAMPLING DATA FOR LONG-LIVED ALPHA EMITTERS

OCTOBER THROUGH DECEMBER, 1961

	Sampling Locations	Samples Collected	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
A. Downwind Sampling						
	83	159	14.13×10^{-13}	2.54×10^{-14}	0.127	42.3
B. Upwind Sampling						
	12	24	2.28×10^{-13}	1.65×10^{-14}	0.082	27.5
C. Difference						
			11.85×10^{-13}	0.89×10^{-14}	0.045	14.8

* All Concentrations in Tables II and III are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

TABLE III

ENVIRONMENTAL MONITORING LOCATIONS AND RESULTS FOR LONG-LIVED ALPHA EMITTERS

OCTOBER THROUGH DECEMBER, 1961

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.	1	____	0.0	0.0	0.0
2. Junction of Route 73 & Interstate 75	1	____	0.0	0.0	0.0
3. Red Lion, Ohio	1	____	0.27×10^{-14}	0.013	4.0
4. Lebanon, Ohio	1	____	0.0	0.0	0.0
5. South Lebanon, Ohio	1	____	0.36×10^{-14}	0.018	6.0
6. Junction of Bethany Rd. & Mason-Montgomery Rd.	1	____	0.0	0.0	0.0
7. Bethany, Ohio	1	____	0.36×10^{-14}	0.018	6.0
8. Monroe, Ohio	1	____	0.0	0.0	0.0
9. Blue Ball, Ohio	1	____	0.54×10^{-14}	0.027	9.0
10. Junction of Route 123 & Dayton-Oxford Rd.	1	____	0.18×10^{-14}	0.009	3.0
11. Chautauqua, Ohio	1	____	0.18×10^{-14}	0.009	3.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
12. Junction of Benner Rd. & Route 25	1	——	0.0	0.0	0.0
13. Miami Drive In Theatre in Miamisburg (on Route 25)	1	——	0.0	0.0	0.0
14. Junction of Farmington Rd. & Chautauqua Rd.	1	——	0.72×10^{-14}	0.036	12.0
15. Junction of Farmington Rd. & Union Rd.	1	——	0.72×10^{-14}	0.036	12.0
16. Junction of Farmington Rd. & Butter St.	1	——	1.26×10^{-14}	0.063	21.0
17. Carlisle, Ohio	1	——	0.63×10^{-14}	0.031	10.5
18. Middletown, Ohio	1	——	3.15×10^{-14}	0.036	52.5
19. Junction of Route 4 & Route 73	1	——	1.08×10^{-14}	0.054	18.0
20. Junction of Route 4 & Route 747	1	——	0.63×10^{-14}	0.031	10.5
21. New Miami, Ohio	1	——	2.25×10^{-14}	0.112	37.5
22. Junction of West Elkton Rd. & Tolbert Rd.	1	——	0.63×10^{-14}	0.031	10.5
23. Jacksonburg, Ohio	1	——	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
24. Junction of Hetzler Rd. & Hinkle Rd.	1	——	0.0	0.0	0.0
25. Junction of Lower Miamisburg Rd. & Union Rd.	2	15.2×10^{-14}	8.82×10^{-14}	0.441	147.0
26. Junction of Lower Miamisburg Rd. & Jamaica Rd.	2	3.69×10^{-14}	2.97×10^{-14}	0.148	49.5
27. Junction of Route 725 & Route 4	2	10.44×10^{-14}	5.62×10^{-14}	0.281	93.6
28. Germantown, Ohio	2	10.08×10^{-14}	8.46×10^{-14}	0.423	141.0
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.	2	9.81×10^{-14}	4.90×10^{-14}	0.245	81.6
30. Gratis, Ohio	2	9.63×10^{-14}	6.03×10^{-14}	0.301	100.0
31. Eaton, Ohio	2	2.79×10^{-14}	1.75×10^{-14}	0.088	29.1
32. Camden, Ohio	2	3.78×10^{-14}	2.52×10^{-14}	0.126	42.0
33. Somerville, Ohio	2	1.80×10^{-14}	1.03×10^{-14}	0.515	17.1
34. Junction of Greenbush Rd. & Route 122	2	5.31×10^{-14}	3.10×10^{-14}	0.155	51.6
35. Junction of Oxford Rd. & Browns Run Rd.	2	0.63×10^{-14}	0.49×10^{-14}	0.024	8.1

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
36. Miamisburg South City Limit on Route 25	2	4.41×10^{-14}	3.55×10^{-14}	0.177	59.1
37. Junction of Mound Ave. & Route 25	No samples were collected at locations 37 through 48 during this quarter due to the lack of wind direction toward that area at the prescribed sampling times.				
38. Junction of Union Rd. & Route 725					
39. Junction of Union Rd. & Manning Rd.					
40. Junction of Manning Rd. & Route 4					
41. Junction of Route 4 & Farmersville-West Carrollton Rd.					
42. Junction of Diamond Mill Rd. & Mile Rd.					
43. Junction of Clayton Rd. & Amity Rd.					
44. Brookville, Ohio					
45. Junction of Lexington Salem Rd. & Preble County Line Rd.					
46. Junction of Lexington Salem Rd. & Engle Rd.					

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
47. Junction of Farmersville-West Alexandria Pike & DeChant Rd.					
48. Farmersville, Ohio					
49. Fifth St. & Central Ave. in Miamisburg, Ohio	2	3.96×10^{-14}	1.98×10^{-14}	0.099	33.0
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	2	1.62×10^{-14}	0.81×10^{-14}	0.040	13.5
51. One mile north on Upper River Rd. from sample #50	2	0.54×10^{-14}	0.49×10^{-14}	0.024	8.1
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	2	0.27×10^{-14}	0.13×10^{-14}	0.006	2.1
53. Dayton Speedway	2	1.17×10^{-14}	0.58×10^{-14}	0.029	9.6
54. Dayton, Ohio	2	1.62×10^{-14}	1.21×10^{-14}	0.060	20.1
55. Murlin Heights	2	—	0.0	0.0	0.0
56. Little York	2	0.99×10^{-14}	0.49×10^{-14}	0.024	8.1
57. Clayton, Ohio	2	1.17×10^{-14}	0.58×10^{-14}	0.029	9.6

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
58. Trotwood, Ohio	2	____	0.0	0.0	0.0
59. Union Rd. & Liberty-Dayton Rd.	2	1.62×10^{-14}	0.81×10^{-14}	0.040	13.5
60. Union Rd. & Bear Creek Rd.	2	1.44×10^{-14}	0.72×10^{-14}	0.036	12.0
61. Harmon Field in Miamisburg	5	1.98×10^{-14}	1.53×10^{-14}	0.076	25.8
62. Junction of Route 725 & Heincke Rd.	5	8.64×10^{-14}	2.53×10^{-14}	0.126	42.1
63. Junction of Elm St. & Route 25 in West Carrollton	5	1.26×10^{-14}	0.46×10^{-14}	0.023	7.6
64. Woody's Market in Carrollton	5	1.53×10^{-14}	0.90×10^{-14}	0.045	15.0
65. Junction of South Broadway & Dryden Rd.	5	1.17×10^{-14}	0.43×10^{-14}	0.058	7.1
66. Junction of Route 75 & Wagner Ford Rd.	4	9.72×10^{-14}	2.70×10^{-14}	0.135	45.0
67. Junction of Route 201 & Chambersburg Rd.	4	141.3×10^{-14}	36.38×10^{-14}	1.82	606.
68. Fairborn, Ohio	4	1.71×10^{-14}	0.58×10^{-14}	0.029	9.6

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
69. Junction of Fair-ground Rd. & New Germany-Trebein Rd.	4	3.87×10^{-14}	1.15×10^{-14}	0.057	19.1
70. Belmont Auto Theatre	4	16.11×10^{-14}	5.67×10^{-14}	0.283	94.5
71. Town & Country Shopping Center in Kettering, Ohio	4	2.97×10^{-14}	0.81×10^{-14}	0.040	13.5
72. Junction of Yankee St. & Mad River Rd.	4	4.52×10^{-14}	1.26×10^{-14}	0.063	21.0
73. Junction of Maue Rd. & Linden Ave.	1	____	0.0	0.0	0.0
74. Junction of Byers Rd. Belvo Rd.	1	____	0.0	0.0	0.0
75. Junction of Route 725 & Route 75	1	____	0.0	0.0	0.0
76. Junction of Yankee St. & Route 725	1	____	0.0	0.0	0.0
77. Centerville, Ohio	1	____	0.0	0.0	0.0
78. Bellbrook, Ohio	1	____	0.0	0.0	0.0
79. Xenia, Ohio	1	____	0.9×10^{-14}	0.045	15.0
80. Junction of Spring Valley-Paintersville Rd. & Route 380	1	____	0.0	0.0	0.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
81. Spring Valley, Ohio	1	___	0.0	0.0	0.0
82. Mt. Holly, Ohio	1	___	0.0	0.0	0.0
83. Junction of Route 48 & Social Row Rd.	1	___	0.0	0.0	0.0
84. Waldruhe Park	1	___	$.54 \times 10^{-14}$	0.027	9.0
85. Junction of Mound Rd. & Benner Rd.	2	5.94×10^{-14}	2.97×10^{-14}	0.148	49.5
86. Junction of Benner Rd. & Miamisburg-Springboro Pike	2	0.45×10^{-14}	0.22×10^{-14}	0.011	3.6
87. Junction of Medlar Rd. & Miamisburg-Springboro Pike	2	2.25×10^{-14}	1.12×10^{-14}	0.056	18.6
88. Junction of Wood Rd. & Pennyroyal Rd.	2	0.90×10^{-14}	0.45×10^{-14}	0.022	7.5
89. Springboro, Ohio	2	0.45×10^{-14}	0.27×10^{-14}	0.013	4.5
90. Junction of Route 122 & Utica Rd.	2	1.98×10^{-14}	0.99×10^{-14}	0.049	16.5
91. Orgonia	2	2.07×10^{-14}	1.12×10^{-14}	0.056	18.6
92. Harveysburg, Ohio	2	1.08×10^{-14}	0.54×10^{-14}	0.027	9.0
93. Waynesville, Ohio	2	1.17×10^{-14}	0.58×10^{-14}	0.029	9.6

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
94. By TV Tower on Lytle-Five Points Rd.	2	0.81×10^{-14}	0.40×10^{-14}	0.020	6.6
95. South Montgomery County Airport	2	____	0.0	0.0	0.0

* All Concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

ENVIRONMENTAL MONITORING REPORT

1959/1960

Health Physics Department

1959/1960

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

UNCLASSIFIED

1959-1960

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MONSANTO CHEMICAL COMPANY
MOUND LABORATORY
MIAMISBURG, OHIO

CLASSIFICATION CANCELLED
DATE 4/75
For the U. S. Energy Research and Development Administration
Division of Classification

ENVIRONMENTAL MONITORING DATA REPORT

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ENVIRONMENTAL MONITORING DATA REPORT

Monsanto Chemical Company has conducted a routine environmental air monitoring program in the southwestern section of Ohio for the determination of radioactive materials since operations began at Mound Laboratory in Miamisburg, Ohio, in 1949. Monsanto Chemical Company operates Mound Laboratory under Atomic Energy Commission Contract.

Some 67 locations are monitored routinely. These sampling locations lie in all directions from the Laboratory out to a distance of approximately 40 miles.

The radioactive isotopes in use at this Laboratory are tritium, a low energy beta emitter, polonium and plutonium which are alpha emitting isotopes. During the period covered by the attached summary air monitoring reports, no radioactive materials have been used which have contributed any measurable penetrating ionizing radiation such as gamma or hard beta to the environment.

Since more than one alpha emitting isotope has been in use simultaneously in the Laboratory, one phase of our air monitoring consists of making a gross alpha analysis of all air samples collected.

During the year 1959, a year of transition, the primary alpha emitting isotope which could have contributed to the environmental background was polonium. From the data given in the attached "Summary of Environmental Air Monitoring...January Through December,

1959" under "Gross Alpha" the average concentration of all alpha activity in the samples collected was 1.09×10^{-13} microcuries per cubic centimeter of air. This concentration, if assumed to be all polonium, is 0.054 per cent of the maximum permissible continuous concentration in air for this isotope.

During the first quarter of 1960, as presented in the data in the attached "Summary of Environmental Air Monitoring ...January Through March 1960" under "Gross Alpha," the average alpha activity in the environment was 1.73×10^{-13} microcuries per cubic centimeter of air. During this period, both polonium and plutonium would have been possible contaminants contributed to the environmental background. Since the maximum permissible continuous concentration of plutonium in the atmosphere is considerably lower (by a factor of 3,000) we assume that the gross alpha count is contributed solely by the plutonium. In this case, the gross alpha activity detected was 28.8 per cent of the maximum permissible continuous concentration for plutonium in the air.

Monitoring for tritium in the environment was also conducted during 1959 and is being continued at the present time. Monitoring for this isotope is performed routinely out to a distance of five miles in all directions around the Laboratory. Some 54 locations are monitored. The concentration of this isotope in the environment has been immeasurable to date.

The maximum permissible continuous concentration of the various radioisotopes in the air has been set by the National Committee on Radiation Protection and Measurements.

In addition to the environmental air monitoring program, Monsanto Chemical Company conducts concurrently a routine monitoring program for the waters of the Great Miami River. Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity so that the concentration in the water finally discharged to the river is within the maximum permissible continuous concentration recommended by the National Committee on Radiation Protection and Measurement.

Liquid waste from plutonium work is very small in volume. It is handled separately as a packaged waste and not discharged to the river.

Liquid waste from tritium work, also very small in volume, is treated separately to assure that the radioactivity content is within the maximum permissible continuous concentration before discharge to the Great Miami River. During 1959 and to this date, the concentration of this isotope in all river water samples has been below the limits of detection except for one sample. This sample yielded a concentration of 0.003 microcuries per cubic centimeter of water. The permissible concentration of this isotope in water

is 0.050 microcuries per cubic centimeter.* This particular sample was, therefore, 6 per cent of the permissible continuous concentration.

Data obtained from our routine monitoring for polonium in the Great Miami River during 1959 is presented in the attached "Summary of Monitoring for Radioactivity in the Great Miami River, January Through December, 1959." The highest detectable average concentration appeared, as would be expected, at the location where the effluent stream enters the river. The average concentration at this point was 13.57×10^{-8} microcuries per cubic centimeter of water. The maximum permissible continuous concentration of polonium in the river water as recommended by the National Committee on Radiation and Measurement is 7×10^{-6} microcuries per cubic centimeter of water.* Therefore, the highest polonium concentration is slightly less than two per cent of the permitted level. There was no polonium detectable in the water beyond five miles downstream.

The highest average polonium concentration determined during the first quarter of 1960, as presented in the attached "Summary of Monitoring for Radioactivity in the Great Miami River, January Through March, 1960" was 32.60×10^{-8} microcuries per cubic centimeter of water. This represents 4.6 per cent of the permitted level. There was no polonium detectable in the water beyond five miles downstream.

* That quantity which may be continuously present in drinking water.

SUMMARY OF ENVIRONMENTAL AIR MONITORING

MOUND LABORATORY, MIAMISBURG, OHIO

JANUARY THROUGH DECEMBER, 1959

I. Gross Alpha

Distance From Mound Laboratory	Average Concentration	Number of Sampling Locations
0 - 5 miles	1.23×10^{-13} µc/cc	12
5 - 15 miles	1.18×10^{-13} µc/cc	15
15 - 30 miles	0.94×10^{-13} µc/cc	26
30 - 40 miles	1.16×10^{-13} µc/cc	14

Maximum permissible continuous concentration in air - polonium is 2×10^{-10} µc/cc

II. Tritium

We have found no detectable concentration of this isotope.

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SUMMARY OF ENVIRONMENTAL AIR MONITORING

MOUND LABORATORY, MIAMISBURG, OHIO

JANUARY THROUGH MARCH 1960

I. Gross Alpha

Distance From Mound Laboratory	Average Concentration	Number of Sampling Locations
0 - 5 miles	1.84×10^{-13} µc/cc	12
5 - 15 miles	2.06×10^{-13} µc/cc	15
15 - 30 miles	1.62×10^{-13} µc/cc	26
30 - 40 miles	1.49×10^{-13} µc/cc	14

Maximum permissible continuous concentration in air - plutonium is 6×10^{-13} µc/cc

II. Tritium

We have found no detectable concentration of this isotope.

UNCLASSIFIED

SUMMARY OF MONITORING FOR RADIOACTIVITY IN THE GREAT MIAMI RIVER, JANUARY THROUGH DECEMBER, 1959

MOUND LABORATORY, MIAMISBURG, OHIO

I. Polonium

Sample Location*	Average Concentration in $\mu c/cc$
Mound Lab Effluent	13.57×10^{-8}
200 Yards Downstream	0.88×10^{-8}
250 Yards Downstream	0.49×10^{-8}
300 Yards Downstream	0.41×10^{-8}
1 Mile Downstream	0.20×10^{-8}
2 Miles Downstream	0.49×10^{-8}
5 Miles Downstream	0.14×10^{-8}
Over 5 Miles Downstream	0.00

Maximum permissible continuous concentration in water is 7×10^{-6} $\mu c/cc$.

* The first sampling location in the river is the point at which the Laboratory effluent stream contacts the river.

II. Tritium

One sample yielded a concentration of 0.003 $\mu c/cc$ of water.

All other samples indicated no tritium present.

Maximum permissible continuous concentration in water is 0.050 $\mu c/cc$.

SUMMARY OF MONITORING FOR RADIOACTIVITY IN THE GREAT MIAMI RIVER, JANUARY THROUGH MARCH, 1960

MOUND LABORATORY, MIAMISBURG, OHIO

I. Polonium

Sample Location*	Average Concentration in μc/cc
Mound Lab Effluent	32.60×10^{-8}
200 Yards Downstream	0.07×10^{-8}
250 Yards Downstream	0.09×10^{-8}
300 Yards Downstream	0.45×10^{-8}
1 Mile Downstream	0.02×10^{-8}
2 Miles Downstream	0.09×10^{-8}
5 Miles Downstream	0.16×10^{-8}
Over 5 Miles Downstream	0.00

Maximum permissible continuous concentration in water is 7×10^{-6} μc/cc.

* The first sampling location in the river is the point at which the Laboratory effluent stream contacts the river.

II. Tritium

All samples indicated no tritium present.

SUMMARY OF ENVIRONMENTAL MONITORING REPORT FOR SECOND QUARTER 1960

Health Physics Department

Date Issued: August 5, 1960

MOUND LABORATORY
Miamisburg, Ohio Operated By

MONSANTO CHEMICAL COMPANY
Research and Engineering Division

United States Atomic Energy Commission
Contract Number AT-33-1-GEN-53

This report presents in summary form the concentration of radioactive materials detected in the environment around Mound Laboratory. The monitoring procedures used are those best suited to the determination in air and river water samples, those radioactive materials which Mound Laboratory could contribute to the environment.

During the period covered by this report, no radioactive materials have been used which have contributed any measurable penetrating radiation such as gamma or hard beta to the environment.

Polonium, plutonium and tritium are possible air contaminants; polonium and tritium are possible river water contaminants.

Aliquots of the waters of the Great Miami River were collected routinely each week from the Laboratory effluent stream at the point of discharge to the river, to a distance of five miles downstream. Data on river water monitoring are presented in the attached "Summary of Monitoring for Radioactivity in the Great Miami River, April Through June, 1960." The highest detectable average concentration appeared at the location where the effluent stream enters the river. The average concentration at this point was 6.62×10^{-7} microcuries per cubic centimeter of water. This indicates that the effluent discharge concentration was practically at the maximum permissible concentration

for this quarter. The average concentration of all samples collected in the river proper was 0.012×10^{-7} microcuries per cubic centimeter, which is approximately 0.2 per cent of the maximum permissible.

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the river. Liquid waste from plutonium work is small in volume. It is handled separately as a packaged waste and not discharged to the river. Helium-3 being purified at Mound Laboratory yields small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River. During this quarter, the concentration of this isotope in river water samples has been below the limits of detection.

Monitoring of the environmental air for tritium concentration, by means of a continuous air monitor mounted in a one-ton panel truck, is performed routinely out to a distance of five miles in all directions around the Laboratory. Some 54 locations are monitored. The concentration of this isotope in the environment has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment, including a motor-generator power unit, also mounted in the one-ton panel truck used for tritium air sampling. A long-lived gross alpha determination on filter paper samples collected is made only after sufficient time has elapsed after collection to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

During this quarter, air samples were collected upwind as well as downwind in order to determine the possible polonium and plutonium contribution by the difference in the alpha concentration. A study of 146 air samples collected indicates an average concentration of 2.7×10^{-14} microcuries of long-lived alpha per cubic centimeter of air in the range of 0 - 5 miles from the Laboratory and no detectable presence of long-lived alpha material contributed by Mound Laboratory beyond five miles. If the alpha concentration in the 0 - 5 mile range is due to the Laboratory's operations, then the activity would be a combination of polonium and plutonium. At this very low concentration, the two isotopes cannot be distinguished. If we assume that the total activity is from polonium, then the

concentration of 2.7×10^{-14} microcuries per cubic centimeter is 0.13 per cent of the maximum permissible concentration. If we assume that the total activity is plutonium, then this concentration would be 45 per cent of the maximum permissible for this isotope. In either case, the concentration of alpha activity is well within the maximum permissible for the materials being used.

Air sampling data are presented in the attached "Summary of Environmental Air Monitoring, April Through June, 1960" under "Alpha Activity From Polonium and Plutonium."

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards, Handbook 69. The maximum permissible environmental air and water concentration for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

SUMMARY OF MONITORING FOR RADIOACTIVITY IN

THE GREAT MIAMI RIVER,

APRIL THROUGH JUNE, 1960

MOUND LABORATORY, MIAMISBURG, OHIO

I. Polonium

Sample Location	Average Concentration in $\mu c/cc$
Mound Lab Effluent	6.622×10^{-7}
200 Yards Downstream	0.012×10^{-7}
250 Yards Downstream	0.009×10^{-7}
300 Yards Downstream	0.008×10^{-7}
1 Mile Downstream	0.018×10^{-7}
2 Miles Downstream	0.021×10^{-7}
5 Miles Downstream	0.002×10^{-7}

II. Tritium

We have found no detectable concentration of this isotope.

SUMMARY OF ENVIRONMENTAL MONITORING

APRIL THROUGH JUNE, 1960

MOUND LABORATORY, MIAMISBURG, OHIO

I. Alpha Activity From Polonium and Plutonium

(Not including natural background)

Distance From Mound Laboratory	Average Concentration	Number of Sampling Locations	Number of Samples
0 - 5 miles	2.70×10^{-14} μc/cc	12	151
5 - 15 miles	0.00	15	15

II. Tritium

We have found no detectable concentration of this isotope.

MLM-MU-60-72 COC 17

SUMMARY OF ENVIRONMENTAL MONITORING REPORT FOR THIRD QUARTER 1960

Health Physics Department

Date Issued: December 5, 1960

MOUND LABORATORY
Miamisburg, Ohio
Operated By
MONSANTO CHEMICAL COMPANY
Research and Engineering Division

United States Atomic Energy Commission
Contract Number AT-33-1-GEN-53

Summary

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the third quarter of 1960 is presented. The concentration of polonium and tritium in the Great Miami River was well within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also well within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during this quarter.

Introduction

This report presents in summary form the concentration of radioactive materials detected in the environment around Mound Laboratory. The monitoring procedures used are those best suited to the determination in air and river water samples of those radioactive materials which Mound Laboratory could contribute to the environment.

During the period covered by this report, no radioactive materials have been used which have contributed any measurable penetrating radiation such as gamma or hard beta to the environment.

Polonium, plutonium and tritium are possible air contaminants; polonium and tritium are possible river water contaminants.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards, Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

Water Sampling

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume. It is handled separately as a packaged waste and not discharged to the river. Helium-3 being purified at Mound Laboratory yields small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

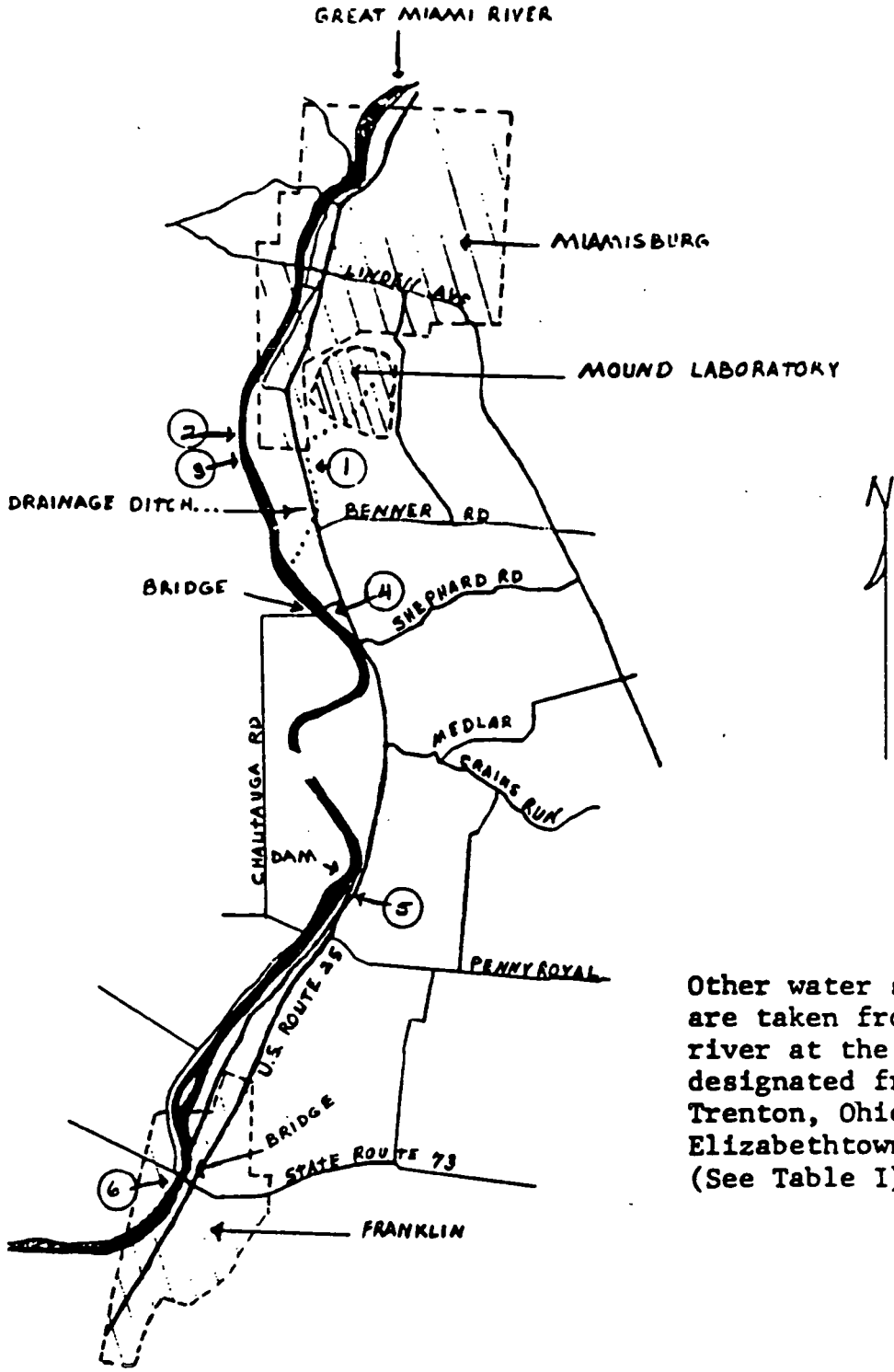
Aliquots of the waters of the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to the Great Miami River, to a distance of five miles downstream. Once each quarter, river water

samples are collected at various locations between Franklin, Ohio, and Elizabethtown, Ohio, where the Great Miami River enters into the Ohio River. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries off all storm sewer water, which eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and part of the river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I "Summary of Off-Site Water Monitoring for Radioactivity, July Through September, 1960."

The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is well within the maximum permissible continuous concentration.

Refer to the "Water Sample Locations" Map 1 on the following page to determine the location of the data presented in Table I mentioned above.



Other water samples are taken from the river at the cities designated from Trenton, Ohio, to Elizabethtown, Ohio. (See Table I)

GREAT MIAMI RIVER WATER SAMPLE LOCATIONS

MAP 1

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

JULY THROUGH SEPTEMBER, 1960

I. Polonium (All River Samples)

Sample Location	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	2	12	2.44×10^{-6}	2.36×10^{-7}	33.70
250 Yards Downstream	3	12	3.60×10^{-9}	1.05×10^{-9}	0.15
Chautauqua Road Bridge	4	11	3.60×10^{-9}	8.11×10^{-10}	0.12
Chautauqua Dam	5	12	3.60×10^{-9}	4.50×10^{-10}	0.06
Franklin, Ohio	6	11	2.70×10^{-8}	3.44×10^{-9}	0.49
Trenton, Ohio	None	1	0.0	0.0	0.00
New Miami, Ohio	None	1	0.0	0.0	0.00
7 Miles North of New Baltimore, Ohio	None	1	0.0	0.0	0.00
New Baltimore, Ohio	None	1	0.0	0.0	0.00
Miamitown, Ohio	None	1	0.0	0.0	0.00
5 Miles North of Elizabethtown, Ohio	None	1	0.0	0.0	0.00

Sample Location	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Elizabethtown, Ohio	None	1	0.0	0.0	0.00
Over-all		65	2.44×10^{-6}	4.45×10^{-9}	0.69

II. Tritium (All River Samples, Except Drainage Ditch)

Sample Location	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Drainage Ditch	1	15	3.0×10^{-3}	4.0×10^{-4}	14.0
Mound Lab Effluent	2	13	0.0	0.0	0.0
Chautauqua Road Bridge	4	5	0.0	0.0	0.0
Over-all		33	3.0×10^{-3}	1.82×10^{-4}	6.1

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

Air Sampling

Monitoring of the environmental air for tritium concentration by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of five miles from the Laboratory. A total of 86 evaluations were made at 30 different locations. The concentration of this isotope in the environment has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for tritium air sampling. During this quarter, a total of 117 air samples were collected and analyzed. A long-lived gross alpha determination on filter paper samples collected was made only after sufficient time had elapsed after collection to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

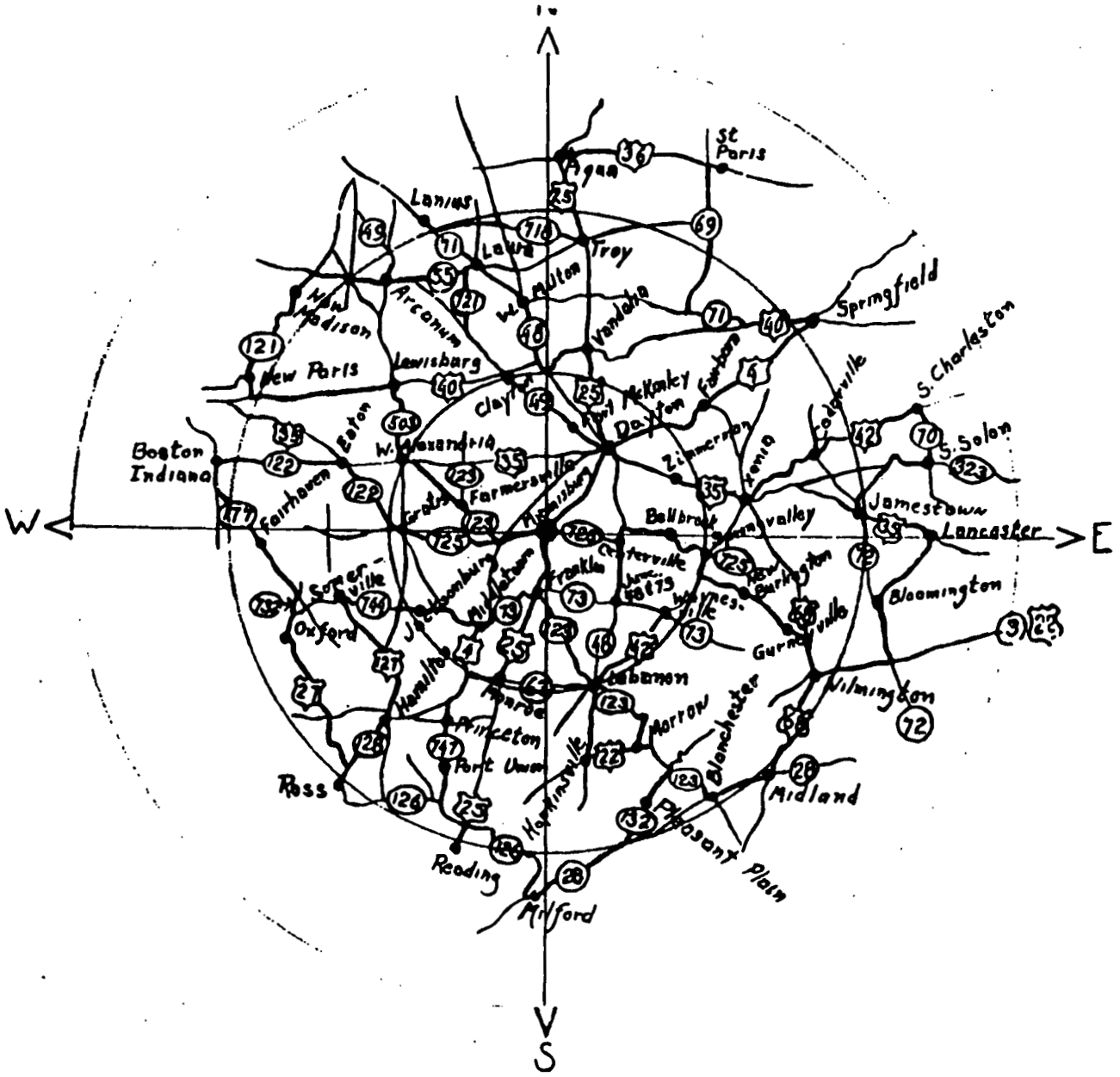
The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision. At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the

gross alpha detected in the environment (see Table II) to the Maximum Permissible Continuous Concentration for polonium in the environment, and assume that all alpha activity detected is polonium, we find that the average polonium concentration would be only 0.05 per cent of the permissible. Our polonium effluent stack monitoring program for this quarter has shown that we should expect essentially no detectable polonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table II again) to the Maximum Permissible Continuous Concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration would be well within the permissible; however, it would be a significant 17.4 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and frequently exceeds the very low permissible concentration for plutonium. That is to say the normal gross alpha (long-lived) count in the environment is usually a very significant per cent of and frequently exceeds the permitted alpha count for plutonium if the total count were attributed

to plutonium. The impact of plutonium work at Mound Laboratory is also placed in proper focus by referring to our plutonium stack monitoring data. During the third quarter of 1960, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say that the plutonium operations (as well as the polonium work) has contributed during this quarter, an insignificant burden to the radioactivity normally present in the atmosphere.

In Table II "Summary of Environmental Air Monitoring For Long-Lived Alpha Emitters," we have listed for each location sampled, the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps showing the location of sampling sites relative to Mound Laboratory are also included.

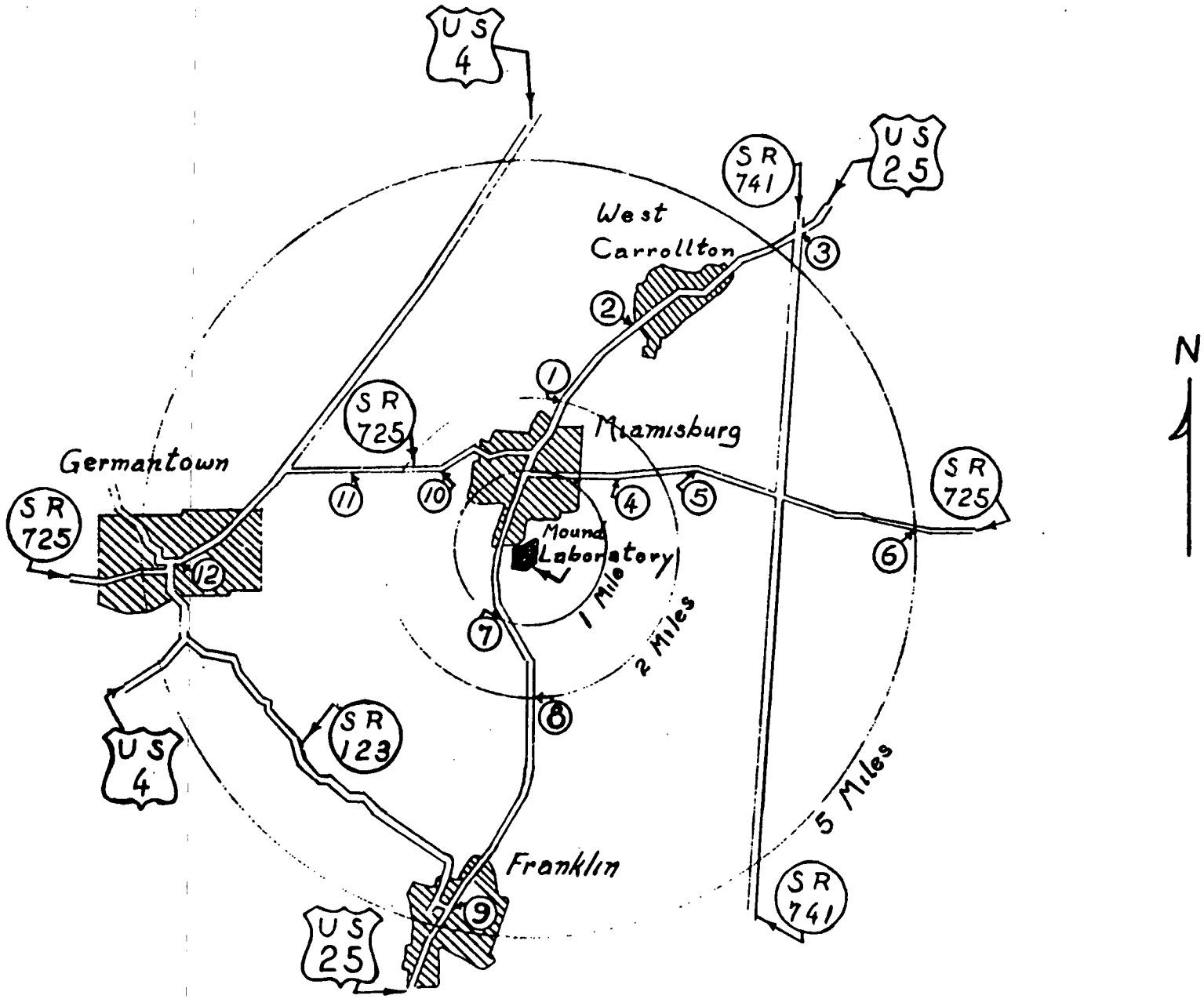


AIR SAMPLE LOCATIONS AND ROAD MAP

Air samples taken at all cities and locations listed.

Concentric rings approximately 15 miles apart.

MAP 2



Air samples taken at points (1) through (12)

AIR SAMPLE LOCATIONS AND ROAD MAP

MAP 3

TABLE II

SUMMARY OF ENVIRONMENTAL MONITORING FOR LONG-LIVED ALPHA EMITTERS

JULY THROUGH SEPTEMBER, 1960

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Franklin, Ohio	1	___	0.90×10^{-14}	0.045	15.0
2. Monroe, Ohio	1	___	4.50×10^{-14}	0.225	75.0
3. Princeton, Ohio	1	___	1.80×10^{-14}	0.090	30.0
4. Port Union, Ohio	1	___	5.40×10^{-14}	0.270	90.0
5. Reading, Ohio	1	___	0.0	0.0	0.0
6. Milford, Ohio	1	___	3.60×10^{-14}	0.180	60.0
7. Pleasant Plain, Ohio	1	___	2.70×10^{-14}	0.135	45.0
8. Hopkinsville, Ohio	1	___	0.0	0.0	0.0
9. Lebanon, Ohio	1	___	3.60×10^{-14}	0.180	60.0
10. Centerville, Ohio	1	___	0.90×10^{-14}	0.045	15.0
11. Junction of Routes 48 and 73	1	___	0.90×10^{-14}	0.045	15.0
12. Waynesville, Ohio	1	___	2.70×10^{-14}	0.135	45.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
13. Morrow, Ohio	1	____	0.90×10^{-14}	0.045	15.0
14. Blanchester, Ohio	1	____	0.0	0.0	0.0
15. Midland, Ohio	1	____	0.0	0.0	0.0
16. Wilmington, Ohio	1	____	3.60×10^{-14}	0.180	60.0
17. Gurneyville, Ohio	1	____	1.80×10^{-14}	0.090	30.0
18. Bellbrook, Ohio	1	____	5.40×10^{-14}	0.270	90.0
19. Spring Valley, Ohio	No samples taken at this location during this quarter				
20. New Burlington, Ohio	No samples taken at this location during this quarter				
21. Bloomington, Ohio	No samples taken at this location during this quarter				
22. Lancaster, Ohio	No samples taken at this location during this quarter				
23. Jamestown, Ohio	No samples taken at this location during this quarter				
24. South Solon, Ohio	No samples taken at this location during this quarter				
25. South Charleston, Ohio	No samples taken at this location during this quarter				
26. Cedarville, Ohio	No samples taken at this location during this quarter				
27. Xenia, Ohio	No samples taken at this location during this quarter				
28. Zimmerman, Ohio	No samples taken at this location during this quarter				

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
29. Fairborn, Ohio	1	____	0.27×10^{-14}	0.014	4.5
30. Springfield, Ohio	1	____	0.0	0.0	0.0
31. St. Paris, Ohio	1	____	1.62×10^{-14}	0.081	27.0
32. Piqua, Ohio	1	____	0.0	0.0	0.0
33. Troy, Ohio	1	____	0.0	0.0	0.0
34. Lanius, Ohio	1	____	0.0	0.0	0.0
35. West Milton, Ohio	1	____	0.0	0.0	0.0
36. Vandalia, Ohio	1	____	0.0	0.0	0.0
37. Ft. McKinley, Ohio	No samples taken at this location during this quarter				
38. Clayton, Ohio	No samples taken at this location during this quarter				
39. Laura, Ohio	No samples taken at this location during this quarter				
40. Arcanum, Ohio	No samples taken at this location during this quarter				
41. New Madison, Ohio	No samples taken at this location during this quarter				
42. New Paris, Ohio	No samples taken at this location during this quarter				
43. Lewisburg, Ohio	No samples taken at this location during this quarter				
44. West Alexandria, Ohio	No samples taken at this location during this quarter				

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
45. Farmersville, Ohio	No samples taken at this location during this quarter				
46. Gratis, Ohio	1	____	0.0	0.0	0.0
47. Eaton, Ohio	1	____	0.0	0.0	0.0
48. Boston, Indiana	1	____	1.26×10^{-14}	0.063	21.0
49. Fairhaven, Ohio	1	____	2.16×10^{-14}	0.108	36.0
50. Oxford, Ohio	1	____	1.26×10^{-14}	0.063	21.0
51. Ross, Ohio	1	____	0.36×10^{-14}	0.018	6.0
52. Hamilton, Ohio	1	____	0.0	0.0	0.0
53. Somerville, Ohio	1	____	0.0	0.0	0.0
54. Jacksonburg, Ohio	1	____	0.0	0.0	0.0
55. Middletown, Ohio	1	____	11.44×10^{-14}	0.572	190.7

See Map 2 for the above locations relative to Mound Laboratory, Page 11.

See Map 3 for the following locations relative to Mound Laboratory, Page 12.

56. Location 1	7	2.70×10^{-14}	0.64×10^{-14}	0.032	10.7
57. Location 2	7	2.70×10^{-14}	$0.5[illegible] \times 10^{-14}$	0.029	9.5

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
58. Location 3	7	2.40×10^{-14}	0.60×10^{-14}	0.030	10.0
59. Location 4	7	3.60×10^{-14}	0.95×10^{-14}	0.048	15.8
60. Location 5	6	4.50×10^{-14}	0.81×10^{-14}	0.041	13.5
61. Location 6	7	11.71×10^{-14}	2.59×10^{-14}	0.130	43.2
62. Location 7	7	2.70×10^{-14}	0.40×10^{-14}	0.020	6.7
63. Location 8	6	1.80×10^{-14}	0.60×10^{-14}	0.030	10.0
64. Location 9	7	0.90×10^{-14}	0.21×10^{-14}	0.011	3.5
65. Location 10	7	0.99×10^{-14}	0.27×10^{-14}	0.014	4.5
66. Location 11	6	10.81×10^{-14}	1.80×10^{-14}	0.090	30.0
67. Location 12	7	0.90×10^{-14}	0.36×10^{-14}	0.018	6.0
Over-all	117	11.71×10^{-14}	1.046×10^{-14}	0.052	17.4

* All concentrations are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration

MLM-MU-61-63-0009

SUMMARY OF ENVIRONMENTAL MONITORING FOR FOURTH QUARTER 1960 AND YEAR 1960

Health Physics Department

Date: March 15, 1961

Issued: MAR 20 1961

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO CHEMICAL COMPANY

MOUND LABORATORY

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I. Summary

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during both the fourth quarter and the entire year of 1960 is presented. The concentration of polonium and tritium in the Great Miami River was well within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also well within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the year.

II. Introduction

This report presents in summary form the concentration of radioactive materials detected in the environment around Mound Laboratory. The monitoring procedures used are those best suited to the determination in air and river water samples of those radioactive materials which Mound Laboratory could contribute to the environment.

During the period covered by this report, no radioactive materials have been used which have contributed any measurable penetrating radiation such as gamma or hard beta to the environment.

Polonium, plutonium and tritium are possible air contaminants; polonium and tritium are possible river water contaminants.

The maximum permissible concentration values in air and water for the radionuclides in use at Mound Laboratory are taken from the U. S. Department of Commerce, National Bureau of Standards Handbook 69. The maximum permissible environmental air and water concentrations for materials used at Mound Laboratory are:

Polonium

Air - 2×10^{-11} microcuries per cubic centimeter

Water - 7×10^{-7} microcuries per cubic centimeter

Plutonium

Air - 6×10^{-14} microcuries per cubic centimeter

Water - 5×10^{-6} microcuries per cubic centimeter

Tritium

Air - 7×10^{-7} microcuries per cubic centimeter

Water - 5×10^{-3} microcuries per cubic centimeter

III. Water Sampling

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant to remove the radioactivity to the concentration at which it may be discharged to the Great Miami River. Liquid waste from plutonium work is small in volume. It is handled separately as a packaged waste and not discharged to the river. Helium-3 being purified at Mound Laboratory yields small quantities of tritium. Liquid waste from this work, also small in volume, is treated separately (diluted with water when necessary) to assure that the radioactivity content is within the maximum permissible concentration before discharge to the Great Miami River.

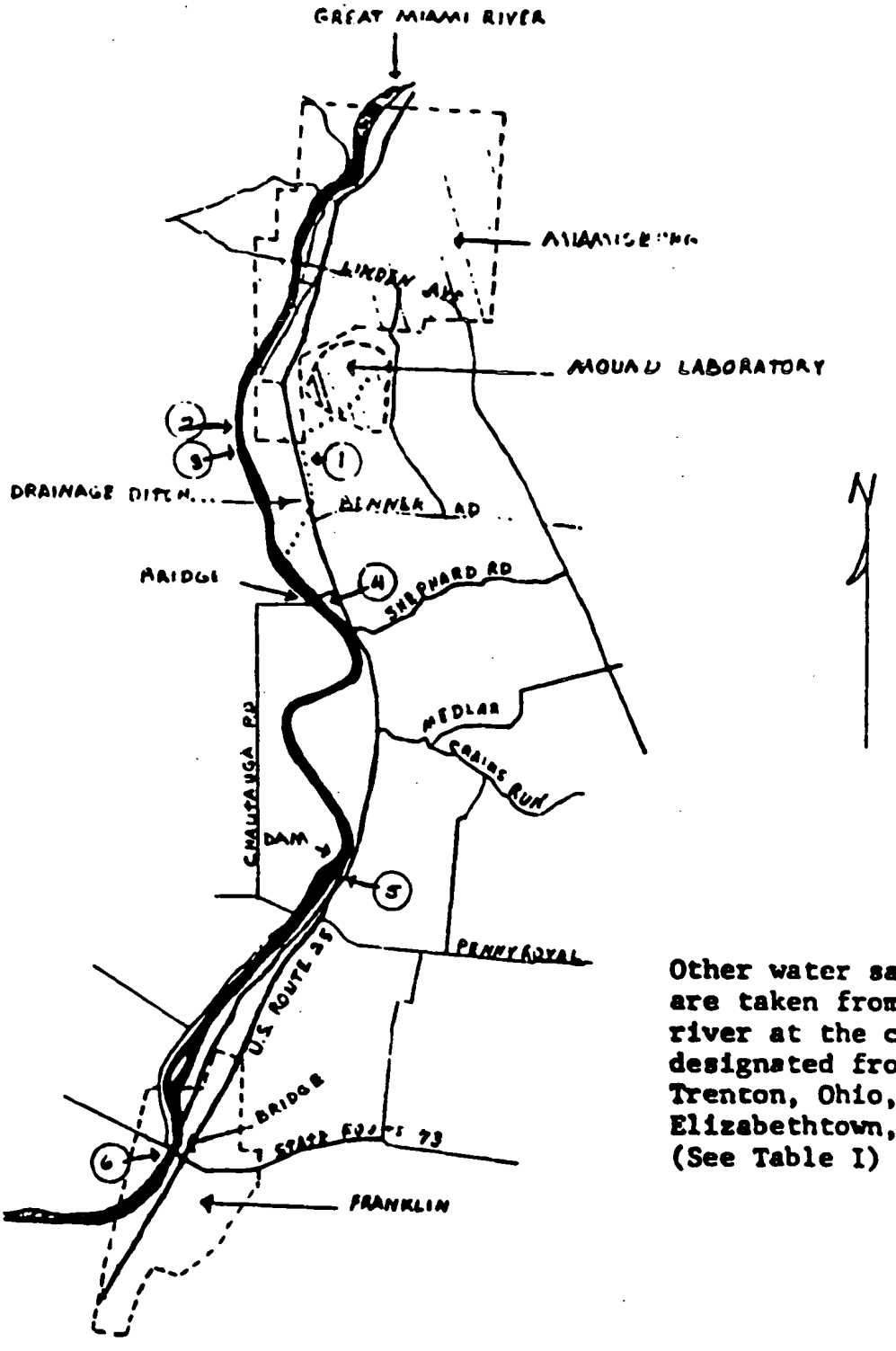
Aliquots of the waters of the Great Miami River are collected routinely each week from the Laboratory effluent stream at the point of discharge to the Great Miami River, to a distance of five miles downstream. Once each quarter, river water

samples are collected at various locations between Franklin, Ohio, and Elizabethtown, Ohio, where the Great Miami River enters into the Ohio River. A weekly water sample is also collected from a drainage ditch which runs through the plant site. This ditch carries off all storm sewer water, which eventually empties into the river. The treated liquid tritium waste is discharged into the storm sewers; the waste disposal plant effluent is discharged directly into the river via a closed sewer line. All of the samples collected from the river are analyzed for polonium concentration. The drainage ditch sample and part of the river samples are analyzed for tritium concentration.

Data of our off-site water monitoring are presented in Table I "Summary of Off-Site Water Monitoring for Radioactivity, October Through December, 1960."

The data presented in Table I indicate that the concentration of polonium and tritium in the Great Miami River is well within the maximum permissible continuous concentration.

Refer to the "Water Sample Locations" Map 1 on the following page to determine the location of the data presented in Table I mentioned above.



Other water samples are taken from the river at the cities designated from Trenton, Ohio, to Elizabethtown, Ohio. (See Table I)

GREAT MIAMI RIVER WATER SAMPLE LOCATIONS

MAP 1

TABLE I

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

OCTOBER THROUGH DECEMBER, 1960

I. Polonium (All River Samples)

Sample Location	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Effluent	2	11	1.14×10^{-7}	1.56×10^{-8}	2.23
250 Yards Downstream	3	11	5.41×10^{-9}	9.82×10^{-10}	0.14
Chautauqua Road Bridge	4	11	7.21×10^{-9}	9.82×10^{-10}	0.14
Chautauqua Dam	5	11	5.41×10^{-9}	1.15×10^{-9}	0.16
Franklin, Ohio	6	11	5.41×10^{-9}	1.15×10^{-9}	0.16
Trenton, Ohio	None	1	0.0	0.0	0.00
New Miami, Ohio	None	1	9.00×10^{-9}	9.00×10^{-9}	1.29
7 Miles North of New Baltimore, Ohio	None	1	1.80×10^{-9}	1.80×10^{-9}	0.26
New Baltimore	None	1	0.0	0.0	0.00
Miamitown, Ohio	None	1	1.80×10^{-9}	1.80×10^{-9}	0.26
5 Miles North of Elizabethtown, Ohio	None	1	0.0	0.0	0.00

Sample Location	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Elizabethtown, Ohio	None	1	0.0	0.0	0.00
Over-all		62	1.14×10^{-7}	3.58×10^{-9}	0.51

II. Tritium (All River Samples, Except Drainage Ditch)

Sample Location	Map 1 Code Number	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
Mound Lab Drainage Ditch	1	10	0.0	0.0	0.0
Mound Lab Effluent	2	10	0.0	0.0	0.0
Chautauqua Road Bridge	4	10	0.0	0.0	0.0
Over-all		30	0.0	0.0	0.0

* All concentrations are in microcuries per cubic centimeter.

** MPC - Maximum Permissible Continuous Concentration

IV. Air Sampling - Fourth Quarter

Monitoring of the environmental air for tritium concentration by means of a continuous air monitor mounted in a one-ton panel truck, was performed routinely out to a distance of 20 miles from the Laboratory. A total of 96 evaluations were made at 79 different locations. The locations sampled for tritium are the same as the ones sampled for polonium and plutonium. The concentration of tritium in the environment has been immeasurable to date.

Monitoring for possible polonium and plutonium in the environment is accomplished by particulate air sampling equipment also mounted in the one-ton panel truck used for tritium air sampling. During this quarter, a total of 154 air samples were collected and analyzed. A long-lived gross alpha determination on filter paper samples collected was made only after sufficient time had elapsed after collection to permit the decay of short-lived daughter products of radon and thoron. Filter paper samples are counted for alpha particle emission in a low background proportional counter.

The concentration of alpha activity detected in the environment was very low. A long counting time analysis was performed on each filter sample in order to obtain good counting precision.

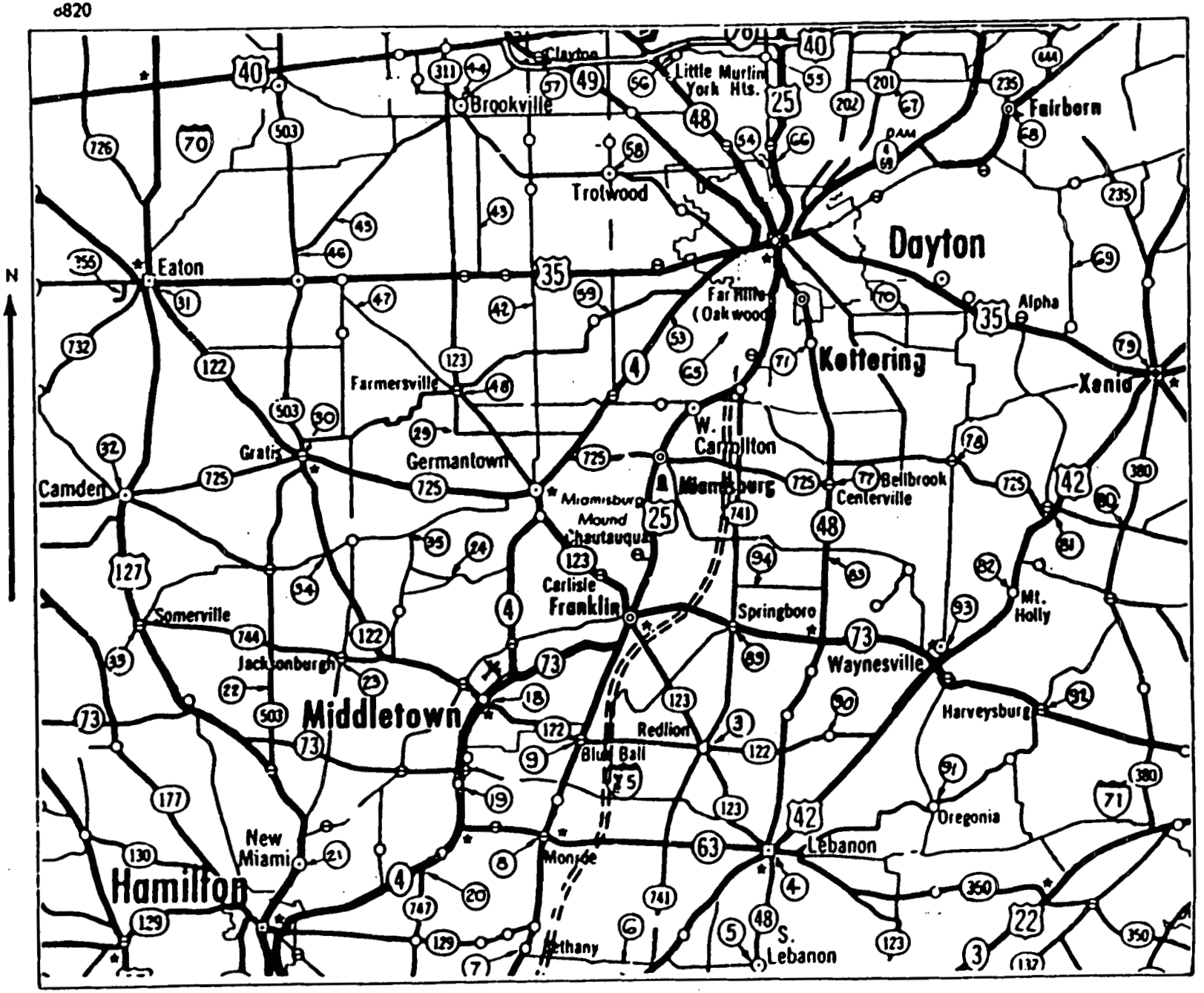
At the low concentrations detected, the isotopes of polonium and plutonium are not distinguishable from each other or from the natural background radioactivity in the air. If we compare the gross alpha detected in the environment (see Table II) to the Maximum Permissible Continuous Concentration for polonium in the environment, and assume that all alpha activity detected is polonium, we find that the average polonium concentration would be only 0.099 per cent of the permissible. Our polonium effluent stack monitoring program for this quarter has shown that we should expect essentially no detectable polonium in the environment due to the operations at Mound Laboratory.

If we compare the gross alpha detected in the environment (see Table II again) to the Maximum Permissible Continuous Concentration for plutonium in the environment, and assume that all alpha activity detected is plutonium, we find that the average plutonium concentration would be well within the permissible; however, it would be a significant 33.0 per cent of the permissible concentration. In order to determine the impact of Mound Laboratory plutonium work on the environment, we must point out that the natural background concentration of alpha contamination in the air in southwestern Ohio is in the range of and frequently exceeds the very low permissible concentration for plutonium. That is to say the normal gross alpha (long-lived) count in the

environment is usually a very significant per cent of and frequently exceeds the permitted alpha count for plutonium if the total count were attributed to plutonium. The impact of plutonium work at Mound Laboratory is also placed in proper focus by referring to our plutonium stack monitoring data. During the fourth quarter of 1960, the average concentration of plutonium in air discharged from the stack was well within the permissible concentration for environmental air. For this reason, and the fact that the air is discharged to the environment from a 200 foot stack at a high velocity which would yield a high dilution factor, we can say the the plutonium operations (as well as the polonium work) has contributed during this quarter, an insignificant burden to the radioactivity normally present in the atmosphere.

In Table II "Summary of Environmental Air Monitoring for Long-Lived Alpha Emitters," we have listed for each location sampled, the number of samples, the maximum concentration, the average concentration and the average concentration in terms of per cent of the maximum permissible continuous concentration for both polonium and plutonium. Maps 2 and 3 showing the location of sampling sites relative to Mound Laboratory are also included.

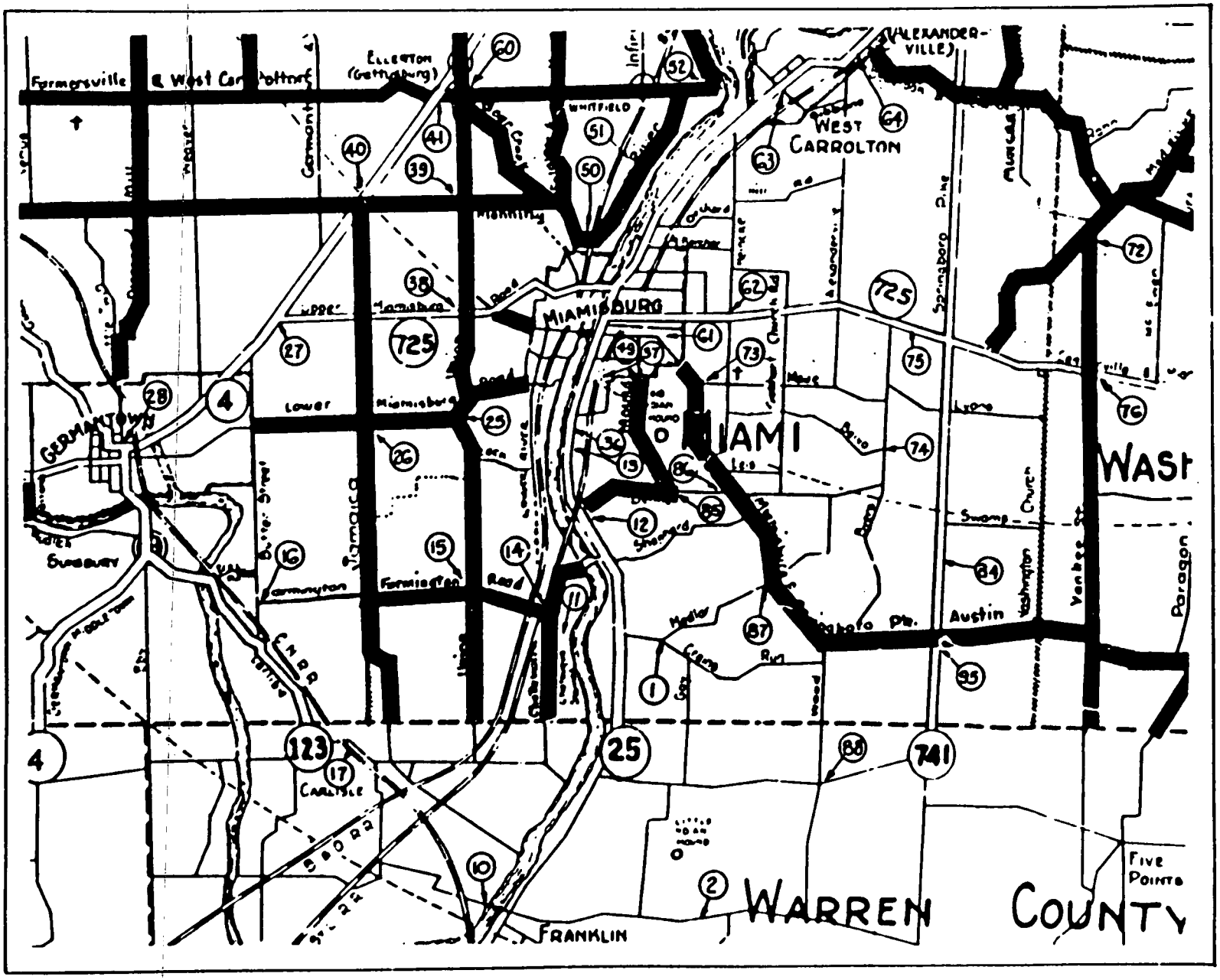
o820



MAP 2

AIR SAMPLE LOCATIONS AND ROAD MAP

LOCATION O→



MAP 3

AIR SAMPLE LOCATION AND ROAD MAP

LOCATIONS O→

TABLE II

SUMMARY OF ENVIRONMENTAL MONITORING FOR LONG-LIVED ALPHA EMITTERS

OCTOBER THROUGH DECEMBER, 1960

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
1. Junction of Crains Run Rd. & Medlar Rd.	1	—	3.06×10^{-14}	0.153	51.0
2. Junction of Route 73 & Interstate Route 75	1	—	1.98×10^{-14}	0.099	33.0
3. Red Lion, Ohio	1	—	1.89×10^{-14}	0.095	31.5
4. Lebanon, Ohio	1	—	5.14×10^{-14}	0.257	85.7
5. South Lebanon, Ohio	1	—	4.05×10^{-14}	0.203	67.5
6. Junction of Bethany Rd. & Mason-Montgomery Rd.	1	—	4.05×10^{-14}	0.203	67.5
7. Bethany, Ohio	1	—	0.90×10^{-14}	0.045	15.0
8. Monroe, Ohio	1	—	3.15×10^{-14}	0.158	52.5
9. Blue Ball, Ohio	1	—	2.79×10^{-14}	0.139	46.5
10. Junction of Route 123 & Dayton-Oxford Rd.	1	—	0.0	0.0	0.0
11. Chautauqua, Ohio	1	—	0.18×10^{-14}	0.009	3.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
12. Junction of Benner Rd. & Route 25	1	—	2.16×10^{-14}	0.108	36.0
13. Miami Drive In Theatre in Miamisburg (On Route 25)	3	10.09×10^{-14}	3.69×10^{-14}	0.184	61.5
14. Junction of Farmington Rd. & Chautauqua Rd.	3	2.07×10^{-14}	1.26×10^{-14}	0.063	21.0
15. Junction of Farmington Rd. & Union Rd.	3	4.05×10^{-14}	1.35×10^{-14}	0.068	22.5
16. Junction of Farmington Rd. & Butter St.	3	2.70×10^{-14}	1.08×10^{-14}	0.054	18.0
17. Carlisle, Ohio	3	0.54×10^{-14}	0.36×10^{-14}	0.018	6.0
18. Middletown, Ohio	3	0.45×10^{-14}	0.13×10^{-14}	0.007	2.2
19. Junction of Route 4 and Route 73	3	1.53×10^{-14}	0.99×10^{-14}	0.050	16.5
20. Junction of Route 4 and Route 747	3	0.0	0.0	0.0	0.0
21. New Miami, Ohio	3	3.60×10^{-14}	1.53×10^{-14}	0.077	25.5
22. Junction of West Elkton Rd. & Tolbert Rd.	3	1.35×10^{-14}	0.45×10^{-14}	0.023	7.5
23. Jacksonburg, Ohio	3	3.15×10^{-14}	1.05×10^{-14}	0.053	17.5

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
24. Junction of Hetzler Rd. & Hinkle Rd.	3	3.60×10^{-14}	1.35×10^{-14}	0.068	22.5
25. Junction of Lower Miamisburg Rd. & Union Rd.	No samples taken at this location during this quarter				
26. Junction of Lower Miamisburg Rd. & Jamaica Rd.	No samples taken at this location during this quarter				
27. Junction of Route 725 & Route 4	No samples taken at this location during this quarter				
28. Germantown, Ohio	No samples taken at this location during this quarter				
29. Junction of Manning Rd. & Farmersville-Johnsville Rd.	No samples taken at this location during this quarter				
30. Gratis, Ohio	No samples taken at this location during this quarter				
31. Eaton, Ohio	No samples taken at this location during this quarter				
32. Camden, Ohio	No samples taken at this location during this quarter				
33. Somerville, Ohio	No samples taken at this location during this quarter				
34. Junction of Greenbush Rd. & Route 122	No samples taken at this location during this quarter				
35. Junction of Oxford Road & Browns Run Rd.	No samples taken at this location during this quarter				

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
36. Miamisburg South City Limit on Route 25	No samples taken at this location during this quarter				
37. Junction of Mound Ave. & Route 25	1	___	4.23×10^{-14}	0.212	70.5
38. Junction of Union Rd. & Route 725	1	___	7.12×10^{-14}	0.356	118.7
39. Junction of Union Rd. & Manning Rd.	1	___	6.49×10^{-14}	0.325	108.2
40. Junction of Manning Rd. & Route 4	1	___	7.84×10^{-14}	0.392	130.7
41. Junction of Route 4 & Farmersville-West Carrollton Rd.	1	___	12.16×10^{-14}	0.608	202.7
42. Junction of Diamond Mill Rd. & Mile Rd.	1	___	4.59×10^{-14}	0.230	76.5
43. Junction of Clayton Rd. & Amity Rd.	1	___	7.93×10^{-14}	0.397	132.2
44. Brookville, Ohio	1	___	2.79×10^{-14}	0.140	46.5
45. Junction of Lexington Salem Rd. & Preble County Line Rd.	1	___	31.53×10^{-14}	1.577	525.6
46. Junction of Lexington Salem Rd. & Engle Rd.	1	___	2.52×10^{-14}	0.126	42.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
47. Junction of Farmersville-West Alexandria Pike & Dechant Rd.	1	___	2.79×10^{-14}	0.140	46.5
48. Farmersville, Ohio	1	___	2.88×10^{-14}	0.144	48.0
49. Fifth St. & Central Ave. in Miamisburg, Ohio	No samples taken at this location during this quarter				
50. Junction of Upper River Rd. & Soldiers Home-Miamisburg Rd.	No samples taken at this location during this quarter				
51. One mile north on Upper River Rd. from sample #50	No samples taken at this location during this quarter				
52. Junction of Farmersville-West Carrollton Rd. & Soldiers Home-West Carrollton Rd.	No samples taken at this location during this quarter				
53. Dayton Speedway	No samples taken at this location during this quarter				
54. Dayton, Ohio	No samples taken at this location during this quarter				
55. Murlin Heights	No samples taken at this location during this quarter				
56. Little York	No samples taken at this location during this quarter				
57. Clayton, Ohio	No samples taken at this location during this quarter				
58. Trotwood, Ohio	No samples taken at this location during this quarter				

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
59. Union Rd. & Liberty-Dayton Rd.	No samples taken at this location during this quarter				
60. Union Rd. & Bear Creek Rd.	No samples taken at this location during this quarter				
61. Harmon Field in Miamisburg	5	6.40×10^{-14}	2.97×10^{-14}	0.149	49.5
62. Junction of Route 725 & Heincke Rd.	5	3.33×10^{-14}	2.52×10^{-14}	0.126	42.0
63. Junction of Elm St. & Route 25 in West Carrollton	5	5.77×10^{-14}	1.89×10^{-14}	0.095	31.5
64. Woody's Market in West Carrollton	5	2.07×10^{-14}	1.08×10^{-14}	0.054	18.0
65. Junction of South Broadway & Dryden Rd.	5	3.15×10^{-14}	1.44×10^{-14}	0.072	24.0
66. Junction of Route 75 & Wagner Ford Rd.	5	2.52×10^{-14}	1.80×10^{-14}	0.090	30.0
67. Junction of Route 201 & Chambersburg Rd.	5	2.70×10^{-14}	1.17×10^{-14}	0.059	19.5
68. Fairborn, Ohio	5	1.71×10^{-14}	0.72×10^{-14}	0.036	12.0
69. Junction of Fairground Rd. & New Germany-Trebein Rd.	5	1.62×10^{-14}	0.63×10^{-14}	0.032	10.5
70. Belmont Auto Theatre	5	2.16×10^{-14}	0.81×10^{-14}	0.041	13.5

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
71. Town & Country Shopping Center in Kettering, Ohio	5	1.44×10^{-14}	0.63×10^{-14}	0.032	10.5
72. Junction of Yankee Street & Mad River Rd.	5	2.70×10^{-14}	1.08×10^{-14}	0.054	18.0
73. Junction of Maue Rd. & Linden Ave.	1	—	1.89×10^{-14}	0.095	31.5
74. Junction of Byers Rd. & Belvo Rd.	1	—	0.99×10^{-14}	0.050	16.5
75. Junction of Route 725 & Route 75	1	—	1.62×10^{-14}	0.081	27.0
76. Junction of Yankee St. & Route 725	1	—	2.25×10^{-14}	0.113	37.5
77. Centerville, Ohio	1	—	6.49×10^{-14}	0.325	108.2
78. Bellbrook, Ohio	1	—	3.15×10^{-14}	0.158	52.5
79. Xenia, Ohio	1	—	1.98×10^{-14}	0.099	33.0
80. Junction of Spring Valley-Paintersville Rd. & Route 380	1	—	0.36×10^{-14}	0.018	6.0
81. Spring Valley, Ohio	1	—	1.53×10^{-14}	0.077	25.5
82. Mt. Holly, Ohio	1	—	1.44×10^{-14}	0.072	24.0
83. Junction of Route 48 & Social Row Rd.	1	—	0.72×10^{-14}	0.036	12.0

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
84. Waldruhe Park	1	—	4.77×10^{-14}	0.239	79.5
85. Junction of Mound Rd. & Benner Rd.	2	0.54×10^{-14}	0.27×10^{-14}	0.014	4.5
86. Junction of Benner Rd. & Miamisburg-Springboro Pike	2	3.69×10^{-14}	1.85×10^{-14}	0.093	30.8
87. Junction of Medlar Rd. & Miamisburg-Springboro Pike	2	0.36×10^{-14}	0.18×10^{-14}	0.009	3.0
88. Junction of Wood Rd. & Pennyroyal Rd.	2	3.87×10^{-14}	2.88×10^{-14}	0.144	48.0
89. Springboro, Ohio	2	12.70×10^{-14}	6.35×10^{-14}	0.318	105.9
90. Junction of Route 122 & Utica Rd.	2	0.45×10^{-14}	0.23×10^{-14}	0.012	3.8
91. Orgonia	2	3.15×10^{-14}	2.79×10^{-14}	0.140	46.5
92. Harveysburg, Ohio	2	2.25×10^{-14}	1.13×10^{-14}	0.057	18.8
93. Waynesville, Ohio	2	0.0	0.0	0.0	0.0
94. By TV Tower on Lytle-Five Points Rd.	2	0.27×10^{-14}	0.14×10^{-14}	0.007	2.3
95. South Montgomery County Airport	2	0.81×10^{-14}	0.41×10^{-14}	0.021	6.8

Sample Location	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
Over-all	154	31.53×10^{-14}	1.98×10^{-14}	0.099	33.0

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

V. Annual Monitoring Data

Table III contains a summary of the polonium and tritium off-site water monitoring data obtained during 1960. Table IV contains a summary of data obtained in 1960 from environmental air monitoring for long-lived alpha emitters.

TABLE III

SUMMARY OF OFF-SITE WATER MONITORING FOR RADIOACTIVITY

1960

I. Polonium

Period	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
First Quarter	84	1.33×10^{-6}	4.38×10^{-8}	6.26
Second Quarter	84	2.63×10^{-6}	9.56×10^{-8}	13.66
Third Quarter	65	2.44×10^{-6}	4.45×10^{-8}	6.36
Fourth Quarter	62	1.14×10^{-7}	3.58×10^{-9}	0.51
Total for Year	295	2.63×10^{-6}	5.03×10^{-8}	7.19

II. Tritium

Period	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
First Quarter	14	0.0	0.0	0.0
Second Quarter	16	0.0	0.0	0.0

Sam	Period	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of MPC for Average**
	Third Quarter	33	3.0×10^{-3}	1.82×10^{-4}	3.6
	Fourth Quarter	30	0.0	0.0	0.0
	Total for Year	93	3.0×10^{-3}	6.45×10^{-5}	1.3

* A

** M

TABLE IV

YEARLY SUMMARY OF ENVIRONMENTAL MONITORING FOR LONG-LIVED

ALPHA EMITTERS

Period	Number of Samples	Maximum Concentration*	Average Concentration*	Per Cent of Polonium MPC for Average**	Per Cent of Plutonium MPC for Average**
First Quarter	119	—	2.71×10^{-14}	.136	45.2
Second Quarter	146	—	2.42×10^{-14}	.121	40.3
Third Quarter	117	11.71×10^{-14}	1.05×10^{-14}	.052	17.5
Fourth Quarter	154	31.53×10^{-14}	1.98×10^{-14}	.099	33.0
Total for Year	536	—	2.06×10^{-14}	.103	34.3

* All concentrations are in microcuries per cubic centimeter

** MPC - Maximum Permissible Continuous Concentration

Changes in Off-Site Air Monitoring Program

November 8, 1960

AIR MONITORING PROGRAM

MONSANTO CHEMICAL COMPANY — *Inter-Office Correspondence*

From LOCATION : MOUND LABORATORY, Miamisburg, Ohio cc: file (3)

DATE : November 8, 1960

SUBJECT : Changes in Off-Site Air Monitoring Program

REFERENCE :

TO : H. E. Meyer

Changes were made in our off-site air monitoring program effective October 1, 1960. The changes were made to provide better coverage, greater accuracy and the data needed to fulfill the new reporting requirements initiated by the AEC this year.

Eight new monitoring routes were drawn up to be used for the off-site monitoring of both tritium and particulate radioactive isotopes, which at present include both polonium and plutonium. A T-289 continuous monitor is used for tritium monitoring and a Staplex Hi Vol Sampler is used for collecting filter paper samples. Routinely, one route is run each week for tritium and one route each week for filter type samples. Special runs will also be made whenever our stack monitors indicate an abnormally high discharge of radioactive materials. The route chosen depends upon the wind direction at the time the run is made.

Each of the eight new sampling routes consists of 14 sampling locations, 12 of which are downwind and two upwind. Upwind samples are collected on each run to show radioactivity concentrations in the atmosphere which cannot be attributed to our plant operations. Fifteen minute samples are taken at each sampling location and all samples are collected within a radius of 20 miles of the plant. Sites were chosen in regards to distance from the plant site as follows:

Downwind		Upwind	
0 to 1 mile	- 1 sample	0 to 3 miles	- 2 samples
1 to 3 miles	- 2 samples		
3 to 5 miles	- 2 samples		
5 to 10 miles	- 2 samples		

10 to 15 miles - 2 samples

15 to 20 miles - 3 samples

Changes have been made in our analysis procedure of the filter samples due to the low maximum permissible concentration listed for plutonium in NBS Handbook 69. We have increased to two inches the diameter of the section of the filter paper which is counted. This in effect has increased the amount of air analyzed for each sample from one cubic meter to two cubic meters. We now count all filter samples for 20 minutes upon receipt at the plant. We keep these samples for seven days and recount them for a period of 16 hours. Previously, we counted all samples for a one hour period within one to two days after collection. During the seven day waiting period, all short-lived daughter isotopes of natural occurring radium or thorium will have decayed. A 16-hour counting period provides good counting precision at the counting rate level of the samples we analyze. The 16-hour count is used to estimate concentrations of polonium and/or plutonium in the environmental air.

A book containing each of the eight new sampling routes is enclosed.

W. A. Bigler

W. A. Bigler

WAB:mw

"SE" Route

(Wind from Southeast)

1. Collect sample at Mound Avenue and Route 25.

2. Turn right on Route 25 to Linden Avenue, turn left on Linden Avenue, cross river, and continue to Route 725, turn left on Route 725 and go to Union Road. Collect sample at junction of Union Road and Route 725.

3. Turn right on Union Road and proceed to Manning Road. Take sample at junction of these two roads.

4. Turn left on Manning Road and go to Route 4. Take sample at junction of Manning Road and Route 4.

5. Turn right on Route 4 and go to Farmersville-West Carrollton Road. Take sample at junction of these two roads.

6. Turn left on Farmersville-West Carrollton Road and go to Diamond Mill Road, turn right on Diamond Mill Road and go to Mile Road. Collect sample at this junction.

7. Continue on Diamond Mill Road to Route 35, turn left on Route 35 and go to Clayton Road, turn right on Clayton Road and go to Amity Road. Take sample at junction of Clayton and Amity Roads.

8. Continue on Clayton Road to Wolf Creek Road, turn left on Wolf Creek Road and proceed to town of Brookville. Take sample in Brookville at junction with Westbrook Road.

9. Turn left on Westbrook Road and proceed to Brookville-Pyrmont Road, turn left on Brookville-Pyrmont Road, which continues as Lexington-Salem Road, and proceed on to junction of Lexington-Salem Road and Preble County Line Road. Take sample at junction of Lexington-Salem Road and Preble County Line Road.

10. Continue on Lexington-Salem Road to New Market-Banta Road, turn left and continue on Lexington-Salem Road to Engle Road. Take sample at junction of these two roads.

11. Turn left on Engle Road and go to Reel Road, turn right on Reel Road and go to Route 35, cross Route 35 on to Enterprise Road, continue on Enterprise Road to Germantown Road, turn left on Germantown Road which becomes Farmersville and West Alexandria Pike at the county line, continue on Farmersville and West Alexandria Pike to Dechant Road. Take sample at this junction.

12. Continue on Farmersville and West Alexandria Pike to town of Farmersville. Take sample by the school as you enter the town.

13. Continue past school to Center Street, turn left on Center Street and go to Route 123, take Route 123 south to West Carrollton-Farmersville Road, turn left on Farmersville-West Carrollton Road and go to Diamond Mill Road, turn right on Diamond Mill Road and go to Manning Road, turn left on Manning Road and go to Union Road, turn right on Union Road and go to Route 725, turn left on Route 725 and return to Miamisburg. Take Mound Avenue south to Benner Road. Collect sample at the junction of Mound Avenue and Benner Road.

14. Turn left on Benner Road and go to Miamisburg-Springboro Pike, turn right on Miamisburg-Springboro Pike and go to Medlar Road, take sample at the junction of these two roads and return to Mound Laboratory.

NOTE: The truck should be parked completely off the road when samples are being taken. Since this may be impossible at some locations listed, collect the samples in the nearest safe spot to the indicated site.

Approximate distance of route - 59 miles.

"SW" Route

(Wind from Southwest)

1. Take Mound Avenue to Sixth Street, turn right on Sixth Street and go one block to Jefferson Street, turn right on Jefferson Street, go to Miamisburg football field and collect sample.

2. Return to Sixth Street, turn right and go to Route 725 (Central Avenue) turn right on Route 725 and go to Heincke Road. Collect sample at junction of Heincke Road and Route 725.

3. Continue on Heincke Road to Ironwood Street, turn right on Ironwood Street and go to Elm Street, bear left on Elm Street and proceed to junction of Elm Street and Route 25 in West Carrollton. Collect sample at this junction.

4. Turn right on Route 25 and proceed to Woody's Market in West Carrollton. Take sample in parking lot of Woody's Market.

5. Continue north on Route 25 to South Broadway (Springboro Pike) turn left on South Broadway and proceed to Dryden Road. Take sample at this junction.

6. Turn right on Dryden Road and proceed to Route 25, turn left on Route 25 and continue in to Dayton on Patterson Boulevard to Jefferson Street, turn left on Jefferson Street and go to Sixth Street, turn left on Sixth Street and go to Main Street, turn right on Main Street and proceed to turn off to new northbound Interstate Route 75, turn right and take Route 75 to Wagner Ford Road. Turn off on to Wagner Ford Road and take sample near exit from Route 75.

7. Proceed on Wagner Ford Road to Needmore Road, turn right on Needmore Road and go to Route 201, turn left on Route 201 and go to Chambersburg Road. Take sample at junction of Route 201 and Chambersburg Road.

8. Turn right on Chambersburg Road which becomes Route 235 and continue through town of Fairborn. Take sample on Route 235 just as you leave city limits of Fairborn.

9. Proceed on Route 235 to Trebein Road, turn right on Trebein Road and go to New Germany-Trebein Road, turn left on New Germany-Trebein Road and go to Fairground Road. Take sample at junction of these two roads.

10. Turn right on Fairground Road and go to Beaver Valley Road, turn left on Beaver Valley Road and go to old Route 35, turn right on old Route 35 and go to Factory Road, turn left on Factory Road and go to new Route 35, turn right on new Route 35 and go to Shakertown Road, turn left on Shakertown Road and go to County Line Road, turn left on County Line Road and take sample in driveway of Belmont Auto Theatre.

11. Continue on County Line Road to Dorothy Lane, turn right on Dorothy Lane and go to Shroyer Road, turn left on Shroyer Road and go to Town and Country Shopping Center. Take sample in rear parking lot of shopping center.

12. Turn left on to Route 40 from the shopping center and go south to David Church Road, turn right on David Church Road and go to Mad River Road, turn left on Mad River Road and proceed to Yankee Street. Take sample at junction of Yankee Street and Mad River Road.

13. Continue on Mad River Road to Route 725, turn right on Route 725 and return to Miamisburg, turn left on Route 25 and go south to Benner Road. Take sample at junction of Route 25 and Benner Road.

14. Return on Route 25 to Miami Drive-In Theatre. Take sample in driveway to theatre and return to Mound Laboratory.

NOTE: The truck should be parked completely off the road when samples are being taken. Since this may be impossible at some of the locations listed, collect the samples in the nearest safe spot to the indicated site.

Approximate distance of route - 66 miles.

"N" Route

(Wind from North)

1. Take Mound Avenue to Route 25, turn left on Route 25 and proceed south to Crains Run Road, turn left on Crains Run Road and proceed to junction with Medler Road. Take sample at this junction.

2. Return on Crains Run Road to Route 25, proceed south on Route 25 to Franklin, Ohio. Turn left on Route 73 in Franklin and proceed to junction with new Interstate Route 75. Take sample near this junction.

3. Continue on Route 73 to Route 741, turn right on Route 741 and go to Red Lion, Ohio. Take sample in Red Lion.

4. Take Route 123 south out of Red Lion to Lebanon, Ohio. Take sample upon entering Lebanon.

5. Continue on Route 123 to Route 42 in Lebanon, turn right on Route 42 and proceed south to town of South Lebanon, turn right on Mason Road in South Lebanon and take sample.

6. Continue on Mason Road (Labeled Mason-Morrow-Milligrove Road on the county map) to Route 42, turn left on Route 42 and proceed to Bethany Road, turn right on Bethany Road and proceed to junction with Mason-Montgomery Road. Take sample at this junction.

7. Continue on Bethany Road to Bethany, Ohio, proceed to Route 25 and turn right. Take sample at convenient location leaving Bethany.

8. Continue north on Route 25 to Monroe, Ohio. Take sample in Monroe.

9. Continue north on Route 25 to Blue Ball, Ohio. Take sample at Blue Ball.

10. Continue north on Route 25 to Franklin, Ohio, and turn left on Route 123, turn right on the first street after crossing the river. This is Dayton-Oxford Road. Take sample at junction of Route 123 and Dayton-Oxford Road.

11. Proceed on Dayton-Oxford Road to Chautauqua Road and north on Chautauqua Road to Chautauqua, Ohio. Take sample in Chautauqua, Ohio.

12. Proceed north on Chautauqua Road to Route 25, turn left on Route 25 and proceed north to the city limits of Miamisburg. Take sample at the city limits on Route 25.

13. Continue north on Route 25 to Route 725, turn left on Route 725, cross river and take sample between river bridge and railroad crossing.

14. Return on Route 725 to Miamisburg and collect sample at the municipal parking lot near Central Avenue. Return to Mound Laboratory.

NOTE: The truck should be parked completely off the road when samples are being taken. Since this may be impossible at some of the locations listed, collect the samples in the nearest safe spot to the indicated site.

Approximate distance of route - 30 miles.

"NW" Route

(Wind from Northwest)

1. Take Mound Road south to Benner Road. Collect sample at the junction of these roads.

2. Turn left on Benner Road and proceed to Miamisburg-Springboro Pike. Turn right on Miamisburg-Springboro Pike and collect sample in front of first house on the right.

3. Continue southeast on Miamisburg-Springboro Pike to Medlar Road. Collect sample at the junction of these two roads.

4. Continue on Miamisburg-Springboro Pike to Wood Road, turn right on Wood Road and go to Pennyroyal Road. Collect sample at this intersection.

5. Turn left on Pennyroyal, cross new super highway, and bear to right on Clearcreek-Franklin Road. Continue on Clearcreek-Franklin Road to Route 73, turn left on Route 73 to town of Springboro. Collect sample in Springboro.

6. Continue east on Route 73 to Route 48, turn right on Route 48 to Ridgeville, turn left on Lower Springboro Road to Utica Road, turn left on Utica Road to town of Utica. Collect sample near junction of Utica Road and Route 122.

7. Turn left on Route 122 and go to Route 42, cross Route 42 and continue on this road, which is now called Middletown Road, turn left where Waynesville Road meets Middletown Road and continue a short distance where Middletown Road turns right and crosses the river. Cross the river and turn right on Corwin Road. Continue on Corwin Road to Orgonia Road, turn left on Orgonia Road, continue to the top of the hill and collect a sample.

8. Continue on Orgonia Road to junction of Harlan-Carroll Road, turn left and continue on Orgonia Road to town of Harveysburg. Collect sample in Harveysburg.

9. Turn left on Route 73 and proceed to Waynesville. Collect sample in Waynesville near junction of Routes 73 and 42.

10. Continue on Route 73 to Route 48, turn right on Route 48 to Lytle-Five Points Road, turn right on Lytle-Five Points Road and proceed to television tower. Collect sample near tower.

11. Continue on Lytle-Five Points Road to Route 741, turn right on Route 741 and proceed to Montgomery County Airport. Take sample in airport parking lot.

12. Continue on Route 741 to Miamisburg-Springboro Pike, turn left and return to Miamisburg. Collect sample at intersection of Fifth Street and Central Avenue in Miamisburg.

13. Turn left on Central Avenue and go to Route 25, turn right on Route 25 to Route 725, turn left on Route 725, cross river, and proceed to Union Road. Collect sample at junction of Route 725 and Union Road. Return to Mound Laboratory.

NOTE: The truck should be parked completely off the road when samples are being taken. Since this may be impossible at some of the locations listed, collect the samples in the nearest safe spot to the indicated site.

Approximate distance of route - 56 miles.

"NE" Route

(Wind from Northeast)

1. Take Mound Avenue To Route 25, turn left and proceed to Miami Drive-In Theatre. Take sample in theatre driveway.

2. Continue south on Route 25 to Chautauqua Road, turn right, cross river, and continue to Farmington Road. Take sample at junction of Farmington Road and Chautauqua Road.

3. Turn right on Farmington Road and proceed to Union Road. Take sample at junction of these two roads.

4. Continue on Farmington Road to Butter Street. Collect sample at the junction of Farmington Road and Butter Street.

5. Turn left on Butter Street and proceed to Route 123, turn left on Route 123 and proceed to town of Carlisle. Collect sample in Carlisle.

6. Continue on Route 123 to Franklin. Take Route 73 west out of Franklin to Miami River Park, which is the outer limits of Middletown. Collect sample in Miami River Park.

7. Continue on Route 73 to where it joins Route 4, turn left and continue on Routes 73 and 4 to junction where Route 73 leaves Route 4, continue short distance on Route 4, cross over railroad and take sample off side of road.

8. Continue south on Route 4 to junction of Route 4 and Route 747. Take sample at this junction.

9. Continue on Route 4 to Liberty-Fairfield Road, turn right on Liberty-Fairfield Road, cross river and continue to Augspurger Road. Turn left on Augspurger Road and proceed to town of New Miami. Collect sample in New Miami.

10. Turn right on Route 127 in New Miami and proceed to West Elkton Road (Route 303) turn right on West Elkton Road and proceed to Tolbert Road. Collect sample at junction of these two roads.

11. Turn right on Tolbert Road to Jacksonburg Road, turn left on Jacksonburg Road to town of Jacksonburg. Collect sample in Jacksonburg.

12. Turn right in Jacksonburg on Route 744 and go to Elk Creek Road, turn left on Elk Creek Road and proceed to Kalbfleisch Road, turn right on Kalbfleisch Road and proceed to Hetzler Road, turn left on Hetzler Road and proceed to Hinkle Road. Take sample at junction of these two roads.

13. Turn right at junction of Hinkle and Hetzler Roads and continue on Hetzler Road to Browns Run Road, turn right on Browns Run Road and proceed to first road to left (no road sign) which is Meyers Road, turn left on Meyers Road and go to Route 4, turn left on Route 4 and proceed to Germantown, turn right in Germantown on Cherry Street and proceed to Route 725, turn right on Route 725 and return to Miamisburg, continue through Miamisburg east on Route 725 to Alexandersville Road. Take sample at the junction of Route 725 and Alexandersville Road.

14. Return on Route 725 and take sample in parking lot of new shopping center at edge of Miamisburg. Return to Mound Laboratory.

NOTE: The truck should be parked completely off the road when sample are being taken. Where this may be impossible at some of the locations listed, collect the samples in the nearest safe spot to the indicated site.

Approximate distance of route - 44 miles.

"W" Route

(Wind from West)

1. Proceed from Mound Laboratory to Linden Avenue, turn right and proceed to Maue Road, turn left and collect sample at junction of Maue Road and Linden Avenue.

2. Proceed on Maue Road to Gebhart Church Road, turn right on Gebhart Church Road and go to Belvo Road, turn left on Belvo Road and proceed to Byers Road. Take sample at junction of Byers and Belvo roads.

3. Turn left on Byers Road and proceed to Route 725, turn right on Route 725 and take sample near Interstate Route 75 underpass.

4. Proceed east on Route 725 to Yankee Street. Take sample at junction of Yankee Street and Route 725.

5. Continue on Route 725 to Centerville, continue straight at traffic light on Franklin Street to Clyo Road. Take sample at junction of Clyo Road and Franklin Street.

6. Turn left on Clyo Road to Route 725, turn right on Route 725 to Bellbrook. Collect sample in Bellbrook.

7. Take Route 725 east out of Bellbrook to Lower Bellbrook Road, turn left on Lower Bellbrook Road and proceed to Xenia. Collect sample in Xenia.

8. Turn right on Route 800 in Xenia and proceed south to Spring Valley-Paintersville Road. Take sample at junction of these two roads.

9. Turn right on Spring Valley-Paintersville Road and proceed to US Route 42. Take sample at this junction.

10. Turn left on US Route 42 and proceed to town of Mount Holly. Take sample in Mount Holly.

11. Turn right on Mount Holly Road and proceed to the county line where this road then becomes Middle Run Road. Continue on Middle Run Road to Wilmington Road, turn left and proceed to Social Row Road, turn right on Social Row Road and proceed to Route 48. Collect sample at junction of Social Row Road and Route 48.

12. Continue west on Social Row Road to Yankee Stree, turn right on Yankee Street to Austin Road, turn left on Austin Road and proceed to Route 741, turn right on Route 741 and proceed to Waldruhe Park. Collect sample in Waldruhe Park.

13. Continue on Route 741 to Route 725, turn left on Route 725 and return to Miamisburg. Take Linden Avenue west out of Miamisburg, cross river and turn left on Riverview Avenue. Continue on Riverview Avenue to where it turns right and becomes Lower Miamisburg Road. Take sample at this corner.

14. Continue on Lower Miamisburg Road to Union Road. Take sample at this junction and return to Mound Laboratory.

NOTE: The truck should be parked completely off the road when samples are being taken. Since this may be impossible at some of the locations listed, collect the samples in the nearest safe spot to the indicated site.

Approximate distance of route - 61 miles.

"E" Route

(Wind from East)

1. Take Linden Avenue west out of Miamisburg to Riverview, turn left on Riverview to where it turns right and continues on as Lower Miamisburg Road, continue on Lower Miamisburg Road to Union Road. Take sample at the junction of these two roads.

2. Continue on Lower Miamisburg Road to Jamaica Road. Take sample at this junction.

3. Turn right on Jamaica Road and go to Route 725, turn left on Route 725 and proceed to Route 4. Take sample at junction of Routes 725 and 4.

4. Turn left on Route 4 and go to Route 123 in Germantown. Take sample in Germantown.

5. Turn right on Route 123 and go to Manning Road, turn left on Manning Road and proceed to Farmersville-Johnsville Road. Take sample at junction of these two roads.

6. Continue on Manning Road to Anthony Road, turn left on Anthony Road and go to Kiefer Road, turn right on Kiefer Road and go to Browns Run Road, turn left on Browns Run Road and go to Route 725, turn right on Route 725 and proceed to town of Gratis. Collect sample in Gratis.

7. Turn right on Route 122 and proceed to Eaton. Take sample in Eaton, Ohio.

8. Turn left in Eaton on to Route 127 and proceed to Camden. Take sample in Camden, Ohio.

9. Continue on Route 127 to town of Somerville. Take sample in Somerville.

10. Turn left on Route 744 in Somerville and proceed to Route 503, turn left on Route 503 and go to town of West Elkton, turn right on Greenbush Road in West Elkton and proceed to Route 122. Take sample at junction of Greenbush Road and Route 122.

11. Continue on Greenbush Road to Preble County Line Road, turn left on to Preble County Line Road then right on to Oxford Road, continue on Oxford Road to Browns Run Road. Take sample at junction of these two roads.

12. Continue on Oxford Road to Mudlick Road, bear right on to Mudlick Road and proceed to Route 4, turn left on Route 4 and proceed to Germantown, turn right at edge of Germantown on Cherry Street and go to Market Street (Routes 725 and 123) turn right on Market Street and return to Miamisburg on Route 725. Turn right on Route 25 and go south to Miamisburg city limits. Take sample at south city limits and Route 25.

13. Continue south on Route 25 to Benner Road, turn left on Benner Road and go to Gebhart Church Road, turn left on Gebhart Church Road and go to Belvo Road. Take sample at junction of Belvo and Gebhart Church Roads.

14. Continue on Gebhart Church Road to Maue Road, turn left on Maue Road and go to Miamisburg-Springboro Pike. Take sample at this junction and return to Mound Laboratory.

NOTE: The truck should be parked completely off the road when samples are being taken. Since this may be impossible at some of the locations listed, collect the samples in the nearest safe spot to the indicated site.

Approximate distance of route - 81 miles.

CHANGE IN OFF-AREA AIR SAMPLING COLLECTION AND COUNTING

As of July 1, 1958, the off-area air samples will be collected with the Hi Vol sampler run for 15 minutes at each site. A 4.25 cm. diameter circle will be cut from each 4" dia. sample and counted for alpha on a Bradley counter. The sample will be counted for one hour and the results recorded in c/m/meter^3 as before. At a flow rate of 14 cfm for 15 min. the Hi Vol will sample 5.949 meter^3 of air. A 4.25 cm. dia. section of the 4" dia. filter paper will correspond to the sampling of 1.041 meter^3 of air. For simplicity it will be assumed that each counting result represents the activity per cubic meter of air.

W. A. Bigler

a. 1st week (or run) Route "A".

b. 2nd week (or run) Route downwind from Mound.

c. 3rd week (or run) Route downwind from Mound, unless this repeats the previously run route, in which case the nearest route to the downwind direction is run.

d. 4th week (or run) Route downwind from Mound, unless this repeats any previously run route, in which case the nearest route to the downwind direction is run.

e. 5th week (or run) chosen same as 4th week run.

f. 6th week (or run) chosen same as 4th and 5th week runs.

g. 7th week (or run) chosen same as 4th, 5th, and 6th week runs.

Result: Each route is run each quarter and no route is repeated in any one quarter.

Note 1. Vegetation samples are to be taken at each sampling site as has always been done in the past.

Note 2. Because of the length of Route #4, and the number of sampling sites, truck driving speeds have been excessive. In order to increase driving time and reduce speed, the sampling site at New Carlisle and Englewood will be discontinued.

Environment
— Air Sampling
1953

D. OFF-AREA MONITORING SCHEDULES

1. By authority of contents of Secret Document #53-2-11 distribution) by Mr. J. E. Bradley, and issued by Dr all Off-Area Monitoring is to be curtailed to meet the following required sampling as of April 1, 1953:

   a. Air Sampling: Routes B and C ("grid" runs at old Units III and IV) discontinued. Routes 1 through 6, and route A will be sampled once each quarter annum. Sampling sites, New Carlisle and Englewood on route #4 are to be discontinued. This route is too long. All other routes remain unchanged.

   b. River Sampling: All mud and water sampling upstream, from the Mound effluent into the river, will be discontinued. Once each week 8 water samples and 4 mud samples will be collected from the Mound Lab effluent point to approximately 10 miles downstream. Twice each year samples (15 total) will be collected from point of Mound Lab effluent to Elizabethtown, Ohio.

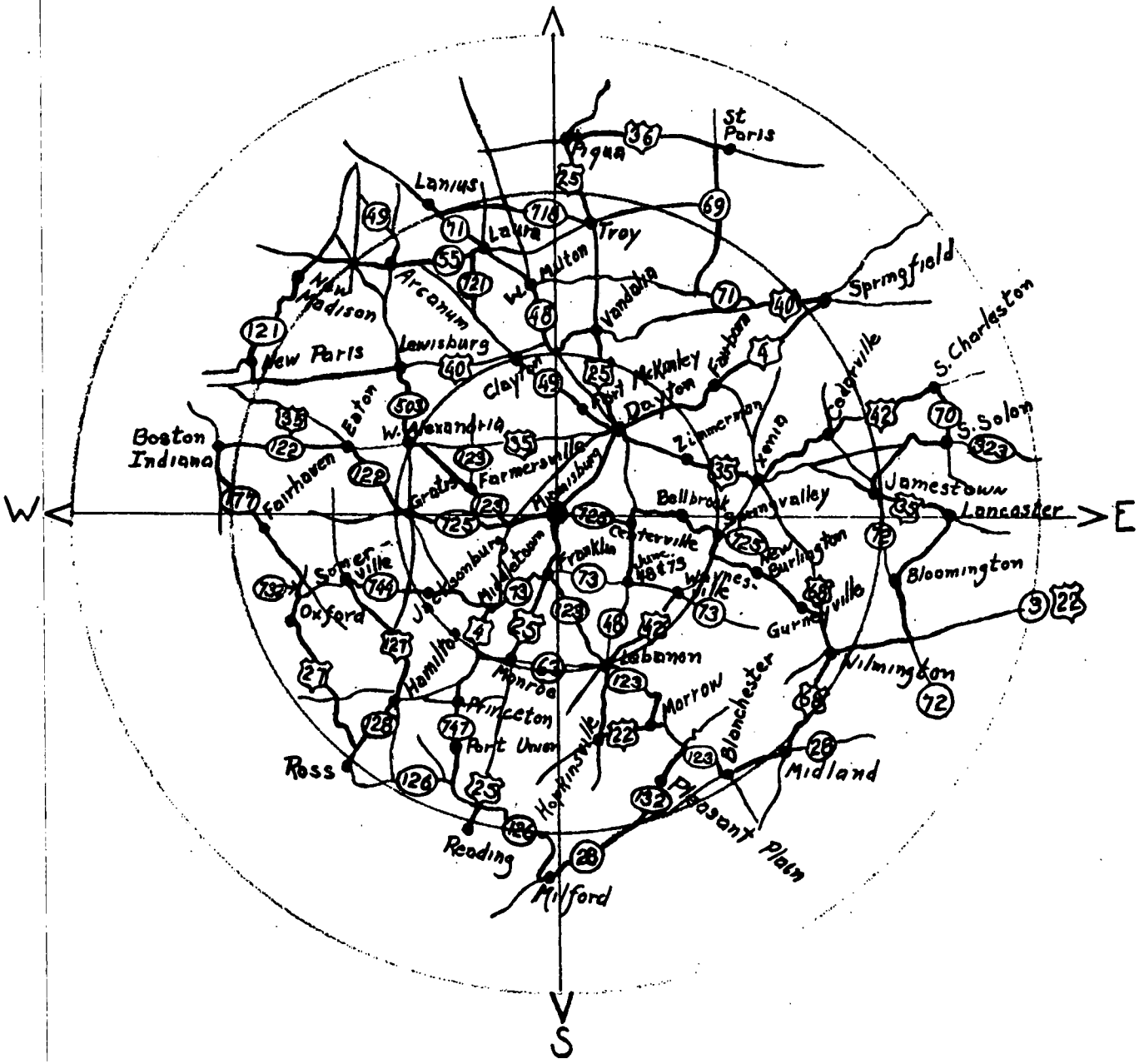
   Precise location of sample sites as of April 1, 1953 as follows:

   (1) Old site # 42 Water sample
   (2) Old site # 43 Mud and water sample
   (3) Old site # 44B Water sample
   (4) Old site # 44C (moved downstream 500 paces from site # 44B) Mud and water sample
   (5) Old site # 44D (moved downstream 500 paces from site # 44C) Water sample
   (6) Old site # 46 - Mud and water sample
   (7) Old site # 49 Water sample
   (8) Old site # 50 (Franklin, Ohio) Mud and water sample

   The additional samples to be collected twice each year (1st week of March and September) are as follows:

   (9) Old site # 51
   (10) Old site # 52A
   (11) Old site # 53A
   (12) Old site # 54A
   (13) Old site # 55
   (14) Old site # 56A
   (15) Old site # 57

2. The old "Grid" routes B and C will no longer be run. The remaining seven routes will be run just once each quarter annum beginning each January, April, July, and October. We request that one route be run each week until the seven have been completed. Monday is the preferred day of the week. (This schedule is loose and can be changed arbitrarily by the Transportation Supervisor according to his work load on any particular day.) However, in case of a schedule change, we request notification of the change. The following is the route sequence to be followed regardless of the day on which routes are run.



AIR SAMPLE LOCATIONS AND ROAD MAP

Air samples taken at all cities and locations listed.

Concentric rings approximately 15 miles apart.

MAP 2

Historical Review of Liquid Sampling Program
Specific Changes in Program
(From Monitoring Reports)

Historical Review of Liquid Sampling Program
Specific Changes in Program
(From Monitoring Reports)

1948 Analyzed water and mud samples collected at 91 locations along both banks of the Great Miami River; spot/grab samples, from Deed's Carillon Tower, (Unit IV outfall), to point where Miami River empties into the Ohio River. Analytical chemical procedure specific for polonium; gross alpha count. Report - Document #51-12-37.

1949 Same as 1948 except water and mud samples collected at 113 locations. Report - document #51-12-37.

1950 thru 1952 Same program as 1949. Report - document #MLM-636 and classified document #53-2-112.

1953 2/25/53 program modified; water and mud samples collected from 8 locations (from Mound outfall to Franklin, Ohio). If positive result at Franklin, then sampled further downstream. (Did not happen.) Twice each year collected samples to location where Miami River empties into Ohio River.

1959 10-year summary data report issued to E. J. Cleary, ORSANCO, 12/17/58. Carbon copies issued to W. G. Belter, DRD, USAEC; H. F. Waring, Ohio Department of Health; and W. B. Creamer, DAO/AEC. Report included data 1948 (declassified Bradley reports) through third quarter 1958. Modified 1953 program continued.

1960 Modified 1953 program continued. Special quarterly reports through 9/30/60 issued to Cleary, ORSANCO and carbon copy distribution for the 10-year report.

Quarterly Environmental Monitoring Data Report, issued "to the public" was initiated at the direction of the AEC. The fact that Plutonium was handled is mentioned, but "liquid waste from plutonium work is very small in volume. It is handled separately as a packaged waste and not discharged to the river." (Pu as 238 was not identified.)

1963 Began issuing Technical Environmental Monitoring Report semi-annually. Modified 1953 program continued.

1965 First report that plutonium liquid waste was processed in a special WD facility. Data on plutonium in the drainage ditch is given. Specific isotope Pu-238 is not identified.

1967 First report to identify plutonium of (major) interest was isotope 238. Plutonium data for the Great Miami River and the drainage ditch. First report of River levels.

1969 First reporting of Pond Water analysis (2 ponds). Water analysis through 1969 was gross alpha.

1970 August - sampling increased to twice per week. (Had been once per week to this time.) Chemical procedure used to selectively recover Pu-238 from water. Sample planchets screened by gross alpha counting. Positive count samples submitted to alpha pulse height counting to maintain specificity for Pu-238 analysis.

1971 Report expanded to cover area community drinking water supplies, non-radioactive pollutants as well as radioactive pollutants in water. Eight additional surface water and pond locations reported on. (Report also covered non-radioactive air pollutant-particulates; foodstuffs, vegetation, soil and silt. Two types of soil analysis are reported - cores and surface scrapings.)

1972 Sampling increase to 5 times per week (week days).

1973 Program reported in 1972 was continued in 1973.

All water data reported against RCG for soluble plutonium.