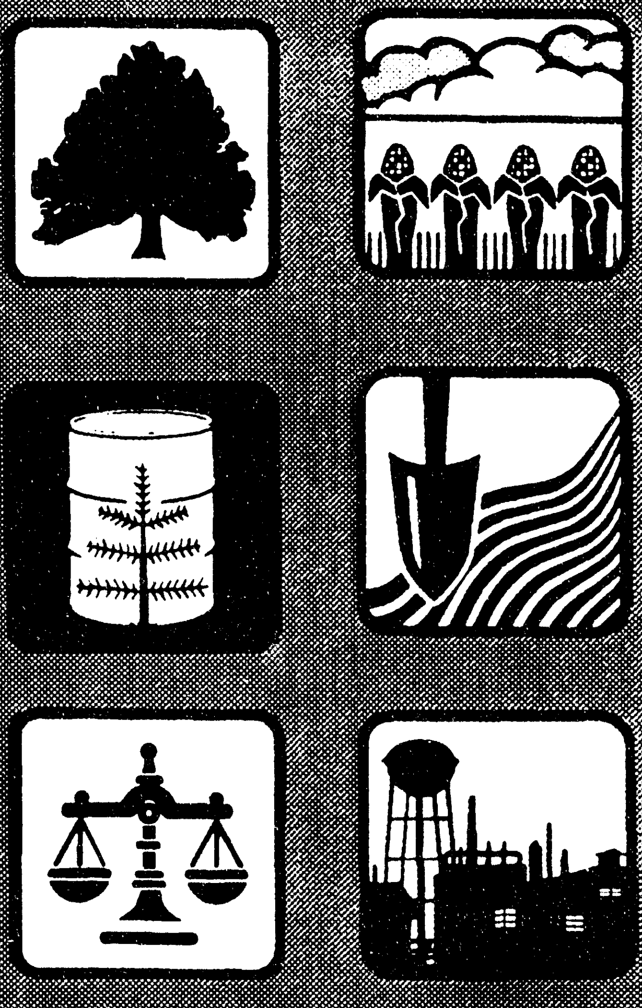
FEMP-2340
UC-707

FERNALD
Environmental Management Project

Site Environmental Report Summary

1992



by the
Environmental Protection Department

Fernald Environmental Restoration
Management Project Corporation

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MASTER

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INTRCDUCTION

In recent years people have become increasingly more concerned about the safety of the environment as well as their own personal health and safety. Throughout the world efforts are being made to conserve both endangered lands and animals, to control emissions into the ozone, and to recycle our natural resources so that we may keep the environment healthy and productive. To protect ourselves effectively, we must know what we may have been exposed to in the past to determine how we may prevent exposure to harmful substances in the future.

In this summary of the Fernald **1992 Site Environmental Report** we will describe the impact of the Fernald site on you and the environment and provide results from our ongoing Environmental Monitoring Program. Also included is a summary of the data obtained from sampling conducted to determine if the site complies with DOE, U.S. Environmental Protection Agency (USEPA), and Ohio EPA (OEPA) requirements. These requirements are set to protect both you and the environment.

This summary may provide sufficient information for many of you. Some of you, however, may wish to read more detailed descriptions found in the full report. Copies of this report are available at the following location:

Public Environmental Information Center
10845 Hamilton-Cleves Highway
Harrison, Ohio 45030
(513) 648-3153

THE FERNALD SITE

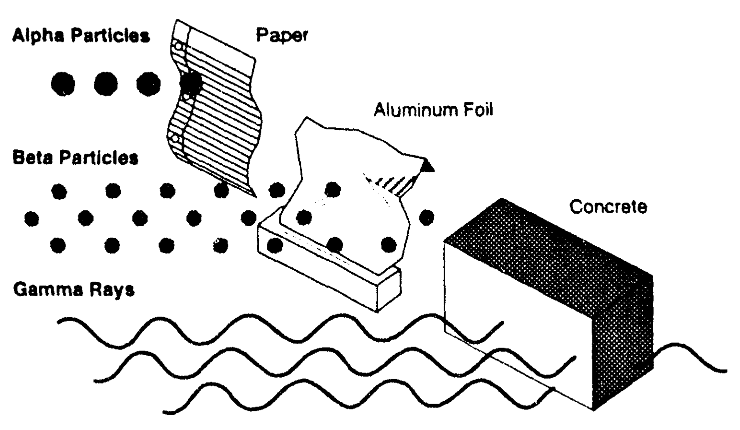
In the early 1950s the government selected a 1,050 acre area, about 17 miles north-west of downtown Cincinnati, Ohio, for the Fernald site. On May 16, 1951, ground was broken here at Fernald to produce uranium metal products in support of Defense activities. Production reached its peak in the 1950s and 60s during the Cold War. During the 1970s, funding for production was reduced; however, due to increased Defense spending in the early 1980s, production increased again. By the late 1980s demand for uranium dropped and production was suspended on July 10, 1989. Since February 1991, when production was formally ended, the site's purpose has been to restore the environment and comply with environmental regulations.

RADIOACTIVE MATERIALS

Although we no longer produce uranium metal, hazardous and radioactive materials are still handled and stored onsite. **Radioactive materials** are hazardous materials that emit radiation. Radiation is a natural part of the environment. **Radioactivity** is the process by which the nucleus of an unstable atom spontaneously decays or disintegrates. **Radiation** is the energy that is released during this process.

The type of radioactive material determines the type of radiation emitted. The three types of radiation that we are concerned about here at Fernald are alpha, beta, and gamma. Alpha radiation can be stopped by any solid material such as a sheet of paper and cannot penetrate your skin. Beta radiation can be stopped by thicker materials such as wood or aluminum but can penetrate your skin. Gamma radiation is the most penetrating and can be stopped only by dense materials such as concrete or steel.

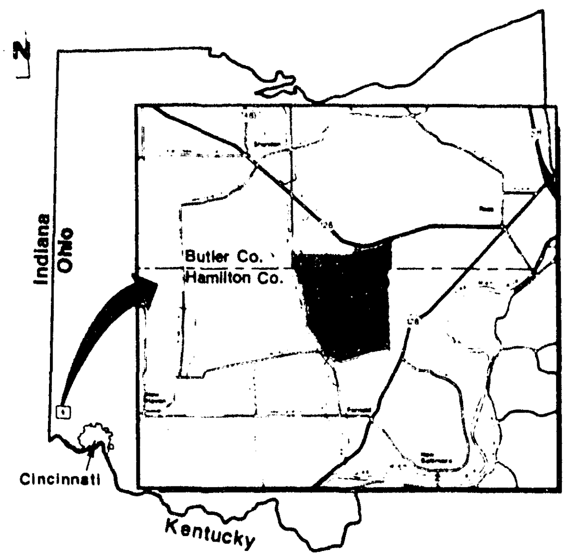
Types of Radiation



We share your concern about public health and environmental safety. Presently we are renovating old structures and adding new ones to store hazardous and radioactive waste more safely. We are also repackaging materials into new drums and moving other materials offsite. Disposing of chemicals at offsite waste facilities has significantly reduced the amount of hazardous materials here.

Most of the towns in the vicinity are small, ranging in population from 69 in Fernald to 2,125 in Ross. The population within a five mile radius is 14,600. The land surrounding the site is used primarily for farming and raising dairy and beef cattle. Major crops include field corn, sweet corn, soybeans, and winter wheat.

Fernald Site and Vicinity



ENVIRONMENTAL MONITORING

We continually investigate the effects of radioactive and hazardous materials on the environment through our **Environmental Monitoring Program**. Monitoring helps ensure that cleanup and restoration activities are being conducted with the public's safety in mind.

The program is designed to:

- Detect unusual release of materials so corrective actions can be taken;
- Monitor releases to ensure standards and guidelines are not exceeded;
- Evaluate past and present effects on the environment;
- Estimate the radiation dose from past operations and current cleanup; and
- Measure progress of correcting problems and using improved environmental management at the site.

Monitoring is necessary to comply with state and federal regulations that govern the site's cleanup activities. We compare data from sampling and monitoring to standards and guidelines set by the National Council on Radiation Protection and Measurements, International Commission on Radiological Protection, U.S. Environmental Protection Agency (USEPA), Ohio Environmental Protection Agency (OEPA), and Department of Energy (DOE). When more than one agency sets a standard, we comply with the most strict regulation of radiation exposure you may receive.

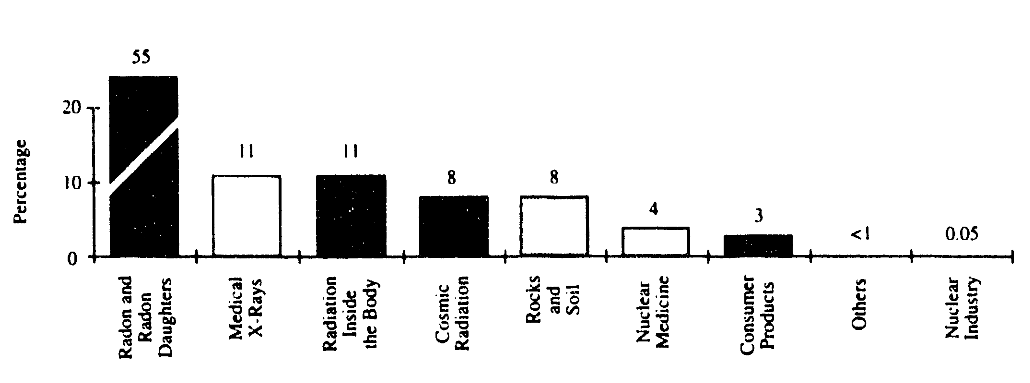
Exposure Pathways to Humans

Radioactive atoms release energy in the form of rays or particles. These atoms are known as **radionuclides,** which can be man-made, naturally occurring, or both. Radioactive materials can be released through the environment which may result in a radiation exposure to the public. Depending on the material, the decay process can take from a fraction of a second to billions of years. There are many different sources of radiation, both natural and man-made, as seen in the chart on the following page.

Measuring Radiation

When you come in contact with radiation, either natural or man-made, the amount that is delivered to your body is called the **dose**. We use this term when comparing the effects of different types of radiation. **Rem** is a unit used to express dose. The more rem, the higher the potential damage. One **millirem** (mrem) is equal to 1/1000 of a rem.

Percentage of an Average American's Annual Dose

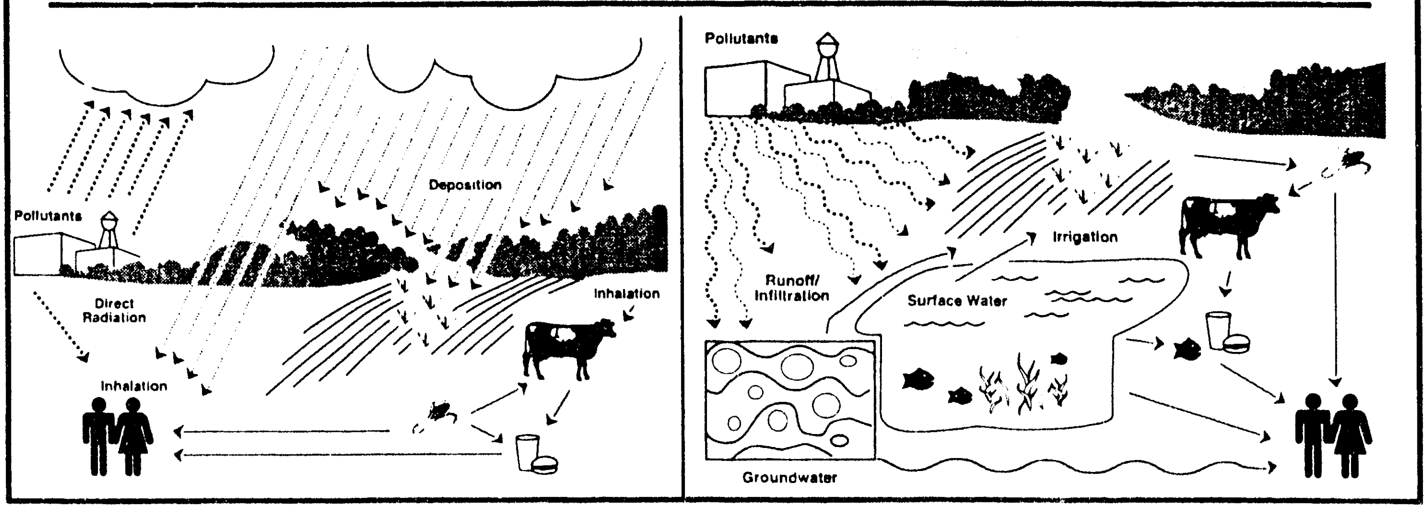


Radiation exposures can occur from radionuclides located outside the body or radionuclides taken into the body through contaminated air, food, or water. For example, if uranium is released into the air and lands on a corn field, some uranium may be absorbed into the corn. Someone who eats this corn may be exposed to radiation. This sequence is kno'vn as an **exposure pathway**. An exposure pathway is a route by which a pollutant can enter your body. We use our Environmental Monitoring Program to study possible exposure pathways of radioactive materials to the community. Through this program, we can estimate how much exposure the community may have received from site operations. In some cases it is difficult for us to determine if a radionuclide is a result of the Fernald site or from other sources such as background radiation, fertilizers, or other industries. Factors such as these make it difficult to exactly measure exposure from the site. A major concern at the site is to protect the public from radiation exposure while the site. We maintain specific site safety standards through an active monitoring and intervention program. The following sections will trace the air and liquid pathways and briefly describe our environmental monitoring procedure.

Air Pathway Monitoring

Air pathway monitoring focuses on airborne pollutants that may be carried from the Fernald site as fugitive dust or stack emissions and how these pollutants are distributed to the environment. **Fugitive dust** is any type of contaminated soil or waste material. The majority of contamination results from fugitive dust released during construction, cleanup, waste handling, and wind erosion. Although the most visible sources of

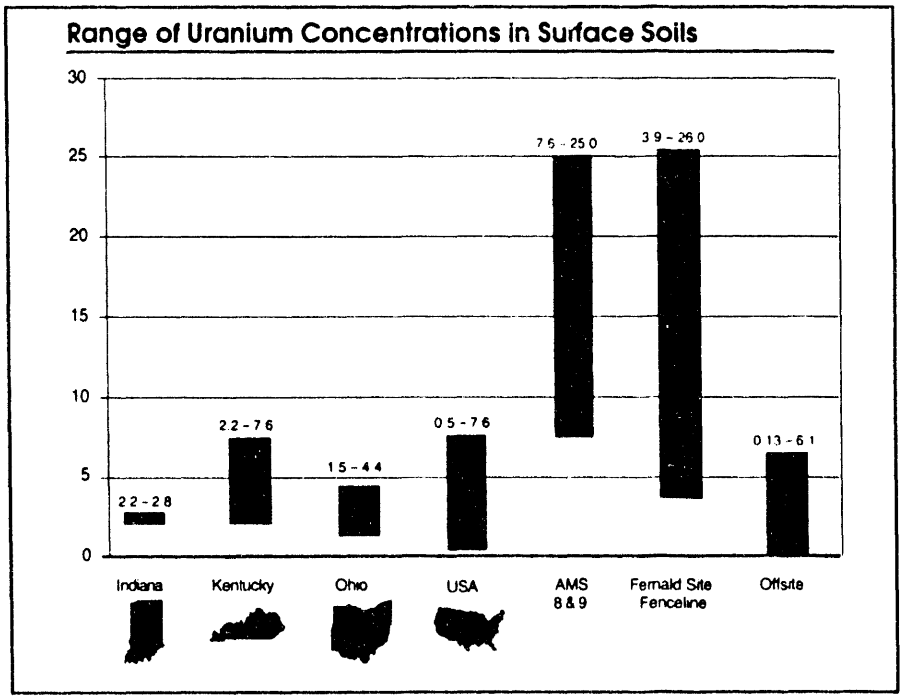
General Air and Liquid Pathways to Humans



contamination are the vent and stack emissions seen daily, they account for a small amount of pollution. During 1992, we continued to monitor radioactive materials in the air pathway by sampling air, soil, grass, produce, and milk. This monitoring enables us to evaluate the effects of our cleanup activities, as well as to fulfill our obligation of protecting and monitoring the environment.

The first step in monitoring the air pathway is measuring stack emissions after they have been treated and filtered. The second step is measuring pollutant concentrations in the air onsite and at site boundaries. During 1992, sixteen air monitoring stations were in operation 24 hours a day, seven days a week as part of the Air Monitoring Program. These air monitoring stations pull air through filters which capture radioactive pollutants. We selected the locations of the air monitoring stations using weather data such as average wind speed and direction. Seven of these stations are located on the fenceline of the site. On the northeast quadrant of the site, we have two monitoring stations to collect air in the prevailing wind direction. At local schools and industries we operate four monitoring stations. The final two locations are in operation at the University of Cincinnati and in Miamitown, Ohio. Each week we check and change these filters and then analyze them for traces of uranium. Portions of the weekly samples are combined and analyzed annually for stronium, technetium, cesium, radium, neptunium, plutonium, and thorium. Airborne concentrations of uranium in 1992 were far below DOE's standards for clean air.

Soil Sampling We take annual soil samples at the onsite air monitoring stations and offsite locations to determine concentrations of uranium in the soil. Uranium found in the soil may be naturally occurring, added by fertilizers, or a result of site operations. Illustrated here is a comparison of naturally occurring uranium concentrations for Indiana, Kentucky, Ohio, and the United States with on- and offsite soil samples. All of our offsite samples were within the normal range for Ohio soil in 1992. Some soil samples along the fenceline, and at air monitoring stations 8 and 9 contained amounts of uranium greater than the normal range for Ohio soil. These samples were collected on the northeast quadrant of the site in the prevailing wind direction. These increased concentrations are most likely from airborne emissions and settling of contaminants during past production of uranium products.



Grass Sampling Uranium contamination in vegetation can result from a plant absorbing uranium through the soil. Contamination may also occur through soil movement due to soil erosion or from uranium being deposited on the plant from the air. We analyzed grass for uranium to determine if airborne emissions affected the amount of uranium in grass. Grass samples were collected at the same locations where our soil samples were collected. An offsite laboratory analyzed the samples for uranium. Our results showed that uranium concentrations in grass onsite were greater than those found offsite; however these concentrations in grass were similar to those of previous years and not affected by recent emissions.

Produce Sampling To ensure operations have not impacted the environment, we monitor the farmland surrounding the site. Sweet corn, tomatoes, beets, potatoes, apples, lettuce, pumpkins, cucumbers, and peppers are some of the produce grown and sold in this area. As part of our environmental monitoring program, we annually compare uranium levels found in local produce (0-3 miles) to levels in produce grown farther away (7-26 miles). No statistical differences were found between the uranium concentrations of local and distant produce; therefore we concluded that no significant amount of contamination had entered local produce. Also, soil samples taken from local farms where the produce was grown were found to be within naturally occurring uranium levels for southwestern Ohio soils.

Milk Sampling Although uranium is not normally concentrated in milk, we monitor cows' milk as part of the air pathway in response to homeowners' concerns about the dairy farm next to the Fernald site. We collect milk each month from this dairy, as well as one in Indiana about 23 miles west of our site for comparison purposes. These samples are examined at an offsite laboratory for uranium concentration. Our results showed that uranium concentrations in milk from the local dairy were comparable to those of the dairy in Indiana. However, the result of the October sample indicated a sudden increase in uranium concentration in milk from the local dairy. The sudden increase was not supported by air monitoring station results for the October period. Also, the well from which the herd receives its water did not show an increase in concentration. In November and December uranium concentrations from the local dairy returned to normal. Therefore, we concluded that the increase in uranium concentration was not caused by releases from our site but by problems with the laboratory analysis. Our environmental monitoring program continues to work to improve the milk sampling and analysis program in order to improve the quality of our data.

Direct Radiation Monitoring Direct radiation originates from sources such as cosmic radiation, naturally occurring radionuclides in soil, background radiation, and radioactive materials here at the Fernald site. The largest source of direct radiation at our site is the material stored in the K-65 silos. Direct radiation levels at and around the site are continuously monitored at 32 locations with thermoluminescent dosimeters (TLDs) that absorb and store the energy given off by direct radiation. Every three months we exchange the TLDs and measure the absorbed energy allowing us to calculate the amount of direct radiation present. As expected, higher levels of radiation were found near the K-65 silos. However, these levels have clearly fallen from previous years because we added a protective bentonite slurry layer within the silos in 1991. **Bentonite slurry** is a clay-like substance suspended in water. This water and clay layer helps to prevent harmful substances such as radon and direct radiation from escaping.

Radon Sampling Radon is a radioactive gas that occurs naturally throughout the environment. Radon is primarily inhaled which may damage the lungs and ultimately cause lung cancer. Not only does radon occur naturally, but it is also released from the waste pits and materials stored in the K-65 silos at the Fernald site.

At the Fernald site we use radon cups to monitor the radon gas. Radon cups are located at the fenceline, the silos, the air monitoring stations, and background locations. In 1992, we measured an average radon concentration of 0.57 ± 0.29 pCi/L at the fenceline. Based on our monitoring for background radon, 0.40 ± 0.13 pCi/L was attributable to background concentrations.

Nonradioactive Pollutants OEPA requires us to estimate emissions from the boiler plant as part of our effort to comply with the Clean Air Act. Last year we estimated the amount of nonradioactive pollutants including sulfur dioxide, nitrogen oxide (NO_x), and carbon monoxide (CO). Our sulfur dioxide emissions were below levels set by OEPA, and to date, the State of Ohio has not set nitrogen oxide or carbon monoxide limits. Both NO_x and CO emissions were below clean air standards in 1991.

In addition to directly affecting concentrations of contaminants in soil, grass, and produce, the air pathway can indirectly influence contaminant concentrations in the liquid pathway. Stormwater runoff is one way materials can be transported into surface water such as Paddys Run. Eventually, these contaminants may affect groundwater as well.

Liquid Pathway Monitoring

Surface Water The liquid pathway includes all pollutants that come from **liquid effluent**, stormwater runoff, and groundwater. Before leaving the site these liquids are monitored and a potential dose is estimated. Particles in the water can become contaminated by the pollutants and settle into sediment, while dissolved pollutants can be absorbed by plants and animals.

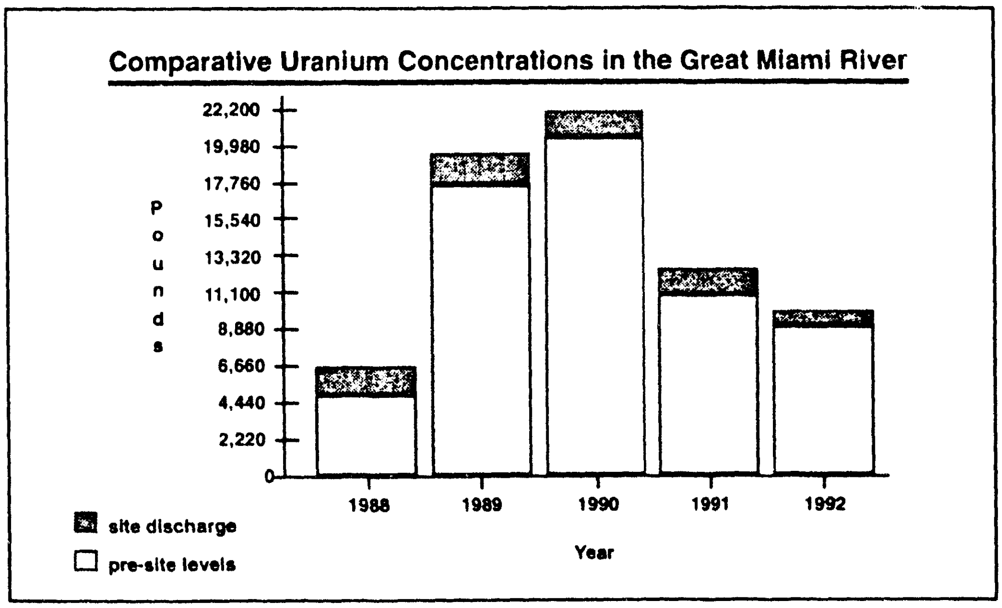
Liquid Effluent
Liquid waste material, usually containing low levels of contamination, that is discharged into the environment.

Each year, we sample various waterways on- and offsite that may carry hazardous pollutants to the public. We treat all controlled effluents as necessary before they are combined, sampled, and eventually sent to the Great Miami River. On an average day, the site combines 580,000 gallons of discharged liquid with 1.8 billion gallons of Great Miami River water. This is an average of one quart of discharge to every 820 gallons of river water.

In addition to monitoring discharges to the river, we monitor uncontrolled discharges to Paddys Run. Since construction of the Stormwater Retention Basin in 1986, the amount of uranium in Paddys Run has been significantly reduced.

DOE standards require that the total percentage of all radionuclides in the liquid effluent may not exceed 100%. If the concentration of all radionuclides when combined exceeds this standard, we must use "best available technology" to treat the waste. We are currently constructing an Advanced Wastewater Treatment Facility to treat both stormwater and wastewater. This system will replace a temporary facility used since July 1992. We are also constructing an additional temporary facility, at another site location, to extract uranium from wastewater.

In 1992 we discharged 961 pounds of uranium into the Great Miami River. This is a 34% decrease from 1991. This is compared to 9,020 pounds of uranium already present in the river before it reaches the effluent line. The accompanying chart shows the levels of uranium present in the river before the effluent line compared to levels that occur after the effluent line.



Based on samples, we estimated that 10 pounds of uranium per inch of rain ran off into Paddys Run. This estimate was lowered to 6.3 pounds of uranium per inch of rain in November because of the completion of the Waste Pit Area Runoff Control Removal Action allowing runoff to be collected and treated before being released into the environment. In 1992, we estimated that 350 pounds of uranium were discharged through stormwater runoff into Paddys Run.

We analyzed samples from 12 locations on- and offsite to measure the total uranium in the surface water in the Great Miami River and Paddys Run. The results from 1992 indicated that the uranium concentrations in both the Great Miami River and Paddys Run were higher downstream than upstream. However, the concentrations did not increase from 1991 and were still well below DOE guidelines for drinking water. The amount of uranium in the runoff to Paddys Run should be lower in the future because of the completed Waste Pit Area Runoff Control Removal Action. We will continue sampling in 1993.

Sediment We sampled the sediment in the stream bed to evaluate the effects of treated discharges into the Great Miami River and stormwater runoff into Paddys Run. This sediment may contain pollutants that gather in the stream beds when contaminants settle out of the surface water.

During 1992, we sampled sediment from 45 locations along Paddys Run and the Great Miami River. These locations were strategically chosen to provide a representative sample of the most recent and greatest amount of sediment deposited. Each sample was analyzed for total uranium; however, there are currently no DOE or USEPA guidelines for uranium in sediment.

Our analyses showed there were no significant differences in uranium concentrations in sediment downstream as compared to upstream in the Great Miami River. Therefore, liquid discharges did not cause a measurable increase in the amount of uranium in the Great Miami River sediment.

Uranium concentrations in 1992 along Paddys Run were similar to those in 1991. However, concentrations in the outfall ditch were higher than background levels. These elevated concentrations appear to be due to onsite stormwater flowing into the outfall ditch. Now that the Waste Pit Area Runoff Control Removal Action is completed, we expect a lower uranium concentration in sediment along the outfall ditch.

Fish Those who fish in the Great Miami River are naturally concerned about any levels of contamination in the fish. Fish sampling can show whether or not fish are retaining any pollutants and what threat this may pose to someone who consumes them. As a fish ages, pollutants can concentrate in its body. This allows us to use fish to investigate our long-term influence on the environment. With the help of a research team from the University of Cincinnati, we have been sampling fish for nine years.

We collected over 490 fish from four locations along the Great Miami River in 1992. One upstream site was used to obtain a background concentration. Since this location is physically separated from the Fernald site by two dams, there is no possibility of downstream fish migrating to this location. The average uranium concentration in the fish from the other three locations was no greater than the background location. Regardless of the sampling location, the health of the fish seemed to be similar.

Nonradioactive Pollutants We control the discharge of nonradioactive pollutants to meet the requirements of our National Pollutant Discharge Elimination System permit. Since no surface water in the Great Miami River downstream of the site is used as a source of public drinking water, we use guidelines in the permit for comparison purposes only. Out of the 6,190 samples collected for nonradioactive pollutants, only 16 were not in compliance. All 16 noncompliances were onsite. We did not sample from Paddys Run for nonradioactive pollutants since the Stormwater Retention Basin did not overflow in 1992.

Groundwater Sampling Good water quality in the Great Miami Aquifer is important because it is a source of water for homes and farms in the area. We sample groundwater at many depths to determine the extent of contamination in the aquifer.

Proposed USEPA Standard for Drinking Water

In addition to comparing groundwater results to background levels, we also use standards set by USEPA. These standards are set lower than the lowest harmful concentration known to cause injury or illness to humans or the environment. USEPA is responsible for setting all drinking water standards throughout the United States. However, if USEPA does not set a standard for a certain substance, other government agencies such as DOE set guidelines.

Before 1990 the only guideline set for uranium in drinking water was a DOE guideline of 20 pCi/L. However, in 1991, USEPA proposed a guideline of 13.5 pCi/L. In this report, we use the proposed standard for comparison to ensure the safety of the people around the site.

The Groundwater Monitoring Program continues to monitor site-owned wells. Private well sampling continues under the Radiological Environmental Monitoring Program as a service to residents who request a sample be taken from their wells. In 1992, there were 37 offsite wells sampled monthly for uranium. All but six of these wells showed uranium concentrations less than 2 pCi/L, or less than 15% of the proposed USEPA standard. All the wells that were above the proposed standard are in an area called the South Groundwater Contamination Plume, discussed below. The uranium-contaminated water in the South Plume will be pumped from the aquifer as part of the South Groundwater Contamination Plume Removal Action.

Public Water Supply Program

DOE has provided bottled water to homeowners whose wells have been affected by the South Plume. Eventually, DOE hopes to eliminate homeowner wells that draw water from the affected area of the Great Miami Aquifer and supply the residents with water from the public water supply. Currently construction is underway on a pipeline that will carry public water to the residents near the site. The completion date is set for the summer of 1994. This completion date depends upon the construction schedule of Hamilton County.

South Plume Over the past several years, groundwater monitoring has led to the discovery of the South Groundwater Contamination Plume. Contamination from the site flows with groundwater, usually to the east and south, toward the Great Miami River. Groundwater travels very slowly; therefore, effects of contamination may not be seen for years. Since contamination moves in the same direction and rate as groundwater, we can track the movement of this plume.

The South Groundwater Contamination Plume Removal Action was initiated to stop further spread of the plume, to limit the exposure of contaminated groundwater, and to protect the groundwater environment. This removal action will pump water from the Great Miami Aquifer to the site for monitoring and discharge into the Great Miami River.

Comprehensive The Comprehensive Groundwater Monitoring Program deals with the sampling of all site-owned wells. We sample as necessary to provide a complete database for reporting purposes. Of the 216 on- and offsite monitoring locations, 37 were above the proposed USEPA drinking water guideline. Of those 37 wells, 12 are located offsite and in the South Plume area. The other 25 locations were onsite.

We also monitor the Great Miami Aquifer for nonradioactive pollutants and general water quality. In 1992 we sampled private wells for 16 metals. All metal concentrations were within guidelines except for iron and manganese. However, iron and manganese are typically found in the groundwater of this area and do not pose a threat to human health or to the environment. We also sampled for 26 Primary Drinking Water Standards in many site-owned wells on- and offsite. Seven of the constituents were above the standards at more than one well. Also detections above the Secondary Drinking Water Standards for iron, maganese, and total dissolved solids were found in several wells. Many of these secondary standards are naturally occurring and do not pose a threat to human health or the environment except at considerably higher concentrations.

ESTIMATED RADIATION DOSES FOR 1992

We realize a primary concern of the public is radiation exposure. We have estimated the radiation doses for 1992 based on extensive monitoring. Our monitoring procedures are important because they show how someone might be affected by radiation. Although we use computer programs designed to estimate radiation doses at the Fernald site, the programs are designed to be conservative, and someone's actual dose from the site will probably be much lower. DOE and USEPA regulations require that the radiation dose will not exceed 100 mrem per year for all pathways, including liquid and air.

Airborne Emissions We use a computer program called CAP-88 to estimate doses from the airborne emissions. The computer program bases this estimate on meteorological data and results from fenceline monitoring. DOE requires us to limit these emissions to 10 mrem. The estimated radiation dose from airborne emissions in 1992 was 0.2 mrem, significantly below the DOE limit.

Doses from Food The estimated potential dose from food is derived from uranium concentrations in locally grown fruits, vegetables, and milk. This estimate is based on the **maximally exposed individual** with a yearly diet of 40 pounds of leafy vegetables (cabbage, lettuce, etc.), 100 pounds of grains (corn, soy beans, wheat, etc.), 150 pounds of fruit, 62 pounds of below- ground vegetables (potatoes, carrots, etc.), 100 pounds of other vegetables, and 30 gallons of milk. The 1992 estimated dose from food was 0.8 mrem.

"Maximally Exposed" Individual

This is a hypothetical individual who is exposed to all pathways of contamination. This individual consumes meat, vegetables, and milk produced only in the area along with fish and water from the Great Miami River. For airborne emissions we assume that this person remains outside, along the site fenceline 100% of the time. When estimating direct radiation doses we take the dose at the home nearest the K-65 silos.

Direct Radiation Direct radiation is a result of gamma and X-rays given off from radionuclides stored onsite. It is unlike the air and liquid pathways because the pollutants are not inhaled or ingested, but absorbed through the skin. Most of the direct radiation was from the K-65 silos and stored thorium compounds. However, the bentonite layer, added to the K-65 silos in late 1991, has effectively reduced direct radiation from the silos this year. Direct radiation occurs naturally in the environment, but since there was no statistical difference from background radiation and site radiation, no direct radiation dose could be attributed to the site.

Radon Dose In 1992, all onsite radon concentrations were well below the DOE limit. The bentonite slurry in the K-65 silos reduced the radon dose by 80%. The emissions from all waste pits were also well below the appropriate regulations. The estimated dose from radon attributed to the Fernald site was 51 mrem. The combined dose of radon from the Fernald site and from background radon that is naturally occurring in local soil was 171 mrem.

Liquid Pathway We use radionuclide concentrations in groundwater, the Great Miami River, and fish from the river to estimate the liquid pathway dose. If someone drank 0.5 gallon of well water per day for 50 years, their dose would be between 0.01 and 0.4 mrem depending on the concentration of uranium in the well. If that person drank the same amount of water from the Great Miami River, their dose would be 0.02 mrem. These are well below the DOE limit of 4 mrem.

Fish are another source of the liquid pathway doses. We collected fish at four different locations. The first location was used to estimate natural occurrence of uranium. This was subtracted from the maximum concentration of uranium in fish collected from the other three locations. From this concentration, we determined that if you ate 10 pounds of fish from the Great Miami River in 1992 your dose from the site would be less than 0.01 mrem.

The chart below represents the doses attributable to the site compared to the applicable guidelines.

Dose to Maximally Exposed Individual

Pathway	Dose Attributable to the site	Applicable Guideline
Air		
Estimated 1992 emissions	0.2 mrem	10 mrem/air
Foodstuffs grown in Fernald area	0.8 mrem	100 mrem/all pathways
Direct radiation	0.0 mrem	100 mrem/all pathways
Liquid		
Water from Great Miami River	0.02 mrem	4 mrem/drinking water
Fish from Great Miami River	0.01 mrem	100 mrem/all pathways
Maximally exposed individual	1.0 mrem	100 mrem/all pathways

It is easy to identify certain hazards to the environment and to your personal health such as black smoke pouring into the atmosphere from an industrial smokestack. But some contaminants are harder to detect, and some are only detectable through monitoring. Measurements collected from our monitoring make it possible to determine what the surrounding communities may have been exposed to and how we may reduce exposure in the future.

We hope that you now have a clearer picture of the Fernald site's impact and the environment during 1992. Although significant improvements in site conditions have been achieved, we will continue to work hard toward an even cleaner environment in the future.

This summary was prepared by the first semester Scientific and Technical Writing Class (1993-94) of Oak Hills High School, listed below, with help from the Department of Energy and FERMCO.

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