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Annual Environmental Monitoring Report: Calendar Year 1972

D. G. Carfagno and W. H. Westendorf

March 15, 1973

AEC Research and Development Report

MOUND LABORATORY
Miamisburg, Ohio
operated by

MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company
for the

U. S. ATOMIC ENERGY COMMISSION

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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

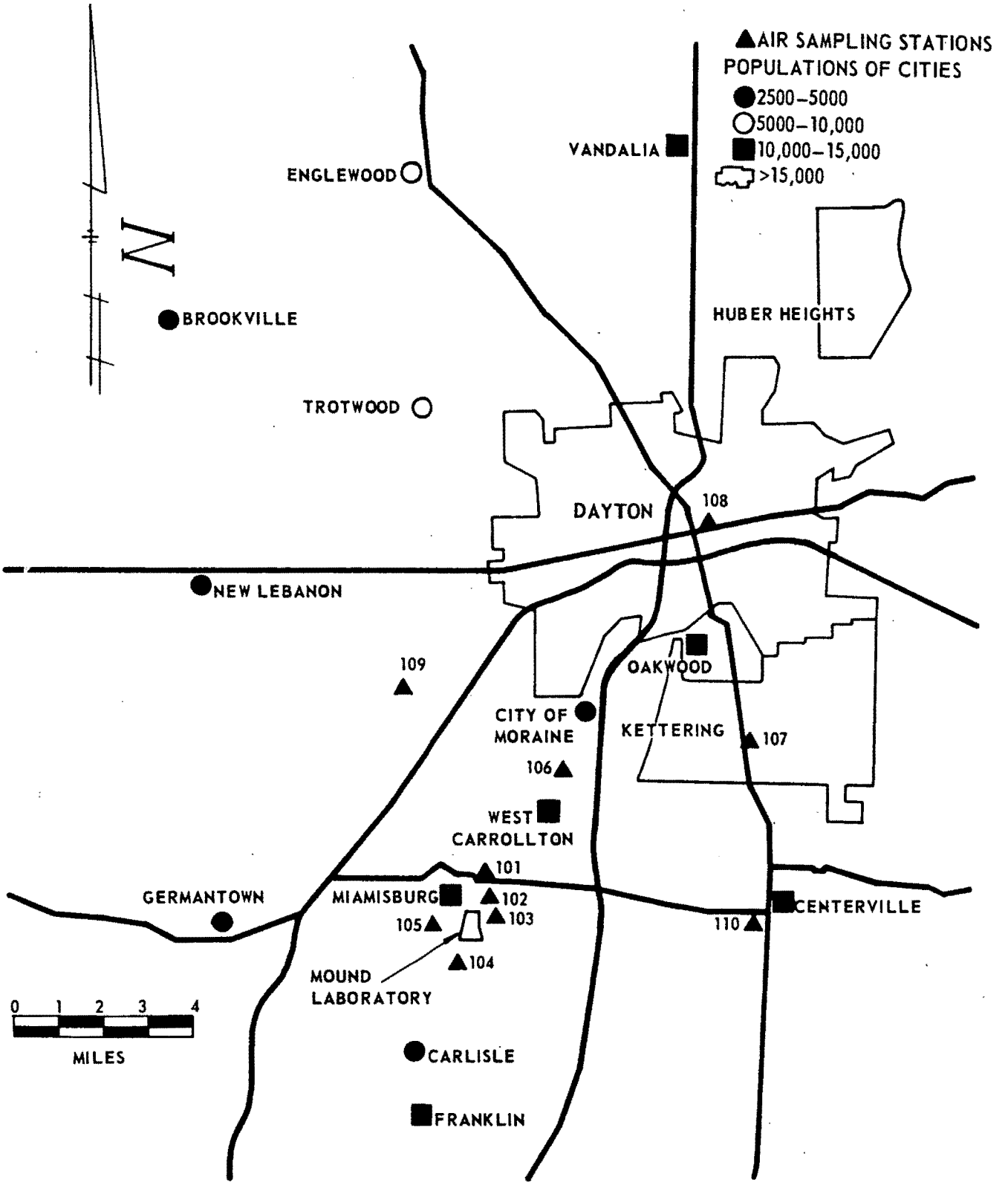

FIGURE 1 - Air sampling locations.

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 x 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 x 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.

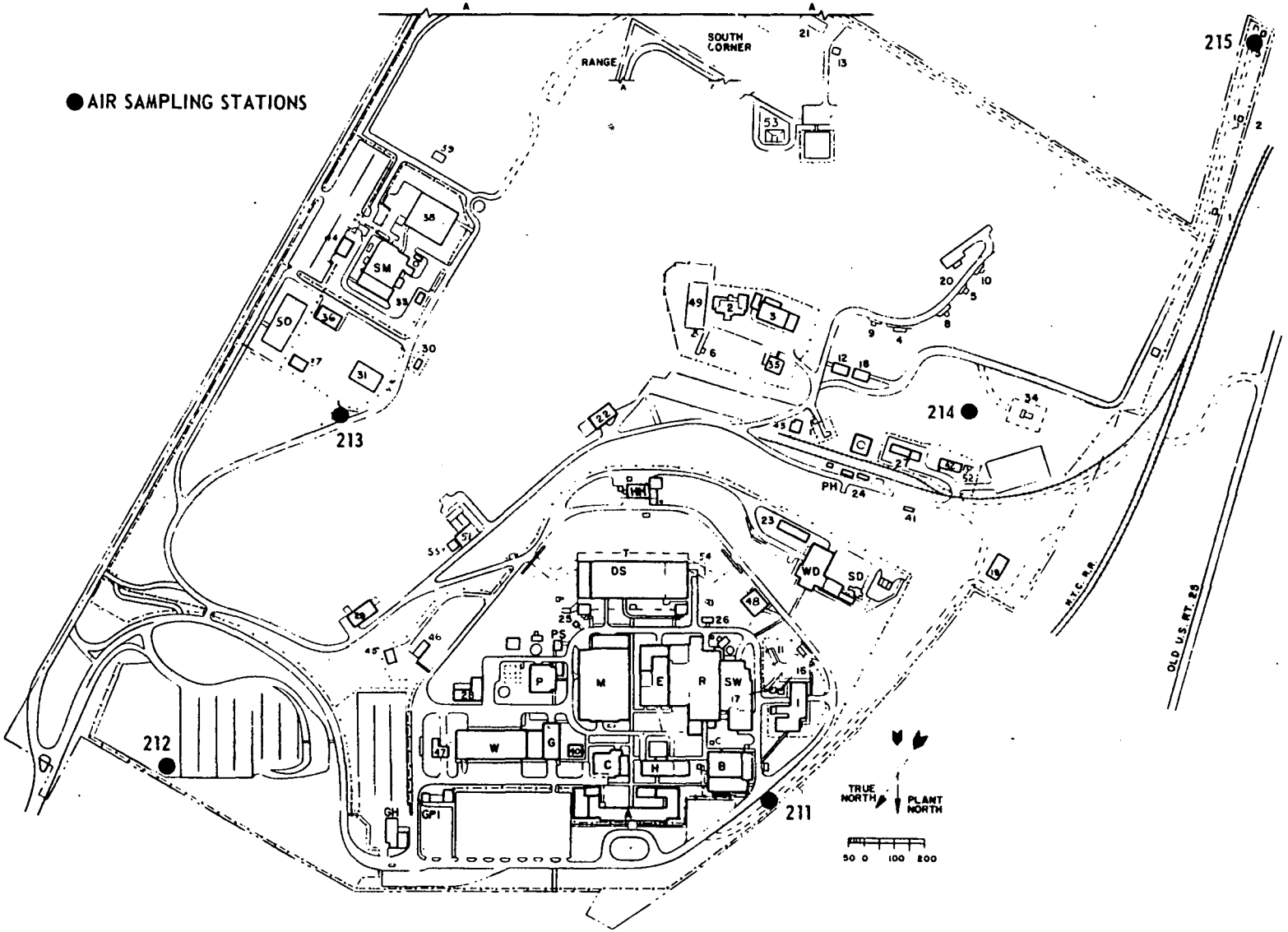

FIGURE 2 - On-site air sampling locations.

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

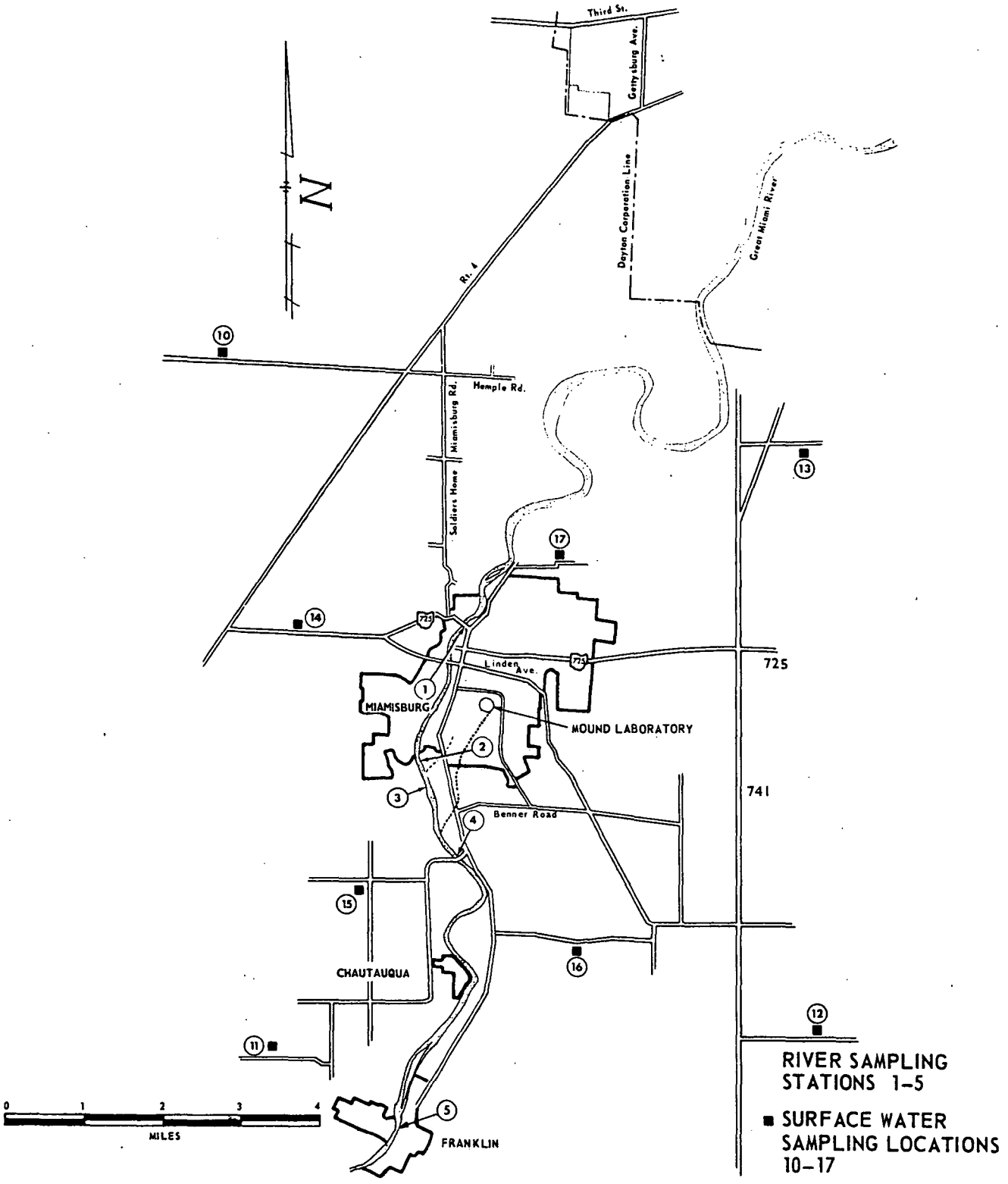

FIGURE 3 - Off-site water sampling locations.

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 x 10^{-19} μCi/ml. The MDL is 0.0007% of the RCG.

**RCG - Radioactivity Concentration Guide = 7 x 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 x 10^{-11} μCi/ml. The MDL is 0.002% of the RCG.

**RCG - Radioactivity Concentration Guide = 2 x 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