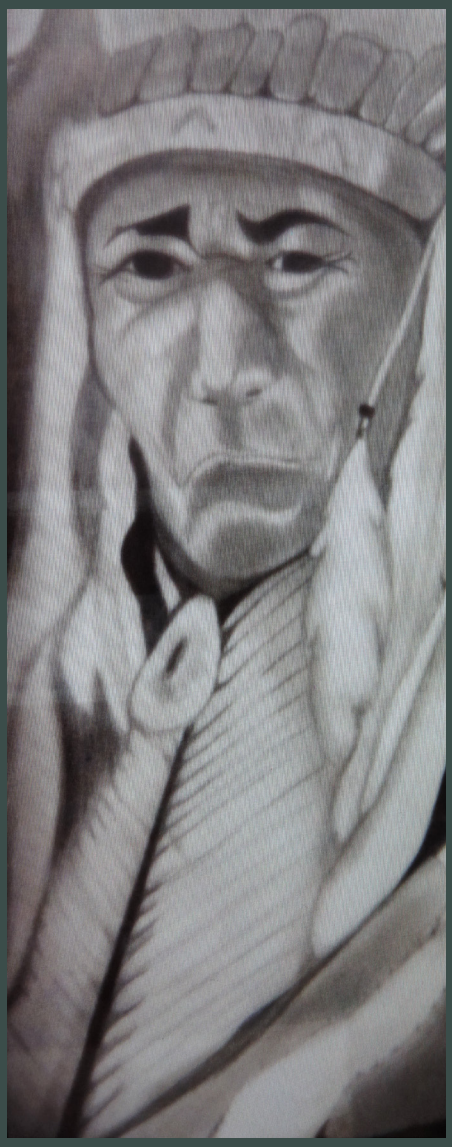
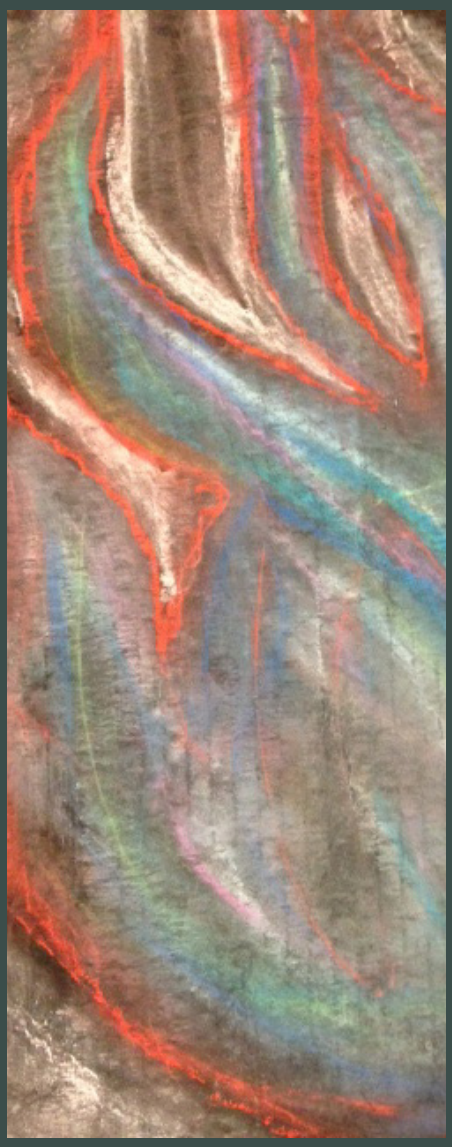
U.S. DEPARTMENT OF ENERGY PORTSMOUTH ANNUAL SITE ENVIRONMENTAL REPORT (ASER) FOR 2012

Student Summary





Message from the U.S. Department of Energy

The U.S. Department of Energy (DOE) conducts environmental monitoring at the former Portsmouth Gaseous Diffusion Plant Site (PORTS) on an ongoing basis. Each year, the information collected is presented in a data volume and a comprehensive publication entitled the Annual Site Environmental Report (ASER). This year, a class at Western Local High School (WHS), located in Pike County, Ohio, developed this summary report. Both the ASER and this summary report are important as they allow DOE to clearly and concisely explain our environmental monitoring programs to our many stakeholders. The information presented in this summary shows that the PORTS site near Piketon, Ohio is safe due in part to the Department's focus on safety. The work at DOE's facilities is highly detailed and technically complex, but it is our commitment to perform each of these activities safely. No matter what we do, our first priority is to protect the well-being of our workers, the surrounding communities, and the environment. We would like to offer our sincerest appreciation to the students and faculty leader at WHS who worked on this summary document. On behalf of the entire DOE, we congratulate each of you for your effort, enthusiasm, and willingness to support DOE with this project. We hope that you enjoy reading the *PORTS 2012 Annual Site Environmental Report Summary*.

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Message from the Students

Dear Reader,

The report that follows is a summary of the U.S. Department of Energy Portsmouth Annual Site Environmental Report for 2012 (ASER), regarding PORTS located near Piketon, Ohio. The summary has been compiled by the 2015 WHS Environmental Science class, made up of juniors and seniors at WHS during the 2014-2015 school year. Even with most of the class having lived in this region for their entire lives, it became apparent how little of the workings of the plant were known by the members of the class.

In the process of putting this summary together, we were able to gain a better understanding of the history, function, and possible future of the site. The presentations provided by Ohio University, Fluor-B&W Portsmouth LLC (FBP), U.S. DOE, and Rio Grande University were greatly appreciated and provided invaluable understanding of the materials which we were asked to summarize. Not only did we learn from the presentations, but we greatly enjoyed the opportunities to participate in the field studies that gave us a glimpse into what is being done at the plant site to ensure the environmental safety of people and wildlife of this region.

Our goal from this summary has been to make the information concerning the monitoring and cleanup of the PORTS facility better understood by the people who it most affects. We hope that this summary makes the information useful to you and that you can gain a better understanding of the cleanup processes that are going on around the site to ensure your safety. Though it has been hard work, we appreciate the opportunity that we have been presented with to learn and share with the people of our community.

Thank You,

The Western High School Environmental Science class, 2015
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Linda Breeding
Anthony Cable
Stevi Donahue
Dakota Hurley
Mark Mollett
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Background For The PORTS Facility

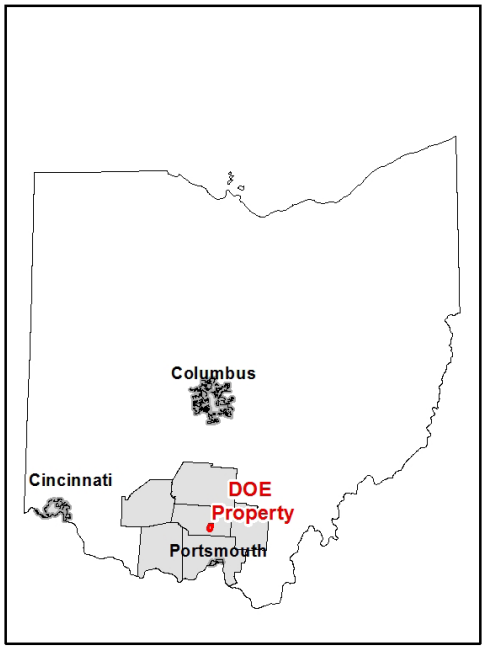
PORTS is located on a 5.9 square mile site in Pike County, Ohio. It is located 2 miles east of the Scioto River and 120 feet above the flood plain.

Piketon is the nearest residential center with a population of just over 2,200 as of the 2010 census. The village of Beaver and the city of Waverly are other residential centers within 10 miles of the facility, as well as the cities of Portsmouth, Chillicothe, and Jackson lying within 25 miles. The total population within a 50 mile radius of PORTS is approximately 677,000.

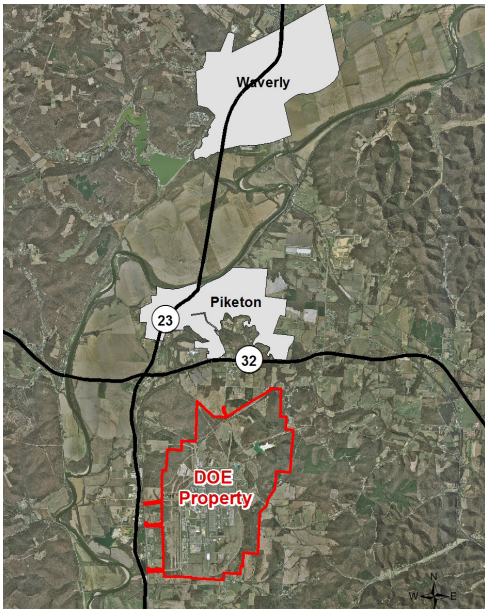
PORTS enriched uranium from 1954-2001. United States Enrichment Corporation (USEC) operated the enrichment facility at PORTS from 1993 until 2001. In 2011, they completed the process of returning the facilities to the U.S. DOE.

Currently, FBP is the DOE contractor responsible for the decontamination & decommissioning (D&D) of PORTS. Additionally, USEC-provided data is included in this report to provide a better understanding of programs in place at PORTS to detect and assess potential impact to human health and the environment as a result of PORTS activities.

This report gives details of regulatory compliance, environmental programs, radiological and non-radiological monitoring programs, and groundwater programs. It is intended to demonstrate compliance with all local, state, & federal regulations. *Director's Final Findings and Orders for Removal Action, Remedial Investigation, Feasibility Study, Remedial Design, and Remedial Action* (DFF&O) are also available and D&D are subject to the these findings and Orders. However, this report is not intended to present all of the monitoring data at PORTS. Further details are available at the PORTS Environmental Information Center. http://energy.gov/pppo/portsmouth-environmental-information-center



Map: Matt Trainer, Voinovich School of Leadership and Public Affairs



Map: Matt Trainer, Voinovich School of Leadership and Public Affairs

Compliance

DOE and the associated responsible contractors FBP and B&W Conversion Services, LLC (BWCS) have permits pertaining to the environmental aspects of discharged water, air emissions, and the storage and disposal of wastes, including radioactive waste. These activities at PORTS are inspected on a regular basis by various agencies at the federal, state, and local level.

FBP and BWCS also prepare compliance reports for the applicable environmental regulations. These reports include groundwater monitoring, a hazardous waste report, a polychlorinated biphenyl (PCB) document log, various air emissions, including specified non-radiological air emissions, monitoring data, and a report of any toxic chemicals released.

- DOE and/or FBP received five Notices of Violation in 2012. First, there was a violation in February of an overflow of groundwater contaminated with trichloroethene (TCE) from an accumulation tank. The overflow affected approximately 250 square feet of surface soil and the Ohio Environmental Protection Agency (Ohio EPA) was contacted immediately. Monitoring revealed that TCE was not detected above the level that DOE and Ohio EPA had agreed upon over a period of time and the violation was abated.

Artwork by Autumn Curlonis

- The second violation was received by DOE and FBP as a result of an inspection conducted by the U.S. Environmental Protection Agency (U.S. EPA) and the Ohio EPA. Containers with used oil and used fluorescent lamps were not labeled. This violation was immediately abated when the containers were properly labeled.
- The third Notice of Violation came from the Ohio EPA to DOE and FBP and involved the storage of Depleted Uranium Hexafluoride (DUF_6) cylinders which allegedly contained hazardous waste which was regulated by Resource Conservation and Recovery Act (RCRA). This violation resulted in a payment of a civil penalty settlement and was later retracted by Ohio EPA.
- In the fourth violation, FBP received a Notice of Violation from the Utah Radiation Control Board in regards to a shipment of radioactive waste received by the facility in Utah. These containers had been packed in 1998 by the previous PORTS site contractor and one container out of 54 shipped had liquids in excess of the facility's acceptance limit. FBP responded by revising the waste program to include additional verification of containers packaged by previous site contractors. The Utah Radiation Control Board responded and the matter was resolved and closed.

- The final Notice of Violation received by DOE/FBP was the result of an inspection conducted by the U.S. EPA and the Ohio EPA. This violation was also for improperly labeled fluorescent lamp containers and was resolved quickly.

Two unplanned releases from DOE activities at PORTS were reported in 2012. The unplanned release of groundwater contaminated with TCE from an accumulation tank that occurred on January 3, 2012 is discussed above. There was also an unplanned release of less than two tablespoons of mercury that occurred during demolition of the X-100B Air Conditioner Equipment Building. Neither of these releases were reportable quantity releases under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) nor the Emergency Planning and Community Right-To-Know Act. Ohio EPA was notified of each release. No impact to human health or the environment was identified from the releases.

Environmental Laws and Acts

This section outlines the PORTS compliance status with regards to environmental laws and regulations, DOE Orders, and Executive Orders.

Artwork by Amanda Nichols

PORTS is not on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List of sites requiring priority cleanup. However, D&D at PORTS is proceeding in accordance with CERCLA and the D&D DFF&O (Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action), which describes the regulatory process for D&D of the gaseous diffusion process buildings and associated facilities that are no longer in use. CERCLA requires notification to the National Response Center if hazardous substances are released to the environment in amounts greater than or equal to the reportable quantity. During 2012, DOE contractors had no reportable quantity releases of hazardous substances subject to notification requirements.

The Emergency Planning and Community Right-to-Know Act of 1986 requires reports on chemicals at the site to various federal, state, and local authorities. During 2012 there were no releases of reportable quantities.

RCRA regulates the generation, accumulation, storage, transportation, and disposal of solid and hazardous wastes. There were several (5) incidents in which DOE or FBP were notified by the Ohio EPA of violations but only one

resulted in a civil penalty. RCRA also requires groundwater monitoring which is discussed further in section six. Another Act that regulates the use, storage, and disposal of PCBs is the Toxic Substances Control Act (TSCA). PORTS is regulated by the TSCA. Both are designed to protect the workers, the public, and the environment. All low-level wastes that are generated and stored at the PORTS facility are in accordance with these Acts.

Air quality is also monitored at PORTS, under the Clean Air Act, Title VI, Stratospheric Ozone Protection Act, and the National Emission Standards for Hazardous Air Pollutants (NESHAP). Air emissions are continuously monitored at the exhaust vents and the pressure relief vents. Some of the tests done are to ensure that the air released is not radioactive.

In addition to the groundwater testing FBP is responsible for the drinking water system at the site which falls under the Safe Drinking Water Act. Samples are taken on a monthly basis and there has not been any contamination or safety issues reported.

Since the activities at the PORTS site are funded by federal dollars, the National Environmental Policy Act is also adhered to. The site evaluates routine operation and maintenance activities to assess potential environmental impacts. The operation and maintenance activities are considered routine and have no significant individual or cumulative environmental impacts. Additionally, a survey was completed for the threatened and endangered species habitat; no Indiana bats and few critical habitats were found.

Environmental Program Information

Decontamination & Decommissioning Program

The DFF&O, an agreement established in April, 2010 between DOE and Ohio EPA, governs the D&D of gaseous diffusion process buildings and associated facilities. The DFF&O uses the CERCLA outline for determining suitable removal and remedial actions. The DFF&O requires that DOE provide a Community Relations Plan, which shows opportunities to give information to the public and get public input.

The DFF&O requires that buildings be evaluated by: engineering evaluations/cost analysis and action memoranda for less complex facilities; a remedial investigation/feasibility study (RI/FS) and a record of decision for process buildings and complex facilities; and a RI/FS and record of decision for evaluation and selection of alternatives for site-wide waste disposition.

In September of 2012, one of the site's most iconic buildings was brought to the ground as part of D&D activities. The X-100 building, constructed in the 1950s to serve as temporary headquarters for construction personnel, was demolished in a little more than one week. Over the years, the facility served as home to plant managers, administrative personnel, Human Resources, Nuclear Regulatory Affairs, and other departments.

Smaller, less complex PORTS buildings undergo D&D under the process for non-time critical removal actions. This includes a site evaluation determining anticipated wastes, volumes, and any potential release of hazardous substances. The Ohio EPA reviews and concurs with these documents.

D&D was completed in 2012 on the X-100 Complex (X-100 Administration Building, X-100B Air Conditioner Equipment Building, X-101 Dispensary, and X-109C Monitoring Station). The process for evaluation and removal of three additional groups of buildings was underway in 2012:

- X-744S Warehouse and X-624-1 Decontamination Pad,
- X-600 Steam Plant Complex (X-600 Steam Plant, X-600B Steam Plant Shop Building, and X-600C Ash Wash Treatment Building), and
- X-102 Cafeteria and X-106 Tactical Response Building.

The most complex of the buildings to be removed under the DFF&O are buildings that must be addressed by the RI/FS process and include the three gaseous diffusion process buildings and four additional buildings (X-700, X-705, X-710, X-720). Almost 250 other facilities or structures (including but not limited to groundwater treatment facilities, warehouses, concrete pads, trailers, storage yards, etc.) may also be included in the RI/FS

process or may be addressed as non-time critical removal actions with the agreement of DOE and Ohio EPA. The RI/FS work plan details the tasks to be completed to standards, determines waste generated, assesses the potential risk to human health and environment, and evaluates potential alternatives. The RI/FS report provides results of the work plan. Ohio EPA reviews and provides concurrence for the pre-investigation evaluation report, RI/FS work plan, and RI/FS report. A proposed plan is made available for public comment and a record of decision is issued with a responsiveness summary to address public comments; then remedial action is selected by DOE and Ohio EPA.

Site-Wide Waste Disposition

This portion of D&D evaluates off-site/on-site waste disposition alternatives for waste generated. The on-site disposal alternative involves construction of an on-site waste disposal facility. The waste disposition project follows a similar process as D&D. Methods of development of waste acceptance criteria for an on-site waste disposal facility is included as part of the RI/FS work plan.

Environmental Restoration Program

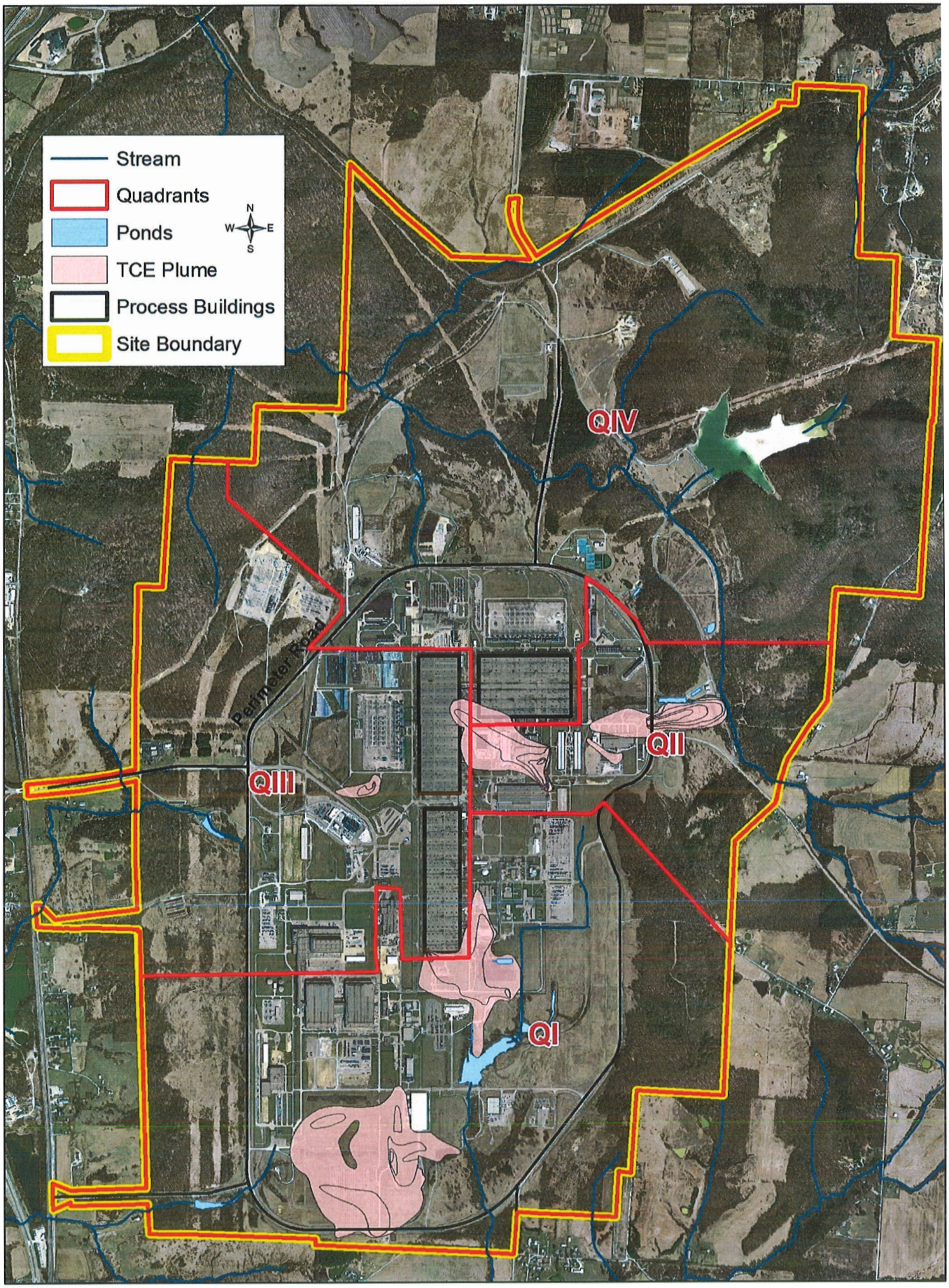
The Environmental Restoration Program was established by DOE in 1989. It is used to identify, control, and remediate the contamination at PORTS. Assessment and investigation of PORTS under the RCRA corrective action process was completed in the 1990s. Since PORTS is so large, it is divided into four quadrants. Remedial actions have been implemented in each quadrant.

Quadrant I

The *First Five-Year Review for the X-749/X-120 Groundwater Plume*, submitted to Ohio EPA in January 2011, found that remedial actions were achieving objectives by preventing migration of contaminants from the X-749 Landfill and controlling the migration of contaminants from the Landfill and the groundwater plume. However, Ohio EPA and DOE agreed that the phytoremediation system was not as successful at reducing TCE concentrations in the groundwater as expected. Phytoremediation is a process that uses plants, in this case poplar trees to remove, degrade, or contain contaminants in soil and/or groundwater. Extraction wells in the groundwater collection trench and barrier walls on the south and east sides of the X-749 Landfill are mostly responsible for reductions in TCE in the X-749/X-120 groundwater plume.

In the *Second Five-Year Review for the X-749B Peter Kiewit (PK) Landfill*, completed in 2008, it was found that remedial actions at the PK Landfill, including groundwater collection systems and a landfill cap, had decreased concentrations of contaminants in PK Landfill wells, sumps, and manholes significantly from 1999 to 2007. The next review of PK Landfill remedial actions will be submitted to Ohio EPA in 2013.

The *First Five-Year Review for the Five-Unit Groundwater Investigative Area and X-231A/X-231B Oil Biodegrading*


Stream
Quadrants
Ponds
TCE Plume
Process Buildings
Site Boundary
N
W
E
S
QIV
QII
QIII
QI
Perimeter Road

Plots report, completed in 2008, shows that remediation activities eliminated potential exposure pathways to contaminants and reduced groundwater concentrations of TCE, although more slowly than expected. The next review of remedial actions at the Quadrant I Groundwater Investigative Area and X-231 A/B Oil Biodegradation Plots will be submitted to Ohio EPA in 2013.

Quadrant II

TCE was detected in soil and groundwater at the Quadrant II Investigative Area. In 2010, Ohio EPA approved an interim remedial measure (IRM) for the area: Enhanced anaerobic bioremediation, which uses injections of fermentable carbon compounds to provide additional food for naturally occurring microorganisms in soil that degrade TCE so that it is no longer harmful. The project continues into 2013.

An IRM approved for the X-701B Holding Pond, where contaminated soil was excavated to inject oxidant directly, was completed in 2011. TCE concentrations decreased in soil samples, but groundwater for wells that monitor the IRM area show a rebound in groundwater TCE concentrations.

The X-633 Former Recirculating Cooling Water Complex was demolished in 2010 using funding provided by the American Recovery and Reinvestment Act. A soil and groundwater investigation was implemented in 2011. Chromium and TCE were detected in groundwater at concentrations above the preliminary remediation goals. A background study was underway in 2012 to provide additional information about the concentrations of naturally-occurring metals in soil within the varying geologic formations at PORTS. DOE agreed to sample eight wells around the area annually to continue evaluation of chromium and TCE in groundwater in this area.

Quadrant III

The *Supplemental Evaluation to the Five-Year Evaluation Report for the X-740 Phytoremediation System*, submitted to Ohio EPA in 2007, showed that over 700 hybrid poplar trees on a 2.6 acre area had not performed as expected to remove TCE from groundwater. Enhanced anaerobic bioremediation took place in December 2010 and January 2011. Groundwater samples were collected in 2011 and 2012. The X-740 Pilot Study Interim Report was submitted to Ohio EPA in November 2012. Ohio EPA found that the pilot study had failed to reduce concentrations of TCE throughout the X-740 groundwater plume to date, but agreed to extend the groundwater monitoring for an additional four quarters (into 2013).

Quadrant IV

No new remedial actions were required in Quadrant IV as of 2000 (remedial actions had already taken place at the X-344D Hydrogen Fluoride Neutralization Pit, X-735 Landfills, X-611A Former Lime Sludge Lagoons, and X-734 Landfills). Areas of soil potentially contaminated with metals were identified at the X-630 Former Recirculating Cooling Water Complex. A background study was underway in 2012 to provide additional information about the

concentrations of naturally-occurring metals in soil within the varying geologic formations at PORTS. Chromium and TCE were detected in groundwater at concentrations above the preliminary remediation goals. DOE continued to sample four wells around that area annually through 2012 to continue evaluation of chromium and TCE in groundwater in this area.

Waste Management Program

The DOE Waste Management Program directs safe storage, treatment, and disposal of waste created by past and present operations and from current D&D and Environmental Restoration projects at PORTS. In 2012, about 9,700 tons of materials from DOE activities at PORTS were recycled, treated, or disposed of at off-site locations. Waste management requirements are complex because of the variety of waste streams made by DOE activities at PORTS. Waste management must be able to demonstrate compliance with DOE Orders, Ohio EPA regulations, and U.S. EPA regulations.

Policies for management of radioactive, hazardous, and mixed wastes include:

- minimizing waste generation;
- characterizing and certifying wastes before they are stored, processed, treated, or disposed;
- pursuing volume reduction (like blending, bulking) as well as on-site storage in preparation for safe and compliant final treatment and/or disposal; and
- recycling.

Environmental Sustainability Program

DOE commits to reducing environmental risks, costs, wastes, and future liability by integrating environmental sustainability principles in DOE activities at PORTS in a cost effective and environmentally conscious manner. The DOE Environmental Sustainability Program is a balanced, holistic approach that links planning, budgeting, measuring, and improving PORTS overall environmental performance to meet specific goals and outcomes. The Program includes elements of pollution prevention, wastes minimization, affirmative procurement, sustainable design, and energy/water efficiency.

DOE works hard to minimize/eliminate the amount and type of waste made and to achieve reduced life cycle costs for managing and disposing property and waste during DOE's projects and activities at PORTS.

These objectives of the Environmental Sustainability Program reduce the life cycle cost and liability of DOE programs and PORTS operations:

- eliminating, minimizing, or recycling wastes that would otherwise require storage, treatment, disposal, and long term monitoring and surveillance;

- eliminating/minimizing use of toxic chemicals and associated environmental releases that would otherwise require control, treatment, monitoring, and reporting;
- maximizing the use (purchasing) of recycled content materials and environmentally preferable products/services, thereby minimizing the economic/environmental impacts of managing by-products and wastes generated in the conduct of mission-related activities;
- reducing the life-cycle cost of managing personal property at PORTS.

The following are accomplishments from fiscal year 2012:

- a 28.8% decrease in greenhouse gas emissions versus fiscal year 2008;
- 8.4% of electricity consumption from renewable energy sources, exceeding the 7.5% goal;
- an increase in alternative fuel consumption of 14.9%;
- received a Bronze Level GreenBuy award for buying products that save energy, conserve water, and reduce health and environmental impacts; and
- implemented power management features on all eligible computers, printers, copiers and monitors to decrease energy use.

Artwork by Autumn Curlonis

Environmental Training Program & Public Awareness Program

DOE contractors at PORTS provide environmental training to increase employee awareness of environmental activities and to enhance the knowledge/qualifications of personnel performing tasks associated with environmental assessment, planning, and restoration. A comprehensive community relations and public participation program is also in place at PORTS. The purpose of the program is to foster a spirit of openness and credibility between PORTS officials and local citizens, elected officials, business, media, and various segments of the public. The PORTS Site Specific Advisory Board is made up of 20 local citizens and provides public input and recommendations to DOE. The PORTS Envoy Program matches employee volunteers with community stakeholders, such as those living close to the PORTS facility. The envoys are able to communicate information about PORTS D&D. The following are information sources for the public:

- Environmental Information Center: portseic@wems-llc.com 740.289.8898
- DOE Portsmouth/Paducah Project Office: www.energy.gov/pppo
- DOE Site Office (Environmental Management Program): 740.897.5010
- Office of Public Affairs (Environmental Management Program): 740.897.3486

Environmental Radiological Information

Environmental monitoring at PORTS measures for radiological and chemical parameters in air, water, soil, sediment, and biota. Tests were performed in 2012 by environmental monitoring programs to measure radiological doses to the public from radionuclides released to the air and surface water, from direct radiation, and for radionuclides detected in sediment, soil, vegetation, and drinking water as required by the state and federal regulations and DOE orders. As part of that testing, environmental monitoring information was collected and reported by DOE contractors for air emissions and water discharges. Environmental monitoring data collected at PORTS are used to assess potential impacts to human health and the environment from radionuclide released by current and historical PORTS operation.

Summary of potential doses to the public from PORTS in 2012

Source of dose	Dose (mrem/year)
Airborne radionuclides (fence line)	0.1
Radionuclides released to the Scioto River	0.001
Direct radiation from cylinder storage yards	0.74
Radionuclides detected by environmental monitoring programs (in sediment, soil, vegetation, and drinking water)	0.41
Total	**1.3**

Monitoring shows a potential dose of about 1.3 millirem (mrem)/year in 2012 in air, waters, soil sediment, and biota in and around the PORTS site given constant exposure and worst-case scenarios. In order to be considered safe, U.S. EPA set a 10 mrem/year for air pathways and DOE set a 100 mrem/year total limit for the dose from radionuclides from all potential pathways. By way of comparison, an average person living in the U.S. receives 311 mrem/year from natural sources.

Environmental permits and regulations, DOE orders, and public concerns are all considered in developing environmental monitoring programs. Due to these considerations, PORTS has limitations on discharges to air and water. Specific radionuclides are monitored at PORTS based on materials handled at PORTS both currently and from historic monitoring data.

Radiological Emissions and Doses

Exposure to radioactive materials can occur from releases to the atmosphere, surface water, or groundwater and from exposure to direct external radiation emanating from buildings and other objects. A dose is a measure of the potential biological damage that could be caused by exposure to and subsequent absorption of radiation to

the body. Doses are estimated for exposure to atmospheric releases, direct radiation, releases to surface water (the Scioto River), and for exposure to radionuclides from operations conducted at PORTS that were detected through DOE environmental monitoring programs. In 2012, doses were estimated for exposure to radionuclides detected by the monitoring programs for sediment, soil, vegetation, and drinking water (groundwater is not estimated as contaminated; groundwater at PORTS is not a source of drinking water).

Most consequences associated with radionuclides released to the environment are caused by interactions between human tissue and various types of radiation emitted by radionuclides. Radiation may come from radionuclides outside the body (in or on environmental media or objects) or from radionuclides deposited inside the body (by inhalation, ingestion, and, in a few cases, absorption through the skin). The most commonly detected radionuclides at PORTS are uranium-234, uranium-235, uranium-238, and technetium-99. A number of specialized measurement units have been defined for characterizing exposures to ionizing radiation. These units include:

Artwork by Donna Fletcher

- *Absorbed dose*—the quantity of ionizing radiation energy absorbed by an organ divided by the organ's mass. Measured in units of rad or gray.
- *Dose*—the product of the absorbed dose (rad) in tissue and a quality factor. Expressed in units of rem or sievert.
- *Effective dose*—the sum of the doses received by all organs or tissues of the body after each has been multiplied by an appropriate weighting factor. In the report, the term "effective dose" is often shortened to "dose."
- *Collective dose/collective effective dose*—the sum of the doses or effective dose of all individuals in an exposed population expressed in units of person-rem or person-seivert.

Airborne Emissions

Airborne discharges of radionuclides from PORTS are regulated under the Clean Air Act and NESHAP. Releases of radionuclides are used to calculate the potential dose to members of the public as reported annually to both the U.S. EPA and the Ohio EPA. In 2012, FBP was responsible for monitoring air emissions from diffusion plant operations which includes the vents of the X-326 and X-330 Process Buildings as well as the X-344A Uranium Hexafluoride Sampling Building, and other emission sources. BWCS was responsible for emission sources associated with the DUF6 Conversion Facility. Meanwhile, USEC, Inc. was responsible for monitoring any release from the Lead Cascade. The emissions from the DUF_6 conversion facility in 2012 were calculated to be 0.0000411 Ci. USEC, Inc. reported emissions of 0.0000113 Ci from operation of the lead cascade. In total, emissions from

all DOE sources in 2012 were calculated to be 0.041 Ci. The maximum potential dose of an off-site individual due to the radiological releases from these facilities in 2012 was 0.031 mrem/year which is well below the 10 mrem/year limit.

DOE also collects samples from 15 ambient air monitoring stations and analyzes them for the radionuclides that could be present in ambient air due to PORTS activities. The highest net dose measured at the ambient air monitoring stations is 6% of the dose calculated from the combined DOE and USEC, Inc. point source emissions. This dose is significantly less than the 10 mrem/year NESHAP limit for airborne radiological releases and 100 mrem/year DOE limit for all radiological releases from a facility.

Discharge of Radionuclides from FBP Outfalls

In 2012, FBP was responsible for 18 monitoring locations. Nine outfalls that discharge directly to surface water, six outfalls discharge to another outfall before leaving the site, and three other locations that are not outfalls are also monitored. All sites were monitored for radiological discharges by collecting water samples and analyzing the samples for uranium, uranium isotopes, technetium-99, and transuranic radionuclides using monthly or weekly monitoring data.

No transuranics were detected in samples collected from the external monitoring points and radionuclide dosage calculated from these outfalls is significantly less than the 100 mrem/year limit for all radiological releases from a facility. Uranium discharges from FBP external outfalls were estimated at 7.7 kilograms and total radioactivity released from the same discharge sites was 0.054 Ci. Discharge of radionuclides in liquids through FBP National Pollutant Discharge Elimination System (NPDES) outfalls have no significant impact on public health and the environment.

Artwork by Serah Jones

USEC, Inc. Monitoring

In 2012, USEC, Inc. was responsible for three monitoring locations through which water is discharged from the site. Transuranic radionuclides and technetium-99 were not detected in any of the samples collected by USEC, Inc. in 2012 and uranium discharges were estimated at 0.28 kilogram. Again, radionuclide dosage calculated with these data is significantly less than the 100 mrem/year limit for all radiological releases from a facility.

Dose Calculation for Releases to Surface Water

Radionuclides are measured at external outfalls and the water from these outfalls is either directly discharged to the Scioto River or eventually flows into the Scioto River from Little Beaver Creek, Big Run Creek, or unnamed tributaries to these water bodies. A hypothetical dose to a member of the public was calculated using the measured radiological discharges and the annual flow rate of the Scioto River. Environmental pathways considered were ingestion of water, ingestion of fish, swimming, boating, and shoreline activities. This exposure scenario is very conservative because the Scioto River is not used for drinking water downstream of PORTS. But, even given these methods, the dose from radionuclides released to the Scioto River in 2012 (0.001 mrem) is significantly less than the 100 mrem/year DOE limit for all radiological releases from a facility.

Radiological Dose Calculation for Direct Radiation

Radiation is emitted from uranium hexafluoride cylinders stored on site at PORTS in the cylinder storage yards located in the northwest portion of the site near Perimeter Road. Environmental radiation is measured at five locations along Perimeter Road near the boundaries of the cylinder storage yards in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant*. The radiological exposure to members of the general public is estimated as the time that a person drives on Perimeter Road past the cylinder yards, which is conservatively estimated at 8.7 hours per year (1 minute per trip, 2 trips per day, 5 work-days per week, and 52 weeks per year). Based on these assumptions, exposure to a member of the public from radiation from the cylinder yards is approximately 0.74 mrem/year. Therefore, the average visitor to the plant would still be exposed to significantly less than the 100 mrem/year DOE limit for all radiological releases from a facility. Even given the persistent exposure of workers at the site, with more than 2,000 DOE employees and contractors being monitored, workers were estimated to have received an average dose of 1 mrem. From that monitoring, it was determined that less than 2% of the monitored workers, primarily cylinder yard workers, received a measurable dose (defined as 10 mrem total effective dose or more). No administrative guidelines or regulatory dose limits were exceeded in 2012.

Radiological Dose Calculations for Off-Site Environmental Monitoring Data

Generally, most public individuals will have limited contact with radionuclides discharged from the plant. However, DOE produces an estimate for the most exposure that a person might have. This information is collected from a number of sources that includes off-site sampling locations. The results are listed in the table below and are well below the 100 mrem/year DOE limit.

Summary of potential doses to public from radionuclides detected by DOE environmental monitoring programs 2012

Source of dose	Dose (mrem/year)
Sediment (based on sediment downstream on Little Beaver Creek)	0.016
Soil (based on samples collected at the ambient air monitoring station at the northeast PORTS property boundary)	0.057
Vegetation (based on detections of radionuclides in soil and vegetation at the ambient air monitoring station north of PORTS)	0.0049
Drinking Water (based on samples collected from a resident drinking water supply south of PORTS)	0.33
Total	**0.41**

Possible Exposure to Plants & Animals

DOE sets absorbed dose rate limits for aquatic animals, riparian animals (animals that live on the banks of a river or in wetlands adjacent to a body of water), terrestrial plants, and terrestrial animals. Analytical data for surface water and sediment samples collected during 2012 from the northern side of PORTS were used to assess the dose limits for aquatic and riparian animals (1 rad/day to aquatic animals and 0.1 rad/day to riparian animals). These locations were selected because levels of radionuclides detected in surface water and sediment were among the highest detected in samples collected in 2012. No transuranic radionuclides were detected and levels of technetium-99 and uranium isotopes resulted in an output calculation within the dose limits.

Data from these locations also indicates that the levels of radionuclides detected in water and soil at these locations did not result in a dose of more than 1 rad/day to aquatic animals and terrestrial plants and 0.1 rad/day to riparian and terrestrial animals from planned discharge during the 2012 year and there were no unplanned releases of radionuclides at PORTS in 2012.

Ambient Air Monitoring

In 2012, samples were collected from 14 ambient air monitoring stations located within and around PORTS, including a background ambient air monitoring station located approximately 13 miles southwest of the plant. Results from air sampling stations closer to the plant are compared to the background measurements. No transuranic radionuclides were detected at the ambient air monitoring stations in 2012. Technetium-99 was detected at each of the 14 ambient air stations, but the maximum activity of technetium-99 in ambient air was only 0.036 pCi/m3, well below the DOE concentration standard of 920 pCi/m3.

Some Uranium isotopes were also detected in all of the samples with a maximum activity of uranium-233/234 (0.00035 pCi/m3) detected at a station northeast of the plant. The maximum activity of uranium-238 in ambient air (0.00029 pCi/m3) was detected at a station east of the plant. These activities are well below the DOE concentration standards for uranium-233/234 (1.1 pCi/m3) and uranium-238 (1.3 pCi/m3).

To confirm that air emissions from PORTS are within regulatory requirements and are not harmful to human health, the ambient air monitoring data were used to calculate a dose to a hypothetical person living at the monitoring station. The highest net dose calculation for the off-site ambient air stations (0.0019 mrem/year) was at a station southwest of the plant. This hypothetical dose is well below the 10 mrem/year limit applicable to PORTS.

Environmental Radiation

Environmental radiation is measured continuously by DOE at 19 locations that include most of the ambient air monitoring locations and other on-site locations. Measuring devices are placed at the monitoring locations at the beginning of each quarter, remain at the monitoring location throughout the quarter, and are removed from the monitoring location at the end of the quarter and sent to the laboratory for processing. Radiation is measured in mrem as a whole body dose, which is the dose that a person would receive if they were continuously present at the monitored location.

Artwork by Amanda Nichols

Three locations detected elevated levels of radiation in 2012: location #874 which monitors the Cylinder Storage Yard; location #862 which is south of the cylinder yards and west of the X-530A Switchyards; and location #933 which is east of the X-701B Holding Pond groundwater monitoring area. These sites had levels of 729 mrem, 126 mrem, and 202 mrem, respectively. The cumulative whole body dose calculated for each of the other 16 locations ranged from 76 to 101 mrem.

In addition, radiation is measured at five locations around the northwest corner of PORTS just inside Perimeter Road near the cylinder storage yards in order to provide dose results for DOE workers, including workers in the cylinder yards. The cumulative annual whole body doses at these locations were 423 mrem, 237 mrem, 771 mrem, 1007 mrem, and 1282 mrem. No administrative guidelines or regulatory dose limits were exceeded in 2012 for DOE workers. The potential estimated dose from the cylinder yards to any member of the public, including delivery people, (0.74 mrem/year) is significantly less than DOE's 100 mrem/year dose limit to the public for radionuclides from all potential pathways.

Surface Water from Cylinder Storage Yards

In 2012, FBP collected surface water samples from the Cylinder Storage Yards that they were responsible for while BWCS collected surface water samples at the cylinder yards associated with the DUF_6 Conversion Facility. Samples were collected monthly (if water was available) and analyzed for alpha activity, beta activity, and uranium. FBP reported maximum levels of uranium (36.4 microgram per liter (µg/L)), alpha activity (21.2 picocurie per liter (pCi/L)), and beta activity (29.1 pCi/L) in the samples from September 2012. Meanwhile, BWCS reported maximum levels of uranium (8.4 µg/L), alpha activity (35 pCi/L), and beta activity (32.3 pCi/L). This information was used in the calculation of outfalls, and were again, significantly less than the 100 mrem/year DOE limit for all radiological releases from a facility.

Artwork by Gavin Hunt

Local Surface Water

Local surface water samples were collected from 14 locations upstream and downstream from PORTS. These samples were taken from the Scioto River, Little Beaver Creek, Big Beaver Creek, and Big Run Creek, as well as from local streams approximately 10 miles north, south, east, and west of PORTS. Samples were collected semiannually and analyzed for transuranic radionuclides, technetium-99, uranium, and uranium isotopes. The results appear in the table below and are well below the Ohio EPA drinking water standards.

Local Surface Water Samples

Site Tested	Date Tested	Radionuclide Found	Concentration Discovered
Little Beaver Creek	2nd quarter	Technetium-99	13.3 pCi/L
Little Beaver Creek	4th quarter	Technetium-99	39.8 pCi/L
Background location south of PORTS	4th quarter	Uranium	2.91 µg/L
Upstream location on Big Beaver Creek	4th quarter	Uranium-233/234	1.97 pCi/L
Background location south of PORTS	4th quarter	Uranium-238	0.97 pCi/L

Sediment

Sediment samples are also collected from the same locations upstream and downstream from PORTS where local surface water samples are taken. Samples are collected annually and analyzed for transuranic radionuclides, technetium-99, uranium, and uranium isotopes in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant*. Uranium and uranium isotopes are naturally occurring, but may also be present due to PORTS activities and are therefore part of this monitoring program. The potential dose resulting from these sites is well below the DOE standard of 100 mrem/year. Results appear in the table below.

Sediment Samples

Site Tested	Radionuclide Found	Concentration Discovered
background sampling location west of PORTS	Uranium Uranium-238	2.2 μg/g 0.736 pCi/g
Little Beaver Creek	Uranium-233/234 Uranium-235 Uranium-236 Neptunium-237 Technetium-99	2.43 pCi/g 0.0978 pCi/g 0.0273 pCi/g 0.011 pCi/g 12.8 pCi/g
Big Run Creek at Wakefield	Plutonium-239/240	0.00918 pCi/g

- Uranium and uranium isotopes detected in 2012 have been detected at similar levels in previous sampling events from 2002 through 2011.
- These detections are much less than the U.S. EPA remediation goal: neptunium-237 (1 picocurie per gram (pCi/g)), and plutonium-239/240 (2.59 pCi/g).

Settleable Solids

DOE collects semiannual water samples from nine effluent locations and three background locations to determine the concentration of radioactive material that is present in the sediment suspended in the water sample. This is to ensure that the discharges do not exceed an annual average (at the point of discharge) of either 5 (pCi/g) above background of settleable solids for alpha-emitting radionuclides, and/or 50 pCi/g above background for beta-emitting radionuclides. In 2012, detections of settleable solids ranged from 5.2 to 10.9 mg/L. These detections are less than 40 mg/L; therefore, monitoring results for the settleable solids monitoring program are in compliance with the DOE Order 458.1, *Radiation Protection of the Public and the Environment.*

Soil

Soil samples are collected annually from ambient air monitoring locations and analyzed for transuranic radionuclides, technetium-99, uranium, and uranium isotopes. Plutonium-239/240 was detected at activities ranging from 0.0104 to 0.0204 pCi/g in the samples collected from monitoring stations. These detections are much less than the U.S. EPA preliminary remediation goal for plutonium-239/240 (2.59 pCi/g) in residential soil, and are most likely present due to atmospheric fallout from nuclear weapons testing at sites other than PORTS. Americium-241 was detected at 0.0132 pCi/g at station A9 (south of PORTS). This detection is also much less than the U.S. EPA preliminary remediation goal for americium-241 (1.87 pCi/g) in residential soil.

Technetium-99 and no other transuranics were detected in any of the soil samples collected during 2012. Uranium and uranium isotopes were detected at each of the sampling locations. Uranium and uranium isotopes are usually detected at similar levels at all the soil sampling locations, which suggests that the uranium detected in these samples is due to naturally-occurring uranium that exists in the local area.

Artwork by Destiny Montgomery

Animals & Vegetation

The *DOE Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* requires biological monitoring to assess the uptake of radionuclides into local biota (deer, fish, crops, milk, and eggs). In order to assess the uptake of radionuclides into plant material, vegetation samples are collected in the same areas where soil samples are collected at the ambient air monitoring stations. For animal testing, samples are taken from deer killed on site in motor vehicle collisions and fish caught at downstream locations on the Scioto River and Little Beaver Creek. The total potential dose to a member of the public resulting from PORTS operations based upon the findings below, even if all food sources came from within this area, is well below the DOE standards. The results can be seen in the tables below.

Vegetation Monitoring

Materials tested for	Concentrations Found
transuranics	None
Technetium-99	0.237 to 0.745 pCi/g
Uranium	0.0239 to 0.206 µg/g
Uranium-233/234	0.0667 pCi/g
Uranium-238	0.00803 to 0.0685 pCi/g

Animal & Crop Monitoring

Animals tested	Materials Tested For	Concentrations
Deer	transuranic radionuclides, technetium-99, uranium, and uranium isotopes	None Found
Fish	transuranic radionuclides, technetium-99, uranium, and uranium isotopes	None Found
Crops (including peppers, corn, tomatoes, cucumbers, squash, and others)	transuranic radionuclides, technetium-99, uranium, and uranium isotopes	None Found
Milk	transuranic radionuclides, technetium-99, uranium, and uranium isotopes	None Found
Eggs (2011 results, as none were available in 2012)	transuranic radionuclides, technetium-99, uranium, and uranium isotopes	None Found

Release of Property Containing Residual Radioactive Material

As many people are aware, the PORTS site has allowed some property to be recycled as part of the D&D process. The recycled property is monitored for any potential contamination, along with property released from the DUF_6 processing. In 2012, no DOE property (equipment, excess materials, etc.) was released to the public that contained radioactive material that exceeded DOE release limits. The release limits are established in accordance with DOE Orders and Federal Regulations.

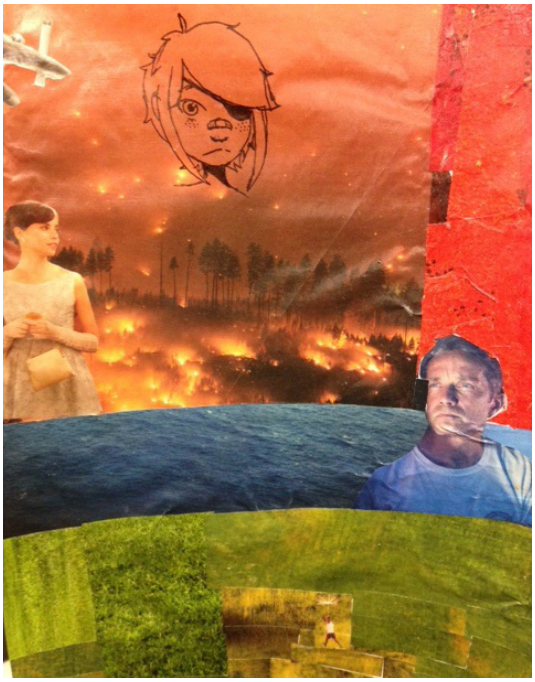
In 2012, BWCS continued off-site shipment of aqueous hydrogen fluoride produced by the DUF_6 Conversion Facility, which converts DUF_6 into uranium oxide and aqueous hydrogen fluoride. Each shipment must meet the release limit of less than 3 picocuries/milliliter (pCi/mL) of total uranium activity. Just over 900,000 gallons of aqueous hydrogen fluoride were shipped off site during 2012. The average total uranium activity of all the shipments was 0.035 pCi/mL.

Environmental Non-Radiological Program Information

As part of the non-radiological environmental monitoring program, data collected includes air, surface water, sediment, and biota (fish). DOE also conducts an extensive groundwater monitoring program at PORTS that includes both radiological and non-radiological constituents. Monitoring of non-radiological parameters is required by state and federal regulations. Environmental permits issued by Ohio EPA to FBP, BWCS and USEC, Inc. specify discharge limitations, monitoring requirements, and/or reporting requirements for air emissions and water discharges. Non-radiological data collected in 2012 are similar to data collected in previous years.

Airborne Discharges

Air emission sources associated with the former gaseous diffusion production and support facilities, which include the boilers at the X- 600 Steam Plant, emit more than 100 tons per year of non- radiological air pollutants specified by Ohio EPA. Facilities that emit major sources of air pollutants are required to submit an annual report called the Ohio EPA Fee Emissions Report to detail emissions of selected non- radiological air pollutants.



Artwork by Serah Jones

FBP reported the following emissions of non- radiological air pollutants, for 2012 in the Ohio EPA Fee Emissions Report:

- 0.105 ton of lead
- 47.5 tons of particulate matter
- 2.11 tons of organic compounds
- 1007 tons of sulfur dioxide
- 117 tons of nitrogen oxides

These emissions are associated primarily with the boilers at the X- 600 Steam Plant, which provide steam for PORTS, the X- 670A Cooling Tower, the X- 627 Groundwater Treatment Facility, and plant roads/parking areas.

BWCS reported less than 10 tons/year of specified non- radiological air pollutants for 2011and 39 lbs. of hydrogen fluoride in 2012.

U.S. EPA also requires annual reports of greenhouse gas emissions and in 2012, FBP reported emissions of 51,021 tons of carbon dioxide, 5.2 tons of methane, and 0.75 tons of nitrous oxide.

Another potential air pollutant present at PORTS is asbestos released by D&D of plant facilities. The amount of asbestos removed and disposed is reported to Ohio EPA. In 2012, 133 tons (265,931 lbs.) of material contaminated with asbestos were shipped from PORTS.

Ambient Air Monitoring

Ambient air monitoring stations in and around the PORTS facility also measure fluoride levels. Fluoride detected at the monitoring sites could be present due to background concentrations (naturally occurring fluoride), activities associated with the former gaseous diffusion process, and operation of the DUF_6 Conversion Facility. In 2012 the average ambient concentration of fluoride measured in samples collected at background station A37 was 0.022 microgram per cubic meter (µg/m3) while fluoride measured at the stations around PORTS ranged from 0.017 µg/m3 to 0.034 µg/m3. There is no standard for fluoride in ambient air and data indicate that concentrations of fluoride at background locations are not different from concentrations at PORTS.

Water

Non- radiological surface water monitoring primarily consists of sampling water discharges associated with the FBP, BWCS, and USEC, Inc. NPDES-permitted outfalls. In 2012, DOE contractors (FBP and BWCS) were responsible for 19 NPDES outfalls or sampling points at PORTS with FBP being responsible for 18 discharge outfalls through which water is discharged from the site. Nine outfalls discharge directly to surface water, and six outfalls discharge to another outfall before leaving the site. Ohio EPA selects the chemical parameters that must be monitored at each site. Chemicals and water quality parameters monitored include; acute toxicity, ammonia nitrogen, biochemical oxygen demand, cadmium, chlorine, chromium, copper, dissolved solids, fecal coliform, fluoride, hexavalent chromium, iron, Kjeldahl nitrogen, manganese, mercury, nickel, nitrite + nitrate, nitrate-nitrogen, nitrite- nitrogen, oil and grease, total PCBs, pH, silver, suspended solids, sulfate, TCE, thallium, and trans-1,2-dichloroethene, and zinc. The FBP NPDES Permit also identifies additional three monitoring points that are not discharge points which measure the toxicity to minnows and other aquatic life as well as water temperature.

In October 2012, the maximum limit for fecal coliform was exceeded at Outfall 003 with a sample result of 3400/100 mL. The exceedance occurred after the shutdown and subsequent start-up of the Sewage Treatment Plant to isolate a release of cooling water containing propylene glycol. The sample was collected just after the restart of the Sewage Treatment Plant, which may have caused material to be dislodged from the pipe walls downstream of the chlorination process. Additionally, the chlorination process may have been temporarily suppressed during the plant restart. Even with this, the overall compliance rate with the NPDES permit in 2012 was 99%.

BWCS NPDES Outfalls

BWCS is responsible for the NPDES permit for the discharge of process wastewaters from DUF_6 Conversion Facility to the West Ditch, which flows to the Northwest Holding Pond and then to the Scioto River. The monitoring data are submitted to Ohio EPA in a monthly discharge monitoring report. The only water released through BWCS NPDES Outfall 001 during 2012 was due to precipitation run-off. In the beginning of November 2008 any process wastewater from the DUF_6 Conversion Facility was taken to the X-6619 Sewage Treatment Plant for treatment prior to discharge through FBP NPDES Outfall 003. Only precipitation run-off was discharged through the BWCS NPDES outfall and the overall compliance rate was 98% in 2012.

USEC, Inc. NPDES Outfalls

USEC, Inc. is responsible for three NPDES outfalls and the monitoring data is submitted to Ohio EPA in a monthly discharge monitoring report. No exceedances of permit limitations at USEC, Inc. outfalls occurred during 2012; therefore, the overall USEC, Inc. compliance rate was 100%.

Artwork by Amanda Nichols

Surface Water Monitoring Associated with BWCS Cylinder Storage Yards

Surface water samples (filtered and unfiltered) are collected quarterly from four locations in the drainage basins downstream from the Cylinder Storage Yards and then analyzed for PCBs. There were no PCBs detected in any of the samples during 2012.

Local Sediment Monitoring

In 2012, sediment monitoring at PORTS included local streams and the Scioto River upstream and downstream from PORTS and drainage basins from downstream from the BWCS cylinder storage yards.

Sediment samples are collected annually at the same locations upstream and downstream from PORTS where local surface water samples are collected and at the NPDES outfalls on the east and west sides of PORTS. In 2012, samples were analyzed for 20 metals and PCBs, in addition to the radiological parameters.

Only one detection of PCBs in sediment around PORTS was more than the risk-based concentration of PCBs for protection of human health developed by U.S EPA and utilized by Ohio EPA. The concentration of PCBs collected

on site in the Little Beaver Creek was 220 micrograms per kilogram (µg/kg) or parts per billion. Investigation and remediation of PCBs in soil and sediment at PORTS will be addressed as part of the environmental remediation of PORTS.

The results of metals sampling conducted in 2012 indicate that no appreciable differences are evident in the concentrations of metals present in sediment samples taken upstream from PORTS , at background sampling locations, and downstream from PORTS. Thus, the metals detected in the samples most likely did not result from activities at PORTS.

Sediment Monitoring Associated with BWCS Cylinder Storage Yards

Sediment samples are collected quarterly from four locations in the drainage basins downstream from the Cylinder Storage Yards and analyzed for PCBs. These locations are inside the PORTS facility and not accessible to the public. In 2012, PCBs were detected in at least one of the sediment samples collected from each location at concentrations of up to 140 (µg/kg) (ppb). None of the samples contained PCBs above the risk-based concentration of PCBs for protection of human health set forth by U.S. EPA at 220 µg/kg (ppb).

Biological Monitoring - Fish

In 2012, fish were collected from upstream and downstream locations on the Scioto River and the Little Beaver Creek. Fish were analyzed for PCBs and the maximum concentration found was 36.5 µg/kg in the Scioto River and was 65.9 µg/kg in Little Beaver Creek. The concentrations of PCBs in fish collected in the Scioto River was below the unrestricted limit (50 µg/kg) of consumption rates and in Little Beaver Creek the concentrations were below the 1/week maximum limit (220 µg/kg) of consumption rates.

The Ohio Sport Fish Consumption Advisory, available from Ohio EPA, division of Surface Water, advises the public on consumption limits for sport fish caught from all water bodies in Ohio and should be consulted before eating any fish caught in Ohio waters.

Groundwater Programs

Groundwater monitoring at PORTS is required by a combination of state and federal regulations, legal agreements with Ohio EPA and U.S. EPA, and DOE Orders. In 2012, more than 400 monitoring wells were used to track the flow of groundwater and to identify and measure groundwater contaminants.

This section provides only an overview of groundwater monitoring at PORTS and the results of the groundwater monitoring program for 2012. It also provides information about the remedial actions implemented at a number of the areas to reduce or eliminate groundwater contamination. This section also includes information on the groundwater treatment facilities at PORTS. These facilities receive contaminated groundwater from the groundwater monitoring areas and treat the water prior to discharge through the permitted discharge systems. The 2012 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant provides further details on the groundwater plumes at PORTS, specific monitoring well identifications, and analytical results for monitoring wells.

Overview of Groundwater Monitoring At PORTS

Groundwater Use and Geology

Two water-bearing zones are present beneath PORTS. The uppermost water-bearing zone contains most of the groundwater contamination at PORTS. The other, deeper water-bearing zone is usually separated by the Sunbury shale, which acts as a barrier to impede groundwater flow between the formations. Additional information about site hydrogeology is available in the PORTS Environmental Information Center.

Artwork by Kendra Hart

Groundwater directly beneath PORTS is not used as a domestic, municipal, or industrial water supply, and contaminants in the groundwater beneath PORTS do not affect the quality of the water in the Scioto River Valley buried aquifer. PORTS is the largest industrial user of water in the vicinity and obtains water from water supply well fields west of PORTS in the Scioto River Valley buried aquifer. DOE filed a deed notification at the Pike County Auditor's Office that restricts the use of groundwater beneath the PORTS site.

Monitoring Activities

Groundwater monitoring at PORTS includes several activities. Samples of water are collected from groundwater monitoring wells and analyzed to obtain information about contaminants and naturally occurring materials in the groundwater, as well as other information about groundwater. The level of water, combined with information about the subsurface soil, can be used to estimate the rate and direction of groundwater flow. The rate and direction of groundwater flow can be used to predict the movement of contaminants in the groundwater and to develop ways to control or remediate groundwater contamination.

Groundwater Monitoring Areas

The *Integrated Groundwater Monitoring Plan* requires groundwater monitoring of 12 areas within the site designated by the RCRA Corrective Action Program. This plan also contains requirements for 1) surface water monitoring in creeks and drainage ditches at PORTS that receive groundwater discharge; and 2) water supply monitoring.

In general, samples are collected from wells (or surface water locations) at each area and are analyzed for metals, Volatile Organic Compounds (VOCs), and/or radionuclides. Potential contaminants detected in the groundwater are then compared to standards called preliminary remediation goals in order to assess the potential for each substance to affect human health and the environment.

Five areas of groundwater contamination, commonly called groundwater plumes, have been identified at PORTS. Groundwater contamination consists of VOCs (primarily TCE) and radionuclides such as technetium-99. The areas that contain groundwater plumes are X-749/X-120, Quadrant I Groundwater Investigative Area, Quadrant II Groundwater Investigative Area, X-701B Holding Pond, and X-740 Former Waste Oil Handling Facility.

X-749/X-120/PK Landfill (X-749/X-120 groundwater plume)

The X-749 Contaminated Materials Disposal Facility (11.5 acres) was active from 1955 to 1980 with potential contamination sources of buried waste contained in metal drums or other containers deemed compatible with the waste. The landfill contains materials such as industrial solvents, waste oils from plant compressors and pumps, sludge classified as hazardous, and low-level radioactive materials. Remedial actions include1) multimedia cap installed, 2) a barrier wall extended down to bedrock, 3) subsurface groundwater drains with sumps installed, 4) water discharged through treatment facility, 5) planting of hybrid poplar trees for phytoremediation and 6) nine extraction wells installed.

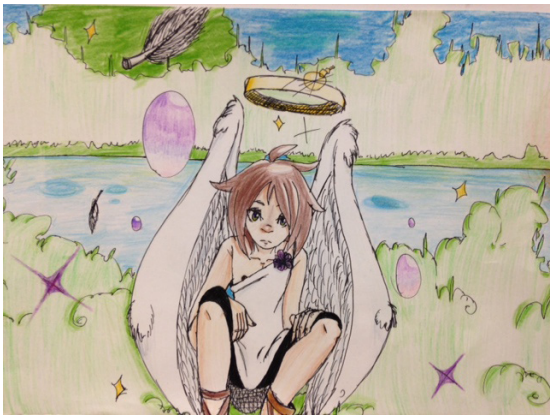
The X-120 Old Training Facility was constructed in the 1950s and included a machine shop, metal shop, paint shop, and several warehouses with potential contamination from material from the construction of PORTS. Groundwater in the vicinity of this facility is contaminated with VOCs, primarily TCE.

The PK Landfill (west of Big Run Creek and south of the X-230K Holding Pond) was in operation from 1952 to1968. The area was used as a salvage yard, burn pit, and trash area during the construction of PORTS. After construction, the site was operated as a sanitary landfill until 1968 when native grasses were planted. A portion of Big Run Creek was relocated to stop seeps from the PK Landfill and a groundwater collection system was installed in the old creek channel to capture the seeps. In 1998, a cap was constructed over the landfill and in 2012, nine wells and two sumps were sampled.

Monitoring results for this groundwater monitoring area show that TCE increased in one well and remained less than 5 (µg/L) in three wells. TCE was detected at concentrations up to 37 µg/L in wells X749-14B and X749-112G in 2011. Samples collected in the second and fourth quarters of 2012 show TCE levels less than .5 µg/L which is typical for these wells. In 2012, vinyl chloride was detected in samples collected from wells PK-17B and PK-21B at concentrations ranging from 6.2 to 28 µg/L, exceeding the preliminary remediation goal of 2 µg/L.

Quadrant I Groundwater Investigative (5-Unit) Area/X-749 A Classified Materials Disposal Facility (Quadrant I Groundwater Investigative [5 Unit] Area groundwater plume)

The Quadrant I Groundwater Investigative Area consists of a number of potential sources of groundwater contamination: Oil Biodegradation Plots, Coal-Fired Steam Plant, Coal Pile Yard, Coal Pile Runoff Treatment Facility, Technical Services Building, Classified Materials Disposal Facility, Pilot Investigation Building, and Mechanical Testing Facility. Groundwater extraction wells were installed between 1991 and 2002 with extracted groundwater treated at the Groundwater Treatment Facility and discharged into the Sewage Treatment Plant. Multimedia landfill caps were installed in 2011 over X-231A and B to minimize water infiltration and control the spread of contamination.



Artwork by Serah Jones

The X-749A Classified Materials Disposal Facility (6 acres) was in operation from 1953 to 1988 for the disposal of wastes classified under the Atomic Energy Act, including PCBs, asbestos, radionuclides, and industrial waste. Closure of the landfill was completed in 1994 with construction of a multilayer cap and installation of a drainage system to collect surface water runoff. Ten wells associated with the landfill were sampled in 2012.

The X-749A area showed increased TCE levels two wells from 2011. The increase in one of these wells, X626-07G indicates that an extraction well is functioning as intended to draw higher concentrations of TCE from the area near the X-326 Process Building to the extraction well. The eastern area of the Quadrant I Groundwater Investigative Area shows decreased TCE concentrations in one well, with higher concentrations expanding north in 2012 based on TCE detection of 130 µg/L in a northern well. Also, none of the statistical control limits for alkalinity, ammonia, calcium, chloride, nitrate/nitrite, sodium, sulfate, and total dissolved solids were exceeded in samples from downgradient Gallia wells in 2012.

Quadrant II Groundwater Investigative (7-Unit) Area

This area consists of groundwater contamination from several potential sources including the X-701C Neutralization Pit, which was an open-topped neutralization pit that received waste water containing acid and alkali solutions and rinse water contaminated with TCE and other VOCs from metal-cleaning. The pit was removed in 2001. The natural eastern flow of groundwater toward Little Beaver Creek has been changed though sump pumps in the basement of two buildings so that the groundwater plume in the area does not spread but flows to the sumps to be treated at the X-627 Groundwater Treatment Facility.

There was a decrease in TCE levels in one well, but two other wells increased to levels above 5 µg/L, with one well increasing to 42 µg/L in September 2012. One additional well was not sampled in the fourth quarter of 2012, but a sample from January 2013 contained TCE at 4 µg/L.

X-701B Holding Pond

The X-701B Holding Pond was used from 1954 until 1988 for neutralization and settlement of acid waste from several sources. TCE and other VOCs were discharged to the pond. The area is about 15 acres and surrounds the X-744G Bulk Storage Building. A contaminated groundwater plume extends from the Holding Pond toward Little Beaver Creek. Three groundwater extraction wells and a sump were installed to intercept contaminated groundwater. These wells and sump were removed between 2009 and 2011 and replaced by two groundwater interceptor trenches, or French drains. These interceptor trenches are called the X-237 Groundwater Collection System. From 2006 to 2008, oxidant was injected into the subsurface in the western portion of the area to remediate VOCs in soil and groundwater. After that, to further address contaminants, soil was removed and mixed with oxidant, with additional oxidant mixed into soil at the bottom of the excavation. In 2012, 54 wells were sampled as part of the *Integrated Groundwater Monitoring Plan*, or IRM.

Artwork by Amanda Nichols

Elevated TCE levels were detected in two groundwater wells in the northeast corner of the monitoring area, east of the X-237 Groundwater Collection System in 2011. Additional sampling still showed elevated levels in one well in 2012, and elevated TCE concentrations were found in surface water samples from Little Beaver Creek. The area of transfer from the X-237 Groundwater Collection System to the treatment facility was tested in April 2012, but no leaks were found. In May, the extraction wells were cleaned and lowered. TCE concentrations decreased at surface water monitoring locations and most groundwater monitoring wells, but concentrations in one well increased from 1,800 µg/L to 13,000 µg/L in November 2012.

In the third quarter of 2012, concentration of TCE in two groundwater wells that define a small plume south of the X-744G Building increased. Also, samples from three of the five groundwater wells in or near the X-744G Storage Building and X-744Y Storage Yard show levels of cadmium and nickel above the preliminary remediation levels.

X-740 Former Waste Oil Handling Facility

This facility, located in the western half of PORTS, was in operation from 1983 to 1991 and demolished in 2006. It was used as an inventory and staging facility for waste oil and waste solvents generated from various plant operational and maintenance activities. After previous unsuccessful attempts to reduce the concentrations of volatile organics in ground water in this area, a pilot study of enhanced anaerobic bioremediation began in 2010, continuing through 2012. Twelve monitoring wells were sampled in 2012, including six new wells installed for the pilot study.

TCE decreased to less than 5 μg/L in one well that is part of the treatment area, and TCE may be beginning to decrease in another well that is downgradient from the treatment area.

Additional Monitoring

The X-633 Former Recirculating Cooling Water Complex consisted of a recirculating water pump house and four cooling towers with associated basins. D&D of the facilities was completed in 2010. Two wells are sampled semiannually for chromium, which was detected in both of the X-633 monitoring wells in 2012. Samples at one well showed concentrations above the preliminary remediation goal of 100 μg/L, and samples from the other well contained chromium but at concentrations well below the preliminary remediation goals.

The X-616 Former Chromium Sludge Surface Impoundments were two unlined surface impoundments used from 1976 to 1985 for storage of sludge generated by the treatment of water from the PORTS process cooling system. Seven groundwater wells are sampled annually and nine are sampled biennially. VOCs were detected at low levels in samples collected from five of seven wells sampled in 2012. The only VOCs above the preliminary remediation goals were 1, 1-dichloroethene and TCE in two groundwater wells.

The X-611A Former Lime Sludge Lagoons were comprised of three adjacent unlined sludge retention lagoons constructed in 1954 and used for disposal of lime sludge waste from the site water treatment plant until 1960. A prairie habitat has been developed in the area by placing a soil cover over the north, middle and south lagoons. Six wells are sampled semiannually and analyzed for beryllium and chromium. In 2012 chromium was detected in five of six groundwater wells at concentrations between .55 and 7.8 μg/L, below preliminary remediation goals. Beryllium was detected from three wells, below the preliminary remediation goals.

Several distinct waste management units are contained within the X-735 Landfills area in Quadrant IV. The landfill began operation in 1981, covering 17.9 acres, and ended in 1991. Eighteen wells were sampled in 2012 for concentration of three metals and five indicator parameters that are compared to concentration limits based on drinking water standards or site background concentrations. None of these concentration limits were exceeded in 2012.

The X-734 Landfills in Quadrant IV consisted of three landfill units that were used until 1985 for various material. The landfills were capped in 1999-2000 and fifteen groundwater wells are sampled semiannually. In 2012, no VOCs were detected at concentrations above the preliminary remediation goals.

The X-533 Former Switchyard Complex in Quadrant IV consisted of a switchyard containing electrical transformers and circuit breakers, associated support buildings, and a transformer cleaning pad. Three wells are sampled semiannually for cadmium and nickel. Each of the well samples contained these metals at concentrations above the preliminary remediation goals (6.5 μg/L for cadmium and 100 μg/L for nickel). Cadmium detection ranged from 12 to 58 μg/L, and nickel detection ranged from 140 to 950 μg/L.

The X-344C Former Hydrogen Fluoride Storage Building and associated hydrogen fluoride storage tanks were demolished and removed in 2006. One groundwater well is sampled annually for VOCs. Three VOCs were detected in the sample collected in the first quarter of 2012 at concentrations less than the preliminary remediation goal.

Surface Water Monitoring

Surface water monitoring is conducted in conjunction with groundwater assessment monitoring to determine if contaminants present in groundwater are detected in surface water samples. Surface water is collected and analyzed for potential hazards quarterly from the following locations:

- Little Beaver Creek and East Drainage Ditch (5 locations)
- Big Run Creek (3 locations)
- Southwestern Drainage Ditch (2 locations)
- North Holding Pond
- Western Drainage Ditch (3 locations)

Monitoring results for surface water in 2012

Materials detected	Potential Contaminant Source	2012 Monitoring Results - Locations Detected	2012 Monitoring Results - Levels Detected
Trihalomethanes	VOCs that are byproducts of water chlorination	Most of the surface water sampling locations	Below the Ohio EPA water quality criteria for the protection of human health in the Ohio River drainage basin
TCE	Western portion of the X-749/X-120 groundwater plume	The Southwestern Drainage Ditch	Below the Ohio EPA water quality criterion for TCE for the protection of human health in the Ohio River drainage basin.
TCE	Groundwater from the plume associated with the X-701B Holding Pond	East Drainage Ditch and Little Beaver Creek	Elevated concentrations up to 27.2 µg/L
Americium-241 & other selected transuranics	Americium-241 is present in the environment at very small levels due to atmospheric fallout from nuclear weapons testing around the world	Southwestern Drainage Ditch	Less than the preliminary remediation goal
Technetium-99	Former enrichment process	Little Beaver Creek	Below the Ohio EPA drinking water standard
Uranium	Former enrichment process and storage. NOTE: may also be due to naturally-occurring uranium	Surface water samples	Below the Ohio EPA drinking water standard

Water Supply Monitoring

Routine monitoring of private residential drinking water sources is completed at PORTS as required by the State of Ohio and DOE. The purpose of the program is to determine whether PORTS has had any impact on the quality of the private residential drinking water sources.

Six residential drinking water sources participated in the program in 2012. Wells are sampled semiannually. The PORTS water supply is also sampled as part of this program.

In 2012, TCE was detected in the samples collected from RES-017, south of PORTS. No other VOCs were detected in the samples at this location. Since this residential water supply was added to the monitoring program in 2009, TCE has routinely been detected at concentrations up to 1 µg/L. These detections are less than the drinking water standard for TCE.

Artwork by Amanda Nichols

Benzene and xylenes were detected in samples collected from RES-004 and RES-005 (old and new wells at the same residence south of PORTS). Each of these detections are below the applicable drinking water standards. No other VOCs (other than chloroform, a common residual in treated drinking water, and sample contaminants acetone and methyl ethyl ketone) were detected in the other residential water supply samples collected during 2012.

Each sample was analyzed for transuranics, technetium-99, uranium, and uranium isotopes. Americium-241 was detected in a sample collected from RES-014 (south of PORTS). However, this detection was approximately 0.8% of the drinking water standard. Americium-241 was not detected in later samples collected from RES-014.

No technetium-99 or other transuranics were detected in any of the water supply samples collected in 2012. Low levels of uranium and uranium isotopes detected in some of the wells are consistent with naturally-occurring concentrations found in groundwater in the area.

DOE Order Monitoring Programs

One of the DOE surveillance monitoring programs at PORTS is exit pathway monitoring. Exit pathway monitoring assesses the effect of the facility on off-site surface water and groundwater quality.

TCE was detected at concentrations well below the applicable Ohio EPA water quality criterion in samples collected from Little Beaver Creek. Trihalomethanes (bromodichloromethane, bromoform, chloroform, and dibromochloromethane), which are common residuals in chlorinated drinking water, were detected in samples collected from the Western Drainage Ditch at concentrations well below Ohio EPA non-drinking water quality criteria for trihalomethanes for the protection of human health in the Ohio River drainage basin.

Artwork by Leah Bender

TCE and radionuclides were also detected in several on-site groundwater monitoring wells that are part of the exit pathway monitoring program as explained in earlier parts of this report. In all, for 2012, a combined total of approximately 27 million gallons of water were treated at the Groundwater Treatment Facilities. Approximately 26 gallons of TCE were removed from the water. All processed water is discharged through permitted and monitored outfalls before exiting PORTS.

Conclusions

The PORTS facility is a large and complex industrial site that played a role in ensuring our nation's security. The people who worked, and continue to work there have provided an invaluable service to our country and its people. It is now tasked to those involved in the D&D of the facility to make sure that the people of this region are safe from any dangers presented by the facility.

The processes of D&D, monitoring, and environmental remediation are huge tasks that require the hard work of many people and entities. From the individual worker to the U.S. DOE and from the local environmentalists to the U.S. EPA and Ohio EPA, we thank everyone for their hard work and dedication. This summary has covered environmental monitoring activities at PORTS for calendar year 2012. The following are some of the major events of 2012:

- D&D of the X-100 Complex was completed, and planning and other activities for the D&D of three other facilities were underway in 2012.
- The Environmental Restoration Program implements remedial actions directed by the Ohio EPA for seven PORTS areas where soil and/or groundwater contamination has been identified. Two more projects were underway in 2012 for remediation of soil and/or groundwater contamination in the Quadrant II Groundwater Investigative (7-Unit) Area and the X-740 Former Waste Oil Handling Facility Area.
- FBP shipped nearly 9,700 tons of waste or other materials off-site for treatment, disposal, recycling or reuse.
- The Southern Ohio Diversification Initiative (SODI) received about 887 tons of materials from PORTS, including recyclable metals, paper and plastic, extra office furniture, and over 100 passenger vehicles.
- In 2012, DOE released the PORTS Virtual Museum to the public at www.portsvirtualmuseum.org. This museum is intended to preserve pictures, video, oral histories, and other information associated with operation of PORTS.
- In 2012, DOE and/or FBP received five Notices of Violation, each of which was resolved, and in one case retracted by the Ohio EPA upon payment of a civil penalty settlement.

Potential impacts to human health from PORTS operations are calculated based on environmental monitoring data. The maximum dose that a member of the public could receive from radiation released by PORTS in 2012 is 1.3 mrem. This dose is significantly less than the 100 mrem/year limit set by DOE for the dose to a member of the public from radionuclides from all potential pathways. The dose to a member of the public from airborne radionuclides released by PORTS (0.031 mrem) is also significantly less than the 10 mrem/year standard set by the U.S. EPA. Also, generally, concentrations of contaminants detected within the groundwater plumes at PORTS did not increase or decrease significantly during 2012.

It has been our pleasure to have been asked to play even a small role in this project by summarizing the ASER. We hope that our information has been useful to you. And we thank you for your contribution to the continuing environmental safety of our region.

WHS students observe fish sampling

Definitions

Ambient air – the atmosphere around people, plants, and structures. Ambient air usually means outdoor air (as opposed to indoor air).

Biota – animal and plant life characterizing a given region.

Dose – the energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad, equal to 0.01 joule per kilogram in any medium.

Absorbed dose – the quantity of ionizing radiation energy absorbed by an organ divided by the organ's mass. Absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 gray).

Effective dose – the sum of the doses received by all organs or tissues of the body after each one has been multiplied by the appropriate weighting factor.

Collective dose/collective effective dose – the sums of the doses of all individuals in an exposed population expressed in units of person-rem (or person-sievert). The collective effective dose is also frequently called the "population dose."

Effluent – a liquid or gaseous waste discharge to the environment.

Gaseous diffusion – technology used to produce enriched uranium by forcing gases through a porous barrier (United States Nuclear Regulatory Commission, 2011).

Ionizing radiation – radiation that has enough energy to remove electrons from substances that it passes through, forming ions (U.S. DOE, 2004).

Isotope – form of an element having the same number of protons but differing numbers of neutrons in their nuclei.

Preliminary Remediation Goal – The maximum concentration of a constituent in environmental media (soil, groundwater, etc.) that is considered protective of human health and the environment.

Radionuclide – radioactive nuclide capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accomplished by the emission of photons or particles.

Rem – unit of radiation dose that reflects the ability of different types of radiation to damage human tissues and the susceptibility of different tissues to the damage (U.S. DOE, 2004).

Remediate – correction or cleanup of a contaminated site.

Stratospheric Ozone – the "good" ozone layer that extends upward from about 6 to 30 miles and protects life on Earth from the sun's harmful ultraviolet (UV) rays. This natural shield has been gradually depleted by manmade chemicals, allowing more UV radiation to reach the ground and leading to more health and environmental problems (U.S. EPA, 2010).

Switchyard complex – enclosed area used as the distribution center where power is supplied to the plant from the outside, and power is sent from the plant (Peak Power Engineering, 2012).

Transuranics – elements such as americium, plutonium, and neptunium that have atomic numbers (the number of protons in the nucleus) greater than 92. All transuranics are radioactive.

Acronyms and Abbreviations

BWCS	B&W Conversion Services, LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
D&D	decontamination and decommissioning
DFF&O	The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto
DOE	U.S. Department of Energy
DUF_6	depleted uranium hexafluoride
FBP	Fluor-B&W Portsmouth LLC
IRM	interim remedial measure
LLC	Limited Liability Company
µg/kg	microgram per kilogram (equivalent to part per billion)
µg/L	microgram per liter (equivalent to part per billion)
µg/m3	microgram per cubic meter
mrem	millirem
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
Ohio EPA	Ohio Environmental Protection Agency
PCB	polychlorinated biphenyl
pCi/g	picocurie per gram
pCi/L	picocurie per liter
pCi/mL	picocurie per milliliter
PK	Peter Kiewit
PORTS	Portsmouth Gaseous Diffusion Plant
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
TCE	trichloroethene
TSCA	Toxic Substances Control Act
USEC	United States Enrichment Corporation
U.S. EPA	U.S. Environmental Protection Agency
VOCs	Volatile Organic Compounds
WHS	Western Local High School

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