Student Summary of the U.S. Department of Energy Portsmouth Annual Site Environmental Report (ASER) for 2014

Message from the U.S. Department of Energy

The U.S. Department of Energy (DOE) conducts environmental monitoring at the 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, three classes at Piketon High School (PHS), 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 operated in an environmental safe manner. The work at DOE facilities is highly detailed and technically complex, but DOE is committed to performing each of these activities safely. DOE's first priority is to protect the well-being of our workers, the surrounding communities and the environment. DOE would like to offer its sincerest appreciation to the students and faculty leader at PHS who worked on this summary document. DOE congratulates each of you for your effort, enthusiasm and willingness to support this project.

DOE hopes you enjoy reading the *PORTS 2014 Annual Site Environmental Report Summary.*

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Message from Piketon High School Students

The following report is a summary of the Annual Site Environmental Report (ASER) for 2014. The ASER document is published by DOE regarding the environmental monitoring of PORTS in Piketon, Ohio. The 2016-2017 Piketon High School Chemistry classes, comprised of a mixture of sophomores, juniors and seniors, compiled the ASER Student Summary.

Piketon HS students, PORTS field trip

Through this project, students gained a better understanding of the history of PORTS and how it has shaped the growth and development of Pike County and surrounding counties. Students were given insight into Science, Technology, Engineering, and Math (STEM) related fields as well as what post-secondary path to take in order to pursue those career opportunities. They gained knowledge about the Decontamination & Decommission (D&D) process of PORTS, environmental monitoring and environmental policy with presentations from Ohio University, University of Rio Grande, Fluor-BWXT Portsmouth (FBP) and DOE while providing students with hands-on activities in conjunction with real-world science applications. Students also had the opportunity with an on-site tour of PORTS to gain better knowledge of the facilities and another trip to Lake Hope where they learned about environmental restoration and remediation of local wildlife.

We feel the ASER summary project has allowed students to become informed stakeholders in the cleanup and monitoring process of PORTS. This program has been a valuable experience for those involved and has allowed us to share our knowledge with the community while alleviating misconceptions and giving insight into the cleanup and monitoring processes that are helping to ensure the safety of our community.

Thank you to the U. S. Department of Energy and Ohio University Voinovich School of Leadership for this educational opportunity.

Sincerely,

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Quincy Harris	Bailey Bradley	Austin Spencer	Jamie Morris	Kaleb Gillum
Caitlin Pyle	Scott Lightle	Bryce Coreno	Riley Williams	Kannon Pack
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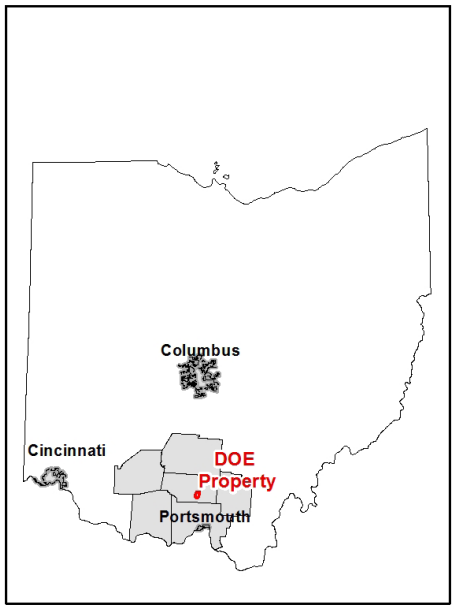
Piketon High School Chemistry classes, 2016-2017

Background For The PORTS Facility

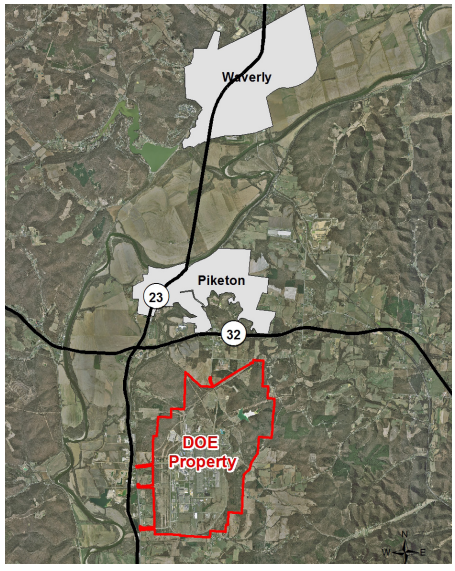
PORTS is located on a 5.9 square mile (3,776 acres) site in Pike County, Ohio. The county has approximately 28,256 residents. The villages of Piketon and Beaver lie within a few miles of the plant. Other residential areas within a 50 miles radius include Waverly, Portsmouth, Chillicothe and Jackson.



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

PORTS, which enriched uranium from 1954 to 2001, is one of three uranium enrichment facilities in the United States. The two remaining facilities, which are also no longer enriching uranium, are located in Oak Ridge, Tennessee and Paducah, Kentucky. DOE leased PORTS to the United States Enrichment Corporation (USEC), who operated the facilities at PORTS from 1993 to 2001. USEC, Inc. became Centrus Energy Corp. (Centrus) in 2014.

DOE is responsible for D&D of PORTS. In 2014, DOE contracted Fluor-BWXT Portsmouth, LLC (FBP); Wastren-EnergX Mission Support, LLC (WEMS) and BWXT Conversion Services, LLC (BWCS) to aid in this process. Additionally, Centrus has been developing a gaseous centrifuge uranium enrichment plant at PORTS.



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

Currently, FBP oversees D&D of uranium enrichment buildings and associated facilities, environmental restoration and waste management and uranium management in accordance with all applicable regulations. D&D activities consists of equipment deactivation; process residue equipment cleansing; demolition, dismantlement and equipment removal. D&D at PORTS is subject to *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* (DFF&O). The goal of DOE through the Environmental Restoration Program is to verify releases from past operations are thoroughly investigated and actions are taken to protect the environment and human health.

The purpose of the full ASER document is to provide details of environmental activities, primarily environmental monitoring, for calendar year 2014. This summary report of the full 2014 ASER provides details in which DOE demonstrates compliance with local, state and federal regulations within environmental programs - both radiological and non-radiological monitoring and groundwater monitoring (DOE, 2016). This report is not intended to present all of the monitoring activities at PORTS and more information can be found at the PORTS Environmental Information Center and website, which is http://energy.gov/pppo/portsmouth-environmental-center.

Compliance Summary

DOE and/or the responsible DOE contractor (FBP or BWCS) held permits for discharge of water to surface streams, air emission permits and a permit for the storage of hazardous wastes. FBP and BWCS are responsible for preparing a number of reports for compliance with various applicable environmental regulations. These reports include an annual groundwater monitoring report.

DOE is responsible for the D&D Program, Environmental Restoration Program, Waste Management Program, uranium operations and maintenance of all facilities not leased to Centrus. FBP is responsible for air emission permits and National Pollutant Discharge Elimination System (NPDES) outfalls associated with the former gaseous diffusion plant operations. BWCS is responsible for activities related with the Depleted Uranium Hexafluoride (DUF_6) Conversion Facility. Centrus is responsible for compliance activities directly associated with the American Centrifuge Plant (ACP) and Lead Cascade including air emission permits connected with the gaseous centrifuge uranium enrichment operations, NPDES outfalls and management of wastes generated by their current operations.

With large machinery making its way through the structure, a worker supplies a steady flow of water for dust suppression purposes.

Several federal, state and local agencies are responsible for enforcing environmental regulations at PORTS. Primary regulatory agencies include the U.S. Environmental Protection Agency (U.S. EPA) and the Ohio Environmental Protection Agency (Ohio EPA). Environmental remediation, or the cleanup of soil, groundwater and other environmental media contaminated by PORTS operations, is conducted in accordance with the U.S. EPA Administrative Order and Consent Decree with the State of Ohio.

The X-106 Tactical Response Building was taken down in September 2013. The 6,214-square-foot structure was built in 1955 to serve as a fire station for the site. Later, it was used by Protective Force personnel for office space and storage.

Environmental Laws and Regulations

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) - PORTS is not on the CERCLA National Priorities List of sites requiring priority cleanup. However, the D&D of PORTS continues to proceed in accordance with the D&D DFF&O and CERCLA, which describe the process for D&D of the gaseous diffusion process buildings and associated facilities that are no longer in use.

Emergency Planning and Community Right-To-Know Act - This Act requires DOE and contractors to report emergency planning information and any and all new, stored and released chemicals to federal, local and state authorities. DOE and contractors must also identify, chart and name any hazardous chemicals present above the threshold planning quantities set by U.S. EPA.

In 2014, DOE contractors reported the permitted release of three chemicals:

- Chlorine: used for water treatment;
- Hydrogen fluoride: released from the DUF_6 Conversion Facility
- Nitrate compounds: released to the Scioto River through permitted NPDES outfalls

Resource Conservation and Recovery Act (RCRA) – RCRA is a nation-wide regulatory policy that requires the monitoring of stored hazardous waste. In order to be considered hazardous, the waste must have various chemical properties such as flammability or corrosiveness. There are certain designated areas on the PORTS site in which hazardous waste are stored. They are inspected and monitored through permits put in place by Ohio EPA. The permits require PORTS to provide notice if there is any event that mishandles the storage of these hazardous wastes. During this period, there were a few instances of small amounts of contamination. However, all were quickly taken care of and not one had hazardous health effects. Many restrictions are also in effect when shipping these hazardous waste off site. RCRA also requires the reporting of groundwater monitoring activities through the *Integrated Groundwater Monitoring Plan*, which are compiled and reported annually to Ohio EPA (DOE 2013b, DOE 2014c, DOE 2015).

Federal Facility Compliance Act - The Federal Facility Compliance Act allows the storage of mixed hazardous/ low-level waste for longer than one year since treatment options for these chemicals are not readily available. The act also requires federal facilities to develop and submit site treatment plans for the treatment of mixed chemicals.

Toxic Substance Control Act (TSCA) – At PORTS this act regulates the storage, use and disposal of polychlorinated biphenyls (PCBs). An annual log is prepared to meet the TSCA requirements which provides information on PCBs at PORTS. DOE was in compliance with the requirements and milestones during 2014.

Clean Air Act - FBP is responsible for many air emission sources involved with the former gaseous diffusion production and support facilities. The Clean Air Act requires FBP to submit quarterly Title V Deviation Reports that state any deviations from the requirements to Ohio EPA. FBP did not have any deviations from the permit requirements. BWCS is responsible for four permitted sources associated with the DUF_6 Conversion Facility. In 2014 the Annual Permit Evaluation Report for the BWCS air emission sources did not report any deviations.

National Emission Standards for Hazardous Air Pollutants (NESHAP) - NESHAP requires DOE to submit an annual report for radiological emissions from DOE air emission sources. FBP and BWCS are both responsible for multiple air emission sources at PORTS.

Clean Water Act and Safe Drinking Water Act - The Clean Water Act regulates the discharge of water from PORTS and requires reports to be submitted to the Ohio EPA to demonstrate compliance. The Safe Drinking Water Act sets the requirements for water testing, treatment and disinfection.

Other Regulations - DOE and DOE contractors must also comply with several other regulations. Some of these regulations are the National Environmental Policy Act, the Endangered Species Act, the National Historic Preservation Act, the Archaeological and Historic Preservation Act and the Archaeological Resources Protection Act. Environmental Program Inspections

Environmental Program Inspections

During 2014, 18 inspections of DOE activities were conducted by the federal, state, or local agencies. DOE and/or FBP received four Notices of Violation in 2014 at PORTS.

- DOE/FBP received notice of the first violation on June 5, 2014. The violation was for failing to include corrosive hazardous waste generated and neutralized in the X-710 Laboratory in the biennial hazardous waste report. The waste report was revised to include the waste in question and the violation was abated.

- FBP received notice of a second violation on June 13, 2014 from the exceedance of a permit limitation for chlorine at Outfall 003. Actions were taken to resolve the exceedance and no further activities were required.

- The third violation was received on July 17, 2014, concerning underground storage tank regulations. Regulations require underground storage tanks be monitored every 30 days. Leak monitoring records after August 2013 were provided to the inspector and no further action was needed.

- The final violation DOE/FBP received was on September 19, 2014. The violation was for incomplete hazardous waste manifest and failing to include corrosive waste generated and neutralized. The manifests were completed and no further actions were required.

Three unplanned releases occurred in 2014. The first release was when piping insulation that contained approximately 6 lbs. of friable asbestos was found outside of the X-333 Process Building on April 1, 2014. The second release was when an oil sheen was discovered on Little Beaver Creek on October 16, 2014. A maximum of 0.5 gallons of oil was estimated to have been released. The final release occurred on November 9, 2014 when groundwater contaminated with trichloroethylene (TCE) was released on-site during excavation activities. All unplanned releases were remedied according to state and federal regulations and did not impact the public.

Environmental Program Information

Decontamination & Decommissioning Program

On April 13, 2010, Ohio EPA issued the D&D DFF&O, which is an enforceable agreement between Ohio EPA and DOE that governs the process for D&D of the gaseous diffusion process buildings and associated facilities that are no longer in use at PORTS. The D&D DFF&O uses the CERCLA framework for determining appropriate removal and remedial actions. Community involvement is an important part of the CERCLA process and the D&D DFF&O. The Community Relations Plan (DOE 2010, DOE 2012) identifies opportunities to provide information to the public and obtain public input. Additionally, the PORTS Site Specific Advisory Board provides recommendations to DOE based on the concerns of the communities surrounding PORTS.

D&D of seven of the most complex facilities at PORTS, including the three gaseous diffusion process buildings, is following the remedial investigation/feasibility study (RI/FS) process. The D&D process began with a pre-investigation evaluation report, which includes site history, a summary of existing data and identification of problems to be addressed in the RI/FS work plan. The process buildings' RI/FS work plan detailed the tasks to be completed to characterize site conditions, determine the nature of wastes to be generated, assess the potential risk to human health and the environment and evaluate potential remedial alternatives. The RI/FS report provides results of the RI/FS work plan which was submitted to Ohio EPA. Once the RI/FS work plan is concurred, a proposed plan is then prepared and made available for public review and comment.

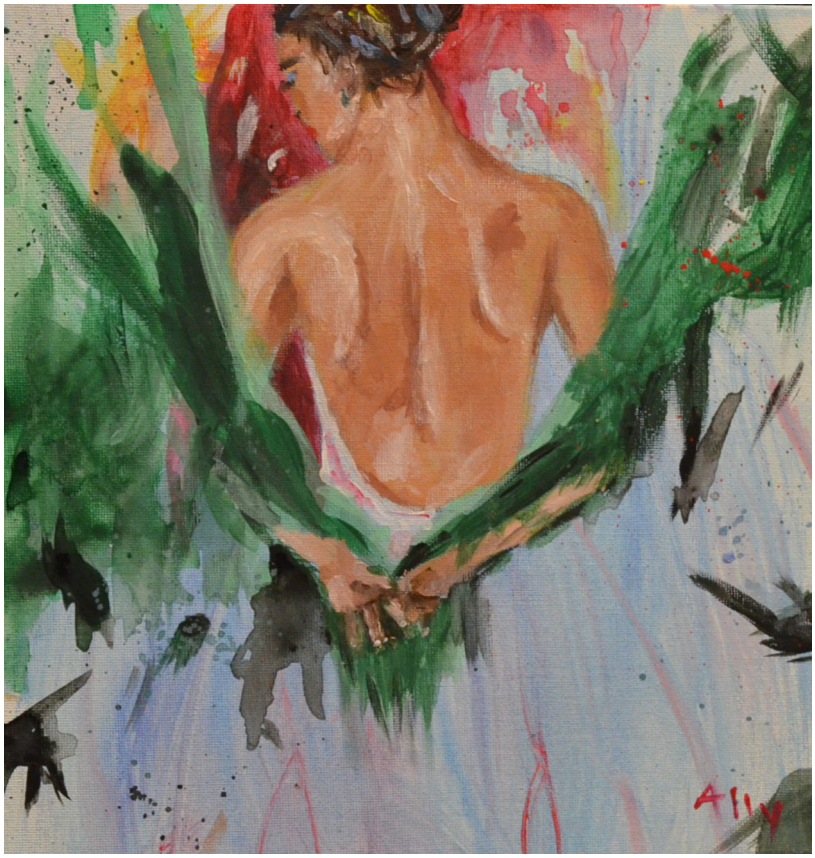
Selected smaller and less complex buildings at PORTS have undergone D&D using the process for non-time critical removal actions. In general, this process includes a removal site evaluation, sampling and analysis plan, engineering evaluation/cost analysis and removal action completion report. Ohio EPA reviews and concurs with each of these documents and the public is given an opportunity to comment on the engineering evaluation/cost analysis, prior to D&D. In 2014, Ohio EPA provided concurrence on the removal action completion report for the X-744S Warehouse, the X-624-1 Decontamination Pad, the X-600 Steam Plant Complex, the X-102 Cafeteria and the X-106 Tactical Response Building.

Site-Wide Waste Disposition

This portion of D&D evaluates off-site and on-site waste disposal alternatives for waste generated by D&D. The on-site disposal alternative to be evaluated involves construction of an on-site waste disposal facility. The initial waste disposition RI/FS report was submitted to Ohio EPA in February 2013. The RI/FS report evaluated the required no-action alternative and two action alternatives. DOE submitted the proposed plan, which recommended a combination of on-site and off-site disposal. The record of decision finalizes the remedial action selected by DOE in the proposed plan with concurrence from Ohio EPA.

Environmental Restoration Program

The DOE established the Environmental Restoration Program 1989 to identify, control and remediate environmental contamination at PORTS. The corrective process consists of identifying contaminants, finding their sources and evaluating how to treat the contamination and prevent a similar release of contamination. After the final cleanup alternative is approved, the Ohio EPA selects the remedial actions that will undergo further review to determine the preferred plan. After thorough public review and consideration, the EPA issues a decision document and the DOE implements the selected plan. Remedial actions are reviewed every five years by the EPA and DOE to ensure protection of human health and the environment. PORTS was divided into four quadrants to facilitate the cleanup process and what follows is a description of the remedial actions in each quadrant.

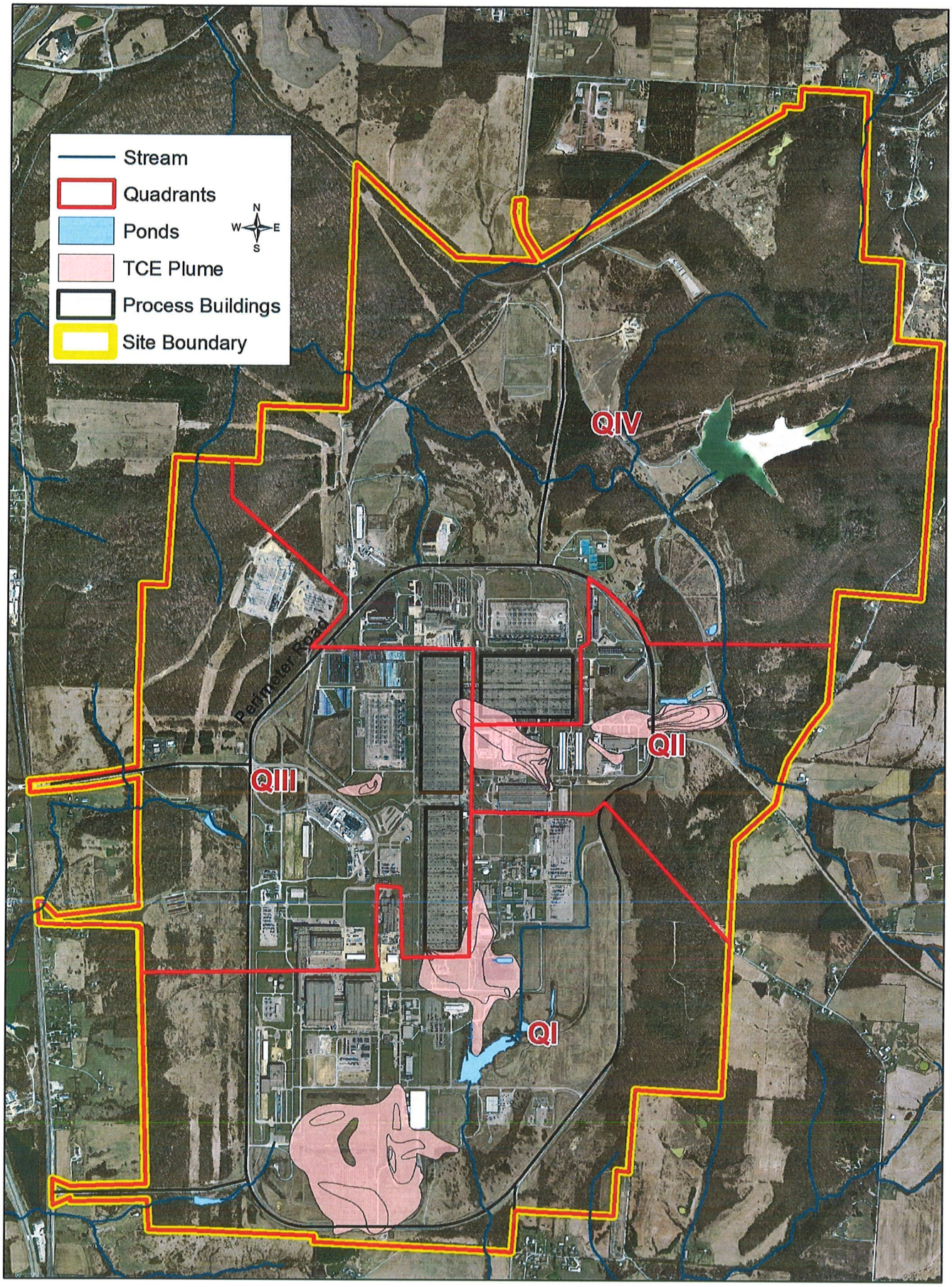


Artwork by Ally Crothers

Quadrant I

The *Quadrant I Cleanup Alternative Study/Corrective Measures Study* was approved by Ohio EPA in 2000 (DOE 2000). Two Decision Documents were produced in 1996 and 2001 which provided the required remedial actions for the X-749/X-120 groundwater plume, the Quadrant I Groundwater Investigative (5-Unit) Area and the X-749B Peter Kiewit (PK) Landfill (Ohio EPA 2001, Ohio EPA 1996). Remedial actions to treat the X-749/X-120 groundwater plume include phytoremediation of the groundwater plume, installation of a barrier wall around the eastern and southern portion of the X-749 landfill and continued operation of the groundwater collecting trenches installed at the PK and X-749 Landfills. Furthermore, groundwater extraction wells were installed in 2007, 2008 and 2010 to control migration of the plume and remediate areas of higher TCE concentrations within the plume. Phytoremediation is a process that uses plants to remove or contain contaminants found in soil and/or groundwater.

The First Five-Year Review for the X-749/X-120 Groundwater Plume, submitted to Ohio EPA in 2011, found that some remedial actions, such as the barrier wall and the extraction wells, had been successful at preventing the migration of contaminants (DOE 2011b). However, Ohio EPA and DOE agreed that the phytoremediation portion had not been as successful as anticipated at reducing concentrations of TCE.


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

The remedial actions required of the PK Landfill consisted of the continued operation of the eastern groundwater collection system and construction of an engineered cap that meets RCRA requirements (Ohio EPA 1996, U.S. EPA 1997). In 2013, the third five-year review found that the corrective actions implemented were continuing to eliminate exposure pathways and reduce potential for contaminant transport (DOE 2013e).

In 2008 a five-year review of the groundwater extraction system for the Quadrant I Groundwater Investigative (5-Unit) Area and the multi-layered caps for the X-231A and X-231B Oil Biodegradation Plots found that that the extraction wells and caps had reduced the concentration of TCE in the groundwater, although it was removed more slowly than expected. A second five-year review revealed that remediation efforts were continuing to eliminate potential exposure pathways to contaminants, control migration of the plume and remove volatile organic compounds (VOCs) from groundwater.

Quadrant II

The *Quadrant II Cleanup Alternative Study/Corrective Measures Study* was approved by Ohio EPA in 2001 and after approval, the Ohio EPA requested an amendment to address the additional remedial alternatives for the X-701B area. A number of deferred units are in the groundwater plume in the Quadrant II Groundwater Investigative (7-Unit) Area and a special investigation was conducted in 2009. The investigation sampled soil and groundwater, which, identified areas of higher TCE concentrations that appeared to be associated with continuing sources of groundwater contamination in the southeastern portion of the plume. In 2010, the Ohio EPA approved an interim remedial measure (IRM) for this area called enhanced anaerobic bioremediation, which utilizes injections of fermentable carbon compounds to provide additional food for naturally occurring microorganisms that degrade TCE. *According to the Final Report for the 7-Unit Interim Remedial Measure*, there was not a measurable reduction of TCE in groundwater and the IRM was concluded. DOE and Ohio EPA agreed that further development of remedial alternatives for the Quadrant II Groundwater Investigative (7-Unit) Area will be incorporated into the *Deferred Units RCRA RFI/CMS Work Plan for Solid Waste Management Units* (DOE 2014a). An IRM also was proposed for the X-701B Former Holding Pond to excavate soil in the western portion of the X-701B plume and directly mix oxidant into contaminated soil to further reduce contaminants in the area. The IRM was completed in 2011.

The X-633 Recirculating Cooling Water Complex was demolished in 2010 and a RCRA investigation of soil and groundwater was implemented in 2011. Chromium and TCE were detected in groundwater at concentrations above remediation goals and DOE agreed to sample eight wells around the area annually to continue evaluation of chromium and TCE in this area.

Quadrant III

The *Quadrant III Cleanup Alternative Study/Corrective Measures Study* was approved by the Ohio EPA in 1998 (DOE 1998a). The Decision Document issued for Quadrant III in 1999, called for the phytoremediation of the groundwater plume located near the X-740 Waste Oil Handling Facility (Ohio EPA 1999). Over 700 hybrid poplar trees were planted in a 2.6-acre area of land above the plume. The first two five-year reviews showed that their efforts to remove TCE was not successful (DOE 2003, DOE 2007). DOE implemented additional remedial

actions and three rounds of oxidant injections were completed in 2008 to remove TCE from the groundwater. These injections temporarily lowered the concentration of TCE, but the levels returned to normal in 2009. In a pilot study taking place during December 2010 and January 2011, emulsified oil, a slow-acting fermentable carbon compound, was injected into the groundwater plume. A collection of groundwater samples to monitor the study will be collected through 2015. TCE concentration has decreased in the wells in the area of the groundwater plume.

Quadrant IV

The *Quadrant IV Cleanup Alternative Study/Corrective Measure Study* was approved by Ohio EPA in 1998 (DOE 1998b). No new remedial actions were required in Quadrant IV. Remedial actions at X-344D Hydrogen Fluoride Neutralization Pit, X-735 Landfills, X-611A Former Lime Sludge Lagoons and X-734 Landfills had already taken place.

Five-year reviews conducted in 2002, 2008 and 2013 found that the soil cover and prairie habitat were meeting remedial action objectives at the X-611A Former Lime Sludge Lagoons by eliminating exposure pathways to contaminants (DOE 2002, DOE 2008b, DOE 2013d). Five year reviews in 2008 and 2013 also found that the landfill caps at the X-734 landfills have achieved remedial action objectives by isolating contaminants in soil and sediment and were also preventing the migration of contaminants from soil to groundwater and from groundwater to surface water (DOE 2008a, DOE 2013c). A background study was underway in 2014 at the X-630 Former Recirculating Cooling Water Complex to provide additional information about concentrations of naturally occurring metals. Chromium and TCE were detected in groundwater at concentrations above the preliminary remediation goals during the 2011 RCRA investigation and DOE agreed to sample four wells annually to continue evaluation of chromium and TCE in this area.

Waste Management Program

The DOE Waste Management Program directs the safe storage, treatment and disposal of waste generated at PORTS. Waste managed under the program includes radioactive waste, hazardous waste, waste containing PCBs and solid waste. Waste management requirements are varied and are sometimes complex because of the variety of waste streams generated by DOE activities at PORTS. Because of this, DOE Orders, Ohio EPA regulations and U.S. EPA regulations must be satisfied to demonstrate compliance with waste management activities.

In 2014, FBP shipped approximately 8900 tons of materials to off-site facilities for treatment, disposal, recycling, or reuse. In addition, the Southern Ohio Diversification Initiative received approximately 1270 tons of materials from PORTS to either repurpose or sell the materials to support economic development in the southern Ohio region.

Environmental Sustainability Program

DOE activities at PORTS integrate environmental sustainability principles 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 specific goals and outcomes. The Environmental Sustainability Program includes elements of pollution prevention, waste

minimization, affirmative procurement, sustainable design and energy and water efficiency. DOE is committed to minimizing and/or eliminating the amounts and types of wastes generated and to achieving reduced costs for managing and dispositioning property and wastes.

The following are accomplishments of the Fiscal Year 2014Site Sustainability Plan for the Portsmouth Gaseous Diffusion Plant fiscal year 2014:

- a decrease of 35.5% in greenhouse gas emissions versus the fiscal year 2008 baseline emissions.
- 11.8% of electricity consumption from renewable energy sources, which exceeds the goal of 7.5%.
- an increase in alternative fuel (E-85) consumption of 26% vs fiscal year 2013.
- a reduction of 5.2% in paper and printer usage vs fiscal year 2013.

PORTS also received a Silver Level GreenBuy Award from DOE for fiscal year 2014 for buying products that save energy, conserve water and reduce health and environmental impacts.

Public Awareness Program

A comprehensive community relations and public participation program is 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 public awareness program also provides the public with opportunities to become involved in the decisions affecting environmental issues at PORTS.

Artwork by Annie McGaughey

The PORTS Site Specific Advisory Board (SSAB) is made up of citizens from the local community. The SSAB provides public concerns and recommendations to DOE regarding D&D, environmental remediation, waste management and related issues. The PORTS Envoy Program matches employee volunteers with community stakeholders living next to DOE property, community groups and local government organizations.

DOE also maintains a public Environmental Information Center to provide public access to documents used to make decisions. Public meetings and workshops on specific topics are also held to keep the public informed and receive their comments and questions.

The following are information sources for the public:

- Site Specific Advisory Board: www.ports-ssab.energy.gov or 740.289.5249
- Environmental Information Center: http://energy.gov/pppo/portsmouth-environmental-center or 740.289.8898
- DOE Portsmouth/Paducah Project Office: www.energy.gov/pppo or www.fbportsmouth.com
- DOE Site Office: 740.897.5010
- Office of Public Affairs: 740.897.3933

Environmental Radiological Information

Environmental monitoring at PORTS measures radiological and chemical parameters in air, water, soil, sediment and biota. Environmental monitoring is required by state and federal regulations, permits and DOE Orders. Data is collected at PORTS for current and historical radionuclides handled at the plant to assess potential impacts to human health and the environment.

Summary of potential doses to the public from PORTS in 2014

Source of dose	Dose (mrem/year)*
Airborne radionuclides (off-site individual)	0.017
Radionuclides released to the Scioto River	0.0015
External radiation at station A29	0.81
Radionuclides detected by environmental monitoring programs (sediment, soil, vegetation and drinking water)	0.077
Total	**0.91**

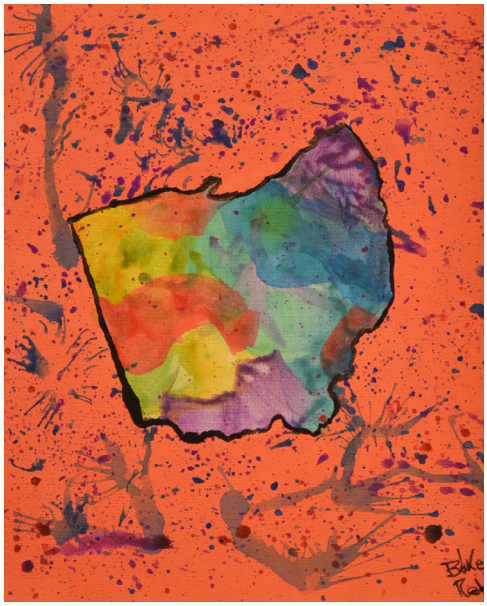
**100 millirem per year (mrem/year) is the DOE limit in DOE Order 458.1*

Environmental monitoring takes place all through the year. Monitoring programs include airborne discharges, ambient air, external radiation, discharges to surface water, sediment, soil, vegetation and of biota. DOE also conducts an extensive groundwater monitoring program at PORTS, which will be discussed in later sections. A US resident can expect to receive an average dose of 311 mrem/year of radiation from sources of natural radiation (NCRP 2009). A dose is a measure of potential biological damage that could be caused by exposure to and subsequent absorption of radiation to the body. Airborne releases from the facility are limited to a dose rate 10 mrem/year to any member of the public by U.S. EPA. DOE order 458.1, *Radiation Protection of the Public and the Environment*, sets the annual dose limit of 100 mrem/year to any member of the public from all releases from a facility. The NESHAP regulations set dose limit of 10 mrem/year and applies only to airborne releases. By way of comparison, the maximum dose of radiation a member of the public could receive from PORTS in 2014 was 0.91 mrem/year, which is below the DOE limit of 100 mrem/year.

Radiological Emission and Doses

Exposure to radioactive materials can happen from releases to the atmosphere, surface water or groundwater, soil and sediment, as well as external radiation from buildings or objects. Monitoring data is used to determine if it is possible that any doses of radiation could have been received by the public. Exposure to radionuclides detected

in groundwater at PORTS is not included because contaminated groundwater at PORTS is not a source of drinking water. In 2014, radionuclides were not detected in samples of residential drinking water, deer, fish, crops and dairy products. People working at and visiting the facility, as well as the environment, are also monitored for radiation exposure.



Artwork by Blake Reader

Most consequences associated with radionuclides released to the environment are caused by interactions between human tissue and various types of radiation emitted by the radionuclides. Radiation may come from radionuclides outside the body (external) or from radionuclides inside the body (internal). External exposure happens only as long as a person is near the external radionuclide and internal exposure continues as long as the radionuclide remains inside the body. For uranium isotopes and other radioactive isotopes, a number of specialized measurement units have been defined to describe the amount of ionizing radiation in terms of biological consequences of the absorbed energy. These units are absorbed dose, equivalent dose, effective dose and collective dose.

Airborne Emissions

Airborne discharges of radionuclides from PORTS are regulated under the NESHAP and are reported annually to the U.S. EPA and Ohio EPA. In 2014, FBP was responsible for air emission sources associated with the former gaseous diffusion plant operations. Some of these locations are continuously monitored while some are sampled before and after equipment is removed as part of the D&D work being performed. Total emissions from DOE/FBP airborne sources in 2014 were calculated to be 0.00987 curie (Ci). BWCS was responsible for air emissions sources associated with the DUF_6 conversion facility. Total emissions from the DOE/BWCS airborne sources in 2014 were calculated to be 0.0000405 Ci. Total emissions from all DOE airborne sources in 2014 were calculated to be 0.00991 Ci.

Dose calculations are required to be provided to the US EPA in an annual report. The report estimates effective dose for closest resident under a maximally exposed scenario and for the entire population within 50 miles of the plant. The dose calculations assumptions include that the person eats mostly local vegetables, meats and milk. The maximum potential dose of an off-site individual due to the radiological releases from the PORTS facilities in 2014 was 0.017 mrem/year. This dose is well below the 10 mrem/year limit. The collective dose is the sum of the individual doses to the entire population within 50 miles of PORTS. In 2014, the population dose was 0.151 person-rem/year, which was insignificant.

Ambient air monitoring also occurs at 15 monitoring stations. Samples are analyzed for radionuclides that could be present due to PORTS activities. Doses from exposures were calculated to show worst possible case scenario. Even with these stringent assumptions, the highest dose measured (0.0003 mrem/year) was significantly less than the 10 mrem/year NESHAP limit and the 100 mrem/year DOE limit.

Discharges of Radionuclides from NPDES Outfalls

In 2014, FBP was responsible for 18 monitoring locations identified in the FBP NPDES permit. Nine outfalls discharge directly into surface water, six outfalls go out into another outfall before leaving the site and three other locations are not outfalls, but are monitored. Centrus is also responsible for three of the outfalls, two that go directly from the site and one at X-6619 Sewage Treatment plant. Water from the outfalls go directly into the Scioto River, or eventually flow into the Scioto River after treatment. Radionuclides are measured at the FBP and Centrus outfalls, analyzing the samples for uranium, uranium isotopes, technetium-99 and transuranic radionuclides. Discharges of radionuclides were calculated using monthly or weekly data from the outfalls.

In 2014, uranium discharges from the FBP externals outfalls were estimated at 14 kg while the total radioactivity released from the same outfalls was estimated at 0.070 Ci. Discharges of radionuclides in liquids through FBP NPDES outfalls have no significant impact on public health. No transuranics were detected in the samples collected from external FBP outfalls. Uranium discharges from the Centrus outfalls were estimated at 0.568 kg. The dose calculated with these data and date from external FBP outfalls is significantly less than the 100 mrem/year limit for radiological releases from a facility.

Dose Calculation for Releases to Surface Water

Artwork by Bryce Coreno

Radionuclides are measured at FBP and Centrus external outfalls. Water from these external outfalls is directly discharged or eventually flows into the Scioto River. A hypothetical dose to a member of the public was calculated using the 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 scenario is very conservative because the Scioto River is not used for drinking water downstream of PORTS. The dose of radionuclides released to the Scioto River in 2014 (0.0015 mrem) is significantly less than the 100 mrem/year DOE limit for all radiological releases from a facility.

Radiological Dose Calculation for External Radiation

Radiation is emitted from DUF_6 cylinders stored on site at PORTS in the cylinder storage yards located in the northwest portion of the site near Perimeter Road. External 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* (DOE 2013a). The radiological exposure to an on-site member 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). In 2014, based on these assumptions, exposure to an on-site member of the public from radiation from the cylinder yards is approximately 0.78 mrem/year. A dose calculation was also completed for a representative off-site member of the public, such as a worker at the Ohio Valley Electric Corporation. Assuming that the worker

was exposed to this radiation for 250 days/year, one hour outdoors and 8 hours indoors, the dose to this worker is 0.81 mrem. The average annual dose to a person in the United States from all radiation sources (natural and manmade) is approximately 620 mrem (NCRP 2009). The higher potential estimated dose from external radiation to a member of the public is approximately 0.1 percent of the average yearly radiation exposure for a person in the United States. This is significantly less than the DOE 100 mrem/year limit. The 2014 Radiation Exposure Information Reporting System report indicated that no visitors and less than 4% of monitored workers received a measurable dose (1 mrem or more).

Radiological Dose Calculations for Off-Site Environmental Monitoring Data

Radiological monitoring programs at PORTS include ambient air, surface water, sediment, soil, residential drinking water (well water) and biota (vegetation, deer, fish, crops, milk and eggs). The summary of the dose calculations assumes that the same individual is exposed to the maximum dose calculated from each pathway. In 2014, dose calculations were completed for public exposure to radionuclides detected in sediment, soil and vegetation. Radionuclides were not detected in samples of drinking water, deer, fish, crops and dairy products.
The following table summarizes the results of each dose calculation, which are significantly less than the 100 mrem/year DOE limit.

Summary of potential doses to public from radionuclides detected by DOE environmental monitoring programs 2014

Source of dose	Dose (mrem/year)[a]
Sediment	0.028
Soil	0.045
Vegetation	0.0044
Total	**0.077**

[a] *100 mrem/year is the limit for all potential pathways in DOE Order 458.1*

Protection of Biota

DOE Order 458.1 determines 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 2014 from the east side of the PORTS reservation were used to assess the dose limits for aquatic and riparian animals. These locations were selected because levels of radionuclides detected in surface water and sediment from these locations were among the highest detected in samples collected in 2014. The assessment indicates that the levels of radionuclides detected in water and sediment at these locations did not result in a dose of more than 1 rad/day to aquatic animals and 0.1 rad/day to riparian animals. Similar testing was completed for terrestrial plants and animals. The assessment for terrestrial plants and animals indicates that the levels of radionuclides detected in water and soil at the sampled locations did not result in

a dose of more than 1 rad/day to terrestrial plants and 0.1 rad/day to terrestrial animals. No unplanned releases of radionuclides took place at PORTS in 2014.

Ambient Air Monitoring for Radionuclides

The ambient air monitoring stations measure radionuclides released from 1) DOE and Centrus point sources, 2) fugitive air emissions and 3) background levels of radionuclides. These radionuclides are isotopic uranium, technetium-99 and selected transuranic radionuclides.

In 2014, samples were collected from 15 ambient air-monitoring stations located within and around PORTS, including a background ambient air monitoring station (A37) located approximately 13 miles southwest of the plant. The analytical 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 2014. Technetium- 99 was detected at each of the 15 ambient air stations. Uranium-233/234 and uranium-238 were detected at each of the monitoring stations. The maximum activity of uranium-233/234 in ambient air (0.00026 picocurie per cubic meter (pCi/m^3)) was detected at station A36 (on site at the X-611 Water Treatment Plant). 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 (0.0002 mrem/year) was at station A6 in Piketon. This hypothetical dose is well below the 10 mrem/year limit applicable to PORTS in NESHAP.

External Radiation

External radiation is measured continuously with thermoluminescent dosimeters (TLDs) at five locations near the DUF_6 cylinder storage yards, 19 locations that include 12 of the ambient air monitoring stations and seven additional on-site locations. Radiation is measured in millirems as a whole body dose, which is the dose that a person would receive if they were continuously present at the monitored location.

The potential estimated dose for the representative on-site member, such as a delivery person, is 0.78 mrem/year, which is significantly less than DOE's 100 mrem/year limit. The potential estimated dose for the representative off-site member of the public who works near station A29 is 0.81 mrem/year which is also well below DOE's limit of 100 mrem/year. Three locations on-site measured levels of radiation at least 50% higher than the average off-site locations. The on-site locations with higher doses than the off-site average are not used by the general public. All doses fall under the DOE potential dose limits for on-site and off-site locations. No administrative guidelines or regulatory dose limits were exceeded in 2014.

Surface Water from Cylinder Storage Yards

In 2014, FBP collected surface water samples from the Cylinder Storage Yards while BWCS collected surface water samples at the cylinder yards associated with the DUF_6 Conversion Facility. If water was available, samples were collected monthly. The samples were analyzed for alpha activity, beta activity and uranium. FBP reported maximum

levels of alpha activity (711 picocurie per liter (pCi/L)) and beta activity (794 pCi/L) were detected in samples collected in January 2014. The maximum concentration of uranium (62.1 microgram per liter (µg/L)) was detected in the August 2014 samples. BWCS reported maximum levels of alpha activity (17 pCi/L), beta activity, (22 pCi/L) and uranium (38 µg/L) in samples collected in October 2014. The surface water from the cylinder storage yard flows to FBP NPDES outfalls prior to discharge from the site. Releases of radionuclides from the cylinder yards are monitored by sampling conducted at the FBP outfalls. Radionuclides detected at FBP outfalls are used in the dose calculation for releases to surface water. The dose from radionuclides released to surface water (the Scioto River) in 2014 (0.0015 mrem) is significantly less than the DOE 100 mrem/year limit for all radiological releases from a facility.

Local Surface Water Monitoring for Radionuclides

Artwork by Brylee Lunsford

In 2014, surface water was collected from 14 locations including the Scioto River, Little Beaver Creek, Big Beaver Creek and Big Run Creek. As background measurements, samples were also collected 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 in accordance with the DOE Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant (DOE 2013a). No transuranic radionuclides were detected in the local surface water samples of these surface water sites. However, technetium-99 and uranium were detected. Detections of technetium-99 and uranium isotopes in local surface water samples were well below DOE derived concentration standards (DOE 2011a).

Local Surface Water Samples

Site Tested	Radionuclide Found	Concentration Discovered
Big Run Creek	Technetium-99	8.55 pCi/L
Upstream on Scioto River	Uranium	2.24 µg/L
	Uranium-238	0.742 pCi/L
Downstream on Little Beaver Creek	Uranium	2.24 µg/L
	Uranium-233/234	2.62 pCi/L
Big Beaver Creek	Uranium-235/236	0.164 pCi/L

Sediment

Sediment samples were collected from the same sites local surface water samples were taken 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 (DOE 2013a). Uranium and uranium isotopes are naturally occurring, but may also be present due to PORTS activities. Technetium-99 was detected in the sample collected from Big Beaver Creek and transuranics were detected at sampling locations at Big Beaver Creek, Big Run Creek, and at an on-site sampling location that monitors discharge from the Southwest Holding Pond. Technetium-99, uranium and uranium isotopes detected in 2014 samples have been detected at similar levels in previous sampling from 2002 through 2013. Big Beaver Creek was the off-site sampling location that had the highest dose to a member of the public. The total potential dose to a member of the public resulting from the samples at Big Beaver Creek is 0.028 mrem/year, which is well below the DOE standard of 100 mrem/year.

Sediment Samples

Location Tested	Radionuclide Found	Concentration Discovered
Discharge from the Southwest	Uranium	6.3 microgram per gram (µg/g)
Holding Pond	Uranium-238	2.1 picocurie per gram (pCi/g)
Big Beaver Creek	Uranium-233/234	3.26 pCi/g
	Uranium-235/236	0.163 pCi/g
	Technetium-99	4.5 pCi/g
	Neptunium-237	0.0176 pCi/g
Big Run Creek	Neptunium-237	0.0864 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. The data are used to determine compliance with DOE Order 458.1, Radiation Protection of the Public and the Environment and ensure that the discharges do not exceed an annual average (at the point of discharge) of either of the following:

- 5 pCi/g above background of settleable solids for alpha-emitting radionuclides and
- 50 pCi/g above background for beta-emitting radionuclides.

In 2014, settleable solids were not detected at concentrations above 40 mg/L at any of the monitoring locations; therefore, monitoring results for the settleable solids monitoring program are in compliance with DOE Order 458.1 because the amount of settleable solids was too low to result in exceedance of the compliance value.

Soil

Soil samples are collected annually from ambient air monitoring locations and analyzed for transuranic radionuclides, technetium-99, uranium and uranium isotopes. No transuranics or technetium-99 were detected in any of the soil samples collected during 2014. Uranium, uranium-233/234, uranium-235/236 and/or uranium-238 were detected at each of the sampling locations. Uranium and uranium isotopes are usually detected at similar levels at all the soil sampling locations, including the background location, which suggests that the uranium detected in these samples is due to naturally occurring uranium.

Biological Monitoring

The DOE Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant (DOE 2013a) requires biological monitoring to assess the uptake of radionuclides into selected local biota such as vegetation, deer, fish, crops, milk and eggs. For each of the selected biota, samples are collected and analyzed for transuranic radionuclides, technetium-99, uranium and uranium isotopes. Vegetation samples were collected in the same areas where soil samples are collected at the ambient air monitoring stations. Deer samples are collected from deer that are killed from motor vehicle collisions at PORTS, if available. Fish were caught on the Scioto River, Little Beaver creek and Big Beaver creek. Crops were collected from five off-site locations near PORTS and milk and eggs produced near PORTS were collected. Uranium, uranium-233/234 and uranium-238 were detected in the vegetation samples collected in 2014. The potential dose from to a member of the public from vegetation is 0.0044 mrem/year, which is well below the DOE limit of 100 mrem/year. No radionuclides were found in the other biota samples collected in 2014.

Piketon HS students, Lake Hope environmental monitoring demonstration

OU staff and Piketon HS students at Lake Hope

Release of Property Containing Residual Radioactive Material

DOE Order 458.1 establishes limits for unconditional release of personal and real property from DOE facilities. In 2014, no real property was released, which is land and anything permanently affixed to the land such as buildings, fences, light fixtures and other such items.

FBP uses pre-approved authorized limits established by DOE Orders to evaluate and release materials defined as personal property. In 2014, FBP authorized 1891 release requests for materials/items of personal property.

In 2014, BWCS continued off-site shipping of aqueous hydrogen fluoride produced by the DUF_6 Conversion Facility. Each shipment much reach the release limit of less than 3 picocuries/milliliters (pCi/mL) of total uranium activity. Just over 1,469,500 gallons of aqueous hydrogen fluoride was released off-site in 2014. The average total uranium activity of all the off-site shipments was 0.008 pCi/mL.

Artwork by Ceci Rockwell

Environmental Non-Radiological Program Information

The non-radiological environmental monitoring at PORTS includes air, water, sediment and fish. Monitoring of non-radiological parameters is required by state and federal regulations and/or permits, but is also performed to reduce public concerns about plant operations. Discharges of non-radiological air pollutants from PORTS permitted emission sources have decreased over the last five years due to the demolition of the X-600 Steam Plant Complex in 2013. Environmental monitoring programs at PORTS usually monitor both radiological and non-radiological constituents that could be released to the environment as a result of PORTS activities. Non-Radiological data is not collected for all sampling locations and monitoring programs. Environmental permits issued by Ohio EPA to FBP, BWCS or Centrus specifies discharge limitations, monitoring requirements and/or reporting requirements for air emissions and water discharges. DOE also conducts an extensive groundwater monitoring program at PORTS that includes both radiological and non-radiological constituents.

Airborne Discharges

Artwork by Cheyenne Fout

Permitted air emission sources at PORTS emit non-radiological air pollutants. In addition, the DOE ambient air monitoring program measures fluoride at monitoring stations within PORTS boundaries and in the surrounding area. FBP is responsible for numerous air emission sources associated with the former gaseous diffusion production facilities and support facilities. FBP reported the following emissions of non-radiological air pollutants for 2014: 12.18 tons of particulate matter, 2.96 tons of organic compounds and 0.595 ton of nitrogen oxides. Emissions for 2014 are associated with the X-627 Groundwater Treatment Facility, X-333 Coolant System, X-326 Dry Air Plant Emergency Generator and plant roads/parking areas.

The DUF_6 Conversion Facility emits only a small quantity of non-radiological air pollutants and because of this, Ohio EPA requires a Fee Emissions Report only once every two years. A report was not required in 2014.

U.S. EPA also requires annual reporting of greenhouse gas emissions. In 2014, FBP reported emissions of 15,958 metric tons of carbon dioxide, 0.3 metric ton of methane and 0.03 metric ton of nitrous oxide.

Another potential air pollutant present at PORTS is asbestos released by D&D of plant facilities. Asbestos emissions are controlled by a system of work practices. The amount of asbestos removed and disposed is reported to Ohio EPA. In 2014, no asbestos-containing materials were shipped from PORTS.

Ambient Air Monitoring for Fluoride

In addition to the radionuclides, DOE ambient air monitoring stations also measure fluoride. Fluoride detected at the ambient air monitoring stations could be present due to background concentrations (fluoride occurs naturally in the environment), activities associated with the former gaseous diffusion process and operation of the DUF_6 Conversion Facility. In 2014, the average ambient concentration of samples collected at background stations was 0.017 microgram per cubic meter ($\mu g/m^3$), stations around PORTS was 0.014 $\mu g/m^3$ and 0.021 $\mu g/m^3$ at off-site locations. There is no set standard for fluoride in ambient air. The data indicate that ambient concentrations of fluoride at off-site and background locations are not appreciably different from concentrations at PORTS.

Non-Radiological Water Monitoring

Both surface water and groundwater are monitored at PORTS. They are monitored together, with groundwater being the main source of data. Non-radiological surface water monitoring primarily consists of sampling water discharges associated with FBP, BWCS and Centrus NPDES-permitted outfalls. PCBs are monitored in surface water downstream from the cylinder storage yards. In 2014, DOE contractors (FBP and BWCS) were responsible for 20 NPDES outfalls and Centrus was responsible for three outfalls at PORTS.

FBP NPDES Outfalls

In 2014, FBP was responsible for 18 outfalls or sampling points. 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 outfall based on the chemical characteristics of the water that flows into the outfall and sets discharge limitations for some of these parameters. Some of the monitored chemicals include trans-1,2 dichloroethene and/or TCE.

In 2014, discharge limitations at the FBP NPDES monitoring locations were exceeded on four occasions. The maximum daily concentration limit for chlorine was exceeded three times. The fourth exceedance occurred when the maximum 24-hour temperature limit was exceeded due to the hot and dry weather conditions when the sample was collected. The exceedances were caused by operational issues and were corrected the day of the exceedance. The overall FBP NPDES compliance rate in 2014 was 99%.

Artwork by Dakota Cheadle

BWCS NPDES Outfall

BWCS is responsible for the NPDES permit for the discharge of process wastewaters from the DUF_6 Conversion Facility. The monitoring data collected in accordance with the BWCS permit are submitted to Ohio EPA in a monthly discharge monitoring report. BWCS had five exceedances of NPDES permit effluent limitations in 2014,

all prior to implementation of the new BWCS permit in June 2014. The discharge limitation for total suspended solids was exceeded once and the limitation for dissolved solids were exceeded four times in 2014. The overall BWCS NPDES compliance rate in 2014 was 99%.

Centrus NPDES Outfalls

Centrus is responsible for three NPDES outfalls through which water is discharged from the site. The monitoring data are submitted to Ohio EPA in a monthly discharge monitoring report. No exceedances occurred at Centrus outfalls in 2014 and therefore, the overall Centrus compliance rate with NPDES permits was 100%.

Surface Water & Sediment Monitoring

Surface water samples are collected quarterly from four locations in the drainage basins downstream from the Cylinder Storage Yards. All samples were analyzed for PCBs. During 2014, none of these samples detected PCBs.

In 2014, sediment monitoring at PORTS included local streams and the Scioto River upstream and downstream from PORTS and drainage basins downstream from the BWCS cylinder storage yards. These samples are collected annually from PORTS. These samples are tested for 20 different metals and PCBs. PCBs were detected in samples from both upstream and downstream from PORTS. PCBs were also detected in samples from Little Beaver Creek at the north holding pond, as well as Big Run Creek near the PORTS property boundary. None of the PCBs around PORTS were above the risk based regional screening level for PCBs. While the highest detection of PCBs were in the West drainage ditch. None of the detections of PCBs in sediment around PORTS were above the risk-based regional screening level for PCB-1254/1260 developed by U.S. EPA and utilized by Ohio EPA. The results of the metal sampling conducted in 2014 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.

Artwork by Delaney Rigsby

Sediment samples are also collected quarterly from four locations associated with BWCS Cylinder Storage Yards. In 2014, PCBs were detected in at least one of the sediment samples collected at each location. The concentrations of PCBs detected in 2014 are below the 1 ppm (1000 ppb) reference value set forth in the U.S. EPA *Region 5 TSCA Approval for Storage for Disposal of PCB Bulk Product (Mixed) Waste*.

Biological Monitoring of Fish

Fish samples are collected annually from locations on Little Beaver Creek, Big Beaver Creek and the Scioto River. These samples are analyzed for PCBs, in addition to the radiological parameters previously discussed. These samples

only include the fish fillets, which is the part that a person would consume. Samples collected from the upstream Scioto River consisted of mainly freshwater drum, while the samples collected from the downstream Scioto River mainly consisted of catfish and the samples collected from Little Beaver Creek were bluegill. The Ohio Fish Consumption Advisory Chemical Limits are provided in the State of Ohio Cooperative Fish Tissue Monitoring Program Sport Fish Tissue Consumption Advisory Program (Ohio EPA 2008). These limits are set for the following consumption rates: unrestricted, 1/week, 1/month, 6/year and do not eat.

PCBs were detected in fish collected from the Scioto River at concentrations ranging from 24.4 to 47.6 micrograms per kilogram (µg/kg). PCBs were detected in the bluegill samples from Little Beaver Creek at 235 µg/kg. The concentrations of PCBs detected from the Scioto River are less than the unrestricted limit. While the concentrations of PCBs detected in the bluegill caught on site in Little Beaver creek was above the one-per-week national limit and below the one-per-month national limit. The Ohio Sport Fish Consumption Advisory, available from Ohio EPA, advises the public on consumption limits for sport fish caught from all bodies of water in Ohio and should be consulted before eating any fish 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. More than 400 monitoring wells are used to track the flow of groundwater and to identify and measure groundwater contaminants. Groundwater programs also include on-site surface water monitoring and water supply monitoring.

This section provides an overview of groundwater monitoring at PORTS and the results of the groundwater monitoring program for 2014. In addition, the section 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 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 FBP NPDES outfalls. Groundwater monitoring has been conducted in response to state and/or federal regulations, regulatory documents prepared by DOE, agreements between DOE and Ohio EPA or U.S. EPA and DOE Orders. The *Integrated Groundwater Monitoring Plan* was developed to address all groundwater monitoring requirements for PORTS and provides details on monitoring activities and issues. An annual groundwater report is submitted to Ohio EPA in accordance with the *Integrated Groundwater Monitoring Plan*.

Artwork by Grace Lightle

Groundwater Use and Geology

Two water-bearing zones are present beneath the industrialized portion of PORTS: Gallia and Berea formations. The Gallia is the uppermost water-bearing zone and contains most of the groundwater contamination at PORTS. The Berea is deeper than the Gallia and is usually separated from the Gallia by the Sunbury shale, which acts as a barrier to impede groundwater flow between the two formations.

Groundwater directly beneath PORTS is not used as a domestic, municipal, or industrial water supply and contaminants in the groundwater 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 north or west of the site in the Scioto River Valley buried aquifer. DOE has filed a deed notification at the Pike County Auditor's Office that restricts the use of groundwater beneath the PORTS site.

Groundwater Monitoring Activities

Samples of water are collected from groundwater monitoring wells and analyzed to obtain information about contaminants and naturally occurring compounds in the groundwater. The groundwater elevation can be combined with information about subsurface soil to estimate the rate and direction of flow in the groundwater. This can be used to predict the movement of the contaminants in the water and to develop ways to remediate groundwater contamination.

Groundwater Monitoring Areas

The *Integrated Groundwater Monitoring Plan* requires groundwater monitoring of areas within the quadrants of the site designated by the RCRA Corrective Action Program (DOE 2013b, DOE 2014c). This plan contains requirements for 1) surface water monitoring in creeks and drainage ditches at PORTS that receive groundwater discharge; and 2) water supply monitoring (DOE 2013b, DOE 2014b).

In general, samples are collected from wells (or surface water locations) in each monitored area and are analyzed for metals, VOCs and/or radionuclides. Constituents detected in the groundwater are then compared to standards called preliminary remediation goals to assess the potential for each contaminant 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 facilities, Quadrant I Groundwater Investigative Area, Quadrant II Groundwater Investigative Area, X-701B Former Holding Pond and X-740 Former Waste Oil Handling Facility.

X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility/PK Landfill

The X-749 Contaminated Materials Disposal Facility covers 11.5 acres and was built in an area of highest elevation within the southern half of PORTS. The landfill was active from 1955 to 1990, during which time buried wastes were generally contained in metal drums or other containers compatible with waste. The landfill contains waste contaminated with industrial solvents, waste oils from plant compressors and pumps, sludges classified as hazardous and low-level radioactive scrap materials. The initial closure of the landfill and remedial actions included: 1) the installation of a multilayer cap; 2) the installation of a barrier wall along the north side and northwest corner of the landfill; 3) the installation of subsurface groundwater drains with sumps; 4) the treatment of water discharged at the X-622 Groundwater Treatment Facility; 5) planting of hybrid poplar trees for phytoremediation; 6) the installation of nine extraction wells and 7) the sampling of 84 wells and one sump/extraction well.

The X-120 Former Training Facility (originally called the Goodyear Training Facility), constructed in the 1950s,

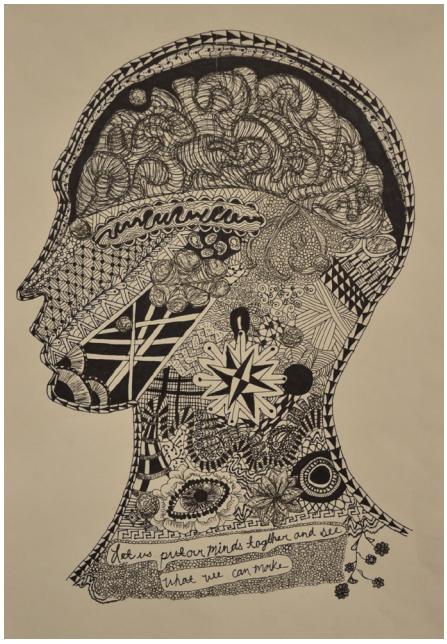
included a machine shop, metal shop, paint shop and several warehouses used during the construction of PORTS. Groundwater in the vicinity of this facility is contaminated with VOCs, primarily TCE. Remediation involved installing a groundwater extraction well in 2010 to reduce TCE concentrations.

The PK Landfill, located west of Big Run Creek in Quadrant I, operated from 1952 to 1968. The landfill 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 the soil was graded over and the area was seeded with native grasses. During site investigations, intermittent seeps were observed emanating from the PK Landfill into Big Run Creek. In 1994, a portion of Big Run Creek was relocated approximately 50 feet to the east. A groundwater collection system was installed in the old creek channel to capture the seeps emanating from the landfill. A cap was later installed in 1998. In 2014, nine wells and two sumps were sampled to monitor the PK Landfill area.

Groundwater monitoring shows concentrations of TCE are stable or decreasing with the X-749/X-120 groundwater plume. The area within the plume where TCE concentrations are less than 5 µg/L became smaller in 2014. Concentrations of TCE remained less than 5 µg/L in 2014 in the other three wells that define the area. These results and other monitoring data indicate that the extraction wells in the groundwater collection system at the southwest side of the X-749 Landfill are functioning as intended to prevent migration of TCE from the landfill.

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

The Quadrant I Groundwater Investigative (5-Unit) Area consists of a groundwater plume resulting from a number of potential sources of groundwater contamination. Potential sources of contamination include Oil Biodegradation Plots, Former Steam Plant Complex, Former Coal Pile Yard, Coal Pile Runoff Treatment Facility, Technical Services Building, the Former Pilot Investigation Building and the Former Mechanical Testing Facility. Groundwater extraction wells were installed between 1991 and 2002, while multilayer landfill caps were installed in 2000 to minimize water infiltration and control the spread of contamination. The extracted groundwater is treated and discharged through a FBP NPDES Outfall. Twenty-seven wells were sampled in 2014 as part of the monitoring program for the Quadrant I Groundwater Investigative (5-Unit) Area.



Artwork by Layne Moorman

The X-749A Classified Materials Disposal Facility (X-749A-Landfill) operated from 1953 through 1988 for the disposal of wastes classified in the Atomic Energy Act. Potential contaminants include PCBs, asbestos, radionuclides and industrial waste. Closure of the landfill in 1994 included the construction of a multilayer cap and the installation of a drainage system to collect surface water runoff. Ten wells associated with the landfill were sampled in 2014.

A contaminated groundwater plume consisting primarily of TCE is associated with the Quadrant I Groundwater Investigative area. In general, no significant changes in TCE concentrations were identified in wells that monitor the area in 2014, however TCE has been detected above and below 5 µg/L in well X749A-18G. The last detection

greater than 5 µg/L occurred in 2011. In addition, the statistical control limits for iron was exceeded in well X749A-17G in the second and fourth quarter samples collected for the well. Based on additional sampling, DOE determined that the X-749A Landfill had not impacted groundwater quality.

Quadrant II Groundwater Investigative (7-Unit) Area

The Quadrant II Groundwater Investigative (7-Unit) Area consists of an area of groundwater contamination with several potential sources. The X-701C Neutralization Pit was monitored prior to the implementation of the *Integrated Groundwater Monitoring Plan*. The Pit received process effluents and basement sump wastewater such as acid, alkali solutions and rinse water contaminated with TCE and other VOC's from metal-cleaning operations. The Pit was removed in 2001. In 2010, Ohio EPA approved an IRM to remediate contaminant sources within the southeastern groundwater plume, which was completed in 2013.

Artwork by Kennedi Meredith

A contaminated groundwater plume that consists only of TCE is associated with the Quadrant II Groundwater Investigative Area. In 2014, the amount of TCE detected in the Quadrant II Groundwater Investigative Area plume was either less than or similar to the amount of TCE concentrations detected in previous years. Wells X700-03G, X701-26G, and X701-27G at the eastern or southeastern boundary were sampled semiannually and TCE was detected in two of the three sampling well locations. The results came back similar to the amount detected in 2013. In all, 18 wells were sampled in 2014 as part of the routine monitoring program for this area.

X-701B Former Holding Pond

The X-701B Former Holding Pond was used from the beginning of plant operations in 1954 until 1988. The pond was designed for neutralization and settlement of acid waste from several sources. TCE and other VOCs were also discharged to the pond. The X-744Y Waste Storage Yard, approximately 15 acres, is south of the X-701B Former Holding Pond and surrounds the X-744G Bulk Storage Building and RCRA hazardous waste was managed in this area. A contaminated groundwater plume extends from X-701B Holding Pond towards Little Beaver Creek.

Three groundwater extraction wells were installed in 1993 and a sump was installed in 1995 as part of the RCRA closure of the unit. These wells and sump were designed to intercept contaminated groundwater emanating from the holding pond area before it could join the existing groundwater contamination plume. The extraction wells and sump were removed between 2009 and 2011 and replaced by two groundwater interceptor trenches, or French drains, in order to intercept TCE-contaminated groundwater. These interceptor trenches are called the X-237 Groundwater Collection System and control TCE migration into Little Beaver Creek.

Groundwater remediation in the X-701B Former Holding Pond Area was initiated in 2006. At this time, oxidant was injected into the subsurface in the western portion of the area to remediate VOCs in soil and groundwater. To further address contaminants remaining in soil and groundwater, contaminated soil was removed and mixed with oxidant with additional oxidant mixed into soil remaining at the bottom of the excavation. In 2014, sixty-three wells that monitor the X-701B Former Holding Pond area were sampled as part of the *Integrated Groundwater Monitoring Plan* (DOE 2014c).

Concentrations of TCE detected in wells within the X-701B plume in 2014 were similar to previous years. However, concentrations of TCE continued to increase in wells that monitor the western portion of the plume. The northern perimeter of the plume expanded in 2014 based on the detection of TCE at 8.2 µg/L in well X701-42G.

TCE was also detected at elevated concentrations of 2200 µg/L in wells that monitor the northeast corner of the monitoring area east of the X-237 Groundwater Collection System and west of Little Beaver Creek. Due to this detection, additional activities were immediately initiated and the X-237 north and south pumping wells were cleaned in April 2014. The concentration of TCE detected decreased to 1400 µg/L in July 2014.

In the third quarter, TCE was also detected at 170 µg/L in the southwestern portion of the monitoring area. The TCE concentrations in this area of the plume have rebounded since the completion of the IRM in 2011.

Artwork by Lauren Carter

Samples from 48 wells that monitor the X-701B Holding Pond were analyzed for radionuclides. Technetium-99 and/or uranium were detected above Ohio EPA drinking water standards (900pCi/L for technetium-99 based on a 4 mrem/year dose from beta emitters and 30 µg/L for uranium) in ten wells near the X-701B Former Holding Pond. Concentrations of radionuclides present in groundwater can be affected by the oxidant used in the X-701B IRM and oxidant injections used from 2006 through 2008. The oxidant affects the reduction potential and pH of the soil and groundwater. This temporarily causes metals in soil to be mobilized into the groundwater. It is expected that the metals will move downgradient with the groundwater flow and be re-adsorbed into the soil matrix as the geochemistry of the soil and groundwater returns to ambient conditions.

Samples from three of the five wells that monitor the area near the X-744 G Bulk Storage Building and Storage Yard show detected levels of cadmium and nickel above preliminary remediation goals. Nickel was also detected above the preliminary remediation goals in samples from well X-701-127G. This area is likely affected by the oxidant used in the X-701B IRM and the oxidant injections conducted in 2006 through 2008.

Additional Ground Monitoring

X-633 Former Recirculating Cooling Water Complex

The X-633 Former Recirculating Cooling Water Complex, located in Quadrant II, consisted of a recirculating water pump house and four cooling towers with associated basins and was identified as an area of concern for potential metal contamination in 1996. D&D of the facility was completed in 2010. Two wells are sampled semiannually for chromium, which was detected in both of the X-633 monitoring wells in 2014. Samples at one well showed concentrations above the preliminary remediation goal of 100 µg/L and samples from the other well contain chromium but at concentrations well below the preliminary remediation goal. These results are typical for these wells.

X-616 Former Chromium Sludge Surface Impoundments

Artwork by Layne Moorman

The X-616 Former Chromium Sludge Surface Impoundments, located in Quadrant III, 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. The sludge was removed from the impoundments and remediated as an interim action in 1990 and 1991. Sixteen wells are sampled as part of the monitoring program for this area. In 2014, chromium was detected above the preliminary remediation goals of 100 µg/L in one well on northeastern boundary of the area, which is typical for this well. Nickel was also detected above the preliminary remediation goal (100 µg/L) in two wells. TCE also was detected above the preliminary remediation goals of 5 µg/L in three wells, which is typical for the wells monitored.

X-740 Former Waste Oil Handling Facility

The X-740 Former Waste Oil Handling Facility, demolished in 2006, was located on the western half of PORTS in Quadrant III. The facility was operated from 1983 to 1991 and was used as an inventory and staging facility for waste oil and waste solvents that were generated from various plant operational and maintenance activities. After several unsuccessful attempts at remediation to reduce concentrations of VOCs in groundwater in this area, additional alternatives for groundwater remediation were evaluated. In 2009, a pilot study of enhanced anaerobic bioremediation (EAB) began in 2010. Routine monitoring of the X-740 area was returned to the *Integrated Groundwater Monitoring Plan* beginning with the second quarter of 2014. This includes continued monitoring of the EAB pilot study. Nineteen wells that monitor the X-740 Former Waste Oil Handling Facility were sampled during 2014. TCE concentrations are decreasing in Gallia wells that monitor the EAB pilot study. Additionally, TCE has decreased in well X740-03G, historically the well with the highest concentrations of TCE in the area, from 1000 µg/L to an average of 20 µg/L in 2014.

X-611A Former Lime Sludge Lagoons

The X-611A Former Sludge Lime Lagoons in Quadrant IV were used for the disposal of lime sludge waste from the water treatment plant site from 1954 to 1960. The lagoons cover 18 acres and are in a low-lying area which includes Little Beaver Creek. As part of the RCRA Corrective Action Program, a prairie habitat and a soil berm were constructed on the lagoon site to facilitate shallow accumulation of water. Six wells are sampled in this area for beryllium and chromium. In 2014, chromium was detected in three of the six wells at concentrations between 0.53 and 6.4 µg/L, which are below the preliminary remediation goal. Beryllium was also detected in two of the six wells at concentrations of 2.6 µg/L or less, which are also below the preliminary remediation goals.

Artwork by Mason Goode

X-735 & X-734 Landfills

Several distinct waste management units are contained within the X-735 Landfills area in Quadrant IV. The landfill began operation in 1981 and initially, 17.9 acres was approved by Ohio EPA and Pike County Department of Health for landfill disposal of conventional solid wastes. Twenty-two wells were sampled in 2014 and concentrations of three metals (cobalt, mercury and nickel) and five indicator parameters (alkalinity, chloride, sodium, sulfate and total dissolved solids) detected in downgradient Gallia wells are compared to concentration limits based on drinking water standards or site background concentrations. None of these concentration limits were exceeded in 2014. Concentrations of alkalinity, ammonia, calcium, chloride, iron, nitrate/nitrite, potassium, sodium and sulfate in downgradient Berea wells were also evaluated to monitor potential impacts to groundwater. No control limits were exceeded for the Berea wells. Samples were also analyzed for radionuclides and if detected, they were below Ohio EPA drinking water standards.

The X-734 Landfills in Quadrant IV consisted of three landfill units that were used until 1985. Detailed records of disposed materials were not kept but wastes known to be disposed included trash and garbage, construction spoils, wood and other clearing wastes and empty drums. These landfills were closed in accordance with regulations in effect at the time and no groundwater monitoring of the area was required. The X-734 Landfills were capped in 1999-2000 as part of the remedial actions for Quadrant IV. Fifteen wells are sampled semiannually as part of the monitoring program for this area. No VOCs or the five metals tested for (beryllium, cadmium, chromium, manganese and nickel) were detected at concentrations above preliminary remediation goals.

X-533 Former Switchyard Complex

The X-533 Former Switchyard Complex, located in Quadrant IV, consisted of a switchyard containing electrical transformers as well as circuit breakers, associated support buildings and a transformer cleaning pad. The X-533

Former Switchyard Complex was identified as an area of concern for potential metals contamination in 1996. The area was added to the PORTS groundwater monitoring program due to concern of groundwater contamination from potential metals. In 2014, three wells were sampled and analyzed in the second and fourth quarters for cadmium and nickel. Each of the well samples contained these metals at concentrations above the preliminary remediation goals of 6.5 µg/L for cadmium and 100 µg/L for nickel. Concentrations of cadmium ranged from 8.7 to 54 µg/L and concentrations of nickel ranged from 120 to 760 µg/L.

X-344C Former Hydrogen Fluoride Storage Building

The X-344C Former Hydrogen Fluoride Storage Building and associated hydrogen fluoride storage tanks, located in Quadrant IV, were demolished and removed in 2006. One well is sampled annually for VOCs under the monitoring program for this area. In 2014, four VOCs were detected in the samples collected at concentrations less than 2 µg/L. These detections were well below the preliminary remediation goals.

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 quarterly from fourteen locations. These locations include Little Beaver Creek (5 locations), Big Run Creek (3 locations), Southwestern Drainage Ditch (2 locations), North Holding Pond and the Western Drainage Ditch (3 locations). Although some VOCs were detected in some of these areas, all concentrations were well below water quality criterion or drinking water standards.

Water Supply Monitoring

Routine monitoring of private residential drinking water sources is completed at PORTS as required by the State of Ohio and the DOE and the Integrated Groundwater Monitoring Plan (DOE 2013b, DOE 2014c). The purpose of this program is to determine whether PORTS has had any impact on the quality of the private residential drinking water sources. Four residential drinking water sources participated in the program in 2014. These wells and the PORTS water supply are sampled semiannually.

In first and third quarters of 2014, TCE was detected at estimated concentrations of 0.18 µg/L and 0.64 µg/L, respectively, in samples collected from RES-017, which is south 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 in the water supply samples at concentrations up to 1µg/L. These detections are less than the drinking water standard for TCE (5 µg/L).

Chlorination byproducts called trihalomethanes, which are common residuals in treated drinking water, were detected in samples collected from residential sampling location RES-015 and RES-018. The total concentrations of these trihalomethanes was less than the Ohio EPA drinking water standard (80 µg/L for total trihalomethanes).

Monitoring results for surface water in 2014

Analytes Detected	Potential Contaminant Source	2014 Monitoring Results -Locations Detected	2014 Monitoring Results -Levels Detected	EPA non-drinking water quality criteria and drinking water standards
Trihalomethanes	VOCs that are byproducts of water chlorination	Most surface water sampling locations	Below the Ohio EPA non-drinking water quality criteria for the protection of human health in the Ohio River drainage basin	Bromodichloromethane —460 µg/L Bromoform—3600 µg/L Chloroform—4700 µg/L Dibromochloromethane —340 µg/L
TCE	Western portion of the X-749/X-120 groundwater plume	Southwestern Drainage Ditch	Below the Ohio EPA non-drinking water quality criteria for TCE for the protection of human health in the Ohio River drainage basin	810 µg/L
TCE	Groundwater from the plume associated with the X-701B Holding Pond	East Drainage Ditch and Little Beaver Creek	Below the Ohio EPA non-drinking water quality criteria for TCE for the protection of human health in the Ohio River drainage basin	810 µg/L
Transuranics (americium-241, neptunium-237, plutonium-238, plutoni-um-239/240)	May be due to fall-out from nuclear weapons testing	Little Beaver Creek	Less than the preliminary remediation goal	140 pCi/L (DOE 2011a) *plutonium 239/240
Technetium-99	Groundwater from the plume associated with the X-701B Holding Pond	East & West Drainage Ditches, Little Beaver Creek, and Big Run Creek	Less than the derived concentration standard.	44,000 pCi/L (DOE 2011a)
Uranium	May be due to naturally occurring uranium	Surface water samples	Below the Ohio EPA drinking water quality criteria.	30 µg/L

Each sample was analyzed for transuranics, technetium-99, uranium and uranium isotopes. No transuranics or technetium-99 were detected in any of the water supply samples collected in 2014. 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 non-drinking water quality criterion in samples collected from Little Beaver Creek. Trihalomethanes (bromodichloromethane, bromoform, chloroform, 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.

TCE and other VOCs were also detected that monitor the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility. TCE was detected at 6.2 µg/L in the first quarter but then decreased to below 5 µg/L in the second, third and fourth quarters. The other detections of TCE were well below the Ohio EPA drinking water standards. No radionuclides were detected from these wells sampled for radionuclides.

Artwork by Mikaila Fremder

Groundwater Treatment Facilities

In 2014, a combined total of approximately 30.4 million gallons were treated at the X-622, X-623, X-624 and X-627 Groundwater Treatment Facilities. Approximately 31 gallons of TCE were removed from the water. All processed water is discharged through permitted and monitored outfalls before exiting PORTS. No NPDES permit limitations were exceeded that were associated with these groundwater treatment facilities in 2014.

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 2014. The following are some of the major events of 2014:

Artwork by Mikaila Fremder

- Proposed plans for the process buildings and waste disposition were submitted to Ohio EPA in July and June 2014, respectively. The proposed plans recommended controlled removal of the process buildings and other facilities and a combination of on-site and off-site waste disposal (DOE 2014d, DOE 2014e). Ohio EPA concurred with the proposed plan in October 2014.

- DOE submitted the *Deferred Units RCRA Facility Investigation/Corrective Measures Study Work Plan for Solid Waste Management Units* to Ohio EPA in April 2014 (DOE 2014a). This work plan lays out the investigation of areas known as "deferred units" or areas that were in or adjacent to the gaseous diffusion production and operational areas such that remedial activities would have interrupted operations.

- SODI received approximately 1,270 tons of materials from PORTS, primarily recyclable metals.

- In 2014, DOE and FBP received four Notices of Violation, which were resolved by DOE and FBP.

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 2014 is 0.91 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 (0.017 mrem) is also significantly less than the 10 mrem/year standard set by the U.S. EPA. In addition, generally, concentrations of contaminants detected within the groundwater plumes at PORTS were stable or decreasing in 2014.

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Definitions

Alpha activity – the rate of emission of alpha particles from a given material.

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

Aquifer – a permeable body of rock below the ground surface that is capable of yielding quantities of groundwater to wells and springs. A subsurface zone that yields economically important amounts of water to wells.

Beta activity – the rate of emission of beta particles from a given source.

Biota – animal and plant life characterizing a given region.

Compliance – fulfillment of applicable regulations or requirements of a plan or schedule ordered or approved by a government authority.

Concentration – the amount of a substance contained in a unit volume or mass of a sample.

Contaminant – any substance that enters a system (the environment, food, the human body, etc.) where it is not normally found. Contaminants include substances that spoil food, pollute the environment, or cause other adverse effects.

Curie (Ci) – a unit of radioactivity, defined as that quantity of any radioactive nuclide which has 3.7×10^{10} (37 billion) disintegrations per second. Several fractions and multiples of the curie are commonly used.

Picocurie (pCi) – 10^{-12} Ci, one-trillionth of a curie; 0.037 disintegration per second.

Decontamination and decommissioning – removing equipment, demolishing buildings, disposing of wastes and investigating potential contamination in areas of PORTS that are no longer part of current operations.

Derived concentration standard – the concentration of a radionuclide in air or water that under conditions of continuous exposure for one year by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation) would result in either a dose of 0.1 rem or a dose of 5 rem to any tissue, including skin and the lens of the eye. The guidelines for radionuclides in air and water are provided in DOE Order 458.1, *Radiation Protection of the Public and the Environment.*

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."

Downgradient – the direction that groundwater flows; similar to downstream for surface water.

Duplicate sample – a sample collected from the same location at the same time and using the same sampling device (if possible) as the regular sample.

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

Environmental Restoration – a DOE program that directs the assessment and cleanup of its sites (remediation) and facilities (decontamination and decommissioning) contaminated as a result of nuclear-related activities.

Exposure (radiation) – the incidence of radiation on living or inanimate materials by accident or intent. Background exposure is the exposure to natural background ionizing radiation. Occupational exposure is exposure to ionizing radiation that takes place at a person's workplace. Population exposure is the exposure to the total number of persons who inhabit an area.

External radiation – the exposure to ionizing radiation when the radiation source is located outside the body.

Gaseous diffusion – technology used to produce enriched uranium by forcing gases through a porous barrier (United States Nuclear Regulatory Commission, 2017).

Groundwater – any water found below the land surface.

Interim remedial measure (IRM) – cleanup activities initiated after it has been determined that contamination or waste disposal practices pose an immediate threat to human health and/or the environment. These measures are implemented until a more permanent solution can be made.

Ionizing radiation – radiation that has enough energy to remove electrons from substances that it passes through, forming ions (United States Nuclear Regulatory Commission, 2015).

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

Migration – the transfer or movement of a material through air, soil, or groundwater.

Millirem (mrem) – the dose that is one-thousandth of a rem.

Monitoring – process whereby the quantity and quality of factors that can affect the environment or human health are measure periodically to regulate and control potential impacts.

Outfall – the point of conveyance (e.g., drain or pipe) of wastewater or other effluents into a ditch, pond, or river.

Person-rem – a unit of measure for the collective dose to a population group. For example, a dose of 1 rem to 10 individuals results in a collective dose of 10 person-rem.

Polychlorinated biphenyls (PCBs) – man-made chemicals that range from oily liquids to waxy solids. PCBs were used in hundreds of industrials and commercial applications due to their chemical properties until production in the United States ceased in 1977. PCBs have been demonstrated to cause a variety of adverse health effects in animals and possibly cause cancer and other adverse effects in humans.

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.

Quality assurance – any action in environmental monitoring to demonstrate the reliability of monitoring and measurement data.

Rad – the unit of absorbed dose deposited in a volume of material.

Radioactivity – the spontaneous emission of radiation, generally alpha or beta particles or gamma rays, from the nucleus of an unstable isotope.

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.

Release – any discharge to the environment. "Environment" is broadly defined as any water, land, or ambient air.

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.

Reportable quantity – a release to the environment that exceeds reportable quantities as defined by the Comprehensive Environmental Response, Compensation and Liability Act.

Resource Conservation and Recovery Act (RCRA) – federal legislation that regulates the transport, treatment and disposal of solid and hazardous wastes.

Riparian – related to the banks of a river or wetlands adjacent to rivers and streams.

Settleable solids – materials settling out of suspension in a liquid within a defined period of time.

Surface water – all water on the surface of the earth, as distinguished from groundwater.

Suspended solids – particles suspended in water, such as silt or clay that can be trapped by a filter.

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.

Trichloroethene (TCE) – a colorless liquid used in many industrial applications as a cleaner and/or solvent. One of many chemicals that is classified as a volatile organic compound. High levels of TCE may cause health effects such as liver and lung damage and abnormal heartbeat; moderate levels may cause dizziness or headache. The International Agency for Research on Cancer considers TCE a probable human carcinogen.

Volatile Organic Compounds (VOCs) – organic (carbon-containing) compounds that evaporate readily at room temperature. These compounds are present in solvents, degreasers, paints, thinners and fuels. Due to a number of factors including widespread industrial use, they are commonly found as contaminants in soil and groundwater. VOCs found at PORTS include TCE, vinyl chloride, benzene and dichloroethenes.

Acronyms and Abbreviations

BWCS	B&W Conversion Services, LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curie
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)
$\mu g/m^3$	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
SODI	Southern Ohio Diversification Initiative
TCE	trichloroethene
TLD	thermoluminescent dosimeters
TSCA	Toxic Substances Control Act
USEC	United States Enrichment Corporation
EPA	U.S. Environmental Protection Agency
VOCs	Volatile Organic Compounds

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