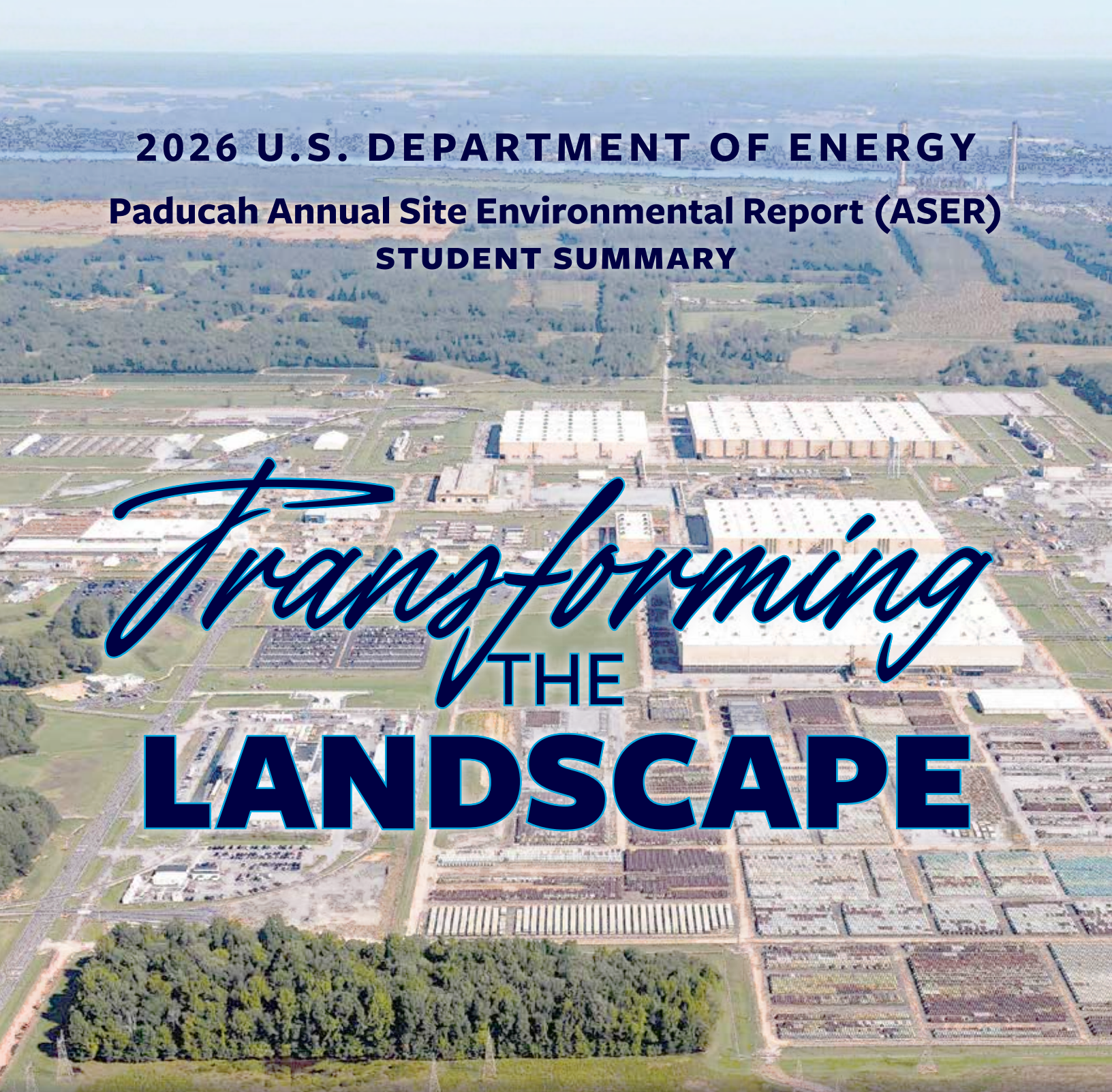
2026 U.S. DEPARTMENT OF ENERGY

Paducah Annual Site Environmental Report (ASER)

STUDENT SUMMARY



Transforming THE LANDSCAPE

MURRAY STATE UNIVERSITY

McCRACKEN COUNTY SCHOOLS

PORTSMOUTH PADUCAH PROJECT OFFICE

Message from the U.S. Department of Energy

Portsmouth Paducah Project Office



April Ladd, PPPO Acting Deputy Manager

The U.S. Department of Energy (DOE) conducts environmental monitoring at the former Paducah Gaseous Diffusion Plant Site (PGDP) on an ongoing basis to ensure continued safety and compliance. Each calendar year, the information collected is presented in a comprehensive publication entitled the Annual Site Environmental Report (ASER).

Each academic year, high school students from the area are invited to participate in the Student ASER summary project. Students review the most recent ASER, producing a group summary document that reflects their experience, and participate in educational outreach efforts to learn about the DOE Paducah Site and help develop this summary report.

During the 2025-26 academic year, students from McCracken County High School's Capstone Engineering and AP Environmental Science classes actively participated in the program. Their involvement extended beyond the classroom to include valuable field activities. Additionally, these students developed and presented summary academic posters at a public, student-led exposition effectively highlighting their work.

Environmental work at DOE's facilities is technically intricate and challenging. Due to the size of the DOE Paducah Site industrial complex, its infrastructure, and impacts on the surface and subsurface environment, management of cleanup efforts by DOE are multifaceted. The environmental monitoring program ensures DOE is protective of our workforce, the environment, and the general public. During calendar year 2024, DOE Paducah Site environmental data collected from soil, surface water, sediment, air and groundwater demonstrated compliance with both state and U.S. Environmental Protection Agency regulatory and human health standards.

Both the ASER and Student ASER serve important functions as they allow DOE to clearly and concisely explain our environmental monitoring programs to our stakeholders. The DOE Paducah Site sincerely appreciates the work of the students and staff at McCracken County High School and in the production of this year's Student ASER. On behalf of the entire DOE complex, we congratulate each of you on your effort, enthusiasm and willingness to support this project. We hope you enjoy reading this informative report and that you continue to be interested in the Student ASER.

Sincerely,
April Ladd, Acting PPPO Deputy Manager

Acknowledgment: This material is based upon work supported by the Department of Energy (National Nuclear Security Administration) under Award Number(s) DE-EM0005318.

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Message from Murray State University





"The U.S. Department of Energy and Murray State University collaboration results in an opportunity to involve secondary and postsecondary students in analyzing the history and the work that has and will occur in our western Kentucky region. The advances to come will create synergies among business partners, governmental agencies and Murray State University. We are grateful to be a part of the partnership with the U.S. Department of Energy and all the peoplewho make the work valuable for our communities." — DR. K. RENEE FISTER, ASSOCIATE PROVOST

ABOUT DR. K. RENEE FISTER

Dr. K. Renee Fister received her Bachelor of Arts degree in mathematics from Transylvania University and her Master of Science and Ph.D. degrees in mathematics from the University of Tennessee at Knoxville. She is a tenured Professor of Mathematics and currently serves as the Associate Provost at Murray State University.

Dr. Fister has published 36 research papers — many of which involved students — given over 100 research presentations, written 30 successful research grants and served as the principal investigator of 21 grants. Her research focuses on mathematics and biology within optimal control theory. She has mentored 30 students in interdisciplinary research areas for undergraduate and master degree projects. She had the fortunate opportunity to serve as an Endowed Professor for the Jesse D. Jones College of Science, Engineering and Technology, until moving into administrative roles.

She assisted the President as a senior advisor for strategic initiatives, led the Office of Institutional Effectiveness with compliance and data initiatives and served in enrollment management with development of enrollment models. She has held leadership positions as the Murray State University Board of Regents Faculty Regent, Treasurer for the Society of Mathematical Biology and Clerk for the Association for Women in Mathematics.

As the Associate Provost, the role encompasses serving as the graduate coordinator for the University; developing strategies for curricular needs; supporting dual credit enrollments; supervising Institutional Research, Sponsored Programs, McNair Scholars and Department of Energy grant; assisting with the Academic Affairs budget; predicting enrollment and working collaboratively with faculty, staff and administrative leadership. Dr. Fister values her family as they have given her support in every aspect of life.

Special Thanks to our Contributors

April Ladd
PPPO Acting Deputy Manager

Samuel Boss
FRNP Industrial Hygienist

Zachary Boyarski
ETAS Public Affairs Specialist

Tom Busclas
FRNP Project FLM

Steve Christmas
FRNP Community Outreach Coordinator

Valerie Crabtree
FRNP Engineering Program Services Manager

Barb DeNeve
FRNP Project Engineer

Clint Dietsch
FRNP Engineer

Mitchell Guthrie
DOE General Engineer

Adam Lyons
FRNP Emergency Management Specialist

Shay Mitchell
FRNP Pump and Treat Operations Manager

Dylan Nichols
FRNP Public Affairs Manager

Robby Purcell
FRNP Emergency Management Specialist

Karen Sizemore
FRNP Chief Engineer

Colby Smith
FRNP IH/IS Technical Support Manager

Darren Tinsley
FRNP HSS&Q Safety and Health Manager

Chris Wagner
DOE Facility Representative

ABOUT ALEX SHERWOOD



Alex Sherwood is the Project Director at Murray State University, overseeing a $1.5 million Department of Energy (DOE) grant, a position she has held since 2024. In her role, she facilitates a collaborative regional effort focused on public outreach and the effective repurposing of the Paducah Gaseous Diffusion Site. By coordinating with governmental agencies, workforce organizations, nonprofits, and educational partners, Alex helps develop actionable strategies that promote STEM activities in local high schools and support faculty-student research initiatives.

As a long-standing member of the Murray State community, Alex earned both a Bachelor of Integrated Studies and a Master of Science in Organizational Communication from the university. She brings over 32 years of professional experience in public relations, marketing, recruitment, and community liaison roles. Additionally, she has spent five years as an adjunct professor in Murray State's Honors College and in organizational communication and leadership programs. Known for her ability to align diverse stakeholders and listen to the needs of the community, Alex is passionate about using her expertise to create positive and lasting change in the region.

Leadership Spotlights: DOE and Murray State University

RISING ENGINEER AT PADUCAH SITE LEADS NEXT-GENERATION WORKFORCE

Contributor: Zachary Boyarski

The Paducah Site is cultivating the next generation of its leaders by linking young professionals with local education initiatives.

Mitchell Guthrie, a third-year engineer at the Paducah Site, is currently in his "rookie" campaign as the lead organizer for the U.S. Department of Energy (DOE) West Kentucky Regional Science Bowl and the Student Annual Site Environmental Report (ASER) programs. Guthrie, 25, has found himself at the forefront of guiding these two programs that work directly with middle and high school students. The initiatives aim to generate the next talent pool for potential science, technology, engineering and math (STEM) careers at the Paducah Site.

Guthrie began his career at the Portsmouth Paducah Project Office (PPPO) under the DOE Pathways Recent Graduates Program. He was then hired for his current position and quickly picked up new roles and responsibilities along the way.

"Mitchell embraced every task he was given, quickly establishing himself as an emerging leader," PPPO Interim Acting Deputy Manager and Paducah Site Lead April Ladd said. "As a young professional, he was an obvious choice to take charge of the Science Bowl and Student ASER programs, helping bridge the gap between DOE and local students."

Guthrie, a local resident who graduated from McCracken County High School and the University of Kentucky College of Engineering – Paducah Campus, brings fresh, new energy and perspective to the programs. He understands connecting with youth is instrumental in bringing the pipeline of talent to the Paducah Site.



DOE Office of Environmental Management General Engineer Mitchell Guthrie, front center, gathers with McCracken County High School students, teachers and administrators to discuss the Student Annual Site Environmental Report (ASER).



Mitchell Guthrie enters the score for a team participating in the DOE West Kentucky Regional Science Bowl.

"When I was growing up, the site was always a mystery," Guthrie said. "I was always curious about what happened behind the gates. These programs, particularly the Student ASER, break down those barriers, allowing students to understand DOE's cleanup program and identify future career opportunities."

Touted as the region's most prominent science competition for high school students, the Science Bowl recently concluded its 18th annual event. Meanwhile, this year's Student ASER is close to completion. The educational outreach program educates local high school students about cleanup activities while they learn about potential career opportunities.

In his first year as lead organizer, Guthrie hopes to see continued steady growth in both programs under his supervision.

"When the Science Bowl first began, we had difficulty attracting teams in the region. This year, we were at capacity but still receiving interest from other local schools. This opens an opportunity to potentially expand the event as soon as next year," he said. "Meanwhile, last year's Student ASER group had a handful of participants as this year's participation ballooned to nearly 30 students."

Building the next generation of Paducah Site leaders is the long-term payoff for Guthrie as local students continue to familiarize themselves with cleanup activities and other operations.

"Seeing the kids show interest and ask questions is the most rewarding part of leading these programs," Guthrie said. "You can tell they want to learn more each time you speak with them. My goal is to build these programs as a springboard for local students. In 10 years, I hope to see some of these kids here at the site, in my position."

Featured Regional Partnership

MURRAY STATE UNIVERSITY PARTNERS WITH OHIO UNIVERSITY TO IMPROVE PORTSMOUTH, PADUCAH EDUCATION OUTREACH

Contributors: Zachary Boyarski and Melissa Green

Murray State University is collaborating with Ohio University (OU) to build STEM interest in local high school students and inspire them to pursue careers at the U.S. Department of Energy's (DOE) Portsmouth and Paducah sites.

Murray State University and Ohio University lead the development and publication of the Portsmouth Paducah Project Office (PPPO) Student Summary of the Annual Site Environmental Report (ASER), commonly referred to as the Student ASER.

"The Student ASER provides an opportunity to involve local students in STEM-based activities and interact with local universities," acting PPPO Manager Erik Olds said. "It is just one of several PPPO educational outreach programs to boost STEM education and prepare a pipeline of talent to fill the jobs of tomorrow."

The ASER is an environmental report that details monitoring results on and around PPPO's cleanup sites. To help students better understand the ASER content, the universities connect them with subject matter experts, field trips and months of learning about the site's history and deactivation and demolition work. At the program's end, students develop a visual and condensed, non-technical summary of the ASER that is published and presented at a public expo near their respective sites.

In Ohio, Portsmouth West High School and Pike County Career Technology Center students met biweekly throughout the school year to create the Portsmouth Student ASER with guidance from OU's Voinovich School of Leadership and Public Affairs personnel.

"The cross-institutional exchange of ideas sparked fantastic creativity for both our programs," said Stephanie Howe, OU's director of Energy Programs PORTSfuture, a program supported by the DOE Office of Environmental Management that advocates for the efficient and economical restoration of the Portsmouth Site.

Howe continued, "Our conversations with MSU resulted in a refresh of the Portsmouth Student ASER program that has been ongoing for 15 years. Learning about MSU's innovative launch strategies, their ongoing incorporation of MSU faculty and the type of content MSU includes in their final student summary document was truly enlightening."



DOE General Engineer Mitchell Guthrie (right) speaks with McCracken County High School student Torin Townsend about his research during an expo focused on the Paducah Student Summary of the Annual Site Environmental Report, or Student ASER. The curriculum for students participating in the Student ASER includes published poster presentations for the public to view and discuss.

Similarly in Kentucky, students from McCracken County High School (MCHS) visited the Paducah Site and worked with Murray State personnel to produce the Paducah Student ASER.

"This was our second year working with DOE on the Student ASER," Murray State University DOE Project Director Alex Sherwood said. "Stephanie Howe and the OU team provided a big boost to establish the Paducah Student ASER by understanding their past successes. Because of this, we added substantial information to our Student ASER playbook and MCHS students were offered new and unique opportunities for educational growth as part of their research."

The ASER is key to PPPO's effort to inform the public about environmental conditions at the Portsmouth and Paducah sites through a detailed overview of environmental activities each year.

Portsmouth Annual Site Environmental Reports can be viewed at **bit.ly/4tYHqJt**.

Paducah Annual Site Environmental Reports can be viewed at **bit.ly/490wWvJ**.

Past Student ASER reports can be viewed on the PORTSfuture website and Murray State University DOE grant website at **bit.ly/43AVvIG**.

MSU's Office of the Provost Awarded $1.5 Million DoE Grant

ECONOMIC IMPACT ON THE COMMONWEALTH

Murray State University's (MSU) Office of the Provost was recently awarded a $1.5 million grant by the Department of Energy (DOE) from May 1, 2024, to Sept. 30, 2028, to support efficient and effective work consistent with the environmental cleanup and beneficial reuse of the former Paducah Gaseous Diffusion Plant Site.

The project goal is to develop information that the DOE's Portsmouth/Paducah Project Office (PPPO), its contractors, and the public can use in decision-making for the environmental cleanup, beneficial reuse, and public outreach at the Paducah site.

"The MSU/DOE grant allows collaborative work with industry, community, K-12, and postsecondary education for connected study involving reuse of the land at the former Paducah Gaseous Diffusion Plant," said Murray State Associate Provost Dr. Renee Fister. "We are grateful to learn more from the community, build partnerships for successful training and outreach, perform research and scholarship projects involving high school and college students, and work to make a difference in workforce initiatives in this important area of our Commonwealth."

The project will focus on site repurposing, STEM activities in local high schools, and public outreach, as well as scholarship and creative activities for faculty and students.

"This grant enables MSU to continue to serve the Jackson Purchase region, particularly Paducah-McCracken County, by providing public outreach and educational programs regarding the DOE Diffusion Site," said Alex Sherwood, Project Director for the MSU/DOE grant. "We are so grateful to witness our active partnerships with local high schools for the STEM components, and it's a huge win that our specialized faculty and students are fully engaged in driving hands-on research—like our engineering department's projects on ion exchange resins and the Occupational Safety & Health department's work on heat stress monitoring—to solve real site challenges. We appreciate the DOE giving us this opportunity to keep collaborating and making a meaningful impact right here in our community."

SITE REPURPOSING & SOCIO-ECONOMIC IMPACT

Site repurposing feeds into the end-state configuration for the site, and is expected to expedite real property transfer for future repurposing of the site, resulting in reducing the PPPO-managed footprint at Paducah. The Paducah Site has been an important economic driver in western Kentucky for many decades, impacting the region's socio-economic profile. As the Paducah Site undergoes environmental remediation, decontamination, and decommissioning, it is expected that the Paducah Site will further impact the region's socio-economic profile, as well as growth opportunities. The extent to which decision-makers can minimize transitional stress and maximize the economic prospects for the area hinges greatly upon the cleanup and transfer of the Paducah Site and site assets for other economic use.

The project will also utilize the Paducah Site as a learning opportunity to promote careers in STEM disciplines to local high school students. After the hiring of the project director in the summer of 2024, the work to connect with locals will ensue. Public outreach faculty/staff members at Murray State will assist with the focus of STEM activities and interactions with local high school teachers and administrators.

PUBLIC OUTREACH FOCUS

The project's final focus will be on public outreach, including an update to "Community Visions for the former Paducah Gaseous Diffusion Plant," a report finalized in September 2011 by the Kentucky Research Consortium for Energy and Environment. The process implemented in the study provided insights into a range of perspectives and community preferences related to the future use of the former Paducah Gaseous Diffusion Plant and surrounding DOE-owned properties. This step will involve several public meetings, workshops, and training sessions.

"We are thankful to the Department of Energy for this grant and its support of this project, which enhances student learning and research opportunities while fostering stronger connections with our community and regional partners," said Murray State University President Dr. Ron K. Patterson. "This work reflects Murray State's commitment to serving our region, and we look forward to continued collaboration with stakeholders in Paducah, McCracken County, and throughout the Jackson Purchase to create lasting impact for years to come."

College Graduates and Regional Footprint

COLLEGE GRADUATES

Murray State University alumni are working and contributing in their communities around the Commonwealth of Kentucky.

41,997 RACER ALUMNI

Total number of Murray State University graduates residing in Kentucky

$1.18 BILLION

Estimated increase in earning capacity generated by Racer alumni



REGIONAL FOOTPRINT



Located in western Kentucky, Murray State University is a nationally-recognized public regional comprehensive university. Murray State University offers in-person academic programs and 100 percent online programs at its Murray campus, as well as regional campuses in Fort Campbell, Henderson, Hopkinsville, Madisonville and Paducah. A total of 52 countries, 49 states, and 115 counties in Kentucky comprise Murray State's student body.

Based on a 2017 comprehensive study led by Professor Emeritus Dr. Gil Mathis, updated for inflation, Murray State University generates more than $633 million in economic output activity through the Commonwealth.

$633 MILLION

Total economic impact Murray State University has on the Commonwealth of Kentucky annually

$265 MILLION

Total revenue generated by University employee, student and visitor spending ($726,000/day)

$23 MILLION

Annual state and local tax revenue generated by activity associated with Murray State University

Institutional Partners and Contributors



MSU/DOE Grant Website, photo by Kristopher Fister



WEB DESIGN

Charley Allen is an award-winning web designer and poet with over 20 years of experience in front-end development and digital marketing. Born and raised in Western Kentucky, she has built a career that blends creativity with purpose. With a degree in creative writing and a master's in organizational communication from Murray State University, Charley's education brings a unique perspective to her work, helping her create websites that tell meaningful stories and incorporate empathy in design.



PHOTOGRAPHY

Kristopher Fister (*left*) is a Murray State News photographer who won College Journalist of the Year at the Kentucky Press Association convention on January 24, 2025, in Lexington, Kentucky.

PUBLICATIONS AND GRAPHIC DESIGN TEAM

- **Brittney McWaters:** Design Coordinator
- **Melissa Shown:** Director of Graphic Design and Printing Services

To view the website, scan the QR code or go to **murraystate.edu/doegrant/index.html**.

Murray State Paducah Regional Campus

ABOUT KARAMI UNDERWOOD



Karami Underwood is the director of the Murray State University Paducah Regional Campus. A Murray State alumna with an M.S. from the University of Alabama, she has a background in healthcare management, marketing, and community outreach, including work with the American Cancer Society. An active regional leader, she serves on the boards of the Paducah Area Chamber of Commerce and the Paducah-McCracken County Senior Center.

Education: B.S. in Business (Murray State, 2005);
M.S. in Human Environmental Sciences (University of Alabama, 2016).



Interior Entrance Lobby of the Paducah Regional Campus



Interior Student Lounge Facility and ASER Poster Display Boards Wall

Paducah Site Public Affairs and Communications



PUBLIC AFFAIRS & MEDIA LEAD



Dylan Nichols serves as the Public Affairs Manager for Four Rivers Nuclear Partnership, LLC at the Paducah Site. A professional photojournalist who studied his craft at Western Kentucky University, Nichols has been embedded at the Paducah Site since 2011. His unique background in print media allows him to successfully leverage visual storytelling to break down the site's technically complex cleanup operations for local stakeholders and national audiences.

Nichols is deeply passionate about capturing the "human element" behind the world's largest environmental cleanup, collaborating closely with technical and field organizations to translate environmental milestones into engaging visual narratives. His exceptional camerawork earned national distinction when one of his site photographs was selected as the front cover image for the U.S. Department of Energy Office of Environmental Management's (EM) 2023 Year in Review.

PUBLIC AFFAIRS TECHNICAL SUPPORT



Zachary Boyarski is a Public Affairs Specialist for Enterprise Technical Assistance Services (ETAS), the technical support services contractor for the U.S. Department of Energy Paducah Site. Zachary began his career at ETAS nearly five years ago. Before joining the ETAS team, he spent approximately six years with the City of Paducah, KY Parks & Recreation department, serving in various roles. His prior professional background also includes working in the Public Affairs/Communications department at Charlotte Motor Speedway in Concord, NC.

Zachary is a 2015 graduate of Western Kentucky University in Bowling Green, KY, where he earned degrees in Broadcast Journalism and Sport Management. Born and raised in Paducah, KY, he graduated from Lone Oak High School in 2011. In his free time, Zachary enjoys watching sports, playing pickleball, collecting sports cards, and spending time with his wife, Elizabeth, and their dog, Beau.

Annual Site Environmental Report (ASER) Overview



The Department of Energy (DOE) requires that environmental monitoring be conducted and documented for its facilities under DOE Order 231.1B, Environment, Safety, and Health Reporting.

Several other laws, regulations, and DOE directives require compliance with environmental standards. The purpose of this Annual Site Environmental Report (ASER) is to summarize 2024 environmental management activities, including effluent monitoring and environmental surveillance, at the Paducah Site; report on environmental compliance status; and highlight significant Paducah Site program efforts. References in this report to the Paducah Site generally mean the property, programs, and facilities at or near the former Paducah Gaseous Diffusion Plant for which DOE has ultimate responsibility.

Environmental monitoring includes two major activities: effluent monitoring and environmental surveillance.

- **Effluent monitoring** is the direct measurement or the collection and analysis of samples of liquid and gaseous discharges to the environment.
- **Environmental surveillance** includes the direct measurement or the collection and analysis of samples of ambient air, surface water, groundwater, and sediment.

Effluent monitoring and environmental surveillance are performed to characterize and quantify contaminants; assess radiation exposure; demonstrate compliance with applicable standards and permit requirements; and detect and assess the effects, if any, on the local population and environment. Samples are collected throughout the year and are analyzed for radioactivity, chemical constituents, and various physical properties.

DOE's overall goals for environmental management are to protect Paducah Site personnel, the environment, and the community, and to maintain full compliance with all current applicable environmental regulations. DOE operates the Paducah Site in a manner that controls and reduces exposures of the public, workers, and the environment.

STEM Enrichment

Thanks to a $1.5 million grant from the Department of Energy (DOE) awarded to Murray State University in 2024, the university collaborated with McCracken County High School to incorporate environmental science into the school's Science, Technology, Engineering, and Mathematics (STEM) curriculum.

The partnership provides students with opportunities to apply their classroom knowledge to real-world environmental projects at the Paducah DOE Site. Some of the experiences the grant offers students include:

- Connecting with STEM subject matter experts and area DOE leaders.
- Learning about future career STEM opportunities.
- Completing a final project called the Student Annual Site Environmental Report.

Students create the Student ASER by reviewing the annual DOE Paducah Site report and simplifying complex data to make the report more accessible to the community. Additionally, the Student ASER project teaches students how to convey scientific information to a broader audience, which is evident in developing the report and also a year-end community presentation.



Dr. Melburn Dayton, assistant professor of occupational safety and health at MSU

STUDENT ASER OPPORTUNITY AND STUDENT ASER TEAM

The Student ASER team consisted of students from Ms. Amanda Atnip's environmental science class at McCracken County High School and Mr. Brian Gill's Capstone engineering class. The students worked in collaboration with Murray State University to produce this ASER summary which serves as an important resource for the regional community. A special thanks to the students for their hard work and the guidance from their teachers.

Additional academic support was provided by faculty in Murray State University's occupational safety and health department.

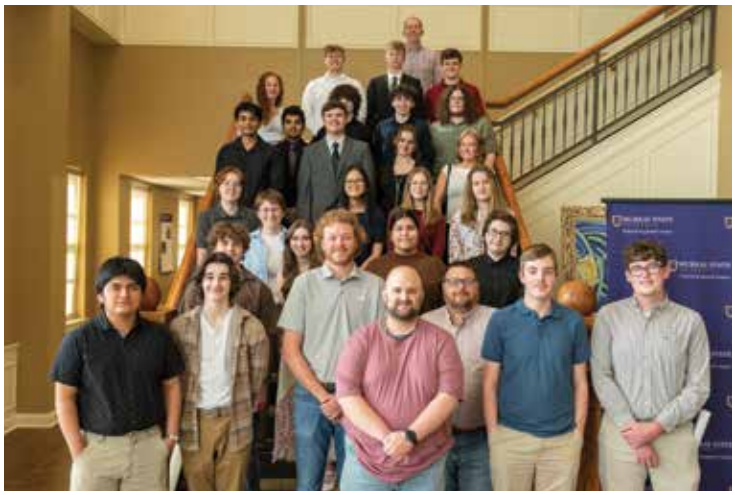




Brian Gill's engineering class and Amanda Atnip's AP environmental class learn from Dr. Melburn Dayton.

Student Poster Expo







This year's program featured the second annual Paducah Site Student ASER Expo—a student-led showcase of deeper learning. This expo gave students a platform to highlight their skills and share their insights with a broader audience through scientific poster presentations.

STUDENT POSTER EXPO SHOWCASE & PRESENTATION EVENT

As a culminating experience, the event did more than summarize the annual report; it drove student engagement, deepened academic understanding, sharpened visual and scientific communication, and shared vital knowledge with the public. These highly research-focused expos build student confidence and communication skills. Through this initiative, students successfully articulated their research on the DOE Paducah Site directly to their local community.

Working through a structured process, students produced high-quality research and fostered supportive community relationships. Ultimately, they summarized key sections of the 2024 Paducah Site Annual Report to help the public better understand the site's past and present operations. The sections below showcase the students' poster work and their summaries of the annual report, covering the following topics:

- Site History
- Deactivation & D&D (C-333 Process Building)
- Public Awareness Program
- Radiological Air Monitoring
- Non-radiological Air Monitoring
- Environmental Restoration
- Waste Management
- DOE Careers
- Radiological Surface Water
- Non-radiological Water
- Site Sustainability
- Groundwater Plumes
- Radiological Soil & Sediment
- Non-radiological Soil & Sediment

Student Poster Expo *(continued)*














Site History

Instructor: Mr. Gill (Engineering) | Students: Beard & Townsend

SITE HISTORY

The Paducah Gaseous Diffusion Plant (PGDP) was built in the early 1950s and began enriching uranium in 1952. It served as one of only three active uranium enrichment facilities in the U.S. and functioned for over 60 years.

LEASE AND RETURN

From 1998 to 2013, the enrichment facilities were leased to a private company. In 2014, ownership was returned to the DOE for environmental cleanup, including waste management and decontamination.





Modern Aerial/Wide-Angle Overview Highlighting C-333. Top: This high-resolution aerial photo provides a wide-angle view of the entire Paducah DOE site. Inset: C-333 Process Building. Bottom: The C-333 Process Building is clearly labeled (highlighted in blue in the annotated version), showing its full exterior footprint amid the complex. These aerials offer the broadest exterior perspective available.



Historic Construction-Era Exterior View (1950s). This black-and-white photo shows the massive C-333 building under construction or early completion, with its distinctive grid-like facade and industrial scale. Vintage cars fill the foreground parking area, giving a strong sense of the era and the building's enormous size.

SITE LOCATION

The site covers 3,556 acres in rural McCracken County, Kentucky. The area features a mix of grasslands and hardwood forests, with 521 acres now serving as a wildlife management area.

REGIONAL ENVIRONMENT

The plant sits on a drainage divide where water flows toward Bayou Creek and Little Bayou Creek.

HISTORICAL TIMELINE

The site has evolved from a WWII munitions plant to a massive uranium enrichment "small city" and is now transitioning to environmental cleanup.

PADUCAH C-333 PROCESS BUILDING

After DOE received the facilities from USEC in October 2014, a strategy was developed to optimize cleanup to allow transfer of land for future use. Utilizing a new integrated site-wide cleanup approach optimizes cleanup activities. This holistic updated approach focuses on end use fueled by community interest in site reuse for economic development, while targeting land which has the highest potential for reuse. The waste disposal decision is key to prioritizing and scheduling actions.

Environmental Restoration & Waste Management

Instructor: Mr. Gill (Engineering) | Students: Patel & Campbell





C-400 Complex / Southwest Plume. From left: Workers collect samples from a storage tank at the above ground treatment unit at the C-400 Cleaning Building at the Paducah site; Paducah deactivation crews inspect equipment during the start of a shift during the deactivation of the C-400 Cleaning Building. Photos by Dylan Nichols.

ENVIRONMENTAL RESTORATION

The main job is cleaning up old contamination to protect people and nature. DOE works with the EPA and Kentucky under a Federal Facility Agreement (FFA) to investigate and fix polluted areas.

REGULATORY FRAMEWORK

CERCLA (Superfund) requires sites to be investigated and remediated if they pose a significant risk to human health.

WASTE MANAGEMENT

Waste is carefully characterized, treated, and disposed of to prevent environmental harm.

COMPLIANCE

The site follows strict protocols, including the Clean Air Act, Clean Water Act, and Safe Drinking Water Act.

ANNUAL PROGRESS

In 2024, over 2,000 samples of air, water, and soil were tested to track progress.

Site Sustainability

Instructor: Mr. Gill (Engineering) | Students: Wilkey & Shelby



Infrastructure Optimization. Geologists Rob Flynn and Ken Davis (foreground) examine a soil sample taken during the Northeast Plume Optimization project at the Paducah site. This photo represents the technical "ground truth" of sustainability—active scientific monitoring to ensure contaminants are being successfully managed. Photo by Dylan Nichols.



Figure 1. TCE Plumes as Interpreted for 2018, 2020, 2022, and 2024.

DEFINITION

Sustainability means keeping groundwater safe and protecting land, air, and water resources. In 2024, the site earned a "green" scorecard from the DOE, indicating full compliance with federal Environmental Management System (EMS) standards.

RESOURCE MANAGEMENT

Efforts focus on radical efficiency. Since the 2015 baseline, the site has achieved a **51% reduction in water usage,** significantly lowering the local environmental footprint.

POLLUTION PREVENTION

A major 2024 milestone was the removal of **1 million pounds of R-114 refrigerant (Freon).** This legacy hazardous material was used to cool uranium enrichment equipment; its disposal is equivalent to removing roughly **4 million gas-powered vehicles** from the road for one year.

IMPACT

Sustainability helps to ensure the protection of air, water, land, and other natural or cultural resources that may be impacted by DOE operations. This helps to support the transition of the old plant into a modern, environmentally friendly place that is ready for future industrial reuse and community economic development.

Deactivation & D&D (C-333)

Instructor: Mr. Gill (Engineering) | Students: Faulkner & Martinez

MISSION

This program focuses on shutting down facilities and testing new technologies to improve safety.

C-333 FOCUS

The C-333 building is a primary focus, where workers remove hazardous materials before demolition.

MATERIAL SIZING AREA (MSA)

Over 497 massive converters in the C-333 building are being processed in the MSA.

FACILITY DEMOLITION

To date, more than 180 site facilities have been demolished to reduce environmental risks.

RISK REDUCTION

Deactivation prepares the site for future community or industrial reuse.









Converter Segmentation. Top, from left: 1.) Deactivation workers at the U.S. Department of Energy Paducah Site use a plasma torch to cut process gas equipment free from the uranium enrichment cascade in the C-333 Process Building. 2.) Deactivation crews in the C-333 Process Building load process gas equipment into a high-sided gondola in the south truck alley. 3.) Workers segment a converter in support of continued deactivation activities at the Paducah C-333 Process Building. 4.) Gabe Puckett, deactivation maintenance mechanic with Paducah Site deactivation and remediation contractor Four Rivers Nuclear Partnership, installs welding curtains on the dust collection system in Unit 6 Cell 3 of the C-333 Process Building during Phase II construction of the Material-Sizing Area. 5.) Material sizing area (MSA) crews lift a surrogate converter into the dust collection system during the on-going MSA readiness demonstration. The MSA crew segmented the surrogate converter as the team prepared for operations during the readiness assessment. Photos by Dylan Nichols.



Waste Management

Instructor: Mr. Gill (Engineering) | Students: Patel & Campbell

OPERATIONS

All waste is carefully sorted and characterized. The site operates three permitted hazardous waste storage facilities.

WASTE MINIMIZATION

Programs aim to create less trash and keep recyclable materials out of landfills.

MIXED WASTE

Hazardous and radioactive waste is managed under a special Site Treatment Plan.

SELF-CORRECTION

In 2024, minor storage issues were quickly fixed with no environmental harm.

LANDFILL MONITORING

The C-746-U landfill is strictly monitored to ensure waste remains contained and safe.







Deactivation. From left: 1.) Workers at the Paducah Depleted Uranium Hexafluoride plant install valve replacements for the specialized cylinders. 2.) Deactivation crews lower a roll-off bin with debris from cell housing removal in Unit 6 Cell 4 of the C-333 Process Building. The picture illustrates the process of managing waste during the deactivation of the C-333 Process Building. A roll-off bin is a large, heavy-duty container designed to be transported by special trucks; in this specific cleanup context, they are used to collect and move debris removed from the enrichment cells. 3.) FRNP Nondestructive Assay Field Operations Manager Tyler Coriell; Enterprise Technical Assistance Services Senior Nuclear Safety Engineer Allen Townsend; FRNP Nondestructive Assay Manager Rick Williams; and EM Portsmouth/Paducah Project Office Safety Systems Oversight Richard Mayer walk down the assembly of detectors in the Large Item Neutron Assay System chamber. Photos by Dylan Nichols.

MANAGING THE LEGACY: THE DUF6 MISSION

What is DUF6?
Over 60 years of uranium enrichment left behind tens of thousands of massive steel cylinders filled with Depleted Uranium Hexafluoride (DUF6).

The Conversion Solution
The site doesn't just store these cylinders; it operates a specialized Conversion Plant that turns the DUF6 into a stable, rock-like oxide that is much safer for long-term disposal.

Turning Waste into Wealth
A byproduct of this conversion is hydrofluoric acid, which the site captures and sells for industrial use, proving that even legacy waste can have a second life.



The U-Landfill (C-746-U). Main: Depleted uranium hexafluoride cylinders stand in a cylinder yard at the Paducah Site. A portion of the site's inventory of more than 40,000 remaining cylinders will be available to commercial partners to turn legacy coproduct of the former uranium enrichment process into opportunities for future energy supplies. Insert: Technicians at the Paducah Depleted Uranium Hexafluoride Conversion Facility monitor operations as the 1,000th cylinder of depleted uranium hexafluoride is safely processed into a stable oxide form.

MODERN CLEANUP: SORTING & DISPOSAL

Characterization
Before a single piece of a building is thrown away, it is "characterized"—meaning scientists test it to see exactly what chemicals or minerals it contains.

Surgical Sorting
Waste is sorted into different "streams." Clean metal is recycled locally, while hazardous materials are sent to specialized facilities. In 2024, the site recycled over 720,000 pounds of scrap metal!

The U-Landfill (C-746-U)
This is the site's high-tech on-site landfill. It features multiple thick plastic liners and a leak-detection system to ensure that waste stays permanently isolated from the soil and groundwater.

SAFETY & OVERSIGHT

Mixed Waste Management
"Mixed waste" (stuff that is both radioactive and chemically hazardous) is managed under a strict legal agreement with the State of Kentucky.

Constant Inspection
In 2024, site inspectors conducted thousands of checks on waste storage areas. Any minor issues, like a loose label or a rusty drum, were fixed immediately to prevent environmental impact.

CONTEXT OF THESE OPERATIONS

Both the **converter segmentation** and the **roll-off bin lifts** are part of the larger mission to deactivate the **C-333 Process Building.** This building is the first of four massive gaseous diffusion process buildings slated for demolition at the Paducah site.

Roll-off bins are used to consolidate the physical debris (like cell housing) after it has been dismantled.

Converter segmentation takes place in the "Material-Sizing Area" (MSA), where large equipment is cut down into smaller pieces so it can fit into transport containers for disposal.

Groundwater Plumes

Instructor: Mr. Gill (Engineering) | Students: Patel, Falconite & Arnold



Figure 1. TCE Plumes as Interpreted for 2018, 2020, 2022, and 2024.

MONITORING NETWORK

Two main underground plumes (Northwest and Northeast) are tracked using more than 200 monitoring wells.

CONTAMINANTS

Primary contaminants include Trichloroethylene (TCE), Technetium-99, and Uranium from past enrichment processes.

TREATMENT

Pump-and-treat systems remove contaminants, and levels of pollutants like TCE continue to decrease.

PUBLIC SAFETY

DOE has provided public water hookups to nearby residents since 1994 as a precaution.

EMERGING MONITORING

In 2024, the site began sampling for emerging contaminants like PFAS.

Public Awareness Program

Instructor: Mr. Gill (Engineering) | Students: Watson & Richard







STEM Outreach. Clockwise from top left: 1.) Nondestructive assay data analyst, Emily Coriell, demonstrates a pipe crawling robot at the Paducah Area Chamber of Commerce STEM 4 Girls event. More than 70 young girls attended the event to learn about careers in science, technology, engineering, and math. 2.) Community Outreach Specialist Steve Christmas (right) uses water bottles and a groundwater model to explain to students at Lone Oak Middle School how contamination effects aquifers and how those aquifers are sampled. 3.) Local middle school students conduct a field experiment during an education outreach activity with scientists from the environmental management sampling team at the Paducah site. Photos by Dylan Nichols.

COMMUNITY ENGAGEMENT

The site holds meetings and workshops to keep the community informed.

PUBLIC INPUT

The Citizens Advisory Board gives residents a voice in cleanup decisions.

STEM EDUCATION

Local students participate in the DOE Science Bowl and environmental science outreach programs.

OUTREACH IMPACT

In 2024, over 150 community members attended outreach events and over 750 students were reached.

TRANSPARENCY

The Paducah Site Information Center provides updates and helps make technical information easier to understand.

DOE Careers

Instructor: Mr. Gill (Engineering) | Students: Magill & Rush









Professional Portraits. Top, from left: 1.) RNP Characterization Laboratory Scientist Jonathan Vaughan secures a cap on 1s cylinder inside a glove box in the C-331 Process Building. The 1s/2s cylinder capping effort is one of the activities FRNP has added to their Path to Excellence for FY24. 2.) From engineering to heavy operations, the Paducah cleanup provides high-quality technical roles for the Western Kentucky workforce. Bottom, from left: 1.) Deactivation crews remove and load NaF Traps from C-310 into ST-90s for disposition. 2.) Workers collect samples from a storage tank at the above ground treatment unit at the C-400 Cleaning Building at the Paducah. Photos by Dylan Nichols.

LOCAL JOBS

Cleanup creates local jobs in engineering, environmental science, and safety with contractors like Four Rivers Nuclear Partnership.

EDUCATIONAL PIPELINE

Outreach events and site visits introduce high schoolers to these careers, which combine science with community service.

CAREER SCOPE

Roles include air and water monitoring, waste management, and radiation protection.

ECONOMIC IMPACT

These roles represent high-quality professional employment for the Western Kentucky region.

Radiological Air Monitoring

Instructor: Ms. Atnip (AP Env. Science) | Students: Woods & Watson

NETWORK

Air is sampled at nine locations around the site using special filters and continuous samplers to check for radioactivity.

2024 RESULTS

No radionuclides were detected above normal background levels, and no unplanned air releases occurred.

PUBLIC SAFETY

The total calculated radiation dose to the public was only 0.0065 mrem, far below the US EPA limit of 10 mrem per year safety limit for air emissions.

CONTINUOUS MONITORING

Stations run year-round to ensure current work stays within strict safety standards.

I. ENVIRONMENTAL SAFETY FRAMEWORK

Across all monitoring programs, the Paducah Site tracks both radioactive and chemical contaminants to ensure environmental safety. Substances monitored include:

- **Radionuclides:** Uranium isotopes and Technetium-99.
- **Industrial Chemicals:** PCBs and Trichloroethene (TCE).
- **Metals:** Mercury, lead, and copper.
- **Water Quality Indicators:** Chloride, sulfate, and dissolved solids.

II. THE AIR MONITORING NETWORK

Across all monitoring programs, the Paducah Site tracks both radioactive and chemical contaminants to ensure environmental safety. Substances monitored include:

- **The Network:** The Paducah Site operates an ambient air monitoring network sampling air at **nine locations** both on-site and off-site.
- **Mechanism:** Stations run year-round using special filters and continuous samplers to check for radioactivity.
- **Target:** DOE monitors **Uranium isotopes** specifically to ensure airborne particles are not released at levels that could pose inhalation risks.

Radiological Surface Water Monitoring

Instructor: Ms. Atnip (AP Env. Science)

Students: Manea, De Le Rosa & Mumford

MONITORING

Surface water is tested at 15 locations, including Bayou Creek and Little Bayou Creek, for radionuclides like Technetium-99.

SAFETY

The radiation dose from water contact is very low (0.1 mrem), well under safety limits.

DATA TRENDS

Results are consistent with previous years, proving that cleanup activities are not harming local streams.

KPDES PERMITS

The site follows strict state-issued permits to protect aquatic life and the surrounding watershed.

I. MONITORING THE WATERSHED

Radiological monitoring in surface water checks for radioactive materials transported into streams and creeks near the site. This monitoring evaluates whether materials enter nearby waterways such as **Bayou Creek** and **Little Bayou Creek.**

- **The Ohio River Connection:** Because these waterways eventually connect to the Ohio River, monitoring is vital to ensure contaminants do not spread beyond the site boundaries.
- **Why it Matters:** Water contamination could affect drinking water sources, aquatic organisms, and human exposure through recreation or accidental ingestion.

II. HYDROGEOLOGY & THE AQUIFER

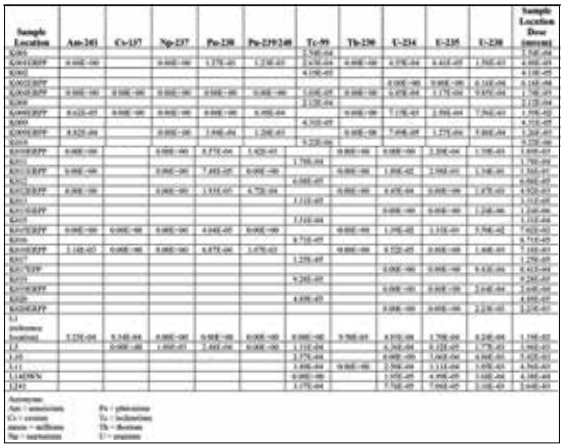
- **The Aquifer:** The site sits above the **Regional Gravel Aquifer,** an underground layer of water-bearing rock. This aquifer also feeds into the Ohio River.
- **The "Sinking" Contaminant: Technetium-99** is a primary focus. Because it is denser than water, it can sink through the water column, leading to contamination at various depths.
- **Public Protection:** Historically, groundwater was a local drinking source. By tracking contaminated areas, the DOE identifies affected residences and businesses to **pay their water bills,** providing municipal water to protect public health.

III. HOW IT IS CHECKED (THE SCIENCE)

- **Frequency:** Water samples are collected **annually and quarterly** at 15 on-site and off-site locations.
- **Analysis:** Samples are analyzed for radionuclides to estimate potential radiation doses to the public.
- **Key References:**
  - **Figure 4.2:** Surface water monitoring locations.
  - **Table 4.6:** Maximum detected radionuclides.
  - **Table 4.7:** Surface water dose calculations.

IV. RESULTS & REGULATORY SAFETY

- **2024 Safety Data:** The estimated dose from incidental ingestion of surface water was approximately **0.16 mrem.**
- **Comparison:** This is only **0.16% of the DOE annual dose limit** of 100 mrem, proving the water remains safe for the surrounding environment.
- **KPDES Compliance:** The site follows strict **Kentucky Pollutant Discharge Elimination System** permits to ensure cleanup activities do not harm the local aquatic ecosystem.





Sample Location	Radionuclide	Maximum detected (pCi/L)
K008	Technetium-99	3.67E+01
K008ERPP	Uranium-234	2.18E+01
K011ERPP	Uranium-235	4.12E+00
K011ERPP	Uranium-238	1.61E+02

Acronym:
pCi/L = Picocuries per liter

Top: Table 4.7. Surface water dose

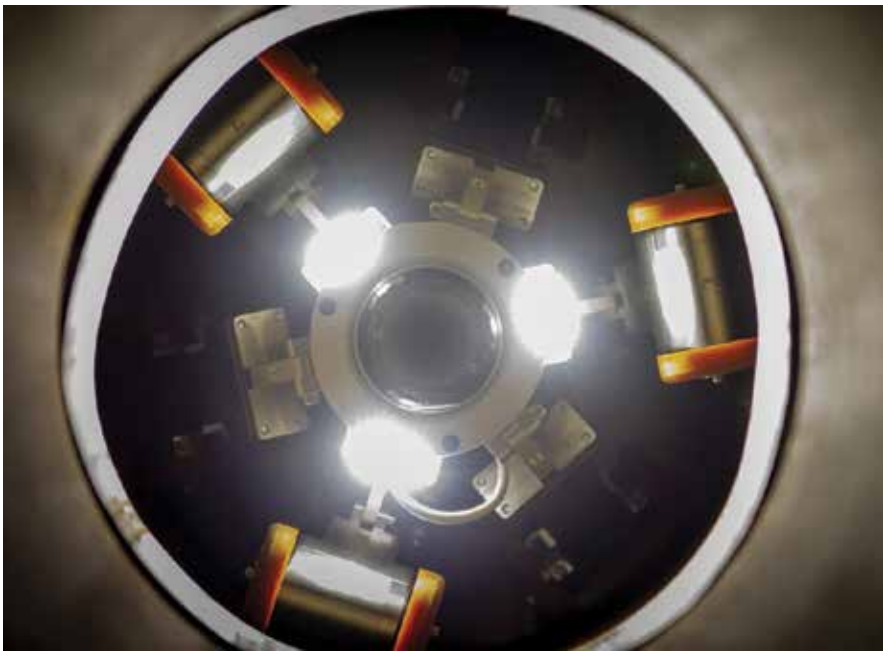
Left: Figure 4.2. Surface water monitoring locations

Right: Table 4.6. Maximum detected radionuclides in surface water samples.

COMPOUND	WHY IS IT MONITORED?
Uranium isotopes (e.g., U-234, U-235, U-238)	Uranium may enter waterways from past enrichment activities and groundwater plumes. Monitoring ensures concentrations remain below regulatory limits.
Technetium-99 (Tc-99)	Tc-99: a by-product from a nuclear power reactor that helps re-enrich U-235. Highly mobile in water and can migrate through groundwater into surface water systems.
Radionuclides associated with plant operations	Monitoring ensures any residual contamination from historical operations does not move into nearby ecosystems.

Radiological Soil & Sediment Monitoring

Instructor: Ms. Atnip (AP Env. Science) | Students: Trevino & Parsons



Field Sampling. Nondestructive assay technicians perform a demonstration of a robotic pipe crawler in a surrogate pipe. Photo by Dylan Nichols.

METHOD

Surface water is tested at 15 locations, including Bayou Creek and Little Bayou Creek, for radionuclides like Technetium-99.

CONSISTENCY

2024 results were very similar to past years and consistent with historical background levels.

SAFE REUSE

The accidental ingestion dose from sediment was extremely low (0.01 mrem), confirming the ground stays safe for future use.

LAND MANAGEMENT

This monitoring ensures the site can be redeveloped safely into new businesses or parks.

THE ROBOTIC CRAWLER

The robotic crawler represents:

- **Remote inspection**
- **Data collection in hazardous areas**
- **Advanced environmental monitoring technology**
- **Soil/sediment investigation**
- **Detecting contamination safely**
- **Long-term site assessment**

Non-radiological Air Monitoring

Instructor: Ms. Atnip (AP Env. Science) | Students: Davis & Galloway

SCOPE

Air is checked for non-radioactive chemicals like volatile organic compounds (VOCs) and metals.

VOLATILE ORGANIC COMPOUNDS (VOCS)

What is it?
VOCs are organic chemicals that evaporate readily at room temperature.

Why is it monitored?
VOCs are monitored to protect human health that is impacted by the evaporated chemicals affecting air quality.

How is it regulated?
The Clean Air Act (1963) established the maximum VOC content threshold and requirements for labeling.

Nephelometers are devices used to measure particulate matter by detecting how particles scatter.

Examples of VOCs
These chemicals can be found in degreasers, paints, thinners, and fuels.

Why are the results safe?
There is no evidence of non-radiological air contamination related to site operations.

COMPLIANCE

The site follows strict air permits under the Clean Air Act; in 2024, no violations occurred.

MITIGATION

Monitoring includes stack emissions and ambient air to ensure cleanup work does not create harmful pollution for the county.

DUST CONTROL

Water sprays and other methods are used during building work to prevent non-radiological particles from spreading.

NON-RAD AIR MONITORING

The 2024 Paducah Annual Site Environmental Report (ASER) indicates that no active non-radiological air emission points currently require monitoring, meaning chemical pollutants in air are not being released at levels requiring testing.

What is Non-Rad Air Monitoring?

- The DOE must monitor chemical pollutants that are released into the air. A pollutant can be defined as any substance that pollutes the environment. If there were any active emissions from the DOE site, it could harm the surrounding areas' air quality.
- There are currently no active emission points that require monitoring, meaning there is no risk to the environment.

Containments of Control

- Air pollutants can travel beyond the site boundary and potentially affect local communities and ecosystems. IF there were any active emissions, these are some pollutants that would need to be controlled and monitored:
  - **Volatile organic compounds (VOCs):**
    VOCs are organic chemicals that evaporate readily at room temperature.
  - **Particulate matter (PM):**
    These are small particles that can cause respiratory issues.
  - **Industrial Solvents:**
    These were used in past plant operations and have been known to affect air quality.

Non-radiological Water Monitoring

Instructor: Ms. Atnip (AP Env. Science) | Students: Vaughn & O'Connor

TESTING

Water is tested for pH, heavy metals, oil, and grease at outfalls and downstream locations.

PERMIT STATUS

The site follows strict KPDES (Kentucky Pollutant Discharge Elimination System) permit requirements.

2024 PERFORMANCE

Two small exceedances occurred but were quickly fixed with no lasting impact on the environment.

BIOLOGICAL HEALTH

Toxicity tests for aquatic life show that water quality is good and continues to improve.

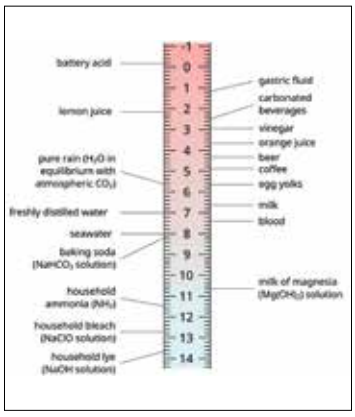
I. REGULATORY OVERSIGHT: THE CLEAN WATER ACT

- **KPDES Permit:** Surface water is monitored under the federal **Clean Water Act of 1972** via the **Kentucky Pollutant Discharge Elimination System.**
- **Outfall Sampling:** Water samples are regularly collected from numerous discharge points **(outfalls)** and tested for pH, turbidity (cloudiness), suspended solids, and chemical contaminants.
- **The Ohio River Connection:** Because the Paducah Site sits near the Ohio River, this monitoring is vital to protect one of Kentucky's primary drinking water sources.

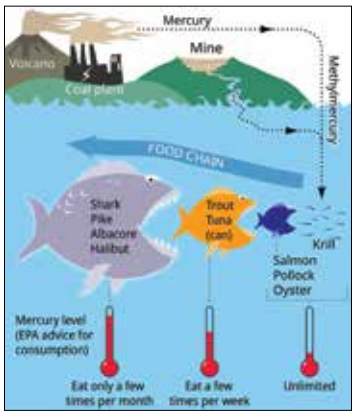
II. CHEMICAL CONTAMINANTS & THEIR RISKS

Scientists track a variety of compounds—found in **Table 5.2** of the ASER—that could impact the environment:

- **Volatile Organic Compounds (VOCs):** Includes **Trichloroethene (TCE),** a prominent historical degreaser. It is a major groundwater contaminant and a possible carcinogen.
- **Industrial Chemicals: Polychlorinated biphenyls (PCBs)** were used in electronic equipment. They are "persistent" pollutants, meaning they stay in the environment for a very long time.
- **Toxic Metals:**
  - **Mercury:** Can accumulate in aquatic life over time.
  - **Lead:** Harmful to humans and wildlife, often causing neurological symptoms.
  - **Copper:** Can accumulate in aquatic life over time.
  - **Iron & Manganese:** Naturally occurring but monitored because high levels indicate industrial contamination.



PH Scale (Wikimedia Commons)



Mercury Food Chain (Wikimedia Commons)

Analyte	Range
Anions	
Chloride (µg/L)	519–36,900
Sulfate (µg/L)	2,630–54,300
Wet Chemistry Parameters	
Biochemical Oxygen Demand (µg/L)	2,670–24,600
Chemical Oxygen Demand (µg/L)	13,200–113,000
Dissolved Solids (µg/L)	81,000–322,000
Hardness—Total as $CaCO_3$ (µg/L)	26,600–238,000
Nonsettleable solids (µg/L)	14,400–18,800
Settleable solids (µg/L)	2,500–231,000
Suspended Solids (µg/L)	600–276,000
Total Organic Carbon (µg/L)	4,040–27,800
Total Solids (µg/L)	109,000–550,000
Volatile Organic Compounds	
Trichloroethene (µg/L)	0.39–0.61
Polychlorinated biphenyls	
PCB-1248 (µg/L)	0.0461–0.0807
PCB-1254 (µg/L)	0.0365–0.0383
PCB-1260 (µg/L)	0.0709–0.528
Total polychlorinated biphenyls (µg/L)	0.0365–0.528
Other Organics	
Oil and Grease (µg/L)	1,350–3,300
Metals	
Aluminum (µg/L)	60–522
Barium (µg/L)	40.7–64.5
Calcium (µg/L)	12,100–29,200
Copper (µg/L)	0.941–3.49
Iron (µg/L)	97.7–21,500
Lead (µg/L)	0.617–0.922
Magnesium (µg/L)	2,740–5,610
Manganese (µg/L)	22.6–266
Mercury (µg/L)	0.00664–0.0467
Nickel (µg/L)	0.671–1.56
Phosphorous (µg/L)	22–1,370
Potassium (µg/L)	3,210–9,160
Sodium (µg/L)	759–27,300
Uranium (µg/L)	0.163–470
Zinc (µg/L)	12.2–147
Acronyms: PCB = Polychlorinated biphenyl	

Table 5.2. Ranges of detected analytes in 2024 surface water samples

III. ECOLOGICAL IMPACT: BIOMAGNIFICATION

- **The Food Chain:** These contaminants have the ability to **biomagnify.** This means that trace amounts of chemicals can increase in concentration as they move up through trophic levels (from tiny organisms to fish to humans).
- **Public Safety:** Measuring outfall concentrations ensures these pollutants do not reach dangerous levels in the food chain or the regional water supply.

IV. 2024 FINDINGS: "SAFE" AND CONSISTENT

- **Compliance:** The 2024 ASER results are deemed **"Safe"** because chemical concentrations are well within regulatory limits.
- **Stability:** Data shows that levels have stayed consistent with previous years, proving that current site activities are not negatively impacting nearby creeks or runoff points.

Non-radiological Soil & Sediment Monitoring

Instructor: Ms. Atnip (AP Env. Science) | Students: Patel & DeBoe

OBJECTIVE

Soil and sediment are tested for chemicals like volatile organics and metals to guide cleanup and future land use.

2024 RESULTS

Levels stayed within safe limits and no unexpected chemical contamination was found.

LAND PLANNING

Data evaluates Solid Waste Management Units (SWMUs) and ensures the ground is safe for redevelopment.

RECLAMATION

This monitoring ensures that remediated fields and landfills are successfully reverting to safe, natural states.

I. PROTECTING LOCAL HABITATS & ECOSYSTEMS

- **The Mission:** Monitoring evaluates whether non-radioactive industrial chemicals are accumulating in the soil or sediment.
- **The Risk:** Sediments can store contaminants for long periods, which can harm aquatic life and potentially transfer pollutants through the food chain.
- **Restoration Goal:** This data ensures the surrounding environment is being restored to its original state, allowing the land to eventually be repurposed for industrial, commercial, or recreational use.

II. KEY CONTAMINANTS & ENVIRONMENTAL IMPACT

The Paducah Site specifically tracks pollutants that are "persistent," meaning they do not break down easily in nature:

- **Polychlorinated Biphenyls (PCBs):** These accumulate rapidly in sediments and organisms. They are a primary focus because they can cause ecological harm and are linked to cancer in living organisms.
  - **2024 Data:** PCB concentrations were reported between **1.81 µg/kg and 293 µg/kg,** which remains within acceptable safety ranges.
- **Heavy Metals (Lead, Copper, Mercury):** These metals settle into the mud. If eroded and transported into the **Ohio or Mississippi Rivers,** they can cause significant harm to aquatic life.
- **Industrial Organics (Oil & Grease):** The presence of these materials serves as a "red flag" indicator of industrial runoff entering nearby waterways.



Demolition. Crews at the Paducah Site pause to discuss how to best proceed with demolition of one of the 33 inactive facilities demolished earlier this year. The safe demolition of unused facilities has been ongoing at the Paducah Site in recent years as the cleanup mission progresses to prepare the site for reindustrialization. Photo by Dylan Nichols.

III. HOW THE SCIENCE IS DONE: SEDIMENT SAMPLING

- **Strategic Locations:** Samples are collected from multiple locations across the site and nearby creeks to analyze for chemicals and metals.
- **Range of Detection:** Scientists look for any noticeable levels of contamination that could affect the "Safety Rating" of the land.
- **Data Transparency:** All detected ranges for Metals, Organics, and PCBs are meticulously documented in **Table 5.2** of the ASER report.

V. 2024 RESULTS: PREPARING FOR THE FUTURE

- **Acceptable Limits:** The 2024 monitoring confirms that contaminant levels are within the "Acceptable" range for land to be considered for future recreational or commercial use.
- **Environmental Reclamation:** These results prove that the cleanup mission is successfully reclaiming the land, ensuring it is safe for the public and the local wildlife.

Field Experiences & Site Tour







During a site tour, students had the opportunity to visit several areas of the Paducah DOE Site. The visit included a guided tour of the site and multiple discussions with on-site workers. McCracken County High School students and faculty visited the Paducah Site as part of the environmental science education grant program.

Environmental Monitoring Highlights

In 2024, measurements were taken on and around the Paducah Site; more than 2,000 samples of air, sediment, and water were collected and analyzed for radioactive and nonradioactive contaminants. Major sampling efforts of environmental monitoring for 2024 are summarized below:

- **Surface Water Streams:** DOE monitored for radionuclides, trichloroethene, metals, and other water quality parameters under the Kentucky Pollutant Discharge Elimination System (KPDES) Permit and the Environmental Radiation Protection Program at 15 locations where surface water flows into Bayou Creek and Little Bayou Creek.
- **External Radiation:** Measured continuously at 64 locations. The measurements were reported quarterly.
- **Ambient Air:** Sampled at nine locations, on-site and off-site, and was analyzed for radionuclides.
- **Radionuclide Surface Water:** Samples were collected annually from two locations and quarterly from seven locations, both on-site and off-site, and analyzed for radionuclides.
- **Landfill Surveillance:** Surface water samples were collected quarterly from on-site landfill locations and one off-site location.
- **Sediment Sampling:** Sediment was sampled at six locations and analyzed for radionuclides and at 14 locations for polychlorinated biphenyls.
- **Toxicity Testing:** Surface water sampling included testing fathead minnows and water fleas for chronic toxicity at three locations and acute toxicity at one location.
- **Groundwater Monitoring:** More than 200 wells were sampled at varying frequencies to monitor corrective actions, movement of groundwater contaminants, and groundwater quality.
- **Potable Water:** Sampled at five locations for per- and polyfluoroalkyl substances (PFAS) compounds.
- **Future Reporting:** Additional PFAS sampling was conducted in 2024 from a variety of environmental media. The results will be presented in a forthcoming PFAS screening assessment summary report.

Environmental Restoration & Regulatory Compliance

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA)

- Usually referred to as Superfund Act.
- Passed in 1980 and amended in 1986.
- The Paducah Site is a designated CERCLA site.
- Under CERCLA, a site is investigated and remediated if it poses a significant risk to human health or environment.
- The Paducah Site complies with CERCLA.

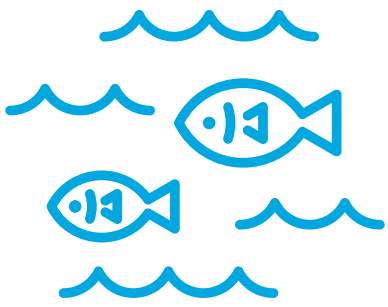


Distribution of Superfund sites in the United States. *Under the Superfund Act, the EPA maintains the National Priorities List of contaminated sites that are eligible for cleanup funds. (U.S. EPA, 2018)*

CLEAN WATER ACT

- Passed in 1972.
- Goal was to control water pollution.
- Regulates point-source and stormwater discharges into waters of the US.
- Regulates discharges of dredge and fill materials into waters of the US.
- Controls and prevents spills of oil and hazardous substances.
- Provides financial assistance to construct publicly-owned sewage treatment works.
- The Paducah site complies with the Clean Water Act.





CLEAN AIR ACT

- The Paducah site complies with the Clean Air Act and its amendments, subsequent federal regulations, and Commonwealth of Kentucky rules by implementing programs, procedures, and permit requirements.

ENDANGERED SPECIES ACT

- Provides for the designation and protection of endangered and threatened animals and plants and protects the ecosystems.
- If necessary, project-specific field surveys are performed to identify threatened and endangered species and their habitats, and mitigating measures are designed as needed.
- The Paducah site complies with the Endangered Species Act.

Acronyms, Abbreviations, and Glossary

ASER - Annual Site Environmental Report
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CFR - Code of Federal Regulations
DOE - US Department of Energy
DOECAP - DOE Consolidated Audit Program
DUF6 - depleted uranium hexafluoride
EISA - Energy Independence and Security Act
EMS - Environmental Management System
EPA - US Environmental Protection Agency
FFA - Federal Facility Agreement
FRNP - Four Rivers Nuclear Partnership, LLC
FY - fiscal year
KAR - Kentucky Administrative Regulations
KDEP - Kentucky Department for Environmental Protection
KDOW - Kentucky Division of Water
KPDES - Kentucky Pollutant Discharge Elimination System
MCS - Mid-America Conversion Services, LLC
MEI - maximally exposed individual
NEPA - National Environmental Protection Act
NESHAP - National Emission Standards for Hazardous Air Pollutants
PACRO - Paducah Area Community Reuse Organization
PEGASIS - PPPO Environmental Geographic Analytical Spatial Information System
PEMS - Project Environmental Measurements System
PFAS - per- and polyfluoroalkyl substances
PGDP - Paducah Gaseous Diffusion Plant
PPPO - Portsmouth/Paducah Project Office
QA - quality assurance
QC - quality control
RCRA - Resource Conservation and Recovery Act
SST - Swift & Staley, Inc.
TSCA - Toxic Substances Control Act
WKWMA - West Kentucky Wildlife Management Area

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absorbed dose: The total amount of energy absorbed per unit mass (the amount of energy deposited in body tissue) as a result of exposure to radiation. The unit of absorbed dose is the rad, equal to 0.01 joule per kilogram in any medium (1 rad = 0.01 gray).

ambient air: The surrounding atmosphere as it exists around people, plants, and structures.

aquifer: A permeable layer of sand, gravel, or rock below the ground surface that is capable of yielding quantities of groundwater to wells and springs.

biota: Animal and plant life.

calibration: Determining the variance from a standard of accuracy of a measuring instrument to ascertain what correction factors are necessary.

compliance: Fulfillment of the applicable 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.

confluence: The point at which two or more streams meet; the point where a tributary joins the main stream.

contaminant: Any substance that enters a system, such as the environment, food, or the human body, where it is not normally found. Contaminants include substances that spoil food, pollute the environment, or cause other adverse effects.

contamination: Deposition of unwanted material on the surfaces of structures, areas, objects, or personnel.

decontamination and decommissioning: Removing equipment, demolishing buildings, disposing of waste, and investigating potential contamination in areas that are no longer part of current operations.

dose: In this document, dose is used exclusively to refer to a radiological dose, defined as the energy imparted to matter by ionizing radiation.

downgradient: The direction that groundwater flows; similar to downstream for surface water.

effective dose: A measure of the potential biological risk of health effects due to exposure to radiation measured in millirem (1 millirem = 0.01 millisievert). In this document, the term effective dose is often shortened to dose.

exposure (radiation): The incidence of radiation on living or inanimate material 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: Exposure to ionizing radiation when the radiation source is located outside the body.

groundwater: Any water found below the land surface.

industrial solid waste landfill: A type of landfill that exclusively disposes of solid waste generated by manufacturing or industrial operations.

maximum contaminant level: The maximum permissible level of a contaminant in drinking water provided by a public water system.

maximum contaminant level goal: A non-enforceable health goal set to allow for a margin of safety, which establishes the highest level of a contaminant found in drinking water that is not expected to cause adverse health effects.

migration: The transfer or movement of a material through air, soil, or groundwater.

monitoring: The process of periodically measuring the quantity and quality of factors that can affect the environment or human health to regulate and control potential impacts.

outfall: The point of conveyance, such as a drain or pipe, of wastewater or other effluents into a ditch, pond, or river.

perfluoroalkyl and polyfluoroalkyl substances: A group of man-made chemicals, collectively abbreviated as PFAS, used in nonstick products, such as Teflon, water- and stain-repellant fabrics, and firefighting foam, among others. PFAS are also used in the aerospace, automotive, construction, electronics, and military industries. Certain types of PFAS may have negative health effects for humans and the environment.

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

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: A radioactive nuclide capable of spontaneously transforming into other nuclides by changing its nuclear configuration or energy level. This transformation is accomplished by emitting photons or particles.

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, which can be trapped by a filter.

volatile organic compounds (VOCs): Organic, or carbon-containing, compounds that evaporate readily at room temperature. These compounds are present in solvents, degreasers, paints, thinners, and fuels. Due to factors including widespread industrial use, they are commonly found as contaminants in soil and groundwater. Volatile organic compounds include trichloroethene, vinyl chloride, benzene, and dichloroethanes.



PORTSMOUTH PADUCAH PROJECT OFFICE

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